4. Energy-Efficient Mobility Systems

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

VTO launched Energy Efficient Mobility Systems (EEMS) to leverage emerging disruptive technologies such as connected and autonomous vehicles, information-based mobility-as-a-service platforms, and advanced powertrain technologies to identify and exploit energy efficiency opportunities at the transportation system level. The knowledge generated by this effort will strengthen understanding of how evolving technology impacts energy efficiency, and ultimately what new technology is needed to improve the energy efficiency of transportation as a system (i.e. mobility). A VTO-funded paper shows that connectivity and automation disruptions could result either in a potential 200% increase in baseline energy consumption, or in a 60% decrease in energy use.

Subprogram Feedback

The U.S. Department of Energy (DOE) received feedback on the overall technical subprogram areas presented during the 2017 Annual Merit Review (AMR). Each subprogram technical session was introduced with a presentation that provided an overview of subprogram goals and recent progress, followed by a series of detailed topic area project presentations.

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

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

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

Question 3: Were important issues and challenges identified?

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

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

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

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

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

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

Question 10: Has the program area engaged appropriate partners?

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

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

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

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

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

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

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

Presentation Number: eems000 Presentation Title: Energy-Efficient Mobility Systems Overview Principal Investigator: David Anderson (U.S. Department of Energy)

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

Reviewer 1:
The reviewer stated that the area was very well covered, including justification for the program by looking at the best and worst case scenarios for energy use by 2050.

Reviewer 2:
The reviewer commented that, yes, there was very good coverage and a high-level overview of Energy-Efficient Mobility Systems (EEMS). The reviewer further appreciated a great job of communicating about how to get further information regarding each specific pillar of EEMS through the week.

Reviewer 3:
The reviewer said that, given the recent initiation of this program, things still appear a bit fuzzy. This may be appropriate at this phase, given the status of planning and other related efforts, but it did make it a bit tough to nail down the full scope of the EEMS activity.

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

Reviewer 1:
The reviewer commented that based off the early stages of this program, the balance was appropriate.

Reviewer 2:
The reviewer remarked that the primary focus is really near-term (with perhaps a little mid-term) for now, looking out only as far as fiscal year (FY) 2020. This appears appropriate given the EEMS charter.

Reviewer 3:
The reviewer stated that there was a clear emphasis on the long term, and to some extent, mid-term R&D. Perhaps due to the early stages of this research and/or the speed at which innovation is occurring, there seemed to be less stated around near-term R&D goals. While there is clearly a lot of near-term activity, the influence of that research tends to all be decades away. Perhaps there is some near-term R&D that also results in near-term wins or stepping stones.

Question 3: Were important issues and challenges identified?

Reviewer 1:
The reviewer stated that EEMS is a great addition to the VTO. The presentation was clear in both aspects.

Reviewer 2:
The reviewer remarked that, yes, challenges were identified under the umbrella of maximum mobility and minimum energy. The confluence of all these technological and market forces at the same time leaves significant opportunities and challenges to shape the future very negatively or very positively.

Reviewer 3:
The reviewer noted that overall issues and challenges were identified. Mobility changes are clearly impacting energy consumption, and so this ties in strongly with vehicle technologies.

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

Reviewer 1:
The reviewer commented that the organizational structure and division of topics do seem to address these issues and challenges for now. It will be very important for the team to be able to change as quickly as the landscape is changing by bringing in new partners as needed and de-emphasizing others as their role and expertise becomes less important.

Reviewer 2:
The reviewer stated that efforts to date included a joint National Renewable Energy Laboratory (NREL)/Argonne National Laboratory (ANL)/Oak Ridge National Laboratory (ORNL) study to look at the possible future energy picture, which helps to lay out a path for addressing issues and challenges.

Reviewer 3:
The reviewer noted that at this stage of the program, all issues were addressed appropriately.

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

Reviewer 1:
The reviewer noted that this is a new program, which started in January 2017.

Reviewer 2:
The reviewer commented that this was not applicable as it is a new program.

Reviewer 3:
The reviewer did not see a measurement against last year other than, for example, a list of accomplishments over the past year. While this is a big part of answering the question, the reviewer stated that it would be nice to have seen some comparison to last year (e.g., 2015-2016 publications cited X times, 2016-2017 publications cited Y times, or some more meaningful way of measuring relevance and progress).

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 stated that EEMS is really at the heart of the problems and barriers that VTO is trying to solve. While many of the other parts of VTO are very important supporting functions, EEMS is a core function for what VTO is working toward addressing (mobility).

Reviewer 2:
The reviewer remarked that, yes, the projects were addressing the broad problems and barriers. Efforts are focused on addressing problems and barriers at an overall transportation systems level, addressing the interaction of vehicles technologies.

Reviewer 3:
The reviewer noted that EEMS is an excellent addition to VTO at the appropriate time. Technology will need to be deployed in an optimal fashion, and EEMS will provide information to make informed decisions.

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

Reviewer 1:
From what the reviewer could tell, the program area seemed very well managed and focused. It might be useful to demonstrate, rather than just state, some measurement of the collaboration outside VTO. For

example, many organizations and agencies are mentioned, but one could envision some table, graph, or chart that shows how each organization contributed and why that was valuable.

Reviewer 2:
The reviewer stated that the presenter was very qualified to lead this team and to provide significant value for optimization of mobility.

Reviewer 3:
The reviewer remarked that this program area still seems to be forming. The roadmap is under development. The program does appear to be focused on addressing specific issues and barriers, as best as can be determined at this relatively early stage.

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 mentioned that a full assessment of strengths and weaknesses is difficult for at least two reasons: EEMS is very new; and this overview presentation was quite general until the more detailed presentations are given later in the week. One piece the reviewer believed would greatly strengthen the effort is a more robust safety component. Safety was mentioned quickly on Slide 15 along with energy and mobility, but other than that there was not much information. Recognizing that this is DOE-sponsored research, it still is important to bring in the U.S. Department of Transportation (DOT) safety side into the presentation more than was mentioned because safety could very much influence the energy analysis trade-offs. For example, perhaps a perfectly synchronized intersection with connected vehicles (CVs) and/or autonomous vehicles (AVs) could have very high throughput and huge energy savings, but maybe as soon as the safety margins and other related considerations are built in, the savings shift to a deficit somehow where a traditional traffic light or roundabout is actually superior. It might be important to know that.

Reviewer 2:
The reviewer said that much of the program is currently focused around how various transportation technologies interact. This is important and traditionally has not been addressed to this degree in VTO. At the same time, many of these projects are in the formative stage, so it is hard to tell at this point which stand out, ether positively or negatively. The reviewer further noted that a number of projects were to be presented in the individual sessions, but few were highlighted specifically in the overview.

Reviewer 3:
The reviewer noted that the key strength was that the national laboratory consortium provides talent, bandwidth, and resources to do the advanced analytics required for projects of this scale. The key weakness was the potential for silos being formed among the stakeholders. Communication is going to be crucial for EEMS to provide full value. The reviewer concluded that all pillars play key roles in the program.

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

Reviewer 1:
The reviewer was confident that the innovation of the national laboratory consortium would result in a major impact in developing solutions to cities' transportation issues.

Reviewer 2:
The reviewer noted that this program represents a new approach within VTO, though it follows on related efforts within Vehicle Analysis and Deployment.

Reviewer 3:
The reviewer did not observe a great deal of novelty or innovation, but perhaps that will emerge later in the week.

Question 10: Has the program area engaged appropriate partners?

Reviewer 1:
The reviewer said that, yes, appropriate partners had been engaged, except to the extent possible it should demonstrate that beyond mentioning the organizations. Even a cursory list of contributions from each partner, highlighting some of the most significant ones, would be very impactful.

Reviewer 2:
The reviewer commented that the program appears to be just starting to engage partners. Partner engagement is really under development, which is to be expected for a program which began only a few months ago.

Reviewer 3:
The reviewer noted that, at this stage, yes, partners were being engaged. It will be important to engage with the transportation industry partners as this program progresses.

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

Reviewer 1:
The reviewer said that, yes, it appeared that effective collaboration was taking place.

Reviewer 2:
The reviewer noted that it was very difficult to gauge collaboration from the presentation. The collaboration group looks excellent, but there was not really a lot of mention of how the collaboration is going and how effective it has been with actual examples (beyond the national laboratories).

Reviewer 3:
The reviewer commented that it is probably too early to tell. The most formal relationship is with the DOT, which assisted DOE in planning a procurement.

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

Reviewer 1:
The reviewer remarked that, as previously mentioned, there was a little bit of development without fully folding in safety concerns at the moment. That is not to say the team is promoting unsafe ideas; it is just saying that if safety had been more thoroughly considered at the outset, some of the projects would have different messages.

Reviewer 2:
The reviewer commented that there needs to be stronger inclusion of alternative fuels, and the needs and solutions they identify for transportation systems-level activities. This will be particularly true if there is a national effort to strengthen U.S. transportation infrastructure, which could provide a significant opportunity in this area.

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

Reviewer 1:
The reviewer noted that at this early stage, it seems all areas are addressed.

Reviewer 2:
The reviewer again identified the gap in safety mentioned previously.

Reviewer 3:
The reviewer pointed out that there could be a stronger description of coordination with other parts of VTO. An example would be the SMART Mobility Framework and Clean Cities coalitions. To be fair, it may simply be too early for some of this detail.

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

Reviewer 1:
The reviewer did not see a lot around developing metrics, or even a definition of mobility. Metrics and definitions such as those will become very important going forward so that uses the same definition, and is measuring something the same way (even if imperfect).

Reviewer 2:
The reviewer reiterated that there should be more explicit inclusion of alternative fuels, particularly as related to overall transportation system planning. This is especially true for alternative fuel infrastructure.

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

Reviewer 1:
The reviewer noted that there needs to be strong stakeholder input on barriers and potential projects. Some has begun related to modeling and data, but the real need is a focus on projects.

Reviewer 2:
The reviewer recommended ensuring that there is connectivity to the many tools being developed from EEMS so that more encompassing and integrated analysis results in the best information for decision making.

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

Reviewer 1:
The reviewer said that this was a very good program with great potential to make a difference.

Reviewer 2:
The reviewer commented that the program could benefit from stronger efforts to validate data and modeling through real-world pilot projects.

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Project Feedback

In this merit review activity, each reviewer was asked to respond to a series of questions, involving multiple-choice responses, expository responses where text comments were requested, and numeric score responses (*on a scale of 1.0 to 4.0).* In the pages that follow, the reviewer responses to each question for each project will be summarized: the multiple choice and numeric score questions will be presented in graph form for each project, and the expository text responses will be summarized in paragraph form for each question. A table presenting the average numeric score for each question for each project is presented below.

Table 4-1 – Project Feedback

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems001	Energy Impact of Connected and Automated Vehicles	Huei Peng (U. of Michigan)	4-11	3.29	3.21	3.36	3.21	**3.25**
eems002	SMART Mobility—Connected and Automated Vehicles	Eric Rask (ANL)	4-16	3.25	3.25	3.33	3.33	**3.27**
eems003	SMART Mobility—Advanced Fueling Infrastructure	John Smart (INL)	4-21	3.42	3.33	3.42	3.17	**3.34**
eems004	SMART Mobility—Multi-Modal	Diane Davidson (ORNL)	4-25	3.29	3.36	3.43	3.50	**3.37**
eems005	SMART Mobility—Mobility Decision Science	Anand Gopal (LBNL)	4-32	3.50	3.17	3.25	3.42	**3.29**
eems006	SMART Mobility—Urban Science	Stan Young (NREL)	4-37	3.20	3.10	3.30	3.10	**3.15**
eems007	SMART Mobility Stakeholders—Curating Urban Data and Models	Joshua Sperling (NREL)	4-44	3.58	3.42	3.83	3.58	**3.53**
eems008	Impact of Population Shift on Energy Use: Detroit Use Case	Josh Auld (ANL)	4-49	3.20	3.10	3.50	3.50	**3.23**
eems009	Energy Assessment of Automated Mobility Districts	Stanley Young (NREL)	4-55	3.30	3.40	3.50	3.20	**3.36**
eems010	Definition of Connected and Automated Vehicle (CAV) Concepts for Evaluation	Steven Shladover (LBNL)	4-59	3.40	3.50	3.00	3.25	**3.38**

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems011	Multimodal Travel Behavior Modeling in Urban Areas using BEAM	Colin Sheppard (LBNL)	4-65	3.30	3.40	3.00	3.50	**3.34**
eems012	Modeling and Analysis of Plug-in Electric Vehicle Charging Infrastructure Supporting Shared Mobility	Yan Zhou (ANL)	4-69	2.40	2.70	2.30	2.60	**2.56**
eems013†	A New System Simulation Framework for SMART Mobility	Phil Sharer (ANL)	4-75	3.20	3.10	2.80	3.10	**3.09**
eems014†	Agent-Based Transportation System Modeling with POLARIS	Josh Auld (ANL)	4-81	3.30	3.30	3.00	3.50	**3.29**
eems015†	Calibration of Activity-Based Transportation System Simulation Tools using High-Performance Computing	Vadim Sokolov (ANL)	4-86	3.30	2.90	3.10	2.90	**3.03**
eems016†	Energy Efficient Connected and Automated Vehicles	Dominik Karbowski (ANL)	4-92	3.40	3.30	3.30	3.30	**3.33**
eems017†	Impact of CAV Technologies on Travel Demand and Energy	Josh Auld (ANL)	4-96	3.20	3.50	3.50	3.30	**3.40**
eems018†	Extended Urban Modeling for Smart Mobility	Budhu Bhaduri (ORNL)	4-102	3.10	3.20	3.10	3.00	**3.14**
eems019†	Smart Urban Signal Infrastructure and Control	H. M. Abdul Aziz (ORNL)	4-107	2.92	3.08	2.83	2.92	**2.99**
eems020†	Energy Impact of Different Penetrations of Connected and Automated Vehicles	Jackeline Rios-Torres (ORNL)	4-113	2.90	3.20	3.00	2.90	**3.06**
eems022†	A Model to Assess Impacts on Fleet-Wide Energy Use from Multi-Modal Opportunities— Freight Fleet-Level Energy Estimation Tool (FFLEET)	Tim LaClair (ORNL)	4-119	3.50	3.50	3.40	3.20	**3.45**

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems023†	WholeTraveler Survey on Life Trajectories and Mobility Decisions	Anand Gopal (LBNL)	4-123	3.30	3.10	3.20	3.10	**3.16**
eems024†	MA3T-MobilityChoice: Analyzing the Competition, Synergy and Adoption of Fuel and Mobility Technologies	Zhenhong Lin (ORNL)	4-130	3.30	3.10	3.40	3.30	**3.21**
eems025†	National Scale Multi-Modal Energy and GHG Analysis of Inter-City Freight	Yan Zhou (ANL)	4-133	3.30	3.40	3.20	3.30	**3.34**
eems026†	Expanding Regional Simulations of CAVs to the National Level and Assessing Uncertainties	Tom Stephens (ANL)	4-138	3.40	3.30	3.40	3.20	**3.33**
eems027†	Opportunities for Improving the Energy Efficiency of Multi-Modal Intra-City Freight Movement	Kevin Walkowicz (NREL)	4-142	3.58	3.25	3.42	3.42	**3.38**
Overall Average				**3.27**	**3.24**	**3.24**	**3.22**	**3.24**

†Denotes a poster presentation.

Presentation Number: eems001 Presentation Title: Energy Impact of Connected and Automated VehiclesPrincipal Investigator: Huei Peng (University of Michigan)

Presenter
Huei Peng, University of Michigan

Reviewer Sample Size
A total of seven 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 that the approach being pursued should yield valuable data and impactful results that the reviewer looked forward to hearing about.

Reviewer 2:
The reviewer commented that the current approach, which combined user behavior study and data-driven modeling, was good.

Reviewer 3:
The reviewer suggested adding in more fleet data.

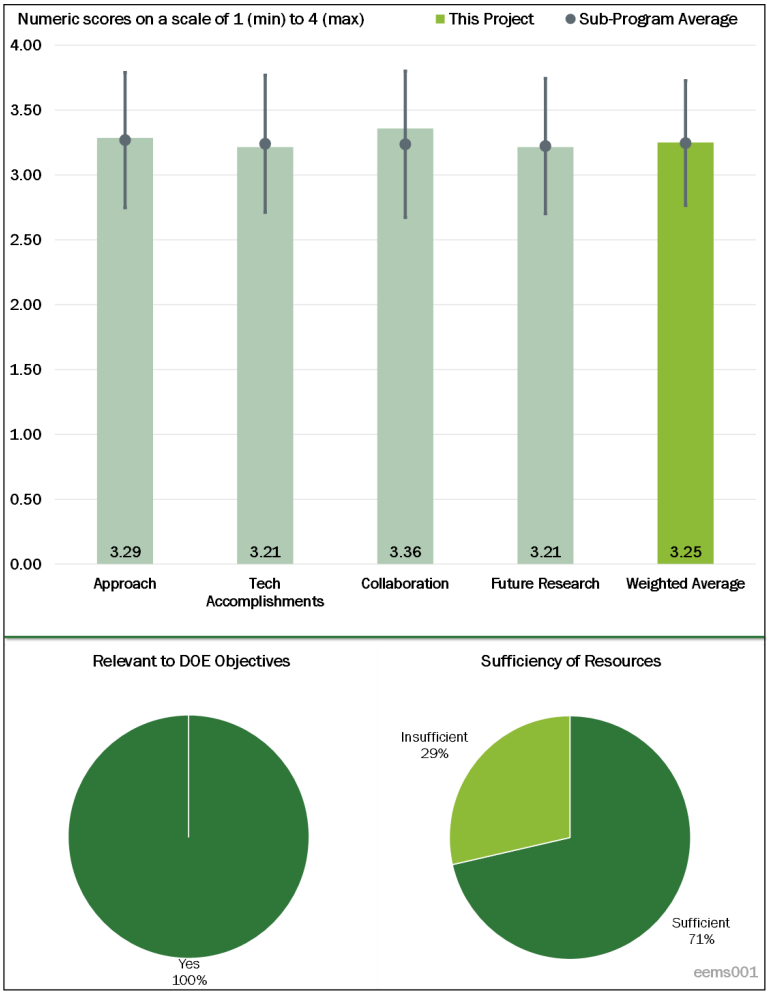

Figure 4-1 - Presentation Number: eems001 Presentation Title: Energy Impact of Connected and Automated Vehicles Principal Investigator: Huei Peng (University of Michigan)

Reviewer 4:
The reviewer stated that the approach leverages the capabilities and knowledge bases of the partners to develop data and models that can be used to assess energy impacts of connected and autonomous vehicles (CAVs). The reviewer said that the project is initially focused on gathering field data to characterize the energy consumption characteristics of baseline vehicle populations (pre-CAVs). The reviewer mentioned that data will be used to create models of geo-spatial traffic flow and vehicle energy consumption for the baseline and CAVs vehicle scenarios. The reviewer said that the approach's progression from representing baseline followed by representing advanced CAV technologies is a solid strategy. However, the reviewer said that it is becoming clear that the original project scope may have been too ambitious/optimistic despite the previous experience of the project team members in collecting data and modeling transportation phenomenology. The reviewer concluded by saying that it is critical that the project focus its resources to ensure that priority tasks are accomplished.

Reviewer 5:
While the reviewer thought this work is invaluable, the reviewer said it could be helped by a slightly broader scope involving original equipment manufacturers (OEMs). The reviewer reasoned that in the end, the project will provide a list of benefits for connected vehicles in a fairly broad driving environment in Ann Arbor. The

reviewer said it will be based on existing technologies and does not take into account potential enhancements that may be made, such as improved brake systems or enhanced ability for drivelines to take adaptive driving into account. The reviewer added that some offshoot that allows an OEM to consider these things along with the project could be useful. The reviewer also mentioned that these studies had to be geared to providing an incentive to the people building the city infrastructures or vehicles; a basket of knowledge was not good enough. The reviewer said that proof of an off-cycle benefit that can be applied by OEMs per technology will incentivize real work and real energy savings.

Reviewer 6:
The reviewer mentioned that the project scope seemed too large despite the large number of collaborators. The reviewer pointed out that the progress was indicated as 45%, but this did not seem to match the accomplishments of all five tasks. The reviewer said that the slides did not adequately describe the method/approach for each task and separately described the accomplishments, making it difficult to gain an understanding of both. The reviewer added that the various tasks did align with the DOE objective of understanding the energy consumption impact of CAVs, and that each task appeared to be well designed and feasible if sufficient resources and time were provided.

Reviewer 7:
The reviewer said that the design of the project could have improved the methods and data to better verify the baseline situations. The reviewer questioned how well the population of 500 vehicles matched the overall population of the city, the region, the state, etc. The reviewer added that for a given cost, it would have been better to capture 1 hertz (Hz) data on fewer vehicles.

The reviewer added that it would be good to establish the degree of confidence in the baseline measurements before introducing variables or modeling this behavior as "baseline." The reviewer mentioned that this project could provide better focus on Tasks 1, 2, and 4 to form a hypothesis before embarking on new control algorithms in Tasks 3 and 5. The reviewer stated that definitive driver behavior, travel patterns, and energy usage should be clearly defined and documented before modeling the effects of new driver control (Task 2), ridesharing (Task 3), and adaptive signals (Task 5). The reviewer said that overall it seems very ambitious to do all of this with the amount of available funding. The reviewer added that the barriers or hypothesis could be better outlined. The reviewer questioned the baseline metrics that can be further analyzed, such as the way drivers currently react at intersections, what cooperative adaptive cruise control (CACC) opportunities were available, and how much fuel could theoretically be saved with some of the methods that were being investigated. The reviewer said that similar to the -60 to +200 fuel consumption graph, it would be helpful to frame the issues with some data and current assumptions to justify what, how and why the presenter was embarking on these activities.

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

Reviewer 1:
The reviewer stated that the project was progressing as planned.

Reviewer 2:
The reviewer noted that the progress was good.

Reviewer 3:
The reviewer mentioned that the presentation described several products that showed considerable work has been done across the five tasks. The reviewer stated that the presenter's list of lessons learned suggested that the team had initially underestimated the cost and difficulty of implementing the data collection task.

Reviewer 4:
The reviewer said that the technical accomplishments looked significant, and that the progress was not as well along because of earlier hardware issues. The reviewer added that some interaction with or consideration for safety was expected. For example, the reviewer asked did safety considerations ever limit the energy savings potential.

Reviewer 5:
The reviewer stated that this work will accomplish much in terms of proving benefits and providing data for a multitude of operating conditions and scenarios. The reviewer said that it could be improved by showing a statistical study showing the confidence in only 500 vehicles. The reviewer suspected it will be fine, but it should be proven.

Reviewer 6:
The reviewer pointed out that overall it seems like a fair amount of progress has been made. The reviewer stated that some better results should be shown in the AMR slides relative to the 0.5 Hz data collection effort. The reviewer questioned what trends were being seen, how it will be analyzed, and what will be analyzed specifically. The reviewer stated that although the data effort is not complete yet, this will help communicate how the researcher will analyze the data when the entire dataset is available.

Reviewer 7:
The reviewer said that it is difficult to understand exactly what has been accomplished from the presentation. The reviewer mentioned that this is likely due, in part, to the scope being large and the presentation time being limited. The reviewer stated that it was difficult to see how 45% of the work has been completed.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the presentation indicates that there is strong participation and contributions by all the partners.

Reviewer 2:
The reviewer remarked that it was a good team.

Reviewer 3:
The reviewer stated that this project leverages the expertise of University of Michigan, Idaho National Laboratory (INL), and ANL. The reviewer remarked that input from OEMs will make it better, although they may hesitate to join this type of project.

Reviewer 4:
The reviewer thought that this presentation demonstrated good partnership and good separation of duties. The reviewer thought that the team members might be expanded to include other partners, such as OEMs and the U.S. Environmental Protection Agency (EPA).

Reviewer 5:
The reviewer stated that there seemed to be a gap in coordinating with the DOT in some capacity to ensure lessons learned are best disseminated and that safety aspects are adequately represented throughout the project rather than as an afterthought.

Reviewer 6:
The reviewer mentioned that the collaboration could be improved by including industry or industry groups, such as the Society of Automotive Engineers (SAE) On-Road Automated Driving (ORAD) committee, at the very least as stakeholders who could help direct the research and ensure that it aligns with industry paths.

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

Reviewer 1:
The reviewer remarked that the most exciting work is still ahead and should prove to be very valuable.

Reviewer 2:
The reviewer pointed out that more factors should be included in future research.

Reviewer 3:
The reviewer stated that the following response to reviewer comments indicates that project leadership has prioritized its future work, which likely narrows the project scope and reduces overall project risk: "The team agrees that the scope needs to be crystal clear, and we will focus on getting the experimental data from Task 1; "driver behavior" (response to advice and trip behavior) from Tasks 2 and 3; and key CAV function like eco-approach and departure, and eco-routing algorithms into the Planning and Operations Language for Agent-based Regional Integrated Simulation (POLARIS) model as the key outcome of this project."

Reviewer 4:
The reviewer noted that this was clearly defined.

Reviewer 5:
The reviewer said that the future work plan seems to be logical but should ensure that work in this project does not overlap with other similar efforts happening under CAVs.

Reviewer 6:
The reviewer stated that it is not clear how the tasks are related to each other and whether/how delays or issues in one will affect the others. The reviewer added that there is no mitigation strategy mentioned.

Reviewer 7:
The reviewer mentioned that a lot of tasks were listed in the future plan, and some of them are tough. The project needs a solid plan to get them done in time.

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

Reviewer 1:
The reviewer said that the project is an excellent example of bringing real-world, hardware-based research into the DOE sphere that grounds future models and analyses on actual measured data.

Reviewer 2:
The reviewer commented that this project is going to provide very useful data to enable the informed to act on physics and added that it is perfectly aligned with the DOE's purpose.

Reviewer 3:
The reviewer mentioned that CAVs are going to have a major, but as of yet unknown, impact on petroleum consumption. The reviewer remarked that this project is an important first step for the EEMS program to begin to quantify this impact.

Reviewer 4:
The reviewer agreed that the project supports the overall DOE objectives of petroleum displacement by helping to develop understanding about the potential energy consumption characteristics of CAVs.

Reviewer 5:
The reviewer stated that CAVs do have a great impact on energy consumption in the future transportation industry.

Reviewer 6:
The reviewer said that the project does support the overall DOE objectives of petroleum displacement.

Reviewer 7:
The reviewer wanted the researchers to provide a better and frequent explanation of the opportunities or dangers, relative to petroleum displacement, for the various scenarios that are being investigated.

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

Reviewer 1:
The reviewer observed that this project does appear to have sufficient funds for what was proposed, and seems to be at the appropriate place in the budget based on accomplishments to date.

Reviewer 2:
The reviewer said that the project has a good team of researchers.

Reviewer 3:
The reviewer stated that the resources seem adequate.

Reviewer 4:
The reviewer remarked that the budget is about right.

Reviewer 5:
The reviewer noted that based on the original project resource requirement estimates, the presentation indicates that additional resources above the initial resource estimates are needed to perform the work. The reviewer added that some of the additional resources have been identified as coming from additional contributions from project partners. The reviewer said that the project has also prioritized its tasks to adapt to the realization of resource constraints.

Reviewer 6:
The reviewer said that it is difficult to know if the project's five tasks can all be completed on time based on the presentation, but that the financial resources appear to be sufficient.

Reviewer 7:
The reviewer remarked that it was mentioned many times in the discussion that more data would be better. The reviewer feared that it may not be enough or may be too coarse due to limitations of the data collection dongles. The reviewer would like to have seen some EPA standpoint on the data about to be collected before finding that it is insufficient for the proof required to provide off-cycle credit for these technologies.

Presentation Number: eems002
Presentation Title: SMART Mobility—Connected and Automated Vehicles
Principal Investigator: Eric Rask (Argonne National Laboratory)

Presenter
Eric Rask, Argonne National Laboratory

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

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

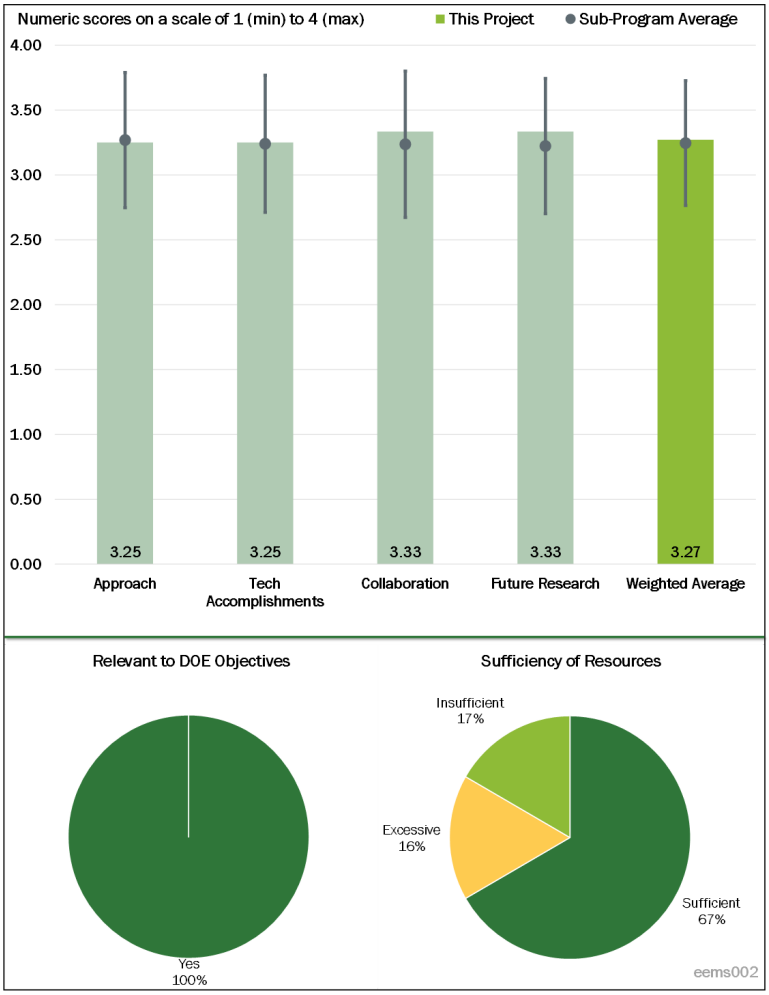

Figure 4-2 - Presentation Number: eems002 Presentation Title: SMART Mobility—Connected and Automated Vehicles Principal Investigator: Eric Rask (Argonne National Laboratory)

Reviewer 1:
The reviewer mentioned that the approach seems quite extensive and possibly quite exhaustive as well. The reviewer remarked that some of the areas of focus, such as platooning of passenger cars (CACC),may face implementation challenges in the U.S. due to consumers' aversion to relinquishing control of certain aspects of their lives (e.g., driving). The reviewer questioned if there are any studies being done to see how some of these technologies will work in the context of the consumer tendencies. The reviewer wondered if that study would belong to another pillar. The reviewer also asked if it is expected that the potential benefits offered by CAVs so far outweigh the negatives that they will eventually be adopted.

Reviewer 2:
The reviewer stated that the approach is good from the standpoint that it has multiple vectors of analysis. The reviewer added that the approach will likely be improved by increased emphasis on concept development and documentation by groups of smart people collaborating together and less emphasis on aggregate simulation.

Reviewer 3:
The reviewer said that although complex and multifaceted, the approach does appear to be sound. The reviewer stated there is a non-zero chance that the components and/or results could become unwieldy if not managed closely. The reviewer opined that, like all teams at all levels, this project team needs to keep the end in mind and have a mission statement to ground any and all decisions/analyses. The reviewer mentioned that perhaps this has already been done and all the parts work together to form a well-oiled machine, but that it was not apparent during the presentation.

Reviewer 4:
The reviewer stated that the four research categories are appropriate. The reviewer remarked that the subject is so broad that it is somewhat difficult to completely assess at this time how effective the approach will be. The reviewer mentioned that this is acknowledged by the proposed feedback loops among the various research activities.

Reviewer 5:
The reviewer observed that this project design, which includes both bottom-up and top-down analyses, is very useful to beginning to quantify the effects of CAVs on the transportation network. The reviewer added that the various tasks appear feasible in the scheduled timeframe, and should result in an advancement in the state of the art. The reviewer said that the "book-ending" of +200% and -60% could perhaps be improved through Intergovernmental Panel on Climate Change-like scenarios in which different configurations and levels of CAV adoption are modeled to provide more insight into CAV impacts on energy usage in the transportation system.

Reviewer 6:
The reviewer said that the presentation was very hard to follow because of the volume of material and the complexities involved. It appeared to the reviewer that the project is something that would be better off being broken into smaller projects or simplified. The reviewer's concern was that the result of the project will be equally as difficult to parse though and thus come to little value.

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

Reviewer 1:
The reviewer mentioned that the progress is excellent, given the breadth of the project and the October 2016 start date.

Reviewer 2:
The reviewer found the technical accomplishments to be excellent from the perspective that they have produced an initial common set of mobility concepts and definitions.

Reviewer 3:
The reviewer said that these pieces of information will be very useful for future use relative to credit applications. The reviewer said that more detail would have to be understood about each one to utilize the results effectively.

Reviewer 4:
The reviewer stated that the project is quite new, but substantial progress appears to have been made. The reviewer mentioned that the DOE goals of understanding how CAV introduction will impact petroleum consumption are being well met through this project.

Reviewer 5:
The reviewer observed that there is good progress, but it appears that there is so much hard work to be done to make sufficient progress while covering all the relevant areas of focus. The reviewer said that POLARIS, for instance, needs to undergo some improvement for it to be deployed effectively in this project. The reviewer said that this means that further progress may be hampered by extraneous factors that the funding of this project may not have direct control over.

Reviewer 6:
The reviewer said that this is a project in a relatively early stage of execution. The reviewer remarked that the accomplishments seem significant, but it was difficult to process all of that during the presentation. The

reviewer added that the presenter often recommended that the audience attend the poster session to learn about the accomplishments, which suggested to the reviewer that the format of this review may not be optimized. The reviewer said that perhaps the expectation for this level of the project should be reconsidered so that the presenter does not feel so much has to be compressed into so little time.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that the project work is distributed appropriately among the laboratories. The reviewer remarked that it is nice to have Volvo as a partner at this early stage.

Reviewer 2:
The reviewer noticed that there are a lot of partners on this project, and that there is evidence of collaboration among several of the partners working on separate tasks.

Reviewer 3:
The reviewer acknowledged that Volvo Trucks is involved in the truck platooning work. The reviewer noted that similar work was done by Volvo Trucks and Ricardo in the European Union. The reviewer asked if there was any reason to not include Ricardo as a partner as well.

Reviewer 4:
The reviewer mentioned that the Systems and Modeling for Accelerated Research in Transportation (SMART) Consortium is obviously a strong collaboration, but the industry and academic collaborations are a bit meager. The reviewer added that the SAE, specifically the ORAD committee, should be considered as an additional collaborator.

Reviewer 5:
The reviewer noted that the partner and collaborator list looks very strong. The reviewer allowed that it would be nice to have seen at a high level how or what the collaboration contributions look like, while realizing that this would be challenging to incorporate into a presentation that is already full. The reviewer added that, for example, the DOE-DOT Memorandum of Understanding (MOU) is cited, but the reviewer was not sure exactly which MOU this was; it was not immediately clear what the details of the partnership looking backward have been. The reviewer clarified that the slide does not misrepresent anything; it is more that the reviewer would be guessing a bit as to what the bullet refers.

Reviewer 6:
From the presentation or from the material, the reviewer could not easily tell who is doing what, but noticed that there is a very detailed task list. The reviewer assumed that those details are behind the scenes and that there was just not time to get into it. That being said, the reviewer needed to know where to retrieve the information after it is created and how it is to be used or read.

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 mentioned that the work plan is very detailed and appropriate for such a large project.

Reviewer 2:
The reviewer said that the simulation tasks are excellent. The reviewer pointed out that the real-world testing tasks could be expanded to include more use cases. The reviewer added that the planned schedule follows a logical and feasible implementation.

Reviewer 3:
Much of the project is in the future, and the reviewer looked forward to seeing the results. The reviewer thought it is important for the principal investigator (PI) and team to be clear on the audience and the goal, such as increased mobility with decreased energy.

Reviewer 4:
It appeared to the reviewer that there is a tremendous amount of work that has to get done, and the reviewer was not sure that all of that can be covered in the available time. The reviewer questioned if the scope of the work should be narrowed somewhat to ensure that whatever gets accomplished is more complete.

Reviewer 5:
The reviewer said that the highlighted future work outline is deficient in that it does not provide a mapping to how each focus item relates to the study questions that were presented. The reviewer added that the presentation does not provide a justification for why the several previous DOE-sponsored fuel efficiency study results regarding platooning and eco-routing are insufficient to inform the mobility study. The reviewer mentioned that it may be useful to provide a verbose rationale for why it is DOE's mission to answer the question of "How will CAVs be adopted?"

Reviewer 6:
The reviewer found the project to be very complex and impossible to follow in the presentation. The reviewer added that the size of the project could lead to delays and excess spending. The reviewer suggested that if some parts could be independently reviewed or eliminated, it may allow the best value for the higher impact items.

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

Reviewer 1:
The reviewer pointed out that mobility and CAVs are big topics now and happen to be a focus of both the past administration and the new administration. The reviewer stated that this is clearly highly relevant.

Reviewer 2:
The reviewer said that the project tries to answer the difficult question of how best to maximize the energy efficiency of future transportation systems, which is appropriate for DOE policy setting.

Reviewer 3:
The reviewer noted that the project seeks to develop a knowledge base of potential energy consumption characteristics of new mobility concepts in the transportation sector. The reviewer mentioned that government and industry can use the knowledge developed to inform policy and technology R&D investment decisions with information on potential petroleum displacement impacts.

Reviewer 4:
The reviewer acknowledged that as the presenter showed, the impacts on petroleum displacement are poorly understood but could be quite significant. The reviewer said that this project will help with this understanding and thus supports the DOE's goals.

Reviewer 5:
The reviewer stated that this project has many facets that can help the objective. The reviewer questioned if this project, as scoped, can do this efficiently, if the results can be adequately put out in a quality way, and if it can do this within the budget. These are questions the reviewer still had after seeing and reviewing the presentation.

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

Reviewer 1:
The reviewer mentioned that at this point in the project, the resources needed to answer the initial questions are adequate.

Reviewer 2:
The reviewer stated that from what could be gleaned from the presentation, the funding seems to be sufficient, but the reviewer would want to dive more deeply to really see what else could be achieved with more, as compared to what could be cast aside with less funding.

Reviewer 3:
The reviewer referred to previous comments.

Reviewer 4:
The reviewer found project funding to be sufficient from the perspective that the project has a very broad set of objectives that requires a substantial resource investment. The reviewer believed that scaling back some of the project scope and resources (approximately 20%-25%) would likely result in a more streamlined effort with superior effectiveness.

Reviewer 5:
The reviewer said that the resources for three of the four tasks are sufficient. The reviewer stated that the small amount for the fourth task should perhaps be reconsidered because this appears to be an important contribution.

Reviewer 6:
The reviewer feared that the resources will not be enough in the end because of the inefficiency and lack of oversight for such a big undertaking.

Presentation Number: eems003
Presentation Title: SMART Mobility—Advanced Fueling Infrastructure
Principal Investigator: John Smart (Idaho National Laboratory)

Presenter
John Smart, Idaho National Laboratory

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

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

Reviewer 1:
The reviewer mentioned that this is a great approach that covered all bases.

Reviewer 2:
The reviewer stated that the approach seems effective as it identifies the problem, objective, and approach of the project. The reviewer said this approach seems to be feasible and is pulling data from prior projects.

Reviewer 3:
The reviewer said that it seems like a good approach with an appropriate scope and plan.

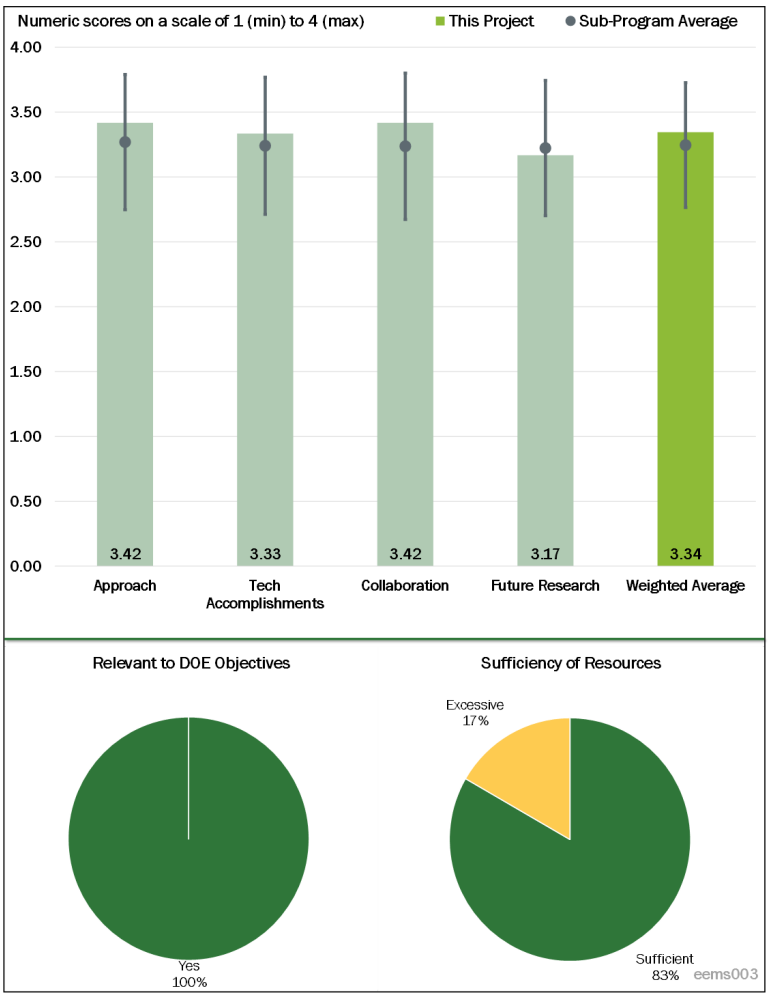

Figure 4-3 – Presentation Number: eems003 Presentation Title: SMART Mobility—Advanced Fueling Infrastructure Principal Investigator: John Smart (Idaho National Laboratory)

Reviewer 4:
The reviewer commented that this project mainly uses existing modeling tools and develops new tools. The reviewer was not quite sure if the new tool will be developed based on the existing modeling tools or if it is more data-driven.

Reviewer 5:
The reviewer noted that this is going to be a limiting factor in the way of realization of a completely optimized fueling infrastructure and energy result. The reviewer mentioned that this is a good step in determining the best solutions and informing cities and businesses about future planning.

Reviewer 6:
The reviewer pointed out that the approach seems too narrowly focused based on the goals of the project, and the presentation remained very high level. The reviewer added that, for example, it seems that an examination into alternative fuel vehicles (AFVs), alternative fuel infrastructure, and SMART Mobility would have to examine supply chains of all the fuels themselves as well as the hardware that delivers that fuel. The reviewer observed it was unclear if that was part of the presentation. The reviewer also stated that there was no mention of automated stationary refueling that would seem to be obvious to SMART Mobility and AFVs (e.g. wireless

power transfer while parked/idling/waiting, robotic fuel delivery, etc.). The reviewer remarked that the answer to the "so what?" question perhaps at the bottom of Slide 7 was not satisfying. The reviewer questioned what part of the private sector was intended, and wondered about considering the public sector, city planners, etc. The reviewer asked what information these customers lack and if the researchers are asking for this information.

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

Reviewer 1:
The reviewer said that the progress to date looks good. The reviewer looked forward to seeing the results.

Reviewer 2:
The reviewer noted it was early in the process, but well on its way.

Reviewer 3:
The reviewer commented that this project appears to be well thought out and organized. Given that it is early in the project, the reviewer was certain this will develop with time; however the identification of multiple cities to work with helps to diversify the answer. The reviewer mentioned that the method of analysis looks reasonable.

Reviewer 4:
The reviewer did not see much exciting output so far because the project was started late last year.

Reviewer 5:
The reviewer said that progress has been made in the project and the researchers have identified the regions where the work will be focused. The reviewer noted that the plan is to synthesize ride-hailing vehicle data from personal-use vehicle data collected during previous projects. The reviewer said the fact that the team has received a commitment from one shared-mobility service provider to share their data is good, but not having received the data to date is a risk of not getting relevant current data to feed the models.

Reviewer 6:
The reviewer stated that the accomplishment slides looked more like approach slides. The reviewer added that perhaps this was due to the project being in the early stages, but it was difficult to discern what the tangible accomplishments really have been to date.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the project has ANL, INL, Lawrence Berkeley National Laboratory (LBNL), NREL, and ORNL as core laboratories along with Pacific Northwest National Laboratory (PNNL) and Los Alamos National Laboratory as supporting laboratories, and that it shows appropriate collaboration on the subject.

Reviewer 2:
The reviewer said that a good array of expertise is employed to look across the spectrum of tasks required to complete the plan.

Reviewer 3:
The reviewer mentioned that it is a great team, and that the team should add a fleet.

Reviewer 4:
The reviewer pointed out that this project leverages modeling skills of different institutes, and that good coordination and communication among different parties is critical to get meaningful output.

Reviewer 5:
The reviewer saw this to be a fundamentally collaborative project, and that the interaction within DOE is of course excellent, but that the interaction outside of DOE is less so. The reviewer remarked that it appears that the team has made an extensive effort to collaborate when possible, but the nature of the emerging market makes this difficult.

Reviewer 6:
The reviewer found the collaboration slide to be very sparse. The reviewer stated that it appeared that most to all collaboration has been among a subset of national laboratories along with some limited outreach to industry. The reviewer pointed out that more than the other presentations, there seemed to be a large gap here to other federal partners within the AFV community, some of which probably could jumpstart much of this research based on past work, such as Federal Transit Administration (FTA), Federal Highway Administration (FHWA), various alternative fuel working groups, etc.

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

Reviewer 1:
The reviewer said that the future research pathway is great.

Reviewer 2:
The reviewer stated that this project has a great long-term plan that seems achievable with low risk.

Reviewer 3:
The reviewer noted that this project was clearly looking at milestones along the timeline and asking questions about future value to proceed. For the moment, and due to the complexity of the issue, the reviewer thought this simple approach is a great start. The reviewer added that it is worth avoiding overcomplication as much as possible and starting to look at the general trends and where they may be leading. The reviewer suggested that some input from the petroleum industry is sought, if they are willing to share, because they may already be considering these questions as a matter of their business planning.

Reviewer 4:
The reviewer mentioned that the proposed future seems planned out on the path that the project will go. The reviewer remarked that the project does not seem to have addressed appropriate decision points, and said that it does not mention what will be an alternative action for acquiring relevant data to feed the models if current planned data are not delivered.

Reviewer 5:
The reviewer said that the future work which is to do the modeling and analysis with the modeling framework being placed, is straightforward. The reviewer cautioned the researchers to be careful in drawing any conclusion with so many different models involved and developed by different institutes. The reviewer reminded researchers that validation is the key.

Reviewer 6:
The reviewer commented that the future research slide was also very sparse, as it only restated the goals of the project without any detail behind where the project is headed.

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

Reviewer 1:
The reviewer said that increasing efficiency and potentially switching to alternative fuels will decrease petroleum usage.

Reviewer 2:
The reviewer stated that this project supports the overall DOE objectives of petroleum displacement because the results of the effort will support shared mobility needs in the future in regards to understanding the value of AFVs and the requirement for fueling infrastructure.

Reviewer 3:
The reviewer commented that if planning is not done for infrastructure, petroleum use will continue until it is convenient. The reviewer said that this project gets at meeting the goal of making alternative fuels more convenient and thereby offsetting petroleum use.

Reviewer 4:
The reviewer suggested that this project may help electrified vehicles prevail.

Reviewer 5:
The reviewer noted that the project supports the overall DOE objectives of petroleum displacement, but that the team should identify areas.

Reviewer 6:
The reviewer observed that the work is highly relevant, though the scope/mission/goal all need to be clarified a bit, perhaps in consultation with the audience or end user, whomever that may be.

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

Reviewer 1:
The reviewer stated that the budget seems well matched to the task.

Reviewer 2:
The reviewer said that most of the project tasks are model-based analysis and that the budget is sufficient.

Reviewer 3:
The reviewer remarked that the current resources seem to be sufficient to support the stated milestones in a timely fashion, but that if more funding becomes available it could be used to create more scenarios to support the other DOE SMART Mobility pillars.

Reviewer 4:
The reviewer said that at this point of the project, this budget should obviously be reviewed next year again. The reviewer stated that due to the large amount of collaboration and the size of the study, it is not excessive at this stage in the planning.

Reviewer 5:
The reviewer recommended just adding a fleet.

Reviewer 6:
The reviewer opined that, for being 19% complete, and with a total budget of $4.5 million, the presentation did not align with those numbers. For the reviewer this implies that the budget is excessive given the work that has taken place and presumably for the work going forward, which is also poorly defined.

Presentation Number: eems004
Presentation Title: SMART Mobility—Multi-Modal
Principal Investigator: Diane Davidson (Oak Ridge National Laboratory)

Presenter
Diane Davidson, Oak Ridge National Laboratory

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

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

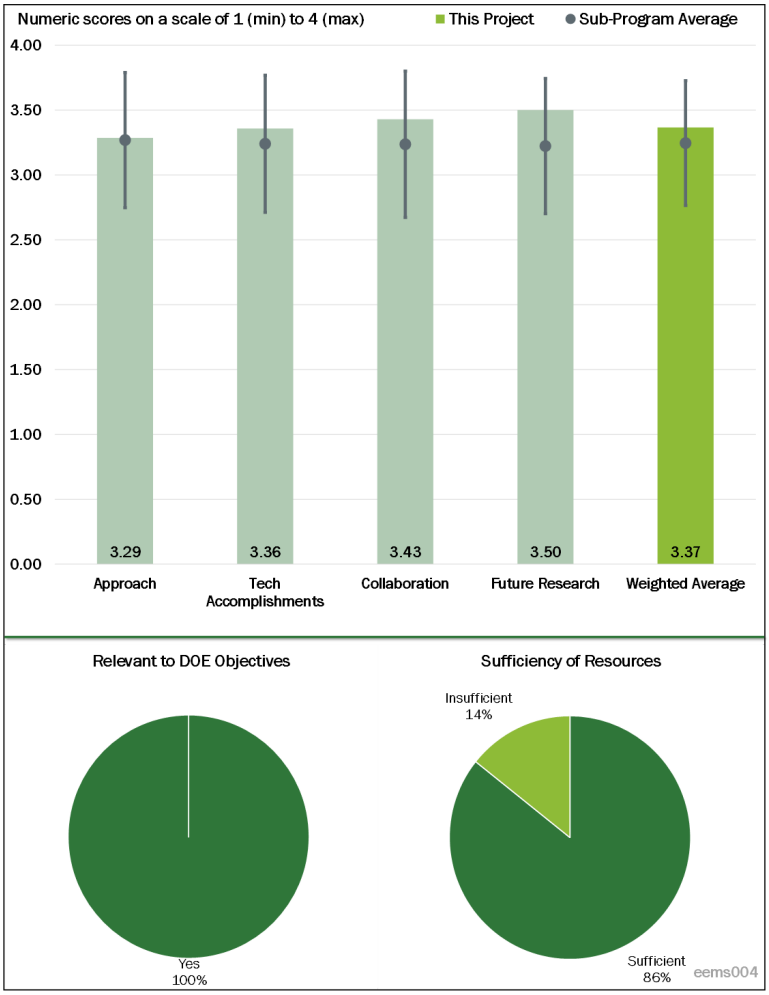

Figure 4-4 – Presentation Number: eems004 Presentation Title: SMART Mobility—Multi-Modal Principal Investigator: Diane Davidson (Oak Ridge National Laboratory)

Reviewer 1:
The reviewer mentioned that the approach is excellent in that it has an early emphasis on developing a thorough understanding of the status-quo transportation modalities as a set of baselines to be used in future comparative analysis of the new traveler/shipper choices. The reviewer added that the approach is excellent because it contains evidence that the analysis will be using practical real-world decision criteria in its analyses.

Reviewer 2:
The reviewer said that this project is very early in its progress, but that the planning appears to be very well laid out and the technologies involved have been comprehended down to things such as stop/start and upcoming modifications to vehicles for improved efficiency. The reviewer noted that the project is looking at what is happening and building models, and that for this year it is well laid out. The reviewer stated that what is found in these studies with LBNL and ORNL will help solidify future planning.

Reviewer 3:
The reviewer found that the research subtopics address the project objectives and that steps are being taken to acquire appropriate data, which is recognized as a significant barrier. The reviewer questioned if air transport and other planned inter-city pathways, like high-speed rail, will be included and that it was not clear why they were not.

Reviewer 4:
The reviewer remarked that the entire concept of SMART Mobility/EEMS is very complex and interwoven across many sectors, necessitating a well-developed organizational structure delineating the various components into discrete, understandable, and manageable components. The reviewer added that upfront, it is good that the Multi-Model pillar has been delineated into three major areas: intra-city passenger travel; intra-

city (urban) freight delivery; and inter-city freight transport. The reviewer said that this helps bound and frame the entire effort and facilitates management.

The reviewer stated that through the three aforementioned areas, the primary thrusts are to collect data, develop models to establish baselines and understand travel modes and behavior, characterize new vehicle choices and modes of passenger and freight delivery, and estimate national energy impacts from technology and model shifts. The reviewer mentioned that research is being conducted on other salient topics to inform and enhance modeling activities and future decision making. The reviewer added that a number of sequential FY 2017-2018 tasks and milestones are identified by quarter, but that there do not appear to be any embedded go/no-go milestones within the project schedule. The reviewer also stated that the presentation provides a good summary of the remaining challenges and barriers, but does not necessarily directly address means to overcome them. The reviewer gave an example of inter-city freight transport needs, and that a challenge mentioned is the need for more accurate energy impacts of partial technology penetration such as CAVs. The reviewer said that partial technology penetration is especially tricky in many aspects, including its potential disruptive aspect on the rest of the conventional vehicular fleet. The reviewer mentioned that the project seems to be integrating well with other efforts including the other four SMART Mobility pillars, Smart City Columbus, and the Advanced Research Projects Agency-Energy (ARPA-E) Transnet projects.

Reviewer 5:

The reviewer said that by and large, the approach looks sound. The reviewer had a few outstanding questions, including clarifying who the customers/end users are of this research and if they were planners or policy makers. The reviewers also asked if their input has been sought as to what would be helpful. The reviewer assumed the goal was how to achieve more freight mobility with lower energy, but that did not jump off the page.

Reviewer 6:

The reviewer mentioned that the aspects that are covered include intra-city passenger travel, inter-city freight, and intra-city freight. The reviewer asked if there is a reason why inter-city passenger travel is not included. The reviewer said that one would think that CAVs could encourage people to live farther out in the middle of nowhere, leading to increased inter-city passenger travel as well. The reviewer added that multi-modal travel has perhaps been more prevalent in Europe and Asia and questioned if there has been enough effort put into learning the lessons these cities/countries have to offer.

Reviewer 7:

The reviewer stated that the approach is a good one with data collection and modeling, then refining. The reviewer added that the model does not appear to capture some relevant data, such as population, housing, business density, type of district (business, light industrial, industrial, residential apartments, housing, etc.), and demographics (i.e., elderly population may embrace the use of shared automated vehicles (AV) more readily as an alternative to walking to a public transit location). The reviewer noted that without these data, there will most likely be substantial variation among the various cities being used for data, which makes it more difficult to predict routes. The reviewer said that the project is well integrated with other efforts, both being populated by data from other projects and being able to support predictions for other projects. The reviewer pointed out that it is a very feasible project and will be a valuable tool for DOE and municipalities performing urban planning/zoning.

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

Reviewer 1:
The reviewer said that significant progress has been made since the October 2016 start date. The reviewer mentioned that the data being acquired are overcoming one of the main barriers to this project. The reviewer liked the collaboration with AT&T on cellphone location data.

Reviewer 2:
For being only early in the project, it appears to the reviewer that a lot has been done with obtaining the foundation for the rest of the study. The reviewer was impressed by the identification of target cities and obtaining records from AT&T, as well as by the preliminary modeling that has been done.

Reviewer 3:
The reviewer stated that the project is early, but is already able to help predict energy savings from platooning (demonstrated as a tool, validating methods that support DOE's goals). The reviewer said that the project is tracking well.

Reviewer 4:
The reviewer noted that the project is at early stages, but that the progress was good.

Reviewer 5:
The reviewer commented that the presentation touches on what appear to be strong starts in several subtasks to include some national level analytic conclusions regarding the energy impacts of platooning. The reviewer said that it is somewhat difficult to assign a higher rating to the technical accomplishments because the project is new and because of the limited depth of progress descriptions.

Reviewer 6:
The reviewer remarked that 6-9 months into the project, a number of technical accomplishments have been achieved. The reviewer stated that for intra-city passenger travel, data collection and analysis has begun in a number of areas, and progress has been achieved in the development of new models and in some cases in the conversion of existing models to permit greater flexibility with regards to vehicle routes and faster simulations. The reviewer said that for intra-city freight delivery, freight movement and volume data from Columbus have been compiled to characterize freight energy use. Literature reviews have also been conducted, as well as identification of new modes and vehicle efficiency improvements along with analysis of consumer data on household transportation expenditures. The reviewer stated that for inter-city freight transport, preliminary national estimates for platooning have been established. Analysis models have been assessed and developed; data have been acquired on modal distributions, origin-destination, and vehicle operations out of Columbus; and data have been compiled on energy profiles and national freight modes. The reviewer said that being early in the project it is somewhat difficult to fully assess technical accomplishments to this point.

Reviewer 7:
The reviewer mentioned that some interesting results and accomplishments were shown and gave the example of the 5.2% annual energy reduction due to truck platooning as a meaningful outcome. The reviewer remarked that what seemed to be missing is a cost component, and that the 5.2% annual energy savings clearly saves money, but questioned what infrastructure or fleet investment was required to achieve this reduction. The reviewer wondered if the cost/benefit equation was even positive, particularly with freight being so cost sensitive, and said that this needs to be more strongly incorporated somehow. Going one step further, the reviewer suggested that there would be value in not only adding cost or cost/benefit aspects, but also the impact to the economy and/or jobs whether positive or negative.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that the partners' list indicates an outstanding effort to create a diverse team that can provide significant unique contributions from each of its members, which include industry, academia, municipal government, and DOE national laboratories.

Reviewer 2:
The reviewer was impressed by the variety of collaborative organizations external to DOE.

Reviewer 3:
The reviewer noted that this project has a very good mix of laboratories, universities, industry and municipalities. The reviewer mentioned that if the project were able to get collaboration from additional groups that are light on information (listed in barriers), it would be an even stronger partnership and would mitigate risk.

Reviewer 4:
The reviewer remarked that this project has a broad array of partners and collaborators, including national laboratories, universities, industry, and metropolitan entities. The reviewer said that it would be good to continue to expand upon this list of partners, especially with regards to metropolitan partnerships. The reviewer added that at the end of the day, entities operating within metropolitan areas—be they transit agencies, airports, shippers, rail authorities, trucking companies, transportation networking companies, schools, medical complexes, large shopping districts, large builders, and so forth — will be instrumental in informing the direction and ultimately facilitating the implementation of smart mobility solutions. The reviewer mentioned that these entities "on the ground" would provide an invaluable perspective and insight into the real-world challenges and ultimately most viable pathways to successful implementation.

Reviewer 5:
The reviewer was curious about the fact that Amazon keeps getting mentioned as the major player in delivery of goods, and how its plans may change the intra- and inter-city freight delivery landscape significantly through the use of drones or other self-driving technology. The reviewer asked if there has been any attempt to reach out to them as a partner.

Reviewer 6:
The reviewer said that although the partners involved are very well coordinated, this project could inform or support further collaboration with OEMs or the EPA. The reviewer stated that the results of this study could provide further useful output by providing incentives through the EPA or informing the OEMs regarding future trends and recommendations.

Reviewer 7:
The reviewer pointed out that multi-modal freight analyses are a specialty within DOT, including mode switch and transloading facilities. The reviewer did not see any DOT link with this work, which is a gap. The reviewer stated that while DOT is charged with enabling a safe transportation system, it is also very involved with enabling an efficient, multi-modal, freight-filled system as well.

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

Reviewer 1:
The reviewer found that the proposed future research looked strong and impactful, and that to some extent, some of the prior concerns may be alleviated with this future research plan.

Reviewer 2:
The reviewer said that the future work description indicates that practical criteria are being evaluated in the analyses.

Reviewer 3:
The reviewer noted that after the data are modeled and ready to be reviewed, the step of analyzing those data and then determining how to collaborate on solutions makes sense. The reviewer suggested continuing to look for ways to incentivize the findings researchers get after analysis.

Reviewer 4:
The reviewer stated that this looks very solid, but questioned if the cost of the energy usage figured into the study, as some modalities might be very energy efficient but costly. The reviewer inquired if this should be a part of future work and if not, why not.

Reviewer 5:
The reviewer commented that the future research is laid out in a logical manner with data gathering, modeling, and adding multiple types of transportation to the model (freight, car sharing, etc.). The reviewer stated that there are assessments early in the project, but not many decision points are listed. The reviewer added that there were relevant barriers listed, but that risk mitigation was not described (alternatives if the barriers cannot be overcome). The reviewer said that the research is all very relevant and as the model is refined further, it will become ever more valuable to urban planning and DOE, as it will help at the macro level, not just at the component or micro level.

Reviewer 6:
The reviewer opined that the proposed future research for FY 2018- 2019 covers a lot of ground in all three of the focus areas. The reviewer stated that it is especially good that under intra-city passenger travel there is an emphasis upon analyzing short-term scenarios by mid-FY 2018. The reviewer added that it is especially important to target attractive areas of initial entry that make sense from the end-users' perspective for any variety of reasons including cost, legacy systems, etc. The reviewer said that in this way, some early "wins" could be achieved demonstrating quantifiable benefits. The reviewer mentioned that this would bolster support for the viability of SMART Mobility and provide a springboard for additional actions in the future. The reviewer noted that under intra-city urban freight delivery, it mentions the development of recommendations on adoption methods. The reviewer found this to be especially important and it should be researched in detail. The reviewer said it is likely that many of the same issues, like cost, lack of understanding, resistance to change, risk, existence of legacy systems, etc., that have bedeviled traditional alternative fuels and vehicles (be it compressed natural gas [CNG], electricity, etc.) are also going to challenge SMART Mobility. The reviewer explained that this makes it all the more important to really get down to the local level and thoroughly understand the guiding principles and constraints and what drives the decision making process there. The reviewer remarked that this "feedback loop" from the ground level would be especially beneficial in validating models, grounding future research directions and thrusts, and focusing implementation.

Reviewer 7:
The reviewer mentioned that the nature of this endeavor is so chock-full of uncertainty, that any answer that the researcher may arrive at can neither be proven wrong nor right. Given that, the reviewer said it would be good to lay out the expectations for these analyses, especially with regard to the range of expected uncertainty.

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

Reviewer 1:
The reviewer commented that the economic and energy impact from freight, particularly through the SMART Mobility lens, is extremely important going forward. The reviewer mentioned that this could become one of the most important economic advantages or disadvantages a nation has while competing on the world stage.

Reviewer 2:
The reviewer observed that the project explores optimal means of maximizing transport flexibility at the macro level while also maximizing energy efficiency. The reviewer mentioned that by selecting the most efficient pathways, this should displace petroleum.

Reviewer 3:
The reviewer stated that the project has the potential to help reduce petroleum displacement. The reviewer pointed out that by developing an energy usage model for transportation, it can help city planners see what effect changes in transportation or trends will have on energy usage. The reviewer said that the cities may be motivated by lower energy usage directly or reduced congestion, which leads to reduced energy usage as a secondary effect, but either way it supports the DOE objective of reduced petroleum usage (energy).

Reviewer 4:
The reviewer mentioned that the project description highlights that new business models are changing the way that our society transports people and goods. The reviewer added that the results of this study will help DOE and policy makers to understand how petroleum consumption will change with the adoption of the new transportation methods.

Reviewer 5:
The reviewer was of the opinion that collaborating on the optimized solutions found in the study will meet the goal of petroleum displacement.

Reviewer 6:
The reviewer said that at the high-level, smart mobility technologies have the potential to significantly reduce or increase petroleum usage, especially within the context of urban environments. The reviewer noted that what is intuitively obvious is that some elements are going to provide a positive benefit while others are likely to lead to negative energy impacts. The reviewer's view was that given that there is a steady migration of the population toward urban environments, it is important to identify and work to implement smart mobility strategies to reduce or at least mitigate the currently increasing petroleum and energy demand trends, especially within urban as well as more rural areas. The reviewer said that due to their congested nature, urban areas are not as typically conducive to traditional transportation energy reduction or displacement approaches. The reviewer added that in many cases, entirely new approaches, many of which are not vehicle- based, are needed to truly transform the urban environment.

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

Reviewer 1:
The reviewer stated that the level of funding seems reasonable for the work done and the work to do. The reviewer could envision even an increase needed in funding depending on how the research progresses and what gaps are uncovered.

Reviewer 2:
The reviewer mentioned that the resources appear to be sufficient, and that the project is new but tracking according to schedule.

Reviewer 3:
The reviewer found the budget to be sufficient to provide results that begin to address each of the project objectives, and that a modest expansion of the funding may help to reduce project risk.

Reviewer 4:
The reviewer said that the resources appear to be sufficient.

Reviewer 5:
The reviewer commented that the currently identified resources of $4.5 million over 3 years appears sufficient to accomplish the Multi-Modal pillar project objectives. The reviewer stated that the broad team partners should have the technical expertise, equipment, and facilities to conduct the project successfully, but should be continually looking to expand team participation to other relevant entities to expand the base of resources and capabilities.

Reviewer 6:
The reviewer noted that this seems to be a very large sum of $4.5 million, but the amount of analysis and simulation required is also extensive. The reviewer did not think the sum is excessive for the scope defined.

Presentation Number: eems005
Presentation Title: SMART Mobility—Mobility Decision Science
Principal Investigator: Anand Gopal (Lawrence Berkeley National Laboratory)

Presenter
Anand Gopal, Lawrence Berkeley National Laboratory

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

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

Reviewer 1:
The reviewer said that first, the entire CAV research environment has added an interesting and needed addition to the VTO at DOE. The reviewer said that this project appears to bring an expert academic approach and methodology to the very complex behavioral subject matter through an agent-based model approach. The reviewer said that the "WholeTraveler Project" analysis concept leading to normative behavioral change is a simply amazing analysis potential, and the reviewer looked forward to future progress.

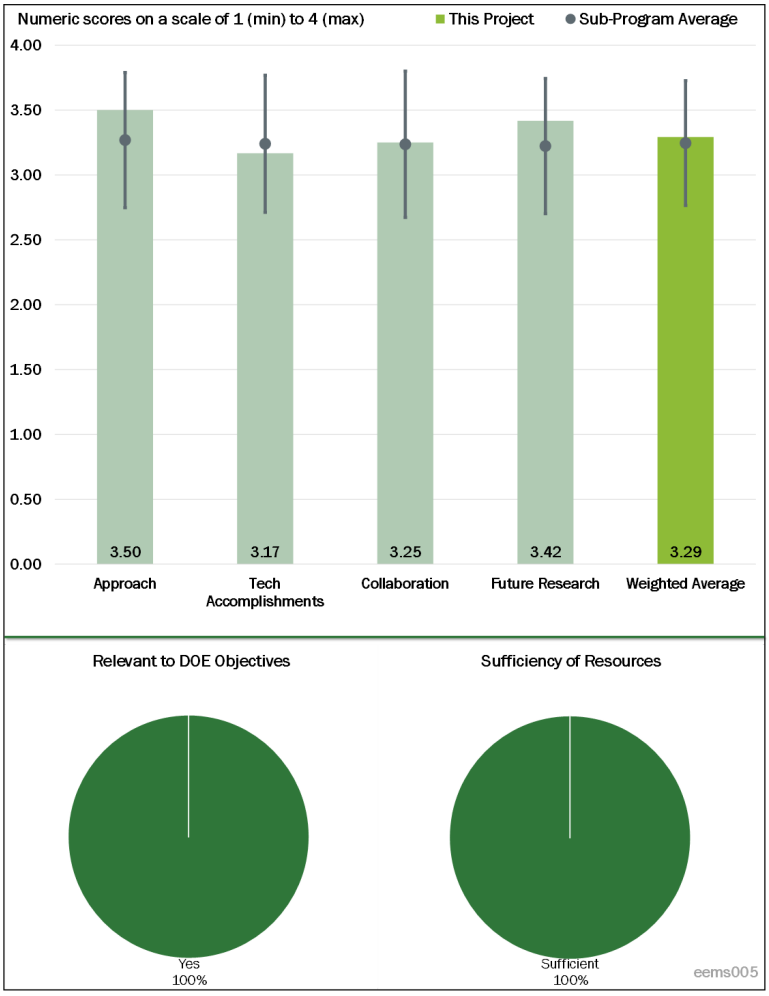

Figure 4-5 - Presentation Number: eems005 Presentation Title: SMART Mobility—Mobility Decision Science Principal Investigator: Anand Gopal (Lawrence Berkeley National Laboratory)

Reviewer 2:
The reviewer said that this project as discussed is apparently a perturbation/response study, which is generally very good at identifying key contributors to energy use, including prevailing societal trends and what causes them. The reviewer hoped that this is able to build something that is predictive as a result and that could be used by the auto industry, municipalities, and the petroleum industry for marketing planning.

Reviewer 3:
The reviewer stated that this project seems to be very well structured and matched to the likely technical barriers.

Reviewer 4:
The reviewer commented that SMART Mobility is a relatively large area for analysis at a national level. The reviewer stated that the project's approach specifically recognizes this, and is therefore focused first on analysis at a regional level (the San Francisco Bay Area). The reviewer added that the project is trying to focus on the long run, rather than primarily short-term. The reviewer mentioned that the project approach explicitly includes processes to address initial results that may dictate changes in directions for future activities. The

reviewer said that this project presented an overview of all Mobility Decision Science projects, including specific ones presented elsewhere in the AMR.

Reviewer 5:
The reviewer found the mobility megatrends to make sense as presented. However, a common vocabulary will be needed, both in this program and DOE-wide, to discuss the topic. The reviewer said that the three questions for descriptive research are all very reasonable. Referencing the second question, the reviewer was unsure how the future vehicle sales increase or decrease is immediately relevant, unless second-order effects are considered (e.g., removal of parking lots, infill, and increased urban density that reduces trip demand and increases building efficiency).

Reviewer 6:
The reviewer noted that it is unclear how effective the life-history survey approach will be in analyzing the costs and benefits involved in new transportation options. The reviewer said that the survey likely can help document the characteristics of conventional transportation choices to include an aversion to accepting the risk of new technologies, but it is unclear how well a history-based model will be able to extrapolate decision constructs that lack historical precedence. The reviewer said that the project may want to supplement the WholeTraveler survey with some system dynamics modeling of the influences affecting traveler decisions.

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

Reviewer 1:
The reviewer stated that as this project is new, progress must be evaluated on how well the work plan is projected and barriers are identified. The reviewer remarked that the approach described in this effort is exceptionally well described for future success.

Reviewer 2:
The reviewer mentioned that the tiered timeframes of the decision model framework are a positive development. It appeared to the reviewer that the upgrades to the decision logic in POLARIS and Behavior Energy Autonomy Mobility (BEAM) are significant improvements to those models.

Reviewer 3:
The reviewer said that although the project is in an initial stage, it seems to be doing well in working toward its goals.

Reviewer 4:
The reviewer remarked that the project only began in fall 2016, and that it therefore seems like much of the effort so far has focused upon structuring activities, as evidenced by completion of the project plan for WholeTraveler. The reviewer said that data collection and analysis plans for estimating value of non-driving travel time have been completed.

Reviewer 5:
The reviewer reported that data collection and analysis through the “life history calendar” WholeTraveler Survey appear to be progressing and are promising for teasing out the medium- and long-term (longitudinal) choices that people make. The reviewer said the survey does not account for type of job, job hours, or job flexibility, which need to be provided by survey taker. The reviewer added that walkscore/transitscore/bikescore of home and job should be considered, as these matter for transport choice. The reviewer wondered how the recommended value of travel time (VOTT) estimates were developed/verified. The reviewer also thought it may be helpful to account for transportation network company (TNC) lease programs where the TNC pays for the vehicle out of the driver’s earnings.

Reviewer 6:
The reviewer commented that the advances already made in creating chronological life events and procuring global positioning system (GPS) data have been good. The reviewer thought it unfortunate that this project is derived from the San Francisco area, because driving behaviors, topography, and vehicle types are very different from most other regions of the United States.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that though the exact relationships within the collaboration group was not expanded upon (impossible in a 20-minute presentation), the collaborative partners appear to be from the highest quality institutions for this subject matter.

Reviewer 2:
The reviewer stated that this is a fundamentally collaborative project, and it seems that the interaction makes sense. The reviewer mentioned that it would be worth talking about collaboration outside of DOE in future presentations.

Reviewer 3:
The reviewer asserted that the project team includes all major laboratories, plus several universities, and that it would not be surprising to have seen additional partners added along the way as needs for these partners arise. The reviewer pointed that in particular, involvement of DOT and state DOTs would be expected to be pursued.

Reviewer 4:
The reviewer wondered how Mobility Decision Science is coordinating with DOT, in particular with the Smart Cities Challenge and with the ARPA-E TRANSNET program. The reviewer mentioned that the latter was mentioned but not in any detail, and because the objective of TRANSNET is normative behavior change through various forms of travel demand management, it would seem critical to coordinate with them for the future work in Mobility Decision Science.

Reviewer 5:
The reviewer remarked that the project team has the potential for strong contributions from several laboratories and universities, and that it is unclear from the presentation materials whether all the partners are coordinated and collaborating.

Reviewer 6:
The reviewer was of the opinion that as results come in from each collaborator, the ability for all participants to work together will be better assessed.

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

Reviewer 1:
The reviewer said that the plan to close the loop and test results is excellent. The reviewer added that in the past, technology changed at a slower pace. The reviewer clarified that with the pace of advancement today and likely in the future, it would be beneficial if results were able to be produced more quickly, and subsequently correlated to predictions.

Reviewer 2:
The reviewer commented that the project seems very well designed to interactively respond to changes in data availability and unexpected developments.

Reviewer 3:
The reviewer looked forward to updates in the future years on this and other EEMS projects. The reviewer said that this type of research can be wide-reaching from informing the needed engineering efforts to transforming our mobility/transportation systems.

Reviewer 4:
The reviewer indicated that most of the project is ahead because it started recently, and that it appears to be focused on doing the data collection, modeling, and analysis leading to obtaining answers to reducing barriers to technology acceptance. The reviewer said that this could well result in identification of new directions, and that the project team and DOE management have specifically taken this possibility into account, setting up a management team and go/no-go points.

Reviewer 5:
The reviewer noted that the mobility decision behavior models flow from the long-, mid-, and short-term choices. The reviewer said that it makes sense that people do not make transportation decisions, but life decisions that lead to transportation choices, as the speaker remarked. The reviewer added that there should be more fleshing out of the behavioral economics application of the normative work. The reviewer stated that even a number of strawman concepts beyond simulation would point to possible field studies. The reviewer mentioned that this would inform the normative work, working from the end backwards, and that coordinating with TRANSNET could inform the shape of the normative work—or even feed into TRANSNET.

Reviewer 6:
The reviewer found the future work descriptions to be logical but too sparse and vague. The reviewer remarked that one strong point of the outline was that it indicates that the project is using a review board to provide feedback on work progress before proceeding with the next steps.

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

Reviewer 1:
The reviewer noted that SMART Mobility has the opportunity to improve efficiency, which will reduce petroleum use.

Reviewer 2:
The reviewer agreed that this project supports the overall DOE objectives of petroleum displacement, given the growing energy consumption share of transportation and the potential to reduce single occupancy vehicles. If decisions at all time scales from daily to decadal can be understood, there is good potential to reduce petroleum through appropriate interventions.

Reviewer 3:
The reviewer said that the project is working on reducing barriers to acceptance of new alternative fuel and higher efficiency vehicle technologies. The reviewer mentioned that this feeds in closely with VTO's objectives. The reviewer added that there is also a funding-constrained scope that has been developed in case the original level of funding is not available. The reviewer mentioned that addressing energy consumption impacts from SMART Mobility is relatively novel, as most projects by others in this area have focused more on the safety and logistical aspects.

Reviewer 4:
The reviewer stated that these forward predictive projects allow the greatest insight to accomplishing more efficient and greater electrified mobility, which will result in energy savings and reduced use of petroleum.

Reviewer 5:
The reviewer observed that the project is developing decision models relevant to new mobility options for travelers and consumers. The reviewer said that these decision models will help DOE understand the possible opportunities for incorporating viable energy consumption reduction mechanisms into future transportation options.

Reviewer 6:
The reviewer suggested that when industry or cities can react to the "marketing weather," then better decisions can be made regarding products to support energy reduction in those new environments. The reviewer stressed that those advances will only be made if there are incentives and clarified that nobody will introduce new product or make extensive changes unless they are free, and they most often are not free.

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

Reviewer 1:
The reviewer brought up that the speaker mentioned a funding-constrained scope. The reviewer stated that it was not fully clear how much of the proposed scope can be done given the $9 million budget currently planned for.

Reviewer 2:
The reviewer commented that if planned funding continues, it should be sufficient. The reviewer stated that this area is currently planned for funding of $9 million.

Reviewer 3:
The reviewer chose "sufficient" because there was no basis for other consideration or concern.

Reviewer 4:
The reviewer noted that the budgeted resource allocation is sufficient to support significant progress in accomplishing the project objectives.

Reviewer 5:
The reviewer said that this was not discussed specifically, but that funding seems appropriate.

Reviewer 6:
The reviewer mentioned that the proposed budget for this project appears to be very large for such a limited geographic region of study. The reviewer questioned if all partners are needed, as sometimes collaboration can be expensive. It was disheartening for the reviewer to hear that the speaker did not believe there was sufficient funding even at $9 million, and said that perhaps there are inefficiencies that can be improved.

Presentation Number: eems006
Presentation Title: SMART Mobility—Urban Science
Principal Investigator: Stan Young (National Renewable Energy Laboratory)

Presenter
Stan Young, National Renewable Energy Laboratory

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

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

Reviewer 1:
The reviewer observed that the approach appears strong, particularly with the strong connection/engagement with cities that should maintain tight grounding to reality and stakeholder needs. The reviewer said that there are opportunities to improve further by incorporating some of the latest thinking—including high-performance computing (HPC), which was alluded to in the presentation—around model validation and advancement of model maturity.

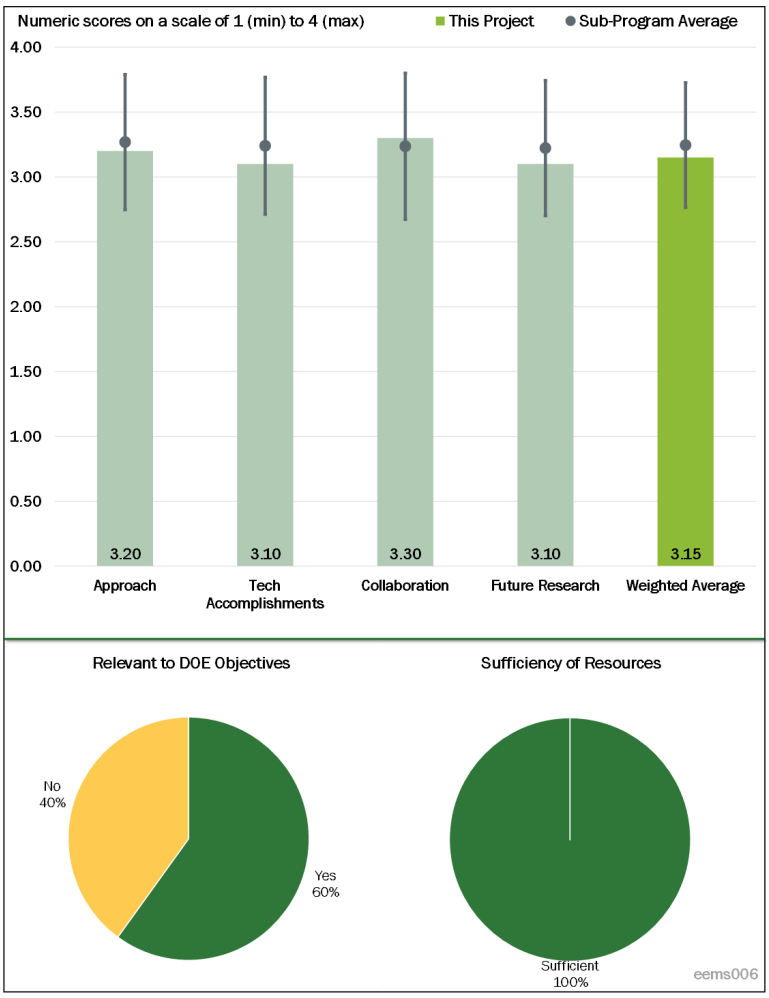

Figure 4-6 – Presentation Number: eems006 Presentation Title: SMART Mobility—Urban Science Principal Investigator: Stan Young (National Renewable Energy Laboratory)

Reviewer 2:
The reviewer acknowledged that it makes sense to capture all the data, case studies, and lessons learned, and house them in a location that would be accessible to other urban centers that are looking at how they can deal with the challenges. The reviewer remarked that the outline of the approach makes sense, but it was expected that the details will evolve as progress is made and more lessons are learned.

Reviewer 3:
The reviewer understood how computational models, design and simulation methodologies barriers are being addressed, but it was not clear how this project is addressing constant advances in technology.

Reviewer 4:
The reviewer said that this is a new area of investigation that requires new tools and methods to be developed. The reviewer stated that the approach is not yet fully mature and it would be expected to change over time. The reviewer pointed out that some of the elements that will create variation in the predicted outputs need deeper investigation, such as the effects of changes in volume and style of package delivery on traffic and parking in urban areas. The reviewer questioned if schools will become more "virtual" thereby taking the buses off the

streets during rush hour. The reviewer added that to tackle the build of a complete enough transportation model environment, it will require future scenarios that must be accommodated in the model.

Reviewer 5:

The reviewer commented that the Urban Science pillar is a critical component of what appears to be a very well-designed and well-integrated five-pillar approach. The reviewer stated that, as an overarching comment, DOE deserves substantial credit and recognition for stepping into this space, as there has been a vacuum of interest and effort in trying to grapple with the challenging longer-term uncertainties involved in the mobility systems of the future. The reviewer said that other agencies and institutions seem to be reluctant to attempt to grapple with the uncertainties facing automation, connectivity, and how they will affect overall system behaviors over the long term.

The reviewer mentioned that the five-pillar framework is not perfect—no framework ever will be—but it is a bold and much-called-for step in an important direction. The reviewer said that the EEMS tagline to achieve "maximum mobility, minimum energy future," is not the best message to send. The reviewer suggested that it would be better to openly acknowledge that the end goal of transportation is not really more mobility in all cases, but is actually to improve "accessibility" of goods, services, and other desired destinations. The reviewer added that it may be the case that the Urban Science pillar is exactly the place to have this conversation—it seems like it might be the best place to raise and address the issue of how to combine the thinking about mobility systems with thinking about land use and the distribution of destinations into a unified macro-system that has a single clear goal of maximum accessibility.

The reviewer questioned if improved understanding of "urban science" can help identify ways to improve mobility without the damaging feedback effects in behavior and land use. The reviewer gave the example of times when improved mobility encourages less efficient travel behaviors, which in turn leads to less efficient land use. The reviewer clarified by asking what urban science can tell us about what needs to happen to enable better mobility (faster, better connectivity, lower travel times, lower cost) without encouraging sprawl. The reviewer explained that another way to think of this is to adopt the energy efficiency approach and ask how people can get access to all the things they need, with minimal movement, and how they can provide "mobility services" without the mobility expenditure. The reviewer mentioned that this is analogous to how the energy efficiency sector talks about providing "energy services"—such as desired temperature and lighting—while consuming minimal or no energy.

The reviewer said that the stated objectives include "methods, models, and data" on impacts and implications of smart mobility, but that there is not very much detail on other current and potential applications resulting from advances in urban science where there may be a lot of other tools and applications enabled by connectivity and better access to data. The reviewer expressed the thought that it would be interesting to take a broader approach to gain a better understanding of the entire flow of goods and people throughout a region, understand what drives those flows, and then examine how data-enabled tools might minimize those flows without impacting access. The reviewer gave an example of having better information about locating public services (hospitals, schools) and alternative "smart" ways to provide services, such as finding other technology solutions to minimize people's need to make trips. The reviewer suggested expanding the scope of this pillar to embrace the full range of everything the public and private sectors do and provide for people, consider the mobility demands related to those services, then do a full analysis of how those mobility demands can be reduced without reducing the ultimate delivery of services. The reviewer asked if there is some role to play for more "delivered" services, or pop-up type locations for a wider range of services. The reviewer remarked that one of the stated goals is to examine "how automation, connectivity, electrification, and shared use might impact the urban network/traveler." The reviewer mentioned that this could be broadened to include data and consider how cities might provide services differently. The reviewer pointed out that if the promises of big data are fulfilled and we can get a much better understanding of exactly where and when people need things, this should enable entirely new and hopefully much more efficient ways of providing goods and services.

The reviewer mentioned that there may also be other Urban Science-type options enabled by new technology worth considering, such as flexible-use road space where "smart-road" technology can make more efficient use of road space by allowing it to dynamically and automatically shift among parking, driving, or changing the direction of flow.

The reviewer said that in terms of models, it would be helpful to have a better description/diagram of the models in this pillar and how they fit together, or some other "taxonomy" of models. The reviewer observed that it looks as if the Urban Science pillar owns the Integrated Urban Mobility model, and this takes inputs from other pillars. The reviewer pointed out that it is not clear if this is a model or a collection of models, and how it relates to other existing models. The reviewer added that there is very little information online about Toolbox for Urban Mobility Simulation (TUMS), what it does, and how it relates to the other modeling efforts.

The reviewer mentioned that another helpful discussion would be to examine what tools exist to understand the nexus of mobility, behavior, and land use. The reviewer added that such tools would be very empowering for municipalities as they plan transportation and infrastructure investments. The reviewer clarified that if good tools exist, it would make sense for DOE to ensure they extend to cover energy consumption; if there is a lack of such tools, it would seem appropriate, then, for DOE to step into this space.

The reviewer indicated that there is also a general challenge facing the broader urban science (or "smart city") and urban planning sector, whereby the terminology sends the false impressiogn that the tools they develop and use are only useful for major cities and dense urban areas. The reviewer acknowledged that this is certainly not the fault of DOE, as this problem is widespread, but that it would be good for DOE to acknowledge and highlight the fact that urban science is about how people live and move and interact with the infrastructure. Urban science focuses on the built environment, but is not limited in its utility to just cities. The reviewer said that the issues in urban science are relevant wherever there are roads, settlements, development, and that they happen to be just a lot more intense and critical with bigger, denser cities.

The reviewer found the approach of spending significant time up front engaging with the seven Smart Cities Challenge finalists to be very strong. The reviewer remarked that it is important to invest the time to fully explore the problem space, and doing so with seven actual cities that have expressed interest and committed resources to achieving "smart city" type goals is a good approach.

The reviewer said that it is a good approach to spend time with the seven Smart City Challenge finalists and fully explore the problem space. The reviewer noted that Task 4.0 focuses on the "role of signal system in smart enabled city," and while this is surely relevant and appropriate, it seems oddly specific. The reviewer remarked that there are so many levers that operations managers can pull, and that signals are just one of them, so it is not clear why that deserves more focus than the others, such as dynamic tolling/congestion pricing, restricted parking/dynamic parking pricing, lane closures/lane-direction changes, etc.

The reviewer suggested that a more thorough explanation for how this pillar interacts with the multi-modal pillar may be called for. The reviewer was interested in knowing if DOE has examined any kind of multi-modal, macro system level, real-time operational concepts to improve efficiency. The reviewer said that based on this, it seems that the matrix of cross-pillar dependencies that is provided should include more interaction with the Multi-Modal pillar.

The reviewer remarked that 3 years is very ambitious, and that it may not be enough time to even fully gain an understanding of the potential role of Urban Science.

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

Reviewer 1:
The reviewer said that for an early project, the accomplishments have been notable, and that among successful various modeling workshops, validation of data input like counts, and incorporation of Automated Mobility Districts (AMDs), the project appears to be off to a strong start.

Reviewer 2:
The reviewer stated that the project appears to have made steady progress in each of the subtasks. The reviewer remarked that Slide 3 shows the range of percentage changes in energy consumption for a standard vehicle. The reviewer mentioned that it would be good to have seen this same graphic for an efficient vehicle as a "result" of this work.

Reviewer 3:
The reviewer noted that the project was initiated relatively recently and that in several areas of interest like platooning and vehicle right-sizing, there has been other work that has already been done by DOE-funded projects or other European consortia like the Safe Road Trains for the Environment project, for instance. The reviewer asked the presenter to ensure that the lessons learned from those various projects are carried over.

Reviewer 4:
The reviewer commented that there is not much to score this on as the team is only reporting on about 6 months' worth of effort. The reviewer mentioned that the work in Tasks 2.1 and 2.2 seems to have made solid progress, and that it is very positive that the team has successfully engaged with four of the Smart Cities Challenge finalists. The reviewer said that not much detail is provided for Tasks 2.3.1 and 2.3.3, and that this is understandable as this is an overview of an entire pillar. The reviewer mentioned that strong progress is shown in convening two workshops and establishing a collaborative relationship with the Mid-Ohio Regional Planning Commission. The reviewer said that the work done in Task 2.3.2 appears very strong, relevant, and valuable. It was not clear to the reviewer how this interfaces with the Multi-Modal pillar. The reviewer also remarked that there is not much detail provided for Task 2.4.

Reviewer 5:
The reviewer pointed out that this is a first year of a multi-year project and that it is still in an organizing mode, which should have been done during the proposal stage, hence the low score. The reviewer mentioned that there are therefore few technical accomplishments to discuss. The reviewer remarked that only organizing the project has been done to this point, and that where it does actually support DOE goals is not yet measurable. The reviewer said that the intent to satisfy any particular DOE goal is not stated at all. The reviewer remarked that this presentation does not state the barriers in the DOE strategic plan that were intended to be overcome as is requested in the AMR review instructions, but rather that the project team appeared to make up its own technical barriers.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer observed that unlike some of the other projects where stakeholders were listed out of obligation with only modest actual collaboration, this project truly is collaborating very effectively through workshops and strong connection to the city stakeholders themselves.

Reviewer 2:
The reviewer said that good collaboration seems to be taking place among the laboratories and with the finalist cities. The reviewer questioned if there are other federal collaborations or coordination that should be taking place, for example with DOT.

Reviewer 3:
The reviewer mentioned that collaborations are still in development and that so far a few good ones have been engaged. The reviewer mentioned that this project needs a lot of input and a way to sift out opinion from fact.

Reviewer 4:
The reviewer found that there appear to be many laboratories, cities, and universities that are involved. The reviewer remarked that notably absent is the University of Michigan Transportation Research Institute, which has done a fair amount of research on driving habits going back many years.

Reviewer 5:
The reviewer commented that it is not clear how much collaboration there has been with DOT and what the nature of that collaboration is. The reviewer mentioned that it may be hard to discern, but DOT has extensive expertise on a range of urban science topics with extensive work in overall system safety and environmental impacts. The reviewer stated that the approach of reaching directly to interested and committed cities, such as the Smart Cities finalists, is a great approach. The reviewer said that regarding Task 4, it would have been helpful to know who the potential collaborators were. The reviewer recommended contacting the organizations in Europe that are doing extensive work with low-speed automated shuttles (e.g., Citymobil2).

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 brought up one comment completely unrelated to this question, but completely applicable to all the SMART Mobility projects: because this is a relatively new area, and is replete with a large number of acronyms that keep evolving rapidly as well, it makes great sense to include a slide or two describing what all the various acronyms stand for. The reviewer asked if the presenter could elaborate on the type of data that need to be accessed from the Smart City finalists and the winner and how the presenter expects to use them for other aspects of this and other EEMS projects. The reviewer said that all the ideas look good, but there is not a lot of clarity in bullet points, and the devil is in the details.

Reviewer 2:
The reviewer said that future work is clearly planned, but that it would be been nice to have seen the correlation among future work and the remaining challenges and barriers (Slide 18 of 26), each of those future work activities is designed to tackle.

Reviewer 3:
The reviewer stated that the future research slides show a significant amount of important work ahead. The reviewer remarked that the only missing piece to which not much attention was given was on costs as factors or constraints. The reviewer said that these would include implementation/infrastructure costs, as well as the cost/benefit analysis that in the future will increasingly need to be more positive than in prior years. The reviewer remarked that energy savings are clearly an easily tangible benefit, but may be overwhelmed with the infrastructure costs necessary to save that energy. The reviewer added that there may be other benefits that need to be incorporated, such as social costs.

Reviewer 4:
The reviewer praised the approach for future work overall as very strong and well thought out. In particular, the use of scenarios as a way to deal with uncertainty is very promising. The reviewer stated that as discussed earlier, it might be even more valuable to capture some of the indirect effects in those scenarios, such as land use impacts. The reviewer said that as noted earlier, working directly with cities is a good approach, but it might be worthwhile to consider balancing this out by engaging with some other institution less constrained by

day-to-day operational concerns, perhaps with more capacity for imagination like an "urban institute," a university, or a quasi-academic institution like the Massachusetts Institute of Technology Media Lab.

Reviewer 5:
The reviewer said that it is still under development and that the overall objective is not fully defined yet. The reviewer said that a general idea of "we want to model smart mobility" is what is currently being worked with, but that by this time one would have assumed that the team would have developed a clearer path to achieve success. The reviewer stated that this one is vague.

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

Reviewer 1:
The reviewer indicated that this work is absolutely relevant and that, if anything, it does not go far enough. The reviewer said that this pillar is beginning to fill a very long-standing and very major gap in DOE's approach. The reviewer mentioned that for too long, there has been no focus at the federal level on how to make entire urban/human-settlement systems more efficient overall. The reviewer recalled that in the past, developing energy efficient vehicles without addressing the way those vehicles are used was somewhat analogous to developing a more efficient furnace without considering how to make the whole building more efficient. The reviewer stated that this is a very welcome solution and is essential to pursue.

Reviewer 2:
The reviewer noted that with cities at the core of population growth and future mobility needs, urban science is clearly a relevant topic.

Reviewer 3:
The reviewer said that the project describes its relevance on Slides 3 and 4, but that the problem with these slides is that there is no quantification of how much petroleum is displaced. The reviewer clarified that there is a quote on Slide 4 that says, "Cities consume close to 2/3 of the world's energy...," but this project does not mention what portion of that is from transportation and how much of that consumption it is trying to reduce. The reviewer stated that the project itself is too broad to provide real metrics. The reviewer remarked that perhaps the individual projects in this pillar (Urban Science) address petroleum displacement in more concrete numbers, but it was not clear how those projects' metrics rolled up into this project.

Reviewer 4:
The reviewer observed that if congestion is reduced, it would reduce petroleum but the current status of the project would not currently be able to claim that. The reviewer mentioned that the estimate of how a smart system would or would not reduce petroleum use is shown to be quite varied from a negative effect to a wildly positive one. The reviewer added that what happens with petroleum use will not be affected by this project, but by what the vehicles themselves may realize, which is excluded as a subject of study in this project. The reviewer said that all this project will do is set up an urban prediction of energy use that may be better or worse than current per capita energy use.

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

Reviewer 1:
The reviewer noted that while the funding is likely sufficient, it leans low. The reviewer mentioned that this activity perhaps could need more funding to ensure the outcomes are best executed.

Reviewer 2:
The reviewer indicated that while the resources appear to be adequate on the surface, this is not an area that should be skimped on, by any means. The reviewer said that minor advances in these macro system-level areas

may completely outweigh major improvements at the vehicle level. The reviewer added that one need look no further than the examples of Western Europe and Japan to see that what makes economies there much less energy intensive than ours is not that they all have much more efficient cars (this surely helps, but does not explain the entire disparity), but that their whole mobility systems are more efficient overall. The reviewer mentioned that it is not clear if this will be completed in a "timely fashion" because it is an entire pillar of work. One concern the reviewer had is that the time issue may not be addressed through more resources. The reviewer remarked that getting a better handle on the messy sprawling issues of urban science may take many iterative discussions, revisions, and stakeholder engagement, and that these are all kinds of things that cannot be rushed, regardless of the resources that are provided.

Reviewer 3:

The reviewer said that the resources are sufficient to excessive.

Reviewer 4:

The reviewer said that it is easy to say sufficient for now because it is not clear as to what exact level of effort is required to meet the milestones. The reviewer stated that the answer to this question is always a guess because the review does not address resources specifically.

Presentation Number: eems007
Presentation Title: SMART Mobility Stakeholders—Curating Urban Data and Models
Principal Investigator: Joshua Sperling (National Renewable Energy Laboratory)

Presenter
Joshua Sperling, National Renewable Energy Laboratory

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

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

Reviewer 1:
The reviewer said that similar to all of the EEMS projects, this project projects an excellent approach by means of methods and analysis to gain understanding of the urban mobility space. The reviewer stated that actions taken from this analysis could be transformative to the mobility future, resulting in significant environmental impact.

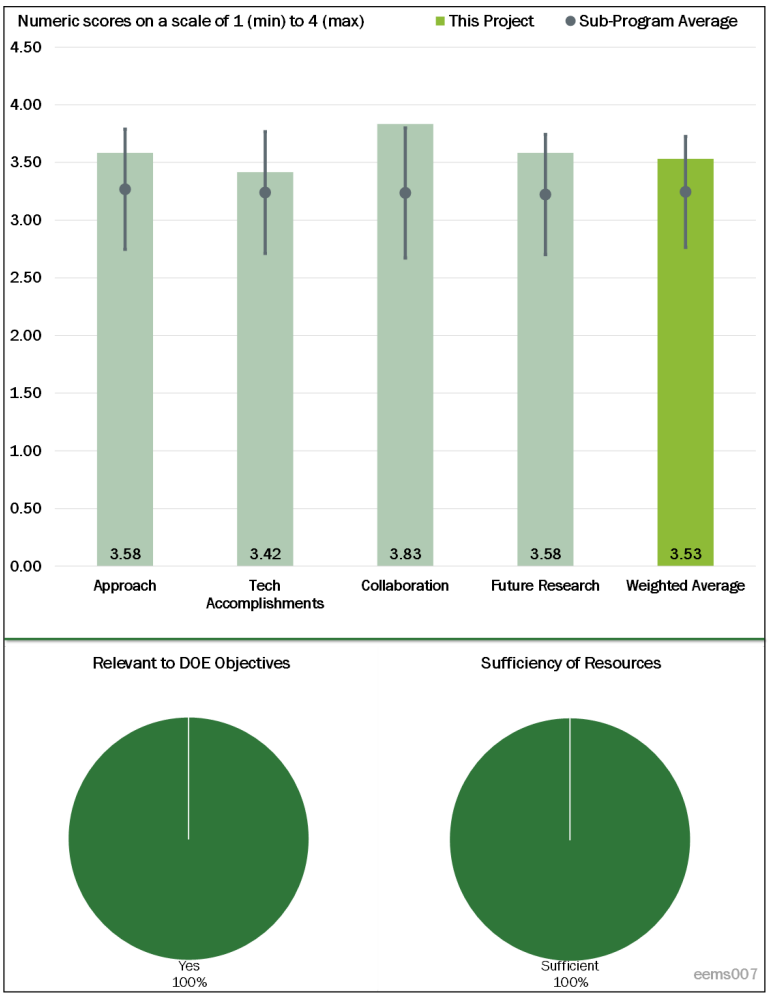

Figure 4-7 - Presentation Number: eems007 Presentation Title: SMART Mobility Stakeholders—Curating Urban Data and Models Principal Investigator: Joshua Sperling (National Renewable Energy Laboratory)

Reviewer 2:
The reviewer stated that this project is early in its progression, but has a very well-defined plan with many collaborators. The reviewer remarked that the risks of making wrong decisions were discussed and the presenter made it clear that this study is required to ensure we have some guidepost to avoid the "nightmare" scenario.

Reviewer 3:
The reviewer commented that the overall project seems to be very well-structured and this specific portion is important in ensuring a useful outcome.

Reviewer 4:
The reviewer indicated that the approach is solid.

Reviewer 5:
The reviewer found the PI to be appropriately focused on barriers in working with multiple external entities and to have a vision of what the project results should be. The reviewer suggested that some specific goals be set for both the curation of data and models and the development of common datasets to be used by the participating cities.

Reviewer 6:
The reviewer pointed out that the workshopping, curating, and convening of city partners and mapping their datasets and decision support systems for planning and policy are an ambitious but necessary task. The reviewer said that the only risk here is being too ambitious in scope and that the researchers may need to focus more narrowly. The reviewer remarked that understanding the nature of existing models and identifying/filling their gaps are clearly something that has not been done before.

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

Reviewer 1:
The reviewer asserted that this is a great project and is moving along well.

Reviewer 2:
The reviewer said that progress to date looks good.

Reviewer 3:
The reviewer stated that for being in its early phases, this project has done some data gathering already and appears to be on track.

Reviewer 4:
The reviewer noted that it is very early in the project development, but that excellent progress has been made in coordinating the participant cities. The reviewer remarked that multiple workshops have been held and a good understanding of methods used by each city is being developed. The reviewer suggested that a more detailed schedule for the balance of the project be developed and/or presented, providing specific milestones and anticipated work products.

Reviewer 5:
The reviewer said that the curation and analysis of existing models of the Denver Regional Council of Governments and other regional transportation models are underway, including Dynamic Traffic Assignment, four-step, and activity-based models. The reviewer explained that there is a framework for analyzing each of the models so their inputs, outputs, and key attributes are being teased apart. The reviewer remarked that some of the early results were shown; initial results shown support benchmarking of cities and segmenting similar cities to understand what determines their per capita vehicle miles traveled (VMT) and parking supply. The reviewer mentioned that reading the Smart Cities Challenge finalists' proposals is a good approach to capture existing datasets and gaps, as are the one-on-one engagements with city agencies. The reviewer was not sure how well success can be measured in this project and suggested that metrics should be crystallized a bit more.

Reviewer 6:
The reviewer saw that, as per all new projects, the accomplishments must be interchanged with plans for success. The reviewer stated that accordingly this project reflects an insight to a very complex set of problems in the space of urban science and mobility while realizing the relationship to behavioral and decision science with urban mobility.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that coordination with multiple cities is an ambitious and difficult effort, and that the PI is to be commended for the dedication to make this happen. The reviewer exclaimed that it is a great effort.

Reviewer 2:
The reviewer remarked that though the concise relationship of "The Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility Lab Consortium" is unclear at this time, a better skilled group of scientists could not be found. The reviewer mentioned that leveraging the national laboratories in a consortium fashion is an incredible accomplishment of DOE and should have great benefits.

Reviewer 3:
The reviewer stated that there appears to be a good planned collaboration with the data gathering entities to pull together the necessary information.

Reviewer 4:
The reviewer said that it is a great team covering all bases.

Reviewer 5:
The reviewer pronounced that this is a fundamentally collaborative project. The reviewer mentioned that in the future it would be useful to spend more time talking about collaboration outside of DOE.

Reviewer 6:
The reviewer indicated that coordination with the Smart Cities Challenge is strong, including the four partner cities and also with the National Institute of Standards and Technology's Global Smart City Transport Event. The reviewer stated that perhaps a collaboration with the World Economic Forum should be considered as well.

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

Reviewer 1:
The reviewer found the overall project to have a well-developed plan and that this project in particular appears to have a clear roadmap.

Reviewer 2:
The reviewer said that it is right on the mark for future research.

Reviewer 3:
The reviewer pointed out that the plan to create future models for the Smart Cities is going to be a learning experience and should result in improved planning for reduced energy usage. The reviewer noted that when this is coupled with potentials for municipal revenue, it should encourage realization of value for this work.

Reviewer 4:
The reviewer stated that the integration of the data models to inform the scenarios for future energy consumption analysis was not discussed at length, but the three scenarios discussed seem like a good starting point. The reviewer said that given the reliance of the project on outside actors beyond the project's control, strong relationships with the cities will be key to develop and maintain. The reviewer mentioned that the project is already considering the available policy levers to influence planning and operations, e.g., airport fees for TNCs that would fund charging stations.

Reviewer 5:
The reviewer reported that the project is observing and quoting an extremely well-defined project plan to do the following: leverage data integration, visualization, and analytical tools to accelerate planning and decision making on urban futures; curate Smart City partners (DOT), transport models, and data to include in a

repository for urban mobility science and research; extend data as a basis to exercise/advance urban models; and identify the impacts of SMART technologies on urban travelers.

Reviewer 6:
The reviewer observed that there is recognition by the PI that coordination of the participant cities and development of datasets and, potentially, models that are useful across the city group are an evolving effort. The reviewer remarked that additional milestones and anticipated results should be developed to support project planning and maintain a project focus.

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

Reviewer 1:
The reviewer pointed out that the overall project is intended to facilitate transportation improvements that would improve efficiency and therefore decrease petroleum use.

Reviewer 2:
The reviewer said that this project supports the overall DOE objectives of petroleum displacement.

Reviewer 3:
The reviewer noted that by the very premise of this type of project/analysis, the end result is intended to provide direction in the efficient actions and decisions of future urban mobility, thus realizing a reduction in energy per human and therefore in the use of petroleum.

Reviewer 4:
The reviewer stated that the growing share of energy consumed by transportation in the United States and the strong correlation with urban density (the Marchetti curve) underscore the importance of understanding how city-regional travel models fall short in enabling more efficient land use and zoning that would decrease petroleum consumption.

Reviewer 5:
The reviewer explained that if the cities can prosper and save money because of reduced energy usage, and if they can open up land that previously had to be used for parking or roads, the effort to clean up the mess made by personalized transport will be self-sustaining.

Reviewer 6:
The reviewer remarked that it is not clear that evolving smart mobility systems will reduce or increase fuel consumption. The reviewer stated that it is, however, clear that this is the most significant issue urban planners will face in the coming decade. The reviewer stated that the support of their efforts to create a utopia and not a nightmare is extremely relevant.

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

Reviewer 1:
The reviewer said that this is very much a level of effort project, and that resources are sufficient at this stage of development. The reviewer remarked that as the project progresses and specific data needs are developed, additional resources may be required.

Reviewer 2:
The reviewer found the funding to be appropriate.

Reviewer 3:
The reviewer stated that resources are good for this project.

Reviewer 4:
The reviewer said that without any basis for differentiation, the resources appear to be sufficient.

Reviewer 5:
The reviewer heard no comment in this presentation about lack of funding.

Reviewer 6:
The reviewer suggested that this is a tall mountain to climb, and that no matter how much funding is thrown at this project, there will probably be more work to do.

Presentation Number: eems008
Presentation Title: Impact of Population Shift on Energy Use: Detroit Use Case
Principal Investigator: Josh Auld (Argonne National Laboratory)

Presenter
Josh Auld, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer commented that the project's approach appeared to be very robust, adapting POLARIS from Chicago to Detroit, and it did a good job involving stakeholders along the way.

Reviewer 2:
The reviewer thought the approach to the project was well done. The reviewer commented that the technical barriers were addressed and the project was able to adhere to the timeline reported. The reviewer noted that there was not any mention in the presentation of integration of this work with other efforts. The reviewer believed that because this project falls under the EEMS Urban Science pillar, it would be been nice to have seen its relationship to that pillar and the EEMS work on a slide. The reviewer found the work to be a very interesting, stand-alone project.

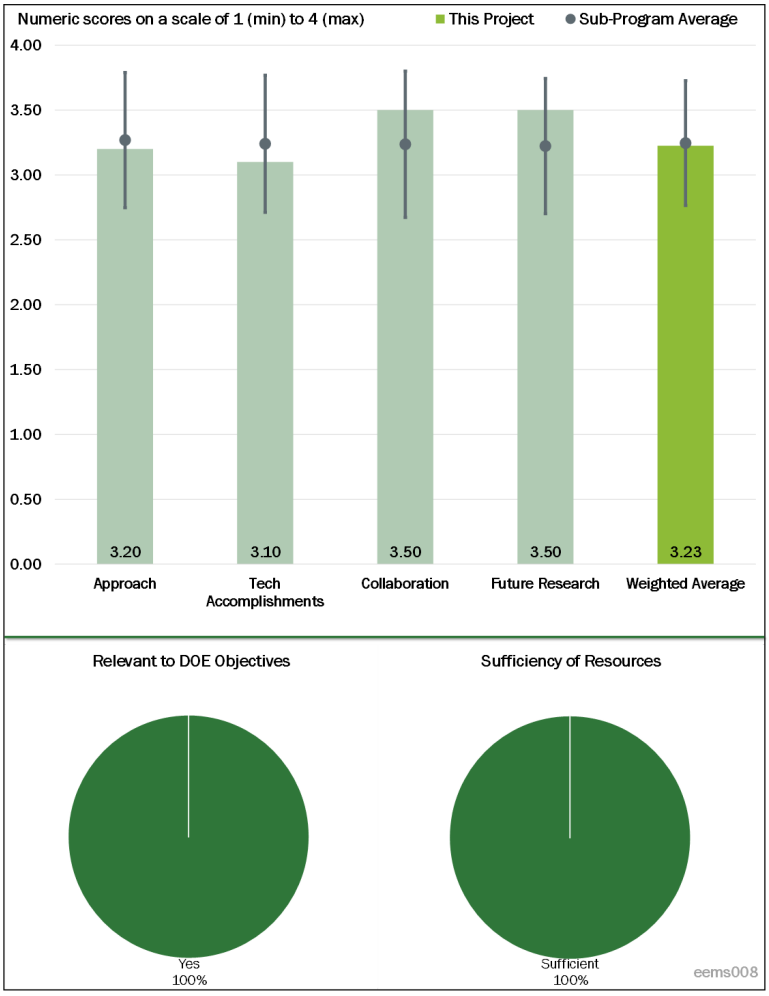

Figure 4-8 - Presentation Number: eems008 Presentation Title: Impact of Population Shift on Energy Use: Detroit Use Case Principal Investigator: Josh Auld (Argonne National Laboratory)

Reviewer 3:
The reviewer found the approach taken by the project to be a good beginning to extend to other projects and to learn from any mistakes that may have been made. The reviewer noted that routes in Detroit are constantly in flux due to construction, and a comment about that would have been worth including in the presentation. The reviewer hoped that re-routing due to construction would not be a constant in Detroit or anywhere else, but believed it certainly must have skewed the results of this study.

Reviewer 4:
The reviewer pointed out that this was a low-funded project that only used existing datasets and questioned its correlation to the real world. The reviewer was confused as to the way the region was modeled. Specifically, the presentation only shows work for Detroit, Wayne County, and Washtenaw County when, in actuality, the majority of the population in southeast Michigan lives in Macomb and Oakland Counties and their transportation patterns greatly affect what happens in the city of Detroit. The reviewer mentioned that in

response to a question during the AMR, the presenter stated that Macomb and Oakland Counties were included in the study. However, the reviewer noted that there is only reference to counties other than these two in the presentation and requested clarification. The reviewer stated that this project appeared to be a low-key application of POLARIS with whatever data were available.

Reviewer 5:

The reviewer noted that land use patterns are set exogenously in the scenarios and believed that that is a major limitation, due to the fact that if feedback is not allowed for between land use and transportation behaviors, the project team may end up with unrealistic scenarios. In other words, there may be inherent tipping points in the system that make certain land use patterns unstable, so leaving them as "fixed" in a scenario and not allowing them to adjust in response to changing behaviors may not be realistic. The reviewer noted that it was understandable, however, that this is a small project, and that this level of modeling may simply have been beyond the scope and capacity of the project. The reviewer stated that if land use is taken as a fixed element, then the outcome is to effectively isolate the question of what these specific land use and population scenarios do to VMT, which the reviewer believed was a valid question, but fairly limited. The reviewer noted that, taken in isolation, the project appears to do a good job of illustrating the one-way causal relationships between land use and population on the one hand, and VMT and employment on the other.

The reviewer stated that POLARIS appears to be an appropriate tool, but the presentation would have benefited from greater discussion of alternatives. Furthermore, it was unclear if other models/approaches were considered.

The reviewer commented that the explanation provided about the relationship among some of the components of the modeling approach was unclear. As an example of this confusion, the reviewer listed the diagram on Slide 5, which seems to indicate that population drives vehicle choice, which drives home and workplace choice, which generates activity demand, which defines traffic flow (which appears to have a feedback effect, where traffic flow is allowed to potentially limit activity demand), which in turn defines vehicle choice. The reviewer is confused as to where mode choice fits into the model, and whether there is any mechanism for traffic flow to influence home and workplace choice directly. The reviewer also noted that it was not clear why traffic flow would be a major input to vehicle choice, and cited the fact that one regularly sees four-wheel drive pickup trucks built for off-road use or heavy cargo hauling, stuck in urban traffic with one occupant and no cargo. The reviewer thought that right-sizing and appropriate vehicle-selection are better addressed separately. In conclusion, the reviewer commented that the relationship between right-sizing and vehicle selection seems like a much less important relationship to understand than the relationship among traffic flow, travel times, and home/workplace choice.

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

Reviewer 1:

The reviewer observed that a significant amount of very useful data was produced and presented. The reviewer further noted that by being able to actually show the regional energy reduction through Detroit Future City's (DFC) plan contrasted with Southeast Michigan Council of Governments' (SEMCOG) plan, the output can and did inform Detroit and regional planners in a very tangible way.

Reviewer 2:

The reviewer noted that the results were clear, easy to understand, and well presented. The reviewer commented that the results themselves did show how the trips and VMT could be reduced under certain city planning scenarios. The reviewer stated that there is a citation for a working paper in the reviewer slides that could not be found in a web search and suggested providing the links to any citations in the body of the presentation.

Reviewer 3:
The reviewer commented that this was a very limited scope project that took existing data and attempted to analyze and create conclusions as to how varying future predictions may impact energy use levels. The reviewer noted that the project was done, but was not sure how representative the original datasets are to venture an opinion regarding how well the differences were analyzed and compared.

Reviewer 4:
The reviewer indicated that it was not clear exactly how Detroit used these studies to inform their future; however, the reviewer saw offshoots for use of the data. One potential use listed by the reviewer was real drive traces for the area, which could be used to improve vehicles in those areas.

Reviewer 5:
The reviewer stated that the presenter explained that the project's goal was to better understand why people do what they do. The reviewer noted that if this explanation implies the project is attempting to answer the question of what the one-way causal relationship is between population and land use and people's travel behavior, then it has done a good job of answering that, or beginning to sketch in a piece of an answer. However, the reviewer stated that this is not a truly systemic answer.

The reviewer commented that the logic applied to convert the land use changes into employment and population forecasts appears solid and well thought through; however, there is a nagging thought that the model rests upon a kind of "build it and they will come" projection; if we designate an area for a certain type of land use, it will be done and population and economic activity will adapt accordingly. The reviewer stated that this is an unusual approach, but it does answer the key "what if" question that should be of value to city planners of what the energy impacts from transportation would be if we are able to achieve certain land use scenarios.

The reviewer emphasized that this is a useful tool for thinking about goals for land use and related impacts; however, it should also be made clear at every opportunity that this is only a scenario-based model and has little value as a "predictive" tool for what the future could look like.

The reviewer noted that, on Slide 14, the presenter glossed over the comparison between baseline model results and existing data sources, and the reviewer believed it was unclear how close those outcomes actually are. The reviewer said that from looking at them there are some obvious differences and further noted that there was no discussion of whether there was any iteration or any attempt to re-calibrate.

The reviewer commented that in the changes in mobility indicators on Slide 16, it was unclear why average travel time is the same for SEMCOG 2040 and DFC 2040 when there are substantially fewer auto trips and substantially lower VMT in the latter case. The reviewer found it hard to believe that the difference between a 3.2% increase in VMT and an 8.8% decrease would amount to no difference at all in travel time. The reviewer believed that there must have been some increase in congestion.

The reviewer noted that there is accounting for mode choice; however, there does not appear to be a mechanism for addressing systemic impacts on mode choice. For example, when more people travel by bus, bus revenue increases, more buses are added, and frequency of service improves, which makes the bus a more appealing option, which leads to more ridership, and so on. This creates a virtuous cycle, which, of course, can also emerge as a vicious cycle if ridership drops. The reviewer commented that this effect does not appear to be modeled.

The reviewer noted that on Slide 16, there is a connection drawn between denser land use and increased transit and walking. It was not clear to the reviewer whether feedback effects are accounted for either. For example, increased transit ridership leads to improved levels of service as more buses are added. Increased walking to and from transit is also likely to have a land use impact by increasing foot traffic and potential for retail access. In short, there are a number of "smart growth" factors that tend to reinforce each other, and it does not appear

these relationships are fully considered. It is understandable, though, given the size of this project if such considerations are outside of scope.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer opined that this project could be a showcase of the power of DOE, the national laboratories, and how they can collaborate and inform a local area. The reviewer did not think there would have been more enhanced outcomes involving the FHWA, the FTA, or others from the DOT.

Reviewer 2:
The reviewer commented that the project team made the proper connections to get the data needed for this project. The reviewer believed that the project team was resourceful in the areas where the data needed were lacking.

Reviewer 3:
The reviewer stated that there was good collaboration with the city of Detroit and good collaboration with those doing the modeling, leading to completion of this project. The reviewer noted that outreach of this project to the industry and the EPA would be useful.

Reviewer 4:
The reviewer remarked that given the size and scope of the project, the collaborations seemed appropriate. The reviewer noted that it was essential that the project collaborated with SEMCOG, and the additional collaboration with DFC was a little illustrative icing on the cake to develop one scenario. However, the reviewer believed that other inputs may have been more interesting and illustrative and suggested finding an extreme scenario for Detroit, especially considering that the city, given its staggering collapse in population in the latter half of the 20th century, has the land and the flexibility to take many different paths in the future. The reviewer suggested sketching out an extremely efficient, transit-oriented-development focused future. Lastly, the reviewer stated that there was not much discussion of integration with other efforts, but this was understandable as the project precedes the five SMART Mobility pillars.

Reviewer 5:
The reviewer indicated that only government partners were involved to provide data and thought the collaborations as presented were limited.

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

Reviewer 1:
The reviewer pointed out that the project is complete and noted that any proposed future research that was presented is not related to this funding as it has been completely exhausted.

Reviewer 2:
The reviewer said that because this project is finished, there is no further work and it will begin with the other pillars doing similar work.

Reviewer 3:
The reviewer commented that while the Q-line was only mentioned in the question and answer portion of the presentation, studying the Q-line data as well as working with planners to possibly address the other corridor that would benefit from a similar system, the Interstate 94 corridor would be very valuable to all involved.

Reviewer 4:
The reviewer stated that while this project has ended, it had identified some good examples for how to use the model and its approach. The reviewer believed that examining the energy impacts of future smart mobility strategies was of special value. The reviewer noted that related future efforts would suffer from the weaknesses pointed out earlier, and noted there did not appear to be a good accounting for feedback effects.

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

Reviewer 1:
The reviewer commented that Detroit has been informed about ways that their infrastructure may be improved and potentially how to respond to changes in population load and that these takeaways may have already resulted in new public transport methods that were mentioned by other reviewers.

Reviewer 2:
The reviewer mentioned that Slide 3 shows one of the objectives of the project is to evaluate energy and mobility impacts of various cases. The reviewer noted that the results demonstrated on Slides 16 and 17 show how energy and petroleum can be reduced. The reviewer stated that this project provided the data needed for the city planners to be informed when taking action. The reviewer believed that if the planners were to execute per the model, the petroleum displacement would be realized.

Reviewer 3:
The reviewer pointed out that there was no way to say for sure, as there was no understanding as to which of the two models may be realized. The reviewer said that the analysis shown could spur actions toward energy use reduction policies.

Reviewer 4:
The reviewer observed that the project does an adequate job of emphasizing the importance of understanding the energy implications of changes in land use and population, which is a very critical question and one that demands far more attention than it has gotten in the past. The reviewer noted, however, there is something lacking in the connection to the other work of the VTO. The reviewer stated that it could be made more explicit that population and land use are key drivers of VMT, which in turn drives the overall impact of VTO's other efforts.

Reviewer 5:
The reviewer said that the project is highly relevant to the Detroit region, but questioned how easily transferable the work would be to other cities. The reviewer stated that while this was addressed in the presentation, it was unclear which cities already have the necessary input data, or even what inputs are required so that a similar project could be ported to other areas.

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, because the project is complete and is out of funding, the funding appears to have been sufficient.

Reviewer 2:
The reviewer found the funding to be sufficient as the project is complete.

Reviewer 3:
The reviewer noted that the overall cost of this project seemed to be low for the accomplishments made and was satisfied that this was money well spent to benefit a single city. The reviewer hoped the experience here will result in improved methods in analysis of other cities.

Reviewer 4:
The reviewer remarked that the resources were appropriate for this limited scope project. The reviewer noted that it would be nice to have had a few additional resources to roll this analysis out to additional cities or create awareness at other cities of this capability and have them exercise this model and team in their future planning efforts.

Presentation Number: eems009
Presentation Title: Energy Assessment of Automated Mobility Districts
Principal Investigator: Stanley Young (National Renewable Energy Laboratory)

Presenter
Yuche Chen, National Renewable Energy Laboratory

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

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

Reviewer 1:
The reviewer asserted that the project took a great approach.

Reviewer 2:
The reviewer noted that the elements of the project—a white paper, stakeholder identification, and developing a modeling architecture—seem like the right way to approach the work this year. The reviewer commented that the four dimensions being considered for energy impacts of AMDs are reasonable, though it was not quite clear how "traveler attitudes" are an input. The reviewer was unsure if this referred to acceptance, valuation of travel time, or something else. The reviewer stated that exercising the model with local government either implementing or planning an AMD will be important to validate the model and cautioned against relying too heavily on fixed guideway personal rapid transit (PRT) studies from the 1970s and 1980s as there are good reasons that PRT never materialized as a viable transport system.

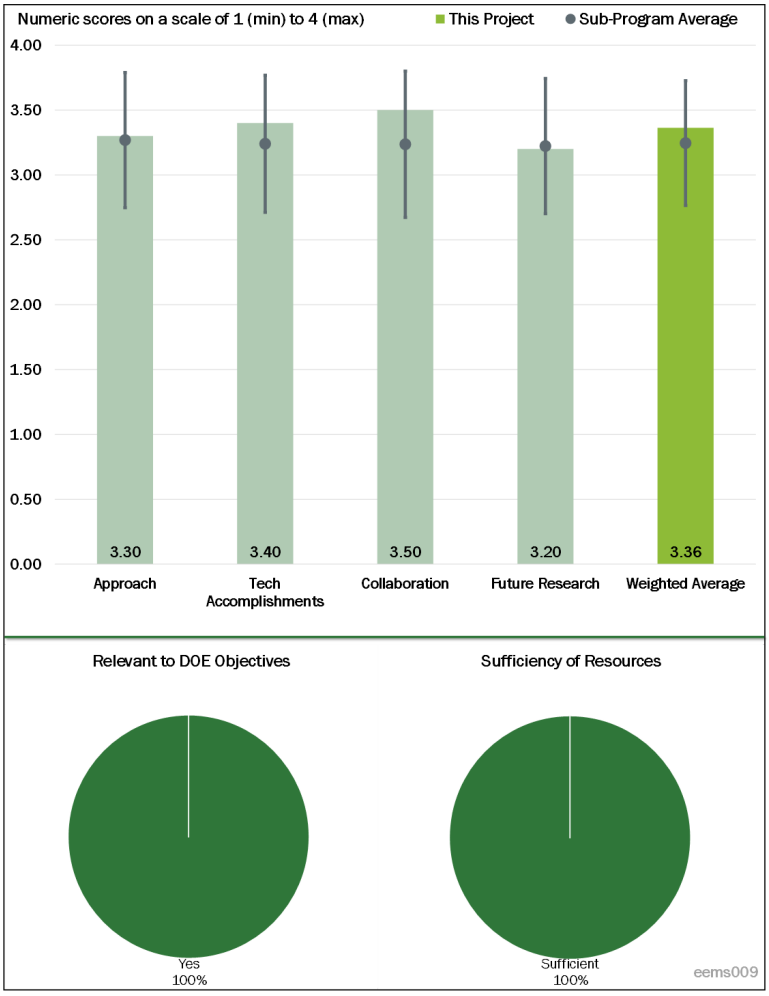

Figure 4-9 - Presentation Number: eems009 Presentation Title: Energy Assessment of Automated Mobility Districts Principal Investigator: Stanley Young (National Renewable Energy Laboratory)

Reviewer 3:
The reviewer commented that by use of highly controlled boundaries, the AMD study approach offers a high potential of "practical" data to validate models in a reduced timeframe. The reviewer stated that this method, and others like it, are necessary first learning steps before widespread automated mobility adaptation.

Reviewer 4:
The reviewer said that the overall project is great and this project seems good, but it is not clear how it fits into the overall project and will coordinate with the other elements.

Reviewer 5:
The reviewer acknowledged that the approach depends on finding a proposed AMD to model and obtain data from, and noted that this is a tenuous dependency that should be addressed to firm up the collaboration partner and remove this significant barrier.

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

Reviewer 1:
The reviewer commented that the project is still at an initial stage, but seems to be on the way toward producing useful results.

Reviewer 2:
The reviewer said that the project is right on plan.

Reviewer 3:
The reviewer noted that the foundational work on the energy analysis of smoother drive cycles on automated vehicles (as would happen in an AMD) is similar to the DOT's Intelligent Transportation System Joint Program Office (ITS-JPO) Applications for the Environment: Real-Time Information Systems program, and the reviewer noted that it would be helpful to cross reference and validate against DOT's program.

The reviewer stated that the project's current work is surveying and identifying AMD planning and early implementation efforts, including the types of campuses and service models. The reviewer noted that the project also surveyed trip generation models.

The reviewer remarked that the role of parking in these AMDs is unclear between being a park- and-ride type of concept or for storage of AVs during off-hours. The reviewer said that the major challenge is that little AMD data exist from actual implementation, and stated that the project will need to determine which model inputs to fix and which ones to keep refining and validating as data from new implementations trickle in. The reviewer also noted that infrastructure within an AMD could be different from the general transport network, including better integration of pedestrian, bike, transit, and other modes and challenged the project to reflect these inputs in the model.

Reviewer 4:
The reviewer commented that this is a new project and the "accomplishments" are perhaps blended with the "planning," but stated that the project has a clear and rational objective that appears to be well scoped and underway.

Reviewer 5:
The reviewer stated that the project is in its early stages and to date little progress on modeling is evident. The reviewer suggested developing a detailed scope and schedule for work beyond September 2017, the last date on the milestone slide, to better focus modeling work.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that this is a fundamentally collaborative project.

Reviewer 2:
The reviewer observed that there is a good team assembled.

Reviewer 3:
The reviewer commented that two DOE laboratories and two universities are project partners, but no city partner that is planning to implement AMDs has been identified. The reviewer noted that the DOT's Smart Cities is cited as a possible beneficiary, but was also an input, for example, by reviewing the Smart Cities applications for how AMDs were proposed to be implemented. The reviewer stated that the future collaborators are promising, including Columbus and Jacksonville.

Reviewer 4:
The reviewer noted that as it appears for all EEMS projects, the SMART Consortium along with the two universities have an excellent combined skill set, though the relationship of the collaboration is unclear.

Reviewer 5:
The reviewer mentioned that several potential partners have been identified and believed that a committed partner should be secured as soon as possible.

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

Reviewer 1:
The reviewer indicated that there seems to be a good plan for future work. The reviewer looks forward to seeing how the project develops.

Reviewer 2:
The reviewer stated that this was a very important project with a good research plan.

Reviewer 3:
The reviewer commented that future work includes setting model requirements and identifying/collecting necessary data and noted there is a challenge here in collecting sparse data to build this model. The reviewer stated the project may need many bounds or a scenario-based approach to understand the uncertainty of AMD energy impact, similar to how general AV energy impacts have been bounded, but hopefully with much less uncertainty. The reviewer said that military base collaboration is promising, and stated that there is a program underway with Major Brandon Newell that should be considered. The reviewer pointed out that the emphasis on performance over cost for the U.S. Department of Defense is going to be a different situation from private sector driven city districts, so exploring both could help bound the energy impacts of AMDs.

Reviewer 4:
The reviewer noted that the future described in the summary is the project itself, as expected with a new project, and stated that the future scope beyond the project may become clearer in the next 18 months.

Reviewer 5:
The reviewer said that a vision for future work exists, but so do barriers, including a lack of an identified AMD facility partner. The reviewer commented that no specific plans are presented for dealing with barriers or for developing the model that is the objective of the project.

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

Reviewer 1:
The reviewer observed that by enabling efficiency improvements this project will decrease petroleum usage.

Reviewer 2:
The reviewer stated that everyone will benefit from this research.

Reviewer 3:
The reviewer mentioned that AMDs are not necessarily going to be pervasive and therefore highly impactful on petroleum displacement for a while, but if they grow rapidly, it is important to understand the factors that determine whether they increase or decrease energy use. Therefore, modeling their impacts, validating them with pilot deployments, and then ensuring policy recommendation outputs will be key to shaping AMDs as they grow in size and fraction of all trips in the United States.

Reviewer 4:
The reviewer noted that this project, as per all of the EEMS projects, is very relevant to support the fundamental objective of DOE, energy savings, and petroleum reliance displacement.

Reviewer 5:
The reviewer commented that in anticipation that an AMD partner can be identified, the project has relevance. If no partner is identified, the relevance is lost as there will be no implementation to support.

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

Reviewer 1:
The reviewer noted that this project seems to be appropriately funded.

Reviewer 2:
The reviewer commented that the project has proper resources.

Reviewer 3:
The reviewer said that the project has sufficient resources, assuming the data acquisition and continual refinement do not drain the resources more than expected.

Reviewer 4:
The reviewer stated that until and unless an AMD partner is committed, the resources are sufficient and believed that once a partner is committed, the resources should be re-assessed.

Reviewer 5:
The reviewer acknowledged having no basis to confirm nor critique the budget necessary for this type of program.

Presentation Number: eems010
Presentation Title: Definition of Connected and Automated Vehicle (CAV) Concepts for Evaluation
Principal Investigator: Steven Shladover (Lawrence Berkeley National Laboratory)

Presenter
Steven Shladover, Lawrence Berkeley National Laboratory

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

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

Reviewer 1:
The reviewer said that given the size of the budget, yet the importance of the work, the approach has been excellent.

Reviewer 2:
The reviewer commented that the approach taken is very good as it limits the scope of CAVs by practical considerations instead of taking a blue-sky approach by assuming technologies that may never materialize.

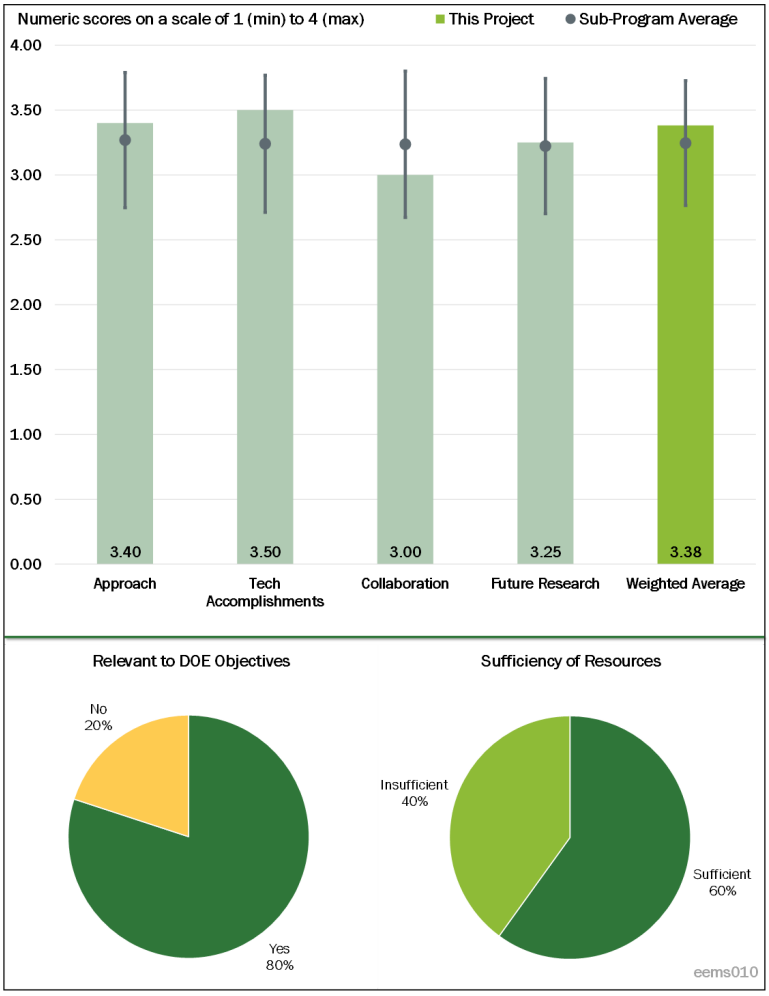

Figure 4-10 - Presentation Number: eems010 Presentation Title: Definition of Connected and Automated Vehicle (CAV) Concepts for Evaluation Principal Investigator: Steven Shladover (Lawrence Berkeley National Laboratory)

Reviewer 3:
The reviewer remarked that the project takes the confusing aspects of CAV and tries to standardize the meanings and terminology. The reviewer hoped that this work may create a standardized way of defining CAVs.

Reviewer 4:
The reviewer commented that the work here is necessary to ensure that all of the pillar projects and other related projects are using the same terminology and noted that without this, there could very easily be a translation problem. The reviewer said that the SAE paper mentioned contains most of what is necessary, however.

Reviewer 5:
The reviewer mentioned that a key shortcoming in the approach is that the project's outreach was limited to national laboratories. While they can be expected to have substantial expertise and knowledge base, the reviewer opined that it would have cost fairly little in terms of time and effort to reach out to major stakeholders—for example, DOT, automakers, the American Association of Highway Transportation Officials, ITS America, and the American Public Transportation Association—to help frame the issue more completely.

The reviewer indicated that the approach identifies the key dimensions, but appears to be essentially an internal thought exercise. The reviewer was unclear whether or how much iteration and feedback was involved in developing and fleshing out these dimensions, and believed some of them appear lacking or a bit limited. The reviewer stated that casting a wider net would have avoided this and defined a broader field, one more likely to capture a fuller range of applications.

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

Reviewer 1:
The reviewer commented that given the budget, the accomplishments have been excellent. The scope seems reasonably constrained and the pieces of the definitions are all there to be combined in hopefully thoughtful ways.

Reviewer 2:
The reviewer said that the project has made excellent progress and noted that the work is essentially complete.

Reviewer 3:
The reviewer stated that the project took all of the various definitions of these vehicles and clarified the definitions. The reviewer asserted that the work was definitely needed.

Reviewer 4:
The reviewer affirmed that having someone who is responsible for setting SAE definitions be also responsible for the DOE project definitions could hardly be better. The reviewer noted that this was demonstrated in the conversation; however, there are always grey areas.

Reviewer 5:
The reviewer indicated that given the resources and time spent thus far, the technical progress is good. The initial fleshing out of the various dimensions appears solid and logical.

The reviewer noted that CV systems are well defined at a high level. The broad categories capture the key functionality. However, the list is neither a full catalog of CV applications, nor does it span the full range of possible (and proposed) CV applications.

The reviewer stated that one key challenge, which the project did not really address, is that CV applications are hard to predict, as in, there is no telling exactly what applications may emerge. The applications can include essentially anything that a developer can do with data from the infrastructure or the vehicle. The reviewer commented that while it would be impossible to catalog them all now, a broader scan may have revealed more categories that would more fully span the space, for example, to include applications for operations, maintenance, efficiency improvements, etc.

The reviewer remarked that the presenter explained that Level 5 automation is not considered in the definitions, as the presenter's belief is that full driverless operation, unconstrained by the operational design domain (ODD), will not happen by 2050. The reviewer commented that while this may be true and the presenter appears to have the credentials to suggest this is a well-informed expert opinion, the absence of this explanation from the original slide deck was a bit glaring. The reviewer stated that it was not until a reviewer asked about it that this point was clarified. In summary, the reviewer believed that given that the audience for this work could be fairly broad and spanning a wide range of expertise, it would be a welcome addition to include at least a passing explanation for why Level 5 is not currently considered.

The reviewer noted that it is not clear why there is a brief, single slide discussion of the "importance of connectivity to performance." While this is certainly a very important issue, and one that demands more

attention, it is not clear how this fits into the discussion of "defining CV and AV concepts." The reviewer believed that it seems like a separate discussion. The reviewer further opined that the example cited showing improvements with CACC over automated cruise control (ACC) appears to be just one study by a single national laboratory. The reviewer commented that it would also be worth mentioning work done by the Crash Avoidance Metrics Partnership in their cooperative-agreement efforts with the FHWA. The reviewer stated that those groups have done extensive work in modeling CACC and also show improvements over ACC.

The reviewer commented that in the area of vehicle classes and business models, the examples provided do a good job of spanning what currently exists and what may exist in the near future. However, there are a number of additional use cases that one can easily imagine, and that have already been sketched out by a number of companies and researchers, for vehicle architectures and business models that fall outside the framework this project has created. The reviewer pointed out that, even today, there are a number of demonstration vehicles in operation that are not clearly captured here. The reviewer provided the example of slow-speed automated shuttles, which the reviewer believed deserve to be in a different class from general "medium-duty," highway-capable vehicles. The reviewer noted that the size, weight, operating characteristics, and overall architectures of such vehicles are radically different from what is consider to be conventional "medium-duty" passenger vehicles, and believed they would seem to deserve a separate category. In addition, the reviewer remarked that the category of "ultralight" seems to be a bit vague and undefined as this could also span a very wide range of current vehicles; for example, this category seems broad enough to include automated low-speed tricycles currently under development as well as two-seat highway-capable automobiles. The reviewer further thought that taking this forward several years, one can imagine a much broader range of vehicle architectures. Removing the need for a human driver or even a human occupant opens up a tremendous range of new possibilities for vehicle architectures, including both much smaller and much larger vehicles. The reviewer cited a 2015 DOT survey of potential "novel modes" of transportation (https://www.rita.dot.gov/sites/default/files/NovelSurfTranspModes-web.pdf) as a potential useful resource. The reviewer commented that, in terms of business models, it may be helpful to ask a broader question about what potential business opportunities are presented by automated vehicles when there is no longer a requirement for a driver or human occupant.

The reviewer noted that the presenter explained that these alternative architectures and business models were not included, as such speculation is more suited to other SMART Mobility pillars. The reviewer stated that if that is the case, then it seems that this project should at least make passing reference to the significant uncertainty in this area, and perhaps define a few additional broad categories to acknowledge and capture some of the potential alternatives. Furthermore, the reviewer believed that this project presents precisely the right opportunity to make sure that all the pillars are thinking as broadly and openly as possible about new architectures and business models, as leaving this issue up to the individual pillars to address independently does not seem like the best approach. The reviewer suggested that it may be appropriate to hold some kind of workshop among the pillars, and include outside stakeholders, focused on the potential new business models and vehicle architectures and when can we expect to see them. The reviewer believed that such a thorough survey of current thinking and expectations would seem very valuable and relevant.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the project had very good collaborations. The reviewer noted that the presenter cited participation in SAE and connections with industry as an indirect source of input, which may be appropriate to indicate in the material.

Reviewer 2:
The reviewer said that the scope of this project is very small and limited and believed extensive collaboration was not required. The reviewer commented that SAE is de facto included. The point about inviting safety input was also taken, and the reviewer was satisfied on this point.

Reviewer 3:
The reviewer remarked that given the size and scope of the project, the collaboration is probably adequate; however, it seemed a bit narrow to only consider national laboratory representatives. The reviewer added that if funding would have allowed, it would have been better to reach out to the DOT to ensure definitions are fully harmonized.

Reviewer 4:
The reviewer commented that only collaborations within DOE are listed and that the work needs to be vetted within the automobile industry and with the standards makers in North America, Europe, and Asia.

Reviewer 5:
The reviewer realized that the collaboration is purposely limited to a DOE definition among the pillars. The reviewer believed not synchronizing with DOT (National Highway Traffic Safety Administration, ITS-JPO, Federal Motor Carrier Safety Association, etc.) may come back to haunt this project as well as the other projects that use the definitions that are the outputs of this project. The reviewer pointed out that this feedback was provided during the question and answer session, and the presenter did assure the audience that the team is very plugged into the DOT space.

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

Reviewer 1:
The reviewer stated that the future work seems fine within the scope and budget of this project.

Reviewer 2:
The reviewer said that the list of future tasks is reasonable and appears manageable.

Reviewer 3:
The reviewer commented that the project is essentially complete, but it should be brought to the attention of industry, standards groups, and regulators.

Reviewer 4:
The reviewer opined that this project could be improved by including some method to allow for future developments and gray areas. The reviewer suggested that the difference in steering types or even longitudinal control could be sub-categorized. The reviewer noted there actually is z-axis control being considered with drones on another project, and was not certain that vertical should be out of scope on this project.

Reviewer 5:
The reviewer indicated that given the work done to date and the overall work plan, the proposed future research is appropriate and adequate. The reviewer noted that estimating timing of availability of emerging technologies is a valid and relevant aspect of this project, but given that the study years reach out to 2050, it seems like there is a very strong justification for including more business models and vehicle architectures. The reviewer believed that there is already so much inherent uncertainty in looking out to 2050 that it does not seem at all out of place to cast a wider net, embrace more uncertainty, and consider more business models and architectures. The reviewer said that any such predictions are going to be wrong to some degree, and there is very little we "know" about how things will turn out; however, we can probably be fairly certain that in 2050 the vehicles and business models are likely to look very different from how they do today.

The reviewer offered one cautionary point, specifically that "historical data from prior vehicle technology changes" can provide a good starting point, but the applicability of historical cases can vary widely. The reviewer pointed out that there can be powerful feedback effects that drive very rapid adoption of a new

technology, in some cases by rendering the old technology unusable in very short order. The transition from the horse and buggy to the automobile is a good example of why typical "vehicle turnover rates" cannot be relied upon as people did not wait for their horses to die before buying a car. The reviewer provided an additional example that, in the last decade, people did not wait for their old cell phones to die before switching to a smartphone. The reviewer noted that there were powerful motivating factors other than just "upgrading to the latest technology" including the fact that society, behavior, and expectations all change with major new technologies; it is not simply a matter of convenience that drives people to buy the latest thing. The reviewer offered a final example: it may become expected that one can work during a commute and those who do not have an automated vehicle will lose precious work time during the day.

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

Reviewer 1:
The reviewer commented that it is clearly very important to bring everyone working in this space toward common definitions.

Reviewer 2:
The reviewer remarked that the project supports analysis to determine energy savings by way of fuel displacement of various CAV-penetration scenarios. This understanding will contribute to the DOE goal of reducing petroleum usage by allowing DOE to more effectively shape policies that contribute to that goal.

Reviewer 3:
The reviewer said that in supporting the projects needing consistency and translation of message, this certainly supports the goal.

Reviewer 4:
The reviewer stated that the project is relevant to DOE goals and has an important role to play. The reviewer noted that getting everyone on the same page, using the same terminology, will definitely pay dividends as the work of the five SMART Mobility pillars proceeds. The reviewer further observed that this is especially true, given the broad scope and wide range of efforts involved in those pillars. The reviewer stated that given that the five pillars may have a tremendous long-term effect on displacing petroleum use, this enabling effort may have a significant indirect impact.

Reviewer 5:
The reviewer saw no real connection to petroleum reduction from this work. CAVs may or may not achieve reductions overall.

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 $50,000 may have been a little too small. The reviewer noted that it would be interesting to have seen the outcome if this project had had sufficient funds to pull together a workshop or two to make this a more lasting, comprehensive effort, especially if it could have been an interagency workshop to make the point of getting all relevant federal agencies on the same page.

Reviewer 2:
The reviewer indicated that this project is barely one person's wages for the year. The reviewer thought it was not enough funding to perform the necessary cross communication, publication, or extension of message outside of the DOE.

Reviewer 3:
The reviewer found that the resources to be sufficient.

Reviewer 4:
The reviewer stated that this was a small project that completed what was defined as the objective and thought the resources were sufficiently employed.

Reviewer 5:
The reviewer commented that the budget is small and while the task is important, it is not resource intensive so the reviewer believed the funding is sufficient.

Presentation Number: eems011
Presentation Title: Multimodal Travel Behavior Modeling in Urban Areas using BEAM
Principal Investigator: Colin Sheppard (Lawrence Berkeley National Laboratory)

Presenter
Colin Sheppard, Lawrence Berkeley National Laboratory)

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

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

Reviewer 1:
The reviewer said that this project as presented is one of, if not the best, multi-disciplined approach to bring into model analysis agent-based behavioral decision making, technical options, and urban mobility optimization criteria. Though the reviewer acknowledged not being familiar with BEAM, it appears to have excellent potential to expand Multi-Agent Transport Simulation (MATSim) tools.

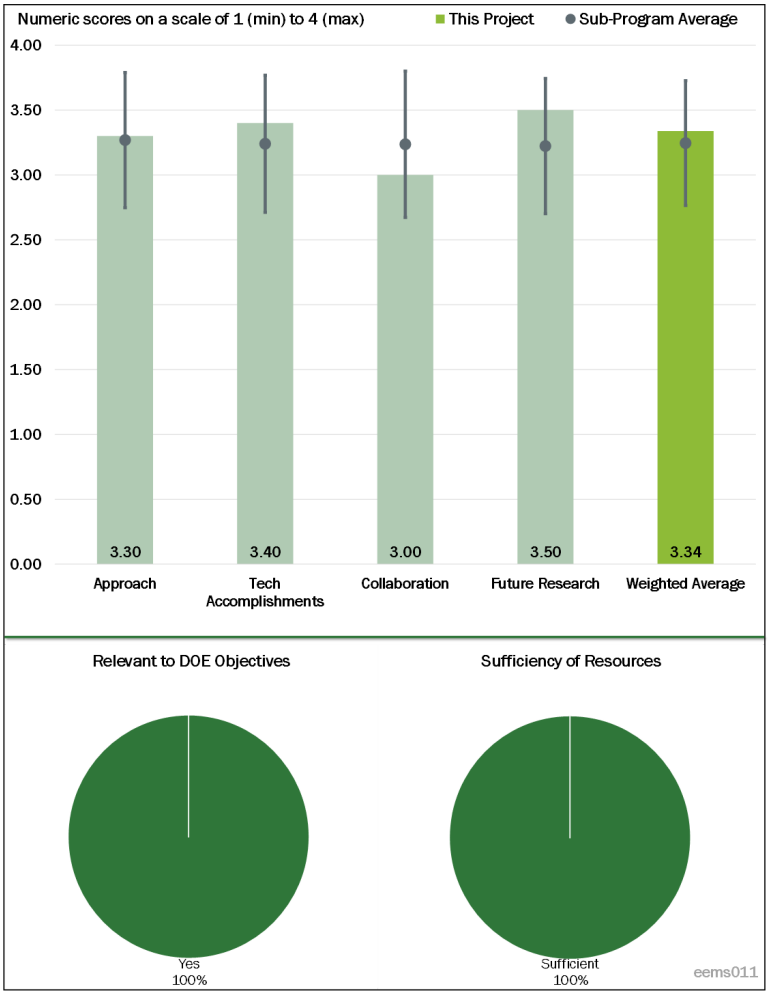

Figure 4-11 - Presentation Number: eems011 Presentation Title: Multimodal Travel Behavior Modeling in Urban Areas using BEAM Principal Investigator: Colin Sheppard (Lawrence Berkeley National Laboratory)

Reviewer 2:
The reviewer commented that the approach makes sense and noted that the milestones as described in Slide 4 show how this project is integrated with the different pillars in EEMS.

Reviewer 3:
The reviewer stated that the narrowly focused approach seems solid and specifically targeted to fixing the model, validating it, and then conducting analysis.

Reviewer 4:
The reviewer remarked that making the model framework accessible and extensible is important for it to be used and to be improved by others in the future, and thought that it is important that the project focuses on this. The reviewer noted that it makes sense to gut the MATSim structure and replace it with something scalable in BEAM that can be parallel computed and can calculate large geographic areas. The reviewer suggested considering including additional validation of the model as it is refined based on actual before-and-after events in a city, such as inclusion of a bike corridor or bus rapid transit or a bridge outage event.

Reviewer 5:
The reviewer mentioned that overall the approach looks good, but there are specific aspects that need clarification, specifically, the scheduler apparently is allowed to relax strict chronology in order to achieve higher computation speeds. The reviewer noted that it is not clear if this will result in an agent missing the bus or the plane. The reviewer also wondered if the scheduler will also ensure that the agent does not miss a plane by delaying the plane. However unlikely, it was not clear from the explanation how this aspect is addressed.

The reviewer also indicated that it is not clear that the reliance on Open Trip Planner as a router is necessarily good. While it is open source, it does not have vital information on the road grade, the knowledge of which is critical to energy consumption calculations and route optimization to ensure minimum energy consumption.

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

Reviewer 1:
The reviewer noted that it is early in the project and that reasonable progress appears to be made.

Reviewer 2:
The reviewer commented that given how little time has passed since the start of this project, the project has made good progress thus far.

Reviewer 3:
The reviewer said that the project had only recently begun last fall, but appears to be making significant progress as planned. The reviewer mentioned that the efforts to date are already pointing to some very useful tools for use by the overall program. The reviewer also noted that the work completed to date was described by the project lead as being the most complicated part of the effort.

Reviewer 4:
The reviewer stated that at this early phase of the program the project appears to be quite well focused and poised for a successful project.

Reviewer 5:
The reviewer commented that the model architecture has been developed, including the three principal components. The reviewer found that the chronological relaxation to allow massively more parallel computation to be a great solution; however, the reviewer wanted to see this space explored in greater detail. The reviewer stated that it would be good to understand the computation benefit versus cost to fidelity curve, generally speaking, to optimize this strategy. The reviewer added that it is helpful to integrate the OTC as well as the Uber open source portal. The reviewer commented that proprietary filtering in the Uber model may limit its utility. The reviewer stated that there is still work to make the model more robust and understand accessibility for each choice agent, but the preliminary implementation is highly encouraging.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that collaboration with the SMART Consortium like all EEMS projects aligns excellent talent; however, the reviewer thought that there is no indication that Berkeley cannot run this quite independently.

Reviewer 2:
The reviewer commented that it may be worth exploring further collaboration with ANL and their approach so that synergies may be exploited and unnecessary repetition of work avoided. The reviewer noted that this is easier said than done.

Reviewer 3:
The reviewer remarked that there would seem to be room for additional collaboration with not only DOT Smart Cities but also state and local DOTs during the project. The reviewer noted that ultimately to be a tool for informing interventions for improving accessibility and reducing energy usage, it will need to be accessible to local DOTs in cities so some validation of before-and-after simulations for a transit change, bridge closure, and dynamic pricing may be helpful as the model is refined.

Reviewer 4:
The reviewer said that the model seems to be in the hands of a few niche people and those are all part of this work currently. The reviewer suggested that later in the project it might make sense to get a person who represents the cities of San Francisco and Chicago when doing the simulations for those cities.

Reviewer 5:
The reviewer observed that the list of partners includes all the DOE national laboratories plus a few other entities. The reviewer stated that it would be good to see the DOT added, along with several state DOTs. These entities will ultimately serve as implementers of the modeling developed so it would be good to get their input sooner rather than later, and the reviewer thought this might have made sense from the point of project initiation. The reviewer noted that the project lead indicated that the project team has considered this, but feels the project is not yet ready for adding these partners. The reviewer stated that at some point, however, it will be important to add those partners. The reviewer noted that the project also appears to be collaborating with the Smart Cities Research Center and proposed that this may turn out to be a way to pull in some of these entities.

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 expected to see more progress by next the AMR and requested that the project team keep previous comments in mind as they proceed—especially the lack of grade information to compute accurate energy information. The reviewer suggested referring to the work done by NREL in support of their Transportation Secure Data Center (TSDC) database, which indicates the limitations of the U.S. Geological Survey data, in case the team plans to utilize that for grade and elevation calculations.

Reviewer 2:
The reviewer commented that for future application and accessibility of this model, the model will need to be capable of being run by others and be of high enough fidelity to be trustworthy and reliable. The reviewer noted that the model will be run over cloud services. The reviewer suggested the model should be graphical user interface driven.

Reviewer 3:
The reviewer said that the proposed future work is well thought out and planned logically and methodically.

Reviewer 4:
The reviewer stated that the future work identified appears to focus on achieving the overall project milestones as laid out in the approach and noted that this work includes completing model enhancements, conducting calibration, and then performing analyses.

Reviewer 5:
The reviewer indicated that the proposed forward progress of the program is well described and ambitious and noted that it will be interesting to see the BEAM analysis in future years.

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

Reviewer 1:
The reviewer mentioned that this, like all of the EEMS projects, supports the fundamental objective of DOE in supporting energy efficiency and reduced petroleum dependence.

Reviewer 2:
The reviewer remarked that the large-scale introduction of CAVs appears to have the ability to either result in decreased energy consumption or increased energy consumption. The reviewer hoped that these projects will ensure that irrespective of whether the VMT goes up or down, the overall system efficiency can still be maximized about that operating point.

Reviewer 3:
The reviewer believed that this project supports petroleum displacement by its modeling efforts but that this is not well described in the presentation. The reviewer noted it would be good to have made a more explicit connection between the project and petroleum displacement in future presentations.

Reviewer 4:
The reviewer commented that the project focuses on the concept that mobility choices impact efficiency of the overall transportation system, determining petroleum consumption. The reviewer said that the better the idea as to where things are headed and what choices are possible, the easier it will be to determine and model overall energy consumption for the future.

Reviewer 5:
The reviewer noted that understanding the adaptive nature of the transportation system, for example, TNC supply-demand matching, and modeling not just individuals, will support intelligent interventions once the model is robust enough and accessible enough to use locally.

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

Reviewer 1:
The reviewer said that resources seem consistent with the scope and schedule.

Reviewer 2:
The reviewer stated that the resources appear to be sufficient for the work at hand.

Reviewer 3:
The reviewer commented that funding appears sufficient.

Reviewer 4:
The reviewer could not determine if funding levels were necessary to accomplish this project.

Presentation Number: eems012
Presentation Title: Modeling and Analysis of Plug-in Electric Vehicle Charging Infrastructure Supporting Shared Mobility
Principal Investigator: Yan Zhou (Argonne National Laboratory)

Presenter
Yan Zhou, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer noted that the approach seems mostly fine; however, the reviewer was confused about the connection between Task 1, which states, "impacts of near-term AFV infrastructure," yet the research seems to be 100% electric vehicles (EVs). The reviewer stated that if the task was not fully fulfilled, it should change to only include EVs. AFVs are considered to be hydrogen fuel cells, biodiesel, propane, CNG, etc. The reviewer said that some might even categorize EVs as something other than AFVs because they would not consider electricity a "fuel."

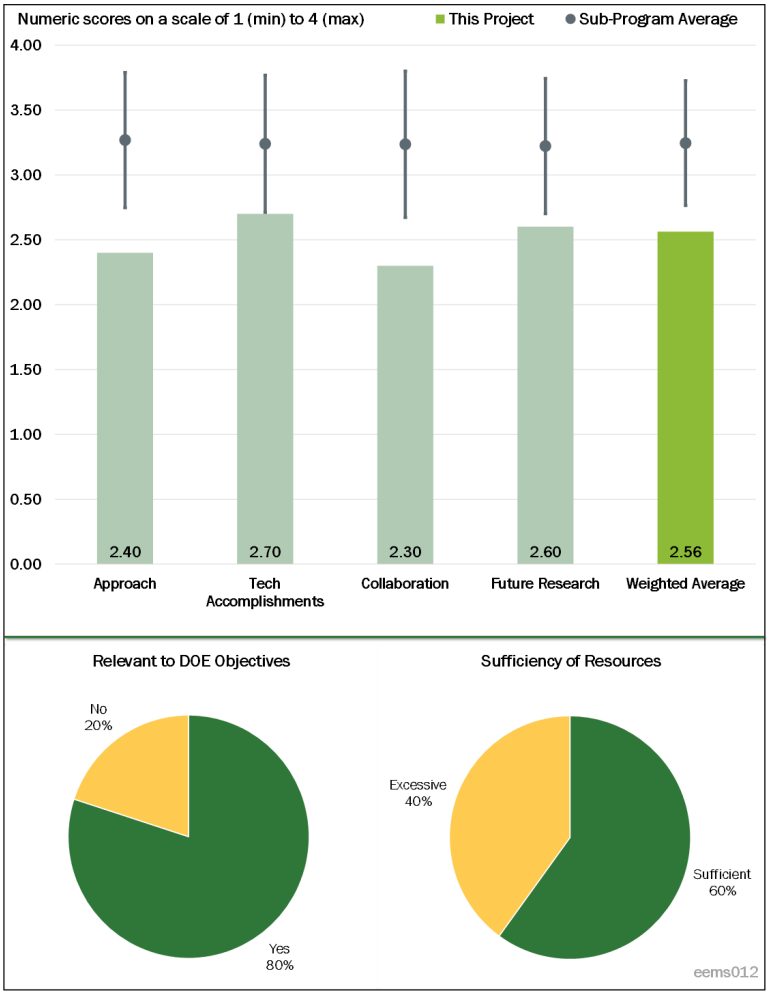

Figure 4-12 - Presentation Number: eems012 Presentation Title: Modeling and Analysis of Plug-in Electric Vehicle Charging Infrastructure Supporting Shared Mobility Principal Investigator: Yan Zhou (Argonne National Laboratory)

The reviewer expected to see more of a pursuit toward actual cost-benefit analysis and noted that all of the elements are in the project including installation cost, revenue scenarios, and operating cost. The reviewer commented that the results could become very useful and interesting if costs and benefits are directly compared in some meaningful way. For example, the lowest cost option may not end up with the best cost-benefit ratio.

Reviewer 2:
The reviewer said that the approach includes mostly a bottom-up approach of electric vehicle supply equipment (EVSE) return on investment (ROI) and travel survey data. The reviewer commented that this could be supplemented with some more top-down analysis. The reviewer noted that overall, the five-step approach is infrastructure driven by how many chargers there are and where, how many opportunities there are to charge, what this does for range extension, what vehicles are sold, and how much energy they consume. The reviewer stated that a possibly missed opportunity in considering the electrification and shared mobility interaction is

the third leg of the automated-shared-electric (ASE) triangle, automation. The reviewer noted that automated shared EVs are distinct from non-automated shared EVs in how efficiently they use EVSE and their range.

Reviewer 3:
The reviewer commented that existing charger use data show an aversion to charging away from home both from a convenience perspective and one of cost, and noted that this approach seems to ignore this fact by focusing exclusively on away from home DC fast charging. The reviewer commented that the use of home charging to support home and work trips for ridesharing should have greater consideration in this model.

Reviewer 4:
The reviewer pointed out that the approach to this project is flawed and that it makes the overriding assumption that the charging (not "fueling") infrastructure is the primary deterrent to EV adoption. The reviewer commented that it has been seen multiple times that vehicle range is the primary deterrent because it is a major departure from the range of a liquid fueled vehicle. The reviewer noted that in an urban environment, very few, if any, drivers would have to "fuel" their car daily. EV owners with short range must do so, especially in extreme weather conditions. The reviewer stated that as EV offerings hit the market with real 200-plus mile range, this deterrent to adoption is removed. The reviewer said there is still a need for urban fast charging infrastructure, but it would not be designed using these datasets as they are described in this project.

Reviewer 5:
The reviewer stressed that difficulty with available data and unpredictability for analysis tools with a maturing industry, such as shared transportation companies, will likely lead to projections errors, which in this case may damage the support of future EVSE infrastructure deployments. The reviewer noted that the project may need to focus on clear data accumulations and standard7ized first level analysis so that there would be something for the model to validate against prior to projecting for multiple deployments and varied market penetrations of technology.

The reviewer said that a misstep in locations for infrastructure investment could drastically reduce future support for EVs in general, calling to memory the news stories when first generation EVSE were removed from various cities after years of non-use.

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

Reviewer 1:
The reviewer commented that for the early stage of the project, a great deal of work has been completed identifying model inputs.

Reviewer 2:
The reviewer said that the technical accomplishments to date look great, though it is clear there is a lot still to do. The reviewer also found it important to define, and then keep sharp focus on, the customer of this work along with the intended influence this work might have. The reviewer suggested that maintaining a strong connection to "more mobility for less energy" is important.

Reviewer 3:
The reviewer stated that the project developed methods and modeling framework for estimating infrastructure impacts on EV market share and energy use, segmenting these by three types of sharing. The reviewer found it helpful that the infrastructure-to- charging opportunity link has been modeled and that high-level impacts of these three sharing types have been qualitatively characterized based on industry research, for example, ride-hailing drivers sometime driving far to get to a denser market, increasing energy usage.

The reviewer noted that looking at national trip purpose segmentation may not reflect urban trip segmentation and suggested that this should be validated. The reviewer also found it unclear whether the model accounted for all trips, or only trips made by car. The reviewer added that home charging and corporate charging would be important to include somehow in this analysis; workplace and home charging account for a significant fraction of EV charging, and might account for shared vehicle charging when a driveway is rented out to an electric Zipcar, for example.

Reviewer 4:
The reviewer remarked that there is a limited understanding about energy impacts of shared mobility applications. The reviewer noted that although the presenter claims to have identified three types of shared mobility, each of these represents a maturing business model that requires more substantial investigation in the various deployment scenarios for each type of shared system before models for any of these three systems would appear to be validated. For instance, the reviewer stated that in order to claim that ride-hailing has a decreasing impact on VMT, it would be appropriate to show the fleet data on vehicles meeting rider demands that indicate those vehicles have a lower VMT than the sum of VMT for vehicles they displace, which would have been in the hand of the riders as operators. The reviewer stated that any taxi or Uber used by a good percentage of travelers shows high VMT.

Reviewer 5:
The reviewer said that making progress on a flawed approach is not of value, and noted that it is hard to understand from the presentation what was being accomplished. The reviewer found one of the most glaring flaws in the SMART Mobility projects is the reliance on incomplete and poorly designed experiments that create dubious datasets that industry does not see as being validated. The reviewer further stated that the data used are what is available and are not agreed upon by significant stakeholders as being appropriate to the purpose it is being applied to.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer believed that coordination with other laboratories and with shared mobility implementations like Hertz, Car2Go, and Zipcar provides an excellent foundation for the modeling.

Reviewer 2:
The reviewer noted that the SMART Mobility inter lab arrangement will yield benefits to EERE by reducing technology overlap and stated that the continued validation of the various models from each laboratory or other transportation partner is required as is the need to ensure that data can be transferred among tools effectively.

Reviewer 3:
The reviewer acknowledged that there is collaboration among the laboratories, but it also appears siloed within DOE and VTO. The reviewer stated that the team is developing industry partnerships, but said this seems insufficient to really create a robust and useful deliverable in the end.

Reviewer 4:
The reviewer commented that working with a city initiative like New York City's electric charger initiative would be a useful collaboration to gain data on EVSE usage by actual shared vehicles. The reviewer further suggested working with a shared vehicle provider like Car2Go, which has EVs in some markets, such as San Diego.

Reviewer 5:
The reviewer noted that collaboration for this project needs to be with all of the stakeholders that are a part of the urban transportation segment that is being studied. The reviewer found this project to be limited to the academic elements within the DOE laboratory system using requested data from a city and charge system operator. The reviewer said that this is extremely limited and will lead to extremely limited conclusions.

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 aside from previously supplied suggestions, the bullets listed on the slide seem great and reasonable.

Reviewer 2:
The reviewer commented that the range and uptake of shared EVs must still be modeled, and observed that there are important assumptions about whether trips are replaced in kind or decrease as shared vehicles displace private vehicles. The reviewer stated that evidence shows that shared vehicles reduce trips per household because the marginal cost of trips becomes explicit and changes traveler behavior.

Reviewer 3:
The reviewer said that there is a good plan for future research in this area, but some of the project difficulties and tool immaturity need to be cleaned up first. The reviewer also stated that as the technologies, such as direct current fast-charging (DCFC) and energy storage systems (ESS), and the EV market change there will be occasion to investigate the accuracy of the Market Acceptance of Advanced Automotive Technologies (MA3T) model as a market prediction tool. The reviewer commented that the new administration may reduce incentives for EVs, the low price of fuel may reach out 3 years, and growth regions with large population densities may also have additional difficulties to deploy DCFC. The reviewer stated that this cost needs to be better understood prior to next level of predictions.

Reviewer 4:
The reviewer stated that the project team expressed concern that the EVI-Pro model has "home dominant charging preference for simulated consumers with economically efficient behavior." The reviewer said that this is viewed as a challenge when it is more a reality than recognized in the approach. The reviewer noted that the use of home charging should be an integral part of the modeling.

The reviewer suggested that the Car2Go EV car sharing project in San Diego be used to understand the issues with EV car sharing. The reviewer cited the white papers from the EV Project, which discussed the difficulties in charging vehicles in the field and the efforts put in place by Car2Go to retrieve the vehicles and charge them at a central location. The reviewer pointed out that this is contrary to any of the models proposed for use in the project.

Reviewer 5:
The reviewer remarked that the slides on project progress were simply a collection of slides stating many things that are clearly apparent in the current EV use world. The reviewer noted that the fact that car sharing would reduce energy is a "known," and it does not matter whether it is an EV or a fossil-fueled vehicle and believed that studying these things is a wasted effort. The reviewer stated that modeling that does not take into account the changes to technology in future EV fleets is a real waste of effort and said that this project lacks attachment to the real world. The reviewer stated that the project will simply use a different set of tools to give the same general predictions that have been previously reported.

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

Reviewer 1:
The reviewer commented that this project has good relevance as it will build EEMS understanding of where and how to focus on areas of interest for electric mobility technology advancement. The reviewer believed the project will be critical in urban centers to offer competitive electric mobility options, to obtain maximum oil

displacement, and to improve air quality. Maturing the tools used for these predictions is a valuable part of EEMS.

Reviewer 2:
The reviewer found a potential for petroleum displacement, but it is unclear whether the project will increase EV penetration.

Reviewer 3:
The reviewer remarked that in the long term, modeling charge infrastructure to support shared mobility is relevant in providing a guide to car sharing operators and support to operators of charging infrastructure intent on supporting ride-hailing services. However, the reviewer noted that from data gathered in the project, it appears that ridesharing would be supported by home charging and by workplace charging, approximately 55% of VMT. The reviewer stated that home charging does not require modeling and workplace charging is already covered by the Workplace Charging Challenge.

In the short term, the large uncertainty of every model input makes the relevance of this effort questionable.

Reviewer 4:
The reviewer noted that the project is relevant, but nonetheless believed the dots need to be connected to the audience to show why it is relevant. The reviewer wanted to know that this work can impact the world.

Reviewer 5:
The reviewer said that the project does not support DOE objectives as it is simply reaffirming old understandings and does not take into account how the EV fleet will change over the next five years. The reviewer stated that the market has spoken and to get widespread EV adoption, the vehicle must perform and be as convenient to use as a fossil fuel car. The reviewer noted that this is why DOE funded battery and fuel cell research to drive down costs and increase power density to extend range.

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

Reviewer 1:
The reviewer allowed that the funds are probably sufficient, but suggested that the data hunt could be a huge effort and data are clearly scarce here. The reviewer stated that it is hard to determine whether resources are in fact sufficient.

Reviewer 2:
The reviewer believed that with data currently unavailable, the resources seem sufficient to sort out inconsistencies in models to be incorporated into the analysis.

Reviewer 3:
The reviewer commented that the resources are sufficient, but there should be additional support available from the national laboratory's modeling community as a whole. The reviewer saw an opportunity to engage an academic branch to help with some of the possible data transfer.

The reviewer observed that for the EEMS project to be successful, there needs to be a concentrated effort to validate the transportation system level predictions of this type of project. This would be no small feat and not the responsibility of this project on its own.

Reviewer 4:
The reviewer appreciated the relevance and the outcomes to date. However, the reviewer noted that this does seems like a lot of funding in total for this work unless the scope is expanded or the outcomes are connected to

a more significant effect, such as providing vital data being asked for from planners and industry to build out the shared AFV mobility space.

Reviewer 5:

The reviewer characterized using valuable technical minds on a project that started with a flawed approach as excessive, especially when, after some time, all that can be reported are a number of well-known things that did not need to be studied again.

Presentation Number: eems013
Presentation Title: A New System Simulation Framework for SMART Mobility
Principal Investigator: Phil Sharer (Argonne National Laboratory)

Presenter
Phil Sharer, Argonne National Laboratory

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

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

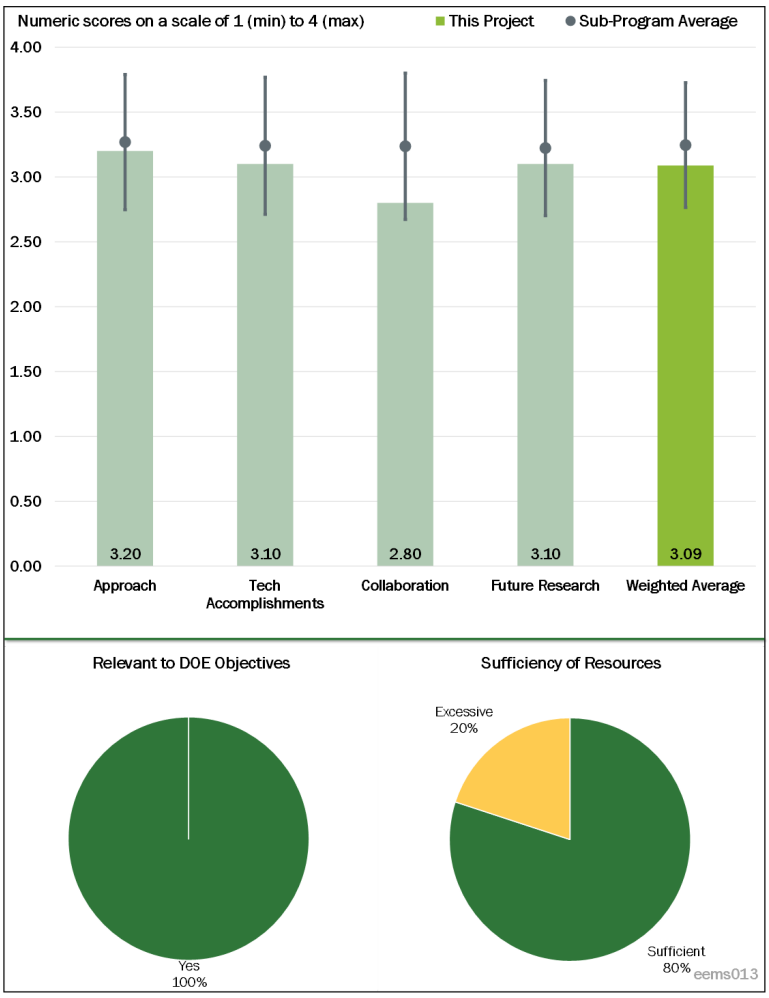

Figure 4-13 – Presentation Number: eems013 Presentation Title: A New System Simulation Framework for SMART Mobility Principal Investigator: Phil Sharer (Argonne National Laboratory)

Reviewer 1:
The reviewer commented that in response to VTO's new program for EEMS, ANL has developed a new simulation tool, the Advanced Model Based Engineering Resource (AMBER), that builds upon the vehicle level simulation model, Autonomie; integrates other national laboratory models like POLARIS (multi-vehicle simulation); and plans to develop new EEMS supporting processes. Given the shift in VTO focus from component level and vehicle systems R&D to the transportation system level, it is appropriate to have an HPC-enabled, multi-workflow model that would help quantify the potential benefits of VTO EEMS activities.

Reviewer 2:
The reviewer pointed out that, as with some of the other posters/projects related to simulation of large interconnected systems, this project does a good job of recognizing not only the need to simulate on a large-scale system and but also that current tools will need changes to more accurately predict the best way to shift mobility toward more efficient technologies. However, the reviewer believed that this project does not attempt to take lessons learned from prior urban and anthropological planning tools in the progression from Autonomie to AMBER other than the future use of MA3T. The reviewer noted that going from Autonomie to multi-vehicle Autonomie simulations will require human factors and reaction interface data unless the project only considers high-level autonomous vehicles with very high market penetration rates or the projections even regarding traffic flow simulation and energy calculations may be in error. The reviewer stated that it would be good to have seen some projections from the POLARIS tool versus real-world data to validate the agent-based models.

Reviewer 3:
The reviewer said that the project approach addresses the barrier of "bringing technologies to market faster" by developing a simulation framework that will speed up the analysis process for new transportation paradigms. The reviewer explained that the project increases the portability and potentially expands the user population for a suite of DOE tools by enabling users to employ precompiled Autonomie vehicle representations that can be run on a free version of MATLAB. The reviewer said that this will allow scientists and engineers to leverage validated vehicle models in their analysis of proposed new mobility solutions.

Reviewer 4:
The reviewer acknowledged that the AMBER project is a much-needed modeling framework that can be applied to a transportation network that still has the granular capabilities of the underlying modeling platforms of Autonomie and POLARIS. The reviewer stated that the project design is feasible and the integration with the underlying modeling platforms is solid. The reviewer said that the only missing element appears to be future plans once this project is complete.

Reviewer 5:
The reviewer commented that the approach to the development of AMBER is not clearly defined, presented, or defended and believed if the barrier being addressed is bringing technologies to market faster or accelerating technology evaluation, then it is unclear how this new tool will help overcome these barriers. The reviewer observed that if the barrier being addressed is simply integrating a diverse set of simulation tools, then someone has to ask why this is necessary, and if it is, why it needs to be done with these specific tools at this level of fidelity and to achieve exactly what goals. The reviewer noted it is not at all clear from the poster whether the goal is to simulate or predict traffic flows, energy use, accident frequency, or any one of a vast array of useful pieces of information.

It was unclear to the reviewer what level of predicted information is being sought and, what technologies would be brought to market faster, including new powertrain concepts, new powertrain components, new vehicle safety systems, new traffic flow measures, and new road designs. The reviewer mentioned that there are better ways to site charging stations, parking structures, or passenger pick-up points, and it was not clear if AMBER is meant to address any or all of such questions or issues. The reviewer noted that the poster implies that AMBER will provide a framework over other tools, such as Autonomie or POLARIS, but how and why are not at all clear. The reviewer stated that understanding the impact of different vehicle populations on energy use in a city does not require knowledge of every detail of every vehicle, such as which alternator or what tires it uses; rather, the information required is something about its energy use over various drive cycles. The reviewer said that including complete models of every vehicle inside a model of fleets or groups of fleets seems like gross overkill for most practical purposes.

In summary, the reviewer believed the barriers this project is addressing are not well defined, and therefore did not think the project is well designed or feasible. As for being integrated with other efforts, the reviewer found little evidence that the work is coordinated with others at ANL or with major potential users, much less with other researchers in the field who are modeling large systems or mining large datasets or trying to optimize vehicle populations for one purpose or another.

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

Reviewer 1:
The reviewer noted that the project's technical accomplishments and progress toward the overall project and DOE goals are outstanding in the sense that they have focused on addressing the requirements of OEMs that are motivated to explore the feasibility and viability of advanced mobility solutions technologies.

Reviewer 2:
The reviewer commented that given the charge to develop the simulation tools for smart mobility, technical accomplishments are in line with the proposed project milestones and noted the milestones are focused on integration of existing and development of new workflows for AMBER. The reviewer stated the project seems on track with the annual milestone of first public release of the model at the end of the fourth quarter of 2017. The reviewer noted that this is a multi-layer approach, with a diverse set of workflows, and a new user interface to run large studies with Autonomie.

Reviewer 3:
The reviewer remarked that the project has made good progress toward its milestones of simplifying workflow modification and basic framework development, but seems to be working outside of the rest of the SMART Mobility team. The reviewer added that it may be appropriate to have an outside evaluation of the best current tools in the industry, then allow the focus to be on datasets that work across tools rather than improving a tool if there is something out in the market better for that portion of workflow.

Reviewer 4:
The reviewer noted that there appears to be significant progress toward the project goals already accomplished. The completed workflows are already enabling useful analyses.

Reviewer 5:
The reviewer stated that the poster indicates that progress has been made and about 60% of the funds have been expended, but there are no specifics provided as to what other tools have been incorporated successfully and how many other tools, or types of tools, need still to be incorporated to make AMBER functional and productive. The reviewer opined that there are no examples provided of a specific problem that AMBER would help address, so it is impossible to say if the project is on the way to meeting its goals. The reviewer mentioned that charts are provided that reference other tools and talk about the vision to generalize any workflow, but the need for this capability and the reasons for mentioning these specific tools, and some discussion of the differences among their inputs and user interfaces and how AMBER is addressing this, are all lacking. The reviewer said that there are no well-defined goals so there is no way to measure progress against those goals. The reviewer noted that the poster says that "customizing workflows is easy," but wondered who was customizing the workflows. The reviewer recommended that the project principals identify the target market for this software, show that they are getting input and direction from that target market, define one or more clear goals, and show progress toward meeting those goals. If any of that currently exists, the poster provided little evidence.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that the decision to replace the previous vehicle system simulation framework (Autonomie) with something that can model a variety of vehicles in a much larger transportation system network was driven by the user community of more than 200. The requirements were developed with the user community and validated by interactions with a couple of domestics OEMs.

Reviewer 2:
The reviewer noted that the project is validating its technical progress by issuing beta versions of the software to potential users. This collaboration improves the likelihood that the tool will meet the evolving requirements of the user community.

Reviewer 3:
The reviewer stated that the use of feedback from Autonomie users is positive, but advocated for receiving feedback from users of other platforms, such as POLARIS. The reviewer noted that there is mention of "specific discussion" with OEMs, but extensive discussions should be the goal and suggested that an academic partner could be helpful as well.

Reviewer 4:
The reviewer noticed that this effort appeared to be ANL- and Autonomie-user centric with partners and input. The reviewer commented that though stated OEM discussions have been taken into consideration, there was a simple statement that "the tool structure was consistent with the requirements." There was no mention that as complex traffic simulation technology matures, and with the impact of driver information and options on travel and choices, there is no standard way to define interactions or responses to information available. The reviewer stated that this type of supplemental research is required, in particular for agent-based models to have credible predictions.

Reviewer 5:
The reviewer commented that the poster provided very little evidence of collaboration or coordination with any other researchers or institutions that are either involved in similar work or might be users of the product of this work. The reviewer noted that there is some brief mention of meetings with General Motors and Ford, but no names are provided of the people involved and there is no record of the outcome or result of the meetings. The reviewer reported that many other software tools are mentioned, but there is no evidence provided of contact with the developers or users of these other tools. The reviewer also noted that the references that are provided at the end of the poster include only prior work by these same researchers, which shows no effort to connect with others in this field. The reviewer was aware that there is substantial competing or complementary work going on at places like Georgia Institute of Technology (Georgia Tech) by Professor Dmitri Mavris and colleagues. The reviewer stated that if AMBER is being designed to interface with large databases of vehicle information, then this reviewer expected coordination with companies like SAS Institute, who are experts in large data. The reviewer pointed out that even companies such as Ricardo and AVL have developed and used their own vehicle simulation tools and are attempting to model systems of vehicles, yet the poster offered no evidence of connecting with such companies or with other national laboratories for the purpose of making the work relevant to potential users.

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 asserted that the future work is outstanding in that it represents a logical, stepped introduction of new capabilities that are critical to accomplishing the overall project objectives. The future work appropriately addresses development of new functionality and validation of the capabilities via analytic exercises that are useful to DOE.

Reviewer 2:
The reviewer commented that the proposed future research is well described and focused. The deliverables are sound and the schedule appears feasible.

Reviewer 3:
The reviewer noted that there are a good set of tasks that will allow the progression of the system framework and workflow and believed that there are real opportunities in this project that would have important progress in HPC applications if they are successful. The reviewer added that a task that highlights a validation with real-world supporting data of a smaller scale prediction would be of significant value.

Reviewer 4:
The reviewer found the future work to be focused on first launching the public version of AMBER and then developing use cases to support current and future VTO technologies with a focus on smart mobility and very large simulations. The reviewer remarked that while developing a simulation tool that can model the potential benefits of the future mobility systems is appropriate, the transportation system being modeled is very complex

and uncertain, making one question the accuracy of results because there will not be any means to validate the outcomes for years to come.

Reviewer 5:
The reviewer observed that the project has identified a number of tasks that appear logical and may be worthwhile, but it has not shown how these future tasks fit into an overall strategy or help to reach important goals. The reviewer stated that the goals appear to be just a random set of additional tasks that involve adding new cases, new vehicles, and incorporating additional workflows. The reviewer believed that no decision points are incorporated and that there appears to be no attempt to evaluate the success or utility or benefits of the future tasks. The reviewer did not see any identification of alternative development pathways, and there is no discussion of risk or risk mitigation, perhaps because when no target is identified there is no chance of missing it. The reviewer commented that the problem with the future research goes back to the problems identified initially: a lack of clear focus and a lack of clearly identified goals and the benefits of reaching them.

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

Reviewer 1:
The reviewer acknowledged that while this project will not directly impact petroleum displacement, it is developing a model that will enable quantification of potential benefits of a variety of smart mobility activities. Its future use is envisioned as one of the analysis tools for VTO.

Reviewer 2:
The reviewer indicated that this project enables the evaluation of transportation energy consumption of existing and emerging technologies on a scale of hundreds or thousands of vehicles. This type of analysis is useful for assessing the potential petroleum displacement impacts of the new technologies. The analyses will help commercial and governmental organizations identify technology strategies that minimize petroleum consumption.

Reviewer 3:
The reviewer commented that the impact of CAVs on petroleum displacement must be considered via modeling of the transportation network as a whole, and that the AMBER project provides the tool for these analyses.

Reviewer 4:
Although the project is very relevant to oil displacement, the reviewer was not completely convinced that it would have significant impact on technology or quicken market strategies unless the following occur: there is significant work aligning a customer impact model like MA3T, which was promised by the project team; and there are supporting incentives from the government, which is uncertain.

Reviewer 5:
The reviewer remarked that the answer to this question with respect to this project is not completely straightforward and suggested it would be better if another answer were allowed, such as “maybe” or “possibly.” The reviewer commented that this project could support DOE’s objective of displacing petroleum if it were properly structured and integrated with other DOE research and if it included more collaboration with stakeholders and other non-DOE research. A software tool like AMBER might help identify how future vehicles, including automated vehicles, might affect traffic flow in a city or might affect energy consumption in a region. It might help guide fueling options and help locate charging stations; help select between mass transit vehicle and route options; and help vehicle designers and urban planners devise better systems. However, it needs to focus on a small number of applications and uses and demonstrate its utility on those specific problems before it tries to be all things for all potential users. The reviewer commented that a program like AMBER could support DOE’s objectives, but it needs much better direction and coordination with other projects before it will do so.

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

Reviewer 1:
The reviewer allowed that $600,000 per year over three years seems like an appropriate investment for building this multi-workflow framework.

Reviewer 2:
The reviewer commented that the resources are sufficient to introduce critical functionality to the AMBER framework.

Reviewer 3:
The reviewer suggested that additional outside input should be considered to focus resources on portions of the project with the most promise, but funding may cover all proposed future tasks if funded to planned amounts.

Reviewer 4:
The reviewer noted that the modest budget appears to leverage existing ANL resources and is cost effective for the significant deliverables.

Reviewer 5:
The reviewer remarked that because the project does not seem to have identified any milestones (at least not meaningful and measurable milestones), then the resources available per milestone are, by definition, excessive. The reviewer brought up that it was not sufficient to simply put other tools into the AMBER workflow and say that it is an accomplishment. The reviewer stated that it seems to be what is happening and it would seem to have minimal utility. The reviewer proposed that rather than put more money into a generalized workflow enabler like AMBER, it would be better for the researchers, with DOE input, to identify a specific problem or limitation that cannot be overcome or addressed by current simulation tools, then define a tool that satisfies that specific need, and next identify the resources needed to develop that specific tool, with goals and milestones along the way. The reviewer said that putting more money into something as ill-defined as the current AMBER project seems like a mistake. The reviewer commented that there are projects and proposals to model a fleet of vehicles, a municipal transportation system, a city's vehicle population, an Army base, or a regional transportation and energy system, but this poster does not communicate how this project or the AMBER software simulation tool will apply to any of these and certainly not in a timely fashion.

Presentation Number: eems014
Presentation Title: Agent-Based Transportation System Modeling with POLARIS
Principal Investigator: Josh Auld (Argonne National Laboratory)

Presenter
Josh Auld, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer pointed out that POLARIS is an open source model designed for large-scale studies modeling the transportation system of a metro area. The reviewer noted that the model takes into account traveler, mode, and energy use when coupled with Autonomie. The reviewer stated that the model is well suited for EEMS modeling, supports four out of five DOE SMART Consortium pillars, and is well integrated with other EEMS modeling efforts.

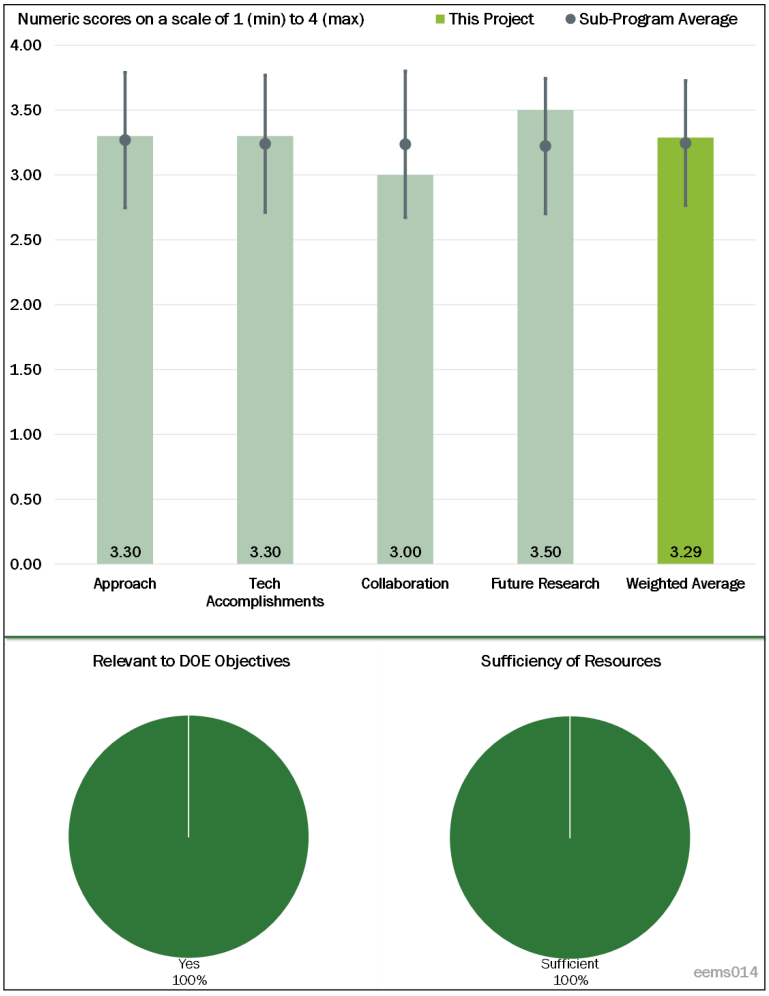

Figure 4-14 - Presentation Number: eems014 Presentation Title: Agent-Based Transportation System Modeling with POLARIS Principal Investigator: Josh Auld (Argonne National Laboratory)

Reviewer 2:
The reviewer remarked that this a major task with many variables in a rapidly changing world. The reviewer noted that the approach is realistic considering the current environment.

Reviewer 3:
The reviewer outlined that the project focus is to further develop the POLARIS model for evaluating the energy impacts of CAV technology implementation and effects of changing travel behavior and modes on a community or metropolitan level basis. The reviewer added that POLARIS is a good platform for this type of modeling given its efficient computing capabilities for large datasets. The reviewer stated that the approach includes five primary milestones: Vehicle Assignment Models; Travel Behavior Models; CAV Traffic Flow Model; Multi-Modal and Transit Model; and POLARIS Core Development. The reviewer commented that the outlined approach is well constructed to result in improved functionality of POLARIS regarding future EEMS technology modeling efforts and fits within the broader context of important POLARIS model development. The reviewer noted that the project is leveraging off several ongoing and complementary modeling efforts and case studies supported by other organizations including DOT.

Reviewer 4:
The reviewer stated that the project has a good approach. However, this reviewer noted that barriers highlighted by the presentation include difficulty transferring models to multiple cities and the need for expensive traffic data, which are not fully sorted as components of initial project barriers.

The reviewer also said that if we understand our models are not accurate in energy estimations given new modes or technologies, we should identify the work that is being done to better understand the agents and validate those foundational components of this approach.

Reviewer 5:
The reviewer commented that it appears that there are data sources from FHWA that may be overlooked.

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

Reviewer 1:
The reviewer observed that vehicle assignment, travel activities, and enhanced traffic flow models have been completed to date, and the core POLARIS and multi-modal transit models are under development. The reviewer stated the project is well on the way to meeting project objectives and milestones.

Reviewer 2:
The reviewer stated that it was very good to see groundwork laid for a computation effort to be placed into the HPC realm and the recognition of the need for critical simulation capability of human interaction and decision science. However, POLARIS seems light on the availability of information and driver response.

The reviewer commented that successes with this project could guide the future focus for EEMS projects and relationships for dense population planning, including charging and parcel drop spot location forecasting. The reviewer noted that the model needs elements of historical data, which can validate model projections.

Reviewer 3:
The reviewer stated that it was very early in the project and that things were very good at this stage.

Reviewer 4:
The reviewer said that the accomplishments appear to be moving toward achieving the goals.

Reviewer 5:
The reviewer indicated that the researchers stated that the project is 15% complete as of development of their presentation, which seems reasonable given an October 2016 start-up. The reviewer noted that the presentation stated that the project should be 25%-30% complete by the end of the fiscal year. The reviewer said that the project has pursued a new approach to vehicle assignment models, initiating work on a new framework for a dynamic vehicle transaction model based on data from R.L Polk and ORNL's MA3T market penetration model.

The reviewer noted that the project also reported progress on travel activity and choice models for representing future mobility modes and options by focusing on new enhancement to POLARIS' traffic flow model to better represent travel times and vehicle speeds due to CAVs. The reviewer commented that the enhancements incorporate road features, traffic conditions, and number of CAVs in the link, and leverage traffic flow micro-simulator work done by Texas A&M University. The reviewer stated that the project has begun work on multi-modal travel with a public transit model, with design and testing of a fast multi-modal router, and prototype development for the Chicago metropolitan area as an initial incorporation into POLARIS. The reviewer also indicated that researchers have also started POLARIS core development activities, including new interface and

visualization tools and software enhancements for automated build and test. However, researchers did not intimate that available datasets has been and will be a limiting factor toward progress.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer found there to be good collaboration with four universities and two other national laboratories.

Reviewer 2:
The reviewer commented that collaboration partners represent all but one capability, fleet logistics. The reviewer emphasized that the model is good with recognition of human decision, but wondered what travel information will impact large fleet services, say for changing routes for drivers or even going to semi-live routing based on truck inventory and stem versus branch routing options. The reviewer stressed that the project needs a partner with a stake in the game to see how they are learning and predicting.

Reviewer 3:
The reviewer said that collaboration and coordination with the other laboratories in the consortium is most crucial.

Reviewer 4:
The reviewer suggested that there appears to be an opportunity to reach out to the DOT and FHWA for data sources and technical expertise

Reviewer 5:
The reviewer applauded that the researchers cited significant current and planned collaboration with outside organizations. To date, this includes SMART Mobility Consortium members and Texas A&M University. The reviewer noted the team has also utilized ORNL's MA3T model and outside data sources for supporting progress to date. Lastly, the reviewer complimented the team on its leveraging of over half of the available funding from non-DOE SMART Mobility sources, including FTA, DOE-VTO, DOE funding opportunity announcements, and ANL laboratory directed R&D.

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

Reviewer 1:
The reviewer commented that proposed future research, new data sources, and automation are well aligned with addressing the remaining barriers.

Reviewer 2:
The reviewer said that there is a lot of potential for POLARIS to play a major role is mobility decisions.

Reviewer 3:
The reviewer found it encouraging that the researchers are taking advantage of the investment made by the DOT and Columbus on the Smart City challenge. The reviewer was hopeful that this can be extended to other cities that proposed or are otherwise participating in some way.

Reviewer 4:
The reviewer noted that the research team has laid out a well-thought out research plan and has made reasonable progress to date that currently funded FY 2018/2019 research activities that appear to support overall project objectives of enhancing POLARIS capabilities for effective future mobility modeling, including development of travel behavior and CAV traffic flow models, and continued development of POLARIS core

capabilities. The reviewer remarked that the researcher recognizes that availability of data, especially travel behavior data, will be a continuing challenge to future work under the project, but the proposed investigation of big data sources from commercial, public, and metropolitan planning organizations should help address some of these deficiencies. The reviewer stated that key attributes of future research will be the development model externalization and leveraging of an HPC environment to allow for large-scale POLARIS EEMS research. The reviewer commented that the researchers also offered interesting post-project research opportunities, pending additional funding (including additional travel modes and refueling and recharging infrastructure), and links to land use and energy and grid models.

Reviewer 5:
The reviewer said that behavioral and traffic flow should be a focus as this category should be able to help identify policies that may truly influence traveler's choices. The reviewer noted this may be the only way to truly validate with cause and effect for future projections.

The reviewer indicated that the automated process for validation of POLARIS seems like it may be an expansion of scope of the project. The reviewer added that it is understood that the ability of the models to transfer to other regions is of great importance, but improving the accuracy of the projections, highlighted as an initial barrier, should trump the focus of spreading to new locations or incorporating new datasets until various models can be evaluated for their performance and downselected.

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

Reviewer 1:
The reviewer said that while this project does not directly impact petroleum displacement, it is developing a transportation modeling tool to quantify the energy impacts of future mobility trends and identify technologies and policies that can be leveraged for a more energy efficient transportation system.

Reviewer 2:
The reviewer affirmed that there is no doubt that the project has impact on the mission to reduce oil consumption, but until projection accuracy improvements can be quantified, there is a question as to the decisions that can be made from this initial work. The reviewer noted that building a stable foundation model that accurately accounts for behavior and impact of new technologies (CAVs) or sharing modes is no small task; this effort is both relevant and should build understanding of critical characteristics relating to model performance in each of the partners.

Reviewer 3:
The reviewer commented that understanding mobility is key to optimizing the technology created through VTO's vehicle investments.

Reviewer 4:
The reviewer stated that the objective appears to be more about efficiency of freight movement rather than petroleum displacement, but the two go hand-in-hand.

Reviewer 5:
The reviewer agreed that this project has significant relevance to DOE objectives for petroleum displacement by investigating model approaches for estimating the energy impacts of future smart mobility technology. The project leverages the existing capabilities of the POLARIS model for providing a common modeling framework for future CAV implementation and travel mode and behavior. The project also looks to expand POLARIS capabilities in performing large-scale modeling in an HPC environment.

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

Reviewer 1:
The reviewer acknowledged that for FY 2017 the $300,000 of DOE funding is being leveraged with another three times that amount provided by other organizations, showing the importance of this work.

Reviewer 2:
The reviewer commented that the research appears to have sufficient resources to complete the proposed activities and that the researchers have done a nice job of leveraging several funding sources, both DOE and non-DOE, to achieve overall stated research objectives.

Reviewer 3:
The reviewer observed that the partnerships described provides confidence that the project will achieve its goals.

Reviewer 4:
The reviewer stated that leveraging the laboratory consortium will be very important to optimize resources.

Reviewer 5:
The reviewer said that it can be difficult to understand the source funding and project scope or partner efforts when Slide 2 discusses multiple streams and possibly projects related to the efforts and their funding.

Presentation Number: eems015
Presentation Title: Calibration of Activity-Based Transportation System Simulation Tools using High-Performance Computing
Principal Investigator: Vadim Sokolov (Argonne National Laboratory)

Presenter
Vadim Sokolov, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer commented that the project took a good approach focused on combining big data, simulation, and HPC. The reviewer noted that new types of mobility datasets are being considered for integration into POLARIS.

Reviewer 2:
The reviewer remarked that while it was early on in the project, the poster presenter had a good handle on the task at hand and the difficulty in truly paring down parameters of interest as well as the importance of sensitivity studies and analysis. The reviewer stated that a basic plan and milestones were in place, but the reviewer also recognized that the project interlaced with other SMART Mobility projects, which the reviewer believed should be able to keep the project in focus and not creep into other areas.

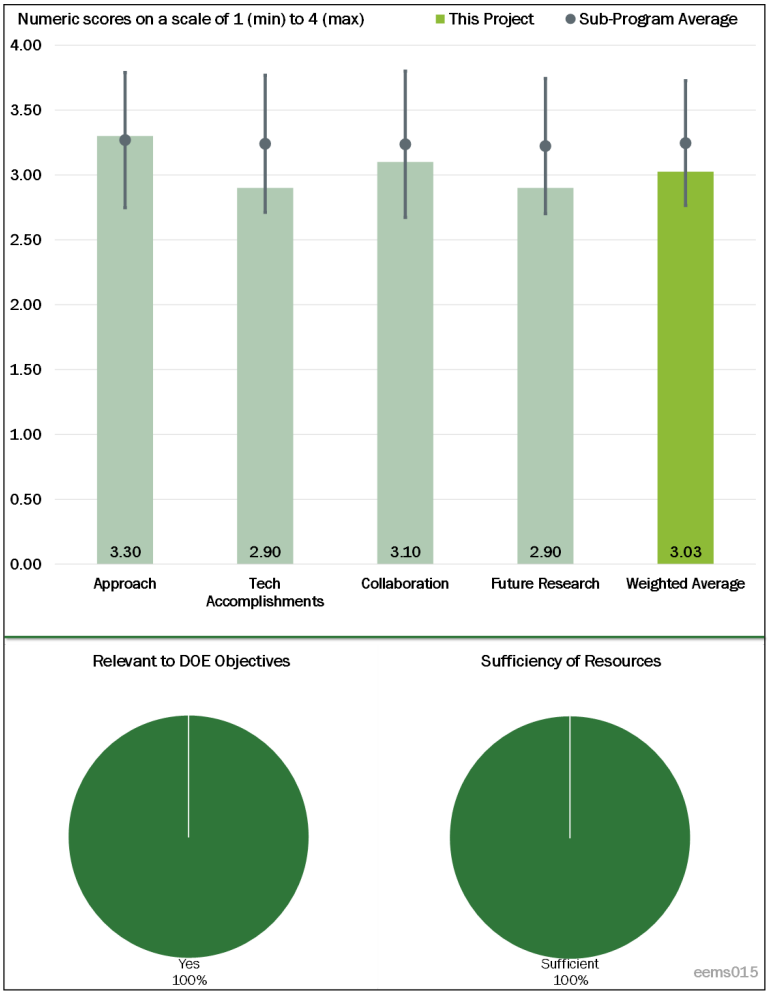

Figure 4-15 - Presentation Number: eems015 Presentation Title: Calibration of Activity-Based Transportation System Simulation Tools using High-Performance Computing Principal Investigator: Vadim Sokolov (Argonne National Laboratory)

The reviewer suggested that the Bayesian optimization and transfer from other industries would be the importance of the similarity of agents and noted that other industries listed are typically profit focused where transportation is activity focused.

Reviewer 3:
The reviewer noted that the project adopts a proven method for minimizing errors to estimate model parameters and said that if datasets of input and output variables were available, the calibration computations are feasible using the method proposed. The reviewer commented that the calibration task is integrated into a multiple step approach for performing EEMS analysis.

Reviewer 4:
The reviewer stressed that calibration of models is crucial to making the models applicable to new locations and stated that this project addresses the calibration needs for a transportation system model and usefully employs POLARIS for the framework.

Reviewer 5:
The reviewer remarked that the poster identifies the technical barriers as "Transportation models are complex" and "Calibrating [them] is costly and inaccurate" and suggested that the team describe the barriers differently. The reviewer, however, believed that this research is addressing important issues and doing so in a relatively logical and well-designed manner. The reviewer noted the research is trying to incorporate new sources of data regarding vehicles and traffic flow while also taking steps to simplify the problem through dimensionality reduction, Bayesian optimization, and Gaussian process emulation. The reviewer said that these methods have been applied to other technical problems and believed their use here makes for a sound approach. The reviewer stated that the project is addressing important technical barriers in a feasible manner and the chance of producing useful results is reasonable. The reviewer was concerned with the lack of more and better integration of this work with other efforts. The reviewer indicated that the poster mentions sources of data and the difficulties in getting good data, but the reviewer would like to have seen evidence that the researchers considered and pursued additional potential sources, such as those that deal with traffic flow in specific cities such as Google Maps and Waze, not to mention other potential data sources, such as Lyft, Uber, and taxi companies. The reviewer suggested attempting to access data from these sources. The reviewer also brought up that other companies such as SAS are involved with mining huge datasets and stated there are others, such as Georgia Tech, who are doing research on modeling of large complex systems. The reviewer said that there is no evidence that the researchers are connecting with other similar research. In summary, the reviewer suggested that the project team could do more to integrate the work with others in the field outside of their current collaborators.

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

Reviewer 1:
The reviewer commented that the project is only 15% complete as it was a new start in FY 2017. The reviewer noted the project has completed a literature review on calibration of complex models, identified three distinct approaches, and prototyped a computational framework for calibration using HPC.

Reviewer 2:
The reviewer found the project to be in its early stages, but stated that it seems to be keeping on pace. The reviewer said it was significant to find early sensitivity, but it was also as significant to recognize early success with calibration of systems regarding input variation, as it may also mean there are more scenarios to examine prior to calling a model calibrated. The reviewer called out the cell phone activity pattern relationship to activity patterning as needing some validation.

Reviewer 3:
The reviewer noted that the preliminary analysis of high-sensitivity results shows that significant challenges remain in the software infrastructure and said that the plan to overcome these challenges appears sound. The reviewer stated the resulting framework will support DOE goals for modeling transportation networks.

Reviewer 4:
The reviewer observed that evidence of the work performed to date was sparse in the presentation and suggested it would be helpful to have seen more complete explanation of results of the sample data exercise that was mentioned in the presentation.

Reviewer 5:
The reviewer said that while the poster talks about some of the progress that has been made in selecting the approach, identifying data sources, reducing dimensionality, and performing a sensitivity analysis, there is no clear evidence of measurable progress against quantifiable milestones because the milestones are not well defined or measurable. The reviewer stated that the milestones should be reconsidered and recast to define a quantifiable level of performance or progress. The reviewer suggested establishing a milestone that could say that the model has been developed to a point where it handles X-number or Y-types of vehicles, or that it has reduced the dimensionality from A to B, or that a certain amount of data has been gathered and analyzed. The reviewer cited the current milestones as offering no way to measure progress or providing any performance indicators. The reviewer noted that despite the technical progress made, no real evidence is provided. The reviewer suggested having more quantifiable milestones will become even more important as the project starts to deal with the issue of calibrating the model against data and found it critical that the DOE project managers demand that all the milestones be redefined in terms that are meaningful and measurable.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer commented that there was good collaboration on calibration framework for POLARIS with George Mason University (GMU), with LBNL on large-scale travel activity data, and with the Colorado Department of Transportation (CDOT) for transportation data exchange.

Reviewer 2:
The reviewer stated that the project is making a good attempt to cover bases with players who can assist in input date and modeling theory, but in looking at the available funding, the reviewer found that a delivery fleet logistics coordinator would go a long way to allow driver agent validation; such a person should have large datasets of traffic flow for analysis with specific traffic inputs and the actual traffic response data. The reviewer suggested such an organization would be a valued partner in this type of analysis.

Reviewer 3:
The reviewer noted that because this work is connected with other researchers at GMU and LBNL, it merits a satisfactory grade for collaboration and coordination. However, the project could do much more in this area, and the reviewer believed it would make the project so much better if the researchers widened the scope of their collaboration activities. The reviewer earlier mentioned collaboration opportunities with companies and organizations that are active in similar areas such as Georgia Tech, SAS, IBM, and CISCO as well as others that could be sources of data such as Uber, Lyft, Waze, taxi companies, and taxi and limousine commissions. The reviewer stated that there is other relevant work at the national laboratories that could also be sources for collaboration. The reviewer suggested that the researchers should do more to collaborate with others if they want to increase their score above the “Satisfactory” level.

Reviewer 4:
The reviewer called the coordination and collaboration among the partners as appearing strong and noted the presentation was specific in naming potential sources for the data sources that the project plans to use.

Reviewer 5:
The reviewer remarked that the collaboration among academia, ANL, and CDOT is strong. The reviewer suggested that additional DOTs could be added as the software framework is developed in order to test it in different locations.

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

Reviewer 1:
The reviewer said that proposed future work is appropriate and focuses on implementation and simulation in FY 2017, mathematical models in FY 2018, and application using cell phone data and origin-destination flows in FY 2019.

Reviewer 2:
The reviewer looked forward to seeing if the future effort changes as the project progresses and noted that completing the process of inputting a large dataset would be valuable for many projects if the datasets are standardized and suggested that this could be useful across multiple EEMS projects.

The reviewer stated that continued work on sensitivity is key and noted that an automated calibration technique was also noted in EEMS014; the reviewer wanted clarification about which activity is funding that specific effort.

Reviewer 3:
The reviewer commented that the future work outline provided in the presentation indicates that the near-term work will focus on process automation and that key datasets such as cell phone data and estimated origin-destination flows will not be incorporated until FY 2019. The reviewer suggested that significant efforts should be made to introduce the key data much earlier in the project timeline as a way to lower project risk. The performers should consider obtaining limited scope, sample data sets of the key data that address small geographic areas from the sources they plan to use for larger studies.

Reviewer 4:
The reviewer indicated that the significant challenges remaining do not have clear paths to success and suggested more milestones should be developed in order to ensure that interim goals are met and the project is progressing at the scheduled pace.

Reviewer 5:
The reviewer saw that the project clearly has plans for the future work and these plans may be logical and useful; however, the reviewer believed they are not expressed in a quantifiable form so it will be impossible to evaluate progress. The reviewer stated that because the researchers have set no measurable goals, they have also not identified any risks in achieving their goals; as a result, there is no discussion of risk or risk mitigation. Because of this, there seems to be no consideration of alternative development pathways. The reviewer proposed that the project needs to lay out a clear path to an endpoint and define milestones along the way that can be evaluated. The reviewer also suggested that the likelihood of meeting the milestones should be estimated and the barriers and risks should be identified for each one so that the DOE program managers can assess whether the project is on track or not. The reviewer stated that the researchers have some fairly clear ideas of what needs to be done, but have not clearly defined the steps along the way and have given no consideration to alternative paths or how to identify and deal with risks and barriers.

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

Reviewer 1:
The reviewer commented that this project is developing an automated calibration process for large datasets to be used in POLARIS and is therefore an enabler for modeling energy use, including petroleum impacts of future mobility systems.

Reviewer 2:
If it were not for the fact that this reviewer had reviewed multiple EEMS projects, it might be easy to overvalue the importance of this project. The reviewer told AMR organizers that it was good to have multiple related projects so that comparisons could be made.

The reviewer mentioned that the focus should remain on highly variable inputs and the effect of final predictions and sensitivities with an eye on validating against other industry models, given agent differences. The reviewer noted that this would mean the project could home in on first blush research projections with a less detailed effort than some other projects.

Reviewer 3:
The reviewer said that models of the transportation networks will require calibration in order for them to be flexible in their location application and that understanding the impacts of CAVs on petroleum consumption within the transportation system is very much aligned with DOE goals.

Reviewer 4:
The reviewer pointed out that at this early stage of the EEMS project, the reviewer's response is based on optimism and giving the benefit of the doubt to the analytic team's vision. The reviewer noted that this calibration task is one of several tasks that work together to provide a simulation framework that will be used to perform analysis on mobility concepts that have potential to both increase and/or decrease petroleum consumption.

Reviewer 5:
The reviewer asserted that the results of this project should be improvements in the calibration of transportation models, which should help make them more accurate and more useful. The reviewer stated that with more accurate transportation models, we should be able to evaluate a host of variables in transportation systems: vehicle population make-up, traffic patterns, and public policy decisions. All of these things could have a significant impact on petroleum use and displacement. The reviewer said that the project is focused on a useful topic, but needs to have clearer goals and better milestones along the way to meeting those goals.

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

Reviewer 1:
The reviewer commented that $500,000 over 3 years is a relatively small project, but it is providing an important pathway for including new kinds of large datasets into transportation systems models.

Reviewer 2:
The reviewer acknowledged that multiple EEMS projects have some common efforts listed and it is hard to address specific funding to specific efforts. The reviewer noted the main effort seems both unique to the program and also important to the foundation of modeling theory for transportation as a whole. The reviewer stated that this was a good project.

Reviewer 3:
The reviewer said that the resources appear to be sufficient for this project.

Reviewer 4:
The reviewer commented that the budget is sufficient based on the assumption that the costs of obtaining the required datasets are low or are funded through another task. The reviewer pointed out that the presentation does not address the costs of the HPC resources and the reviewer assumed that the HPC resources are free to the project.

Reviewer 5:

The reviewer believed the resources are sufficient for making progress in improving the calibration of transportation models, but believed the project might benefit from more interaction with industry, which could bring its own resources through a cooperative research and development agreement or similar arrangement in order to share data and results.

Presentation Number: eems016
Presentation Title: Energy Efficient Connected and Automated Vehicles
Principal Investigator: Dominik Karbowski (Argonne National Laboratory)

Presenter
Dominik Karbowski, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer commented that the approach is a very good way to leverage existing modeling infrastructure and adapt it to the needs of the CAV pillar as it utilizes expertise from other sources to achieve some of the goals and looks like a very practical approach without getting too deeply into the OEM engineering design space.

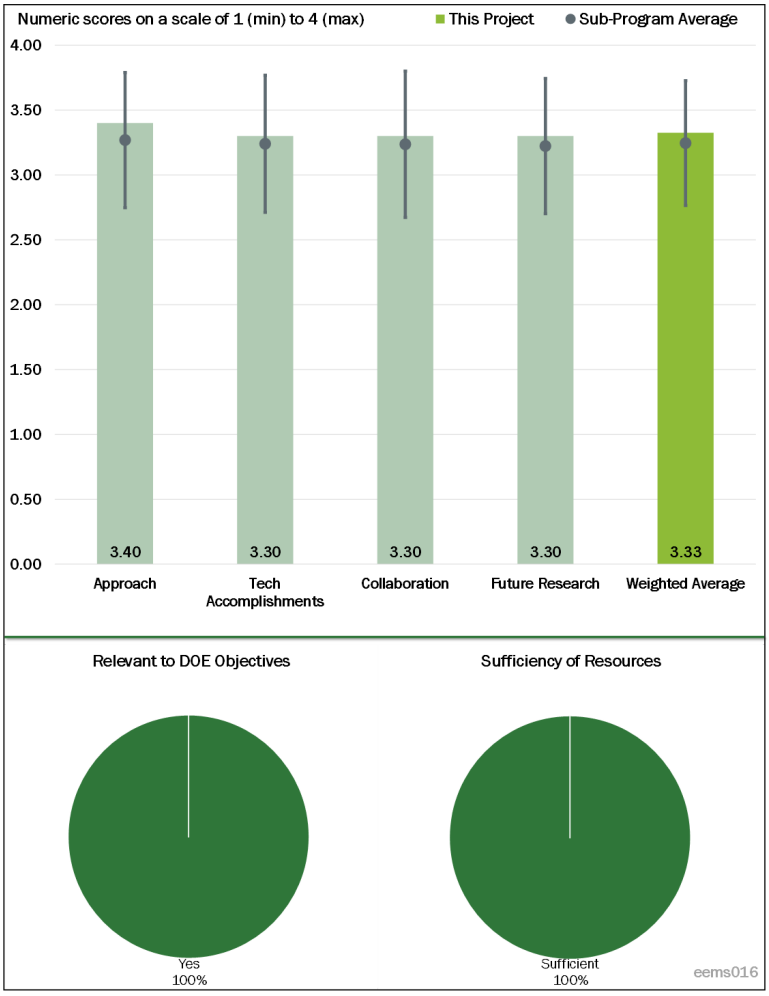

Figure 4-16 - Presentation Number: eems016 Presentation Title: Energy Efficient Connected and Automated Vehicles Principal Investigator: Dominik Karbowski (Argonne National Laboratory)

Reviewer 2:
The reviewer commented that the project makes excellent use of previously developed DOE tools. These are cleverly integrated to achieve the project objectives.

Reviewer 3:
The reviewer said that at this point in the project the approach is appropriate.

Reviewer 4:
The reviewer pointed out that this research addresses several outstanding barriers to future CAV technology, including the role of advanced powertrains in CAV implementation and associated energy impacts. The project objective is to perform control-based simulation focused on powertrain and velocity parameters to assess the energy impacts of advanced powertrains for various CAV strategies. The approach involved CAV modeling framework development, optimal control strategy development, and analysis of a case study on CAV strategy. The project relies on framework development by pairing with an existing ANL powertrain model, Autonomie, for use in evaluating future CAV strategies, and will result in functional CAV libraries that other researchers will be able to utilize in Autonomie. The scope is laid out well, and utilizes existing data and results from other SMART Mobility Consortium members. The reviewer believed project efforts were vehicle-centric, focused on single or small groups of vehicles, but the reviewer suggested project results could eventually support wide-scale CAV simulations through existing models like POLARIS.

Reviewer 5:
The reviewer commented that the project is a dive into a couple of applications for CAVs from a broad swath of potential applications. The reviewer noted these methods are present in the literature, but have not been scaled to include both powertrain control and vehicle dynamics control parameters. The reviewer suggested adopting the ARPA-e differentiation between vehicle dynamic and powertrain controls, wh*i*ch would be more useful in understanding which methods are valuable where.

The reviewer was unsure how the results would be taken to practice and who the target audience was for the work and thought that policy makers would make sense because the methods are far removed from what is practiced in automotive industry.

The reviewer said that there was no mention of methods of prediction and uncertainty in prediction discussed in the presentation.

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

Reviewer 1:
The reviewer noted that accomplishments are helping to answer the questions posed by the CAV pillar and that progress has been excellent thus far. The reviewer was looking forward to further updates.

Reviewer 2:
The reviewer commented that it is very early in the development of this project; however, a detailed plan of work and schedule has been developed and progress to the plan is on target, with the framework development underway.

Reviewer 3:
The reviewer stated that accomplishments were appropriate for this early stage in the project.

Reviewer 4:
The reviewer commented that to date, the researchers claim to be 10% complete with the proposed research plan. However, the PI also verbally stated that the project team expects to have about 25% of the plan completed by the end of FY 2017. The reviewer noted that the research has made meaningful accomplishments including initial development of the simulation framework with early integration of the human driver model, powertrain (Autonomie) model, and CAV model; identification of CAV velocity control parameters; development of optimal control theory for powertrain-velocity combinations including Pontryagin's Minimum Principle (PMP) results; and early results for model-predictive control (MPC) scenarios.

Reviewer 5:
The reviewer was interested in feedback from OEM industry partners on the potential for vehicle integration, if that is the goal/audience.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer acknowledged that the project team did an excellent job of leveraging contributions from universities and other government agencies and laboratories.

Reviewer 2:
The reviewer said that collaboration with other laboratories is excellent within the SMART Mobility Consortium and noted that several partnerships, including universities and the FHWA, have been implemented to obtain data for validation.

Reviewer 3:
The reviewer said that the collaboration and coordination with other laboratory partners are crucial for optimization.

Reviewer 4:
The reviewer commented that researchers have stablished significant collaborative partners with other federal agencies for framework development, national laboratories for testing relevant program data, universities for control theory and human driver and CAV models, and roadway digital map data vendors for roadway conditions for a better understanding of the terrain. The reviewer indicated that as the research proceeds, there should be significant collaborative research opportunities with other organizations concerning human driving and CAV models and translation of results to large-scale CAV simulation using models such as POLARIS.

Reviewer 5:
The reviewer stated that the project team should expand the description of their collaboration and coordination in future AMRs.

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

Reviewer 1:
The reviewer commented that the future work consists of logical next steps and extends modeling capability.

Reviewer 2:
The reviewer noted that the project plan and schedule have been developed and fully support the project objectives. The reviewer stated that the plan for development of the framework, case studies, and predictive control is well thought out.

Reviewer 3:
The reviewer indicated that the proposed future research logically flows from what has already been accomplished on the project. The reviewer noted that activities in FY 2017 and FY 2018 will include a continuing the CAV simulation framework, developing and running specific case studies, and working on optimal control theory including PMP and MPC. Future framework development will focus on human driver models, better integration of Autonomie, and use of real-world driving databases. The optimal control work will start with conventional vehicles and then proceed to hybrids and EVs. The researchers understand the challenges to their controls research that lie ahead and will rely on "optimization-based" heuristic control in case optimal control becomes too complex.

Reviewer 4:
The reviewer stated that an expanded emphasis not only on verification and validation of aerodynamics as proposed, but also of the Autonomie models, would be important to the project. The reviewer was unsure what the levers that the optimization will be turning in Autonomie to be able to achieve optimal fuel economy control, but cautioned it may be outside of the drivability constraints or actuation abilities of real-world powertrains.

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

Reviewer 1:
The reviewer stated that the project provides an excellent tool for CAV developers to optimize vehicle design as it relates to energy use.

Reviewer 2:
The reviewer said that the success of this project can have a significant impact on petroleum displacement and improved mobility.

Reviewer 3:
The reviewer commented that this project supports DOE program objectives by studying the energy and operational relationships of future CAV and advanced powertrains, investigating potential CAV control theories for a variety of operational scenarios and providing a simulation framework for vehicle-specific and wide-scale CAV implementation. The reviewer noted that output of this effort will establish CAV-related libraries and modules for Autonomie that can be used by other researchers in estimating future fuel consumption benefits from CAV technology.

Reviewer 4:
The reviewer indicated that the project is critical to providing analytical results to understand how much efficiency (and hence fuel savings) can be gained from the new transportation modes implied by CAV capability, a key question for the SMART Mobility work.

Reviewer 5:
The reviewer said that the project is fine in regard to this question.

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 research appears to have sufficient resources to complete the proposed activities, both for the current fiscal year as well as future years, based on the planned activities and period of performance.

Reviewer 2:
The reviewer stated that the project plan incorporates the necessary outside resources to accomplish its objectives and noted that there is effective use of existing DOE-developed tools.

Reviewer 3:
The reviewer suggested leveraging all laboratory partners.

Reviewer 4:
The reviewer stated that funding is adequate for FY 2017. The reviewer was unable to judge the FY 2018 funding based upon the presentation.

Presentation Number: eems017
Presentation Title: Impact of CAV Technologies on Travel Demand and Energy
Principal Investigator: Josh Auld (Argonne National Laboratory)

Presenter
Josh Auld, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer said that the approach recognizes that the objective of this effort is to build a framework that becomes a foundation for future evaluation of the effects of CAV use on travel demand and energy use. The reviewer also noted that while some data are available to validate the framework, it is insufficient at this point in CAV development to quantify either the impact on travel demand or energy use. However, the reviewer elaborated, best efforts are planned to utilize available data to bound CAV effects.

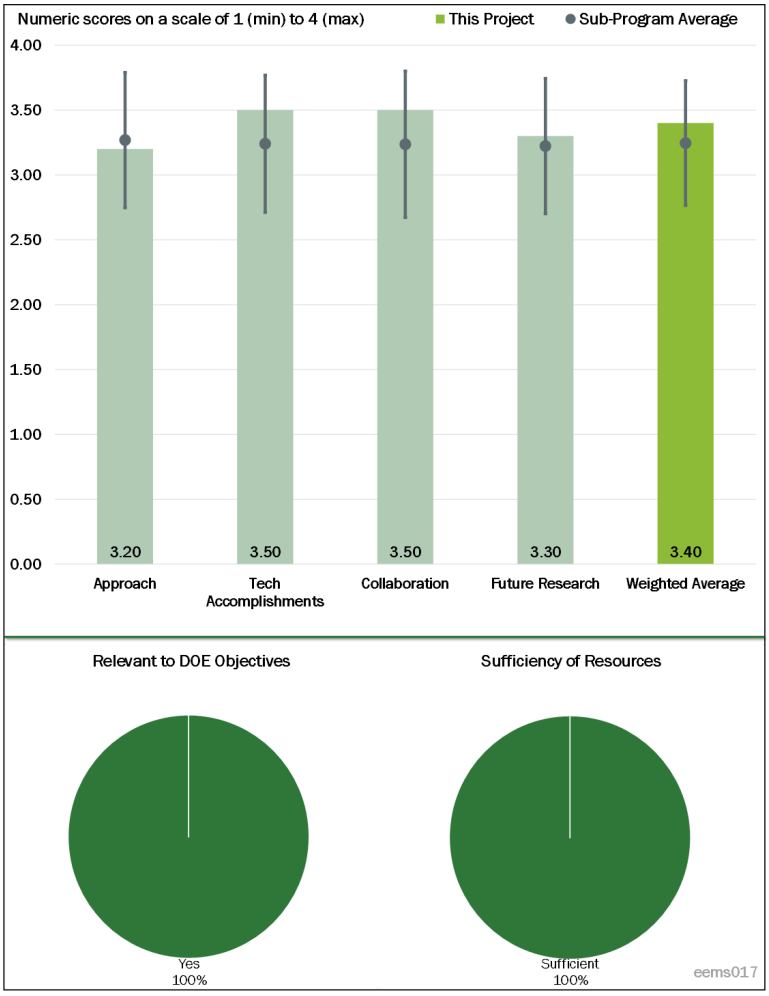

Figure 4-17 - Presentation Number: eems017 Presentation Title: Impact of CAV Technologies on Travel Demand and Energy Principal Investigator: Josh Auld (Argonne National Laboratory)

Reviewer 2:
The reviewer stated that the approach is sound, given all the uncertainties involved in trying to answer the question posed.

Reviewer 3:
The reviewer observed that this project begins the necessary quantification of CAVs energy consumption prediction using survey data. The reviewer said that such data are notoriously inaccurate so the approach of using multiple surveys is sound. The reviewer noted that efforts could be made to either conduct additional surveys for the project itself, but, at least, the literature needs to be continuously monitored for additional survey studies to serve as rationale for updating the inputs to the modeling framework developed by the project. The reviewer pointed out that there is also no model validation mentioned that is to occur after the case studies have been run so efforts should be made to develop validation methodology.

Reviewer 4:
The reviewer remarked that the approach is good in that it considers quantified decision parameters (i.e., VOTT) and CAV penetration characteristics to quantify impact of regional CAV deployment. However, the

reviewer noted, the validity of the case study conclusions are brittle due to the overly simplistic utility function used for the case study (primarily VOTT). For instance, there does not seem to be a fuel or service charge cost penalty for traveling further distances. The reviewer said that the project as a whole could be improved by generalizing the utility function used for decision making; more complete decision functions could be represented and used for analysis. The reviewer added that the project may want to consider making the model capable of having the decision utility function specified via a list of input parameters. This approach would enable the project tools to be flexible to address a wider range of impact studies.

Reviewer 5:

The reviewer observed that generally, the approach appears to be well thought out and logical and is a good start to addressing a very tricky, complex question. However, the reviewer noted that the project should be clear about its limitations and that it is tackling a subset of a larger question.

The reviewer said that, in terms of project design, the project addresses the impact of Level 4 CAVs, but appears to be specifically constrained to Level 4 private passenger vehicles. In other words, there is a wide range of other types of Level 4 CAVs, and these can introduce many different behaviors and impacts on VMT and energy use. For example, Level 4 includes completely driverless (and even unoccupied) vehicles, as long as they are within an appropriate ODD.

POLARIS and Autonomie appear to be strong models and very appropriate for this research. The reviewer said that it is helpful that the project acknowledges that the case study is only a "preliminary assessment" and that outcomes will be richer and more meaningful as information is fed in from other SMART Mobility efforts.

The reviewer remarked that the approach identifies two key impacts: congestion may go down if VMT stays the same, and VMT may increase because drivers can repurpose driving time. The reviewer noted that another key impact not mentioned is that CACC can increase highway capacity, which may induce additional demand (and resulting VMT).

The reviewer noted that another factor not mentioned is that a significant percentage of highway congestion is caused by crashes and hard-braking due to near misses, and full adoption of Level 4 CAVs is likely to dramatically reduce (or virtually eliminate) that major source of congestion. The reviewer offered an interesting question for this research to address: how much energy is saved by avoiding crashes and related slowdowns/inefficient driving and how much additional energy will be used because the effective road capacity is increased by eliminating crashes and therefore more demand is induced. The reviewer stressed that this is not an insignificant question as longer inter-city trips are likely to encounter one or more incident-related slowdowns over a several-hour journey. As a result, travelers will typically adjust their expected times accordingly, and if they get used to shorter travel times without crashes or incidents, they will be more likely to take the trip.

The reviewer noted that the approach outlined on Slide 7 for integrating inputs from other pillars with POLARIS and Autonomie appears reasonable and effective. Of particular value, the reviewer said, is the fact that they clearly identify the current and future inputs so it is clear how this project is integrated with other pillars and how it will evolve as it gains their inputs.

The reviewer brought up that a weakness is that the approach does not clearly illustrate how mode choice is addressed. Similarly, the project does not make it clear how impacts of Level 4 automation on mobility options (including multi-modal trips, shared mobility, etc.) could affect VMT. It seems somewhat narrowly focused on private vehicle ownership and use. However, the reviewer said, given the size and complexity of this question, it is understandable that the scope is somewhat constrained.

The reviewer acknowledged that the scope of this project appears to keep land use and work/residence choices fixed. The reviewer noted that these are major considerations, probably demanding an entire study of their own

so it is understandable if they are not included here. However, it would be helpful for the project to clearly define its scope as not including such factors and to acknowledge those limitations up front.

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

Reviewer 1:
The reviewer commented that the technical achievements and progress to date are excellent in that the case study work was completed. The reviewer said that the case study presentation allowed the reviewer to have a clear picture of the project's approach, assumptions, and initial results. The reviewer noted that the case study results show that the tool is already capable of producing results and also can readily evolve to provide maximum utility to the exploration of energy characteristics of CAV-enabled transportation.

Reviewer 2:
The reviewer said that the progress has been very good and that the early results are interesting and reflect the wide range of possible outcomes.

Reviewer 3:
The reviewer opined that it is too early in the development of this project to measure results. However, the overall plan that has been developed is solid and clearly recognizes the limitations of model results at this point in CAV development.

Reviewer 4:
The reviewer noted that the VOTT and willingness-to-pay (WTP) literature reviews appear sound as is the implementation of the WTP model in CAV adoption and the vehicle selection model. The reviewer said that the proposed future research goals are well developed and the major challenges appear to have been identified. The reviewer indicated that the project appears on track to deliver on DOE's goal of quantifying the impact of CAV energy consumption.

Reviewer 5:
The reviewer indicated that the project team appears to have done a fairly thorough job consulting existing literature on how CAVs will affect VOTT. The reviewer noted that the presenter was very aware of the limitations of current predictions and analysis in this area—in particular, the presenter acknowledged the major uncertainty around VOTT that arises when new vehicle architectures and new forms of activity are introduced for the occupants of CAVs. For example, old VOTT estimates did not take into account the wide range of activities that are possible in a vehicle now due to mobile devices and improved connectivity. In other words, the reviewer explained, if a commuter can be connected remotely to his/her desktop, with access to videoconferencing, he/she may be able to perform a significant majority of work tasks, thereby causing VOTT to drop precipitously.

The reviewer said that the methodology and initial results for consumer adoption appear to be sound based on existing literature. However, the reviewer noted, given the extreme uncertainty around such adoption models, it almost seems like those efforts could be better spent elsewhere. In other words, the reviewer explained, this seems like an area where ROIs diminish very rapidly—one could spend a fortune on trying to perfect these predictions and still be very far off. The reviewer commented that a scenario-based approach might be more appropriate—aiming to identify the energy impacts of CAVs at a wide range of market penetration (e.g., 5%, 10%, 20%, etc.). The reviewer stated that such outputs would still be very useful for policymakers, and would disentangle the discussion from all the potential disagreements about assumptions involved in making a prediction.

The reviewer found the CACC traffic flow simulation results to be interesting, but said that it would be helpful to see how these compare with other results in the literature. In particular, it would be good to know whether the project team consulted with work in this area done by the DOT's ITS-JPO.

The reviewer said that in the "impact on mobility" discussion, it is observed that travelers are likely to take longer trips. However, the reviewer noted, there is no discussion about potentially more trips being taken, as well as entirely new kinds of trips/destinations that could result from Level 4 CAV technology.

The reviewer stated that the outcomes, in terms of potential increases in energy use (while highly qualified and not likely to be "predictive" in any precise sense), are very valuable in that they clearly highlight a potential for substantial increases in energy use. The reviewer stressed that this topic has generally been under-addressed by the transportation community so even though it is far from perfect, by initiating this discussion and highlighting these issues, this project has added a lot of value to the broader conversation. The reviewer noted that it will be very interesting to see what its outputs are as inputs come in from other SMART Mobility pillars.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer observed that the coordination among laboratories to utilize available, DOE-developed tools as part of the SMART Mobility Consortium is outstanding. Additionally, the reviewer noted that two university partners have been incorporated to provide data for the model.

Reviewer 2:
The reviewer stated that the collaboration and coordination were assessed as good because it appeared that only two of the five partners had contributed significantly to the case study results. The reviewer said that the future work indicates that the other partners may have opportunities to make contributions to the efforts.

Reviewer 3:
The reviewer said that the project requires data from a variety of sources and that the proper connections appear to be in place and working.

Reviewer 4:
The reviewer remarked that the collaboration partners listed appear to provide a good background for the inputs used to date. However, the reviewer noted, as more inputs to the model transition over to direct inputs from other SMART pillars, it is unclear what these relationships will continue to provide.

The reviewer commented that one suggestion would be to engage with additional partners, not just for external inputs to the model but also for a deeper discussion of ways to structure the model and possibly examine different versions of the model that could be developed. As noted earlier, this model is somewhat limited in its scope. The reviewer said it might be worthwhile to engage with other experts—perhaps through the DOT's "University Transportation Centers"—to consider alternative approaches for the model and how subsequent versions/variations of the model might address more issues. For example, the issue of mode choice and addressing new mobility options could be a focus of a future version.

Reviewer 5:
The reviewer said that the collaborations with other national laboratories and academia appear sound and that the PI should ensure that the project is broadcast within the SMART Consortium to ensure input from stakeholders that informs the model inputs.

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

Reviewer 1:
The reviewer said that they project is well planned and fully recognizes the limitations of developing models this early in CAV development and deployment.

Reviewer 2:
The reviewer noted that the future task list addresses the current known modeling gaps.

Reviewer 3:
The reviewer commented that the future work can be improved by limiting the scope to regional studies. The reviewer stated that it is important that this project nail the modeling of CAVs concepts at a regional scale before trying to expand the scope. The reviewer said that the case study exposes a need for significant work to develop more complete decision utility functions and that the future activities outlined also indicate the need to develop additional CAVs representations/functionalities for the model.

Reviewer 4:
The reviewer suggested deemphasizing the importance of "vehicle choice models" and market penetration models, given the extreme uncertainty. The reviewer said that this might be a case where scenarios spanning a wide range of outcomes are just as good (or better) than attempts at precise prediction.

The reviewer remarked that the plan to integrate data from surveys, while useful, is clearly somewhat limited. The reviewer noted that the Whole Traveler survey seems to be doing an admirable job considering its limitations but one would hope that there are other data sources being considered as inputs to better address attitudes toward CAVs.

The reviewer noted that there is no mention of addressing changes to work/residential choices in the near- to mid-term and longer term changes in land use; those should at least be on the radar for future research.

Reviewer 5:
The reviewer commented that the project has extensive future research plans that appear to follow a feasible and logical schedule and to meet the DOE goals for the project. The reviewer said that mitigation risk analysis is missing in case alternative pathways to the deliverables could be more extensive.

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

Reviewer 1:
The reviewer acknowledged that the project absolutely supports the overall DOE objectives of petroleum displacement. The reviewer noted that any attempt to understand future transportation energy use and to displace the use of petroleum will have to understand and address the impacts of CAVs on travel demand and energy use. The reviewer said that while this project has significant room for improvement, it is also making significant progress in a very important area, with very clear, direct implications for future energy use.

Reviewer 2:
The reviewer said that the project will provide useful analysis of CAV impact on petroleum displacement and will be used in real-world traffic networks; this aligns well with DOE objectives.

Reviewer 3:
The reviewer commented that given the modeled CAV capabilities, the project tries to determine how they might be used on a large scale, which is necessary for determining the transportation-system level fuel displacement implied by CAV deployment.

Reviewer 4:
The reviewer mentioned that the models developed will provide important tools to support and guide the development and deployment of CAVs.

Reviewer 5:
The reviewer observed that if the project is successful in modeling CAV energy impacts, it will be a useful tool for understanding opportunities for petroleum displacement. The reviewer said that the project may also identify the need for additional strategies necessary to encourage petroleum displacement by CAVs.

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

Reviewer 1:
The reviewer said that the resources are adequate for FY 2017 and that there is no indication of future funding, though the project extends beyond that period.

Reviewer 2:
The reviewer stated that the laboratory and university resources applied appear sufficient to achieve the project objectives.

Reviewer 3:
The reviewer noted that the resources appear to be sufficient to achieve the stated objectives.

Reviewer 4:
The reviewer remarked that assuming that national level analysis is removed from the project scope, the project resources are sufficient to meet the majority of the milestones outlined by the project. The reviewer noted that this portion of the overall energy EEMS analysis process/framework appears most likely to quickly produce tangible analytical results and therefore warrants priority to maintain its funding (in the event of possible reduced funding for EEMS).

Reviewer 5:
The reviewer found the funding level to be sufficient, perhaps a little higher than necessary but by no means excessive.

Presentation Number: eems018
Presentation Title: Extended Urban Modeling for Smart Mobility
Principal Investigator: Budhu Bhaduri (Oak Ridge National Laboratory)

Presenter
Budhu Bhaduri, Oak Ridge National Laboratory

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

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

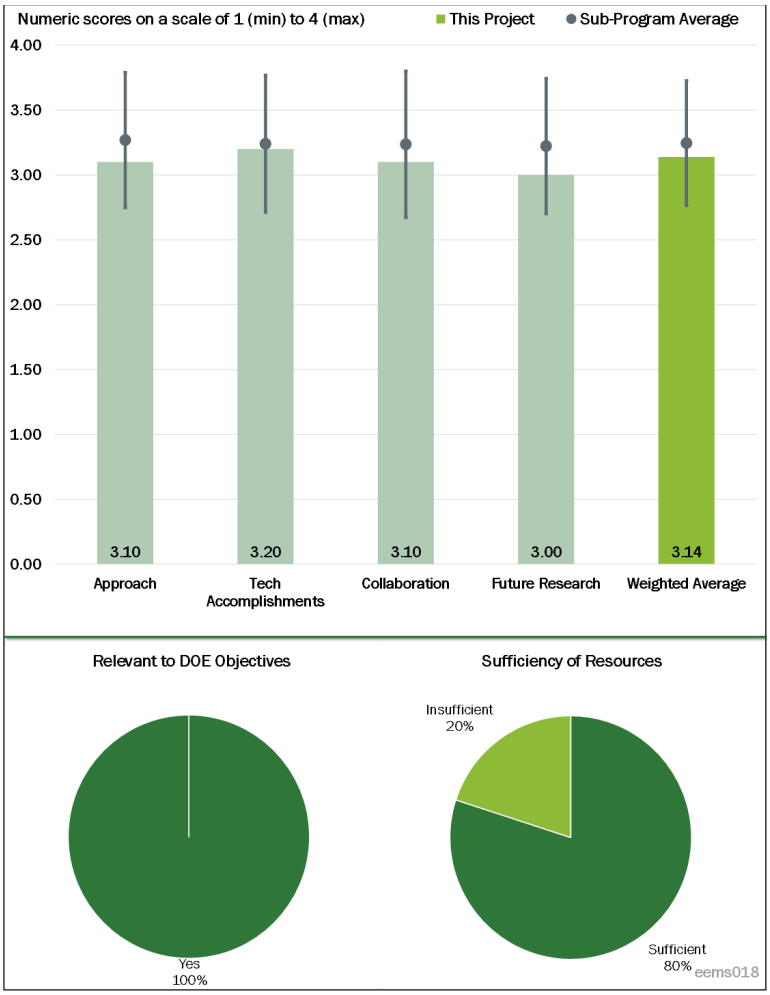

Figure 4-18 – Presentation Number: eems018 Presentation Title: Extended Urban Modeling for Smart Mobility Principal Investigator: Budhu Bhaduri (Oak Ridge National Laboratory)

Reviewer 1:
The reviewer said that the approach is great and that this is a very important project

Reviewer 2:
The reviewer stated that the approach is feasible and that it is an integration effort so it is closely tied to other efforts.

Reviewer 3:
The reviewer noted that the overall approach seems reasonable and that the researchers propose to use existing simulation tools and calibrate them to a target city for demonstration and then apply them to multiple cities and a mix of fleets. However, according to the reviewer, it is unclear how the simulation will be compared to actual data. The reviewer said that it would be very helpful to list the metrics for evaluation of the simulation and judge the quality/validity of the simulation. The reviewer remarked that it could be validated against traffic patterns based on specific scenarios (normal traffic, rush hour, major events, construction, major accidents, etc.) to see if the simulation can model the traffic patterns that emerge in real-world situations.

Reviewer 4:
The reviewer observed that the approach is ambitious; however, there are data sources the researchers should consider, especially from FHWA and the second Strategic Highway Research Program (SHRP2).

The reviewer also noted that ridesharing is not considered.

Reviewer 5:
The reviewer found the overall approach to be very unclear in how it relates to other efforts. The reviewer said that the title of the project sounds very significant, but the funding is fairly small. The reviewer noted that,

based on the title, one would expect this project to produce some kind of centralized, unified model for urban mobility that captures all inputs from the various pillars.

Based on the slides provided and the narrative from the presenter, it is not clear what aspect of the TUMS workflow this project actually focuses on. The reviewer said that it is not very clear what this project adds that is new or different; in some senses it seems that it may be reinventing the wheel.

The reviewer commented that the key objectives are identified as developing a "locally adaptive scalable simulation model…," and "enable efficient transfer of analysis and case studies… to interested cities." However, the reviewer noted, it is not at all clear what the actual final outputs of the project are, or how they would connect to these two objectives.

The reviewer stated that it is good that the approach involves "exploring and understanding the current state of transportation modeling practice by Mid-Ohio Regional Planning Commission (MORPC)." However, the reviewer remarked, it seems as if the goal is to push the TUMS approach onto the MORPC. The reviewer acknowledged not being an expert on the modeling approaches used by MORPC or the limitations thereof, but the reviewer suggested that a better approach might be to fully understand their capabilities, current needs, and likely future needs, then try to figure out how to work within their existing modeling framework. The reviewer said that it is possible that the project is, in fact, taking this approach but, that is unfortunately also not clear.

The reviewer pointed out that the benefits of the traffic simulation output are not well elucidated and that there may very well be some benefits to such a visual tool, but these need to be explored in more detail. The reviewer said that there needs to be much more explanation of how the tool can be used, what controls the user can operate, and what sorts of tests/experiments they can run with it.

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

Reviewer 1:
The reviewer opined that that it is a great start on the project

Reviewer 2:
The reviewer said that the project is new and on track and that initial simulations of some cities are already built.

Reviewer 3:
The reviewer noted that the model appears only to be applicable to urban areas, and rural-to-urban areas are the places of most growth that may be interesting to test with POLARIS.

Reviewer 4:
The reviewer commented that the project is fairly new so there are not many technical outcomes to report. The reviewer said that it appears that they have taken the right first steps though in selecting an urban partner and beginning to collect data.

The reviewer found the TUMS simulation to be interesting and visually appealing. However, the user interface is not at all clear: it is unclear what the purpose of the model is, what the parameters are, and how to operate the simulation. Essentially, it takes a newcomer quite some time to get even a vague sense of what he/she is looking at. The reviewer noted that we can assume that this is a simulation of vehicles moving, but it is not clear what time of day or any of the other parameters involved that would make this meaningful.

The reviewer said that the outcomes of the ORNL workshop are fairly generic and therefore add very little insight. The reviewer mentioned that it is a bit of a truism to say that "data is a major element for transportation models…" The reviewer saw this as obviously true, regardless of whether we are talking about CVs, AVs, or conventional vehicles.

Furthermore, according to the reviewer, if the EPA Motor Vehicle Emission Simulator model is the primary tool for estimating emissions and energy consumption, it is not clear how this relates to (or how the investigators perceive how it relates to) the use of Autonomie and POLARIS and how the SMART Mobility Consortium members should harmonize and/or unify their modeling approaches.

Reviewer 5:

The reviewer stated that the accomplishments to date are understood; however, there is no explanation or justification for the reason why Columbus, Ohio, was identified as the partner city. The reviewer asked what the criteria for selection were, how many cities were vetted, and how these cities and metrics were evaluated. The reviewer noted that also, from a technical perspective, it is not clear what was accomplished to enhance the modeling simulation tools or generate analyses to define baseline metrics. The reviewer asked whether data (insufficient or incomplete data) were available that could be used to provide baseline values for calibration metrics. The reviewer said that it would be very helpful to have a more clear description of the technical accomplishments.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer said that the project has a great team.

Reviewer 2:

The reviewer noted that this is a collaboration effort to combine models and that it is the right mix as both laboratories are involved.

Reviewer 3:

The reviewers commented that researchers have been successful at selecting a target city, developing a relationship with this city, and engaging it in the project. However, the reviewer remarked, it would be helpful to understand if there are specific departments or institutions that are being contacted for data collection or data archives. For example, the reviewer asked if the Columbus DOT or other transportation departments have been contacted.

Reviewer 4:

The reviewer found the collaboration to be very minimal and, in this case, at least some level of collaboration with other modeling/simulation efforts might have been useful.

Reviewer 5:

The reviewer suggested that, based on the team, there should be far more resources of data and computational facilities available.

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 mentioned that the proposed research is logical and that it is more of an integration of models so there are not a lot of true barriers. The reviewer said that the tasks will take time but it would be difficult to mitigate the risk with alternatives.

Reviewer 2:
The reviewer stated that the proposed future research is in line with the overall approach and that most of the work remains to be done.

Reviewer 3:
The reviewer said that the efforts will be at risk of not meeting objectives without reaching out to DOT data sources and expertise and that, furthermore, the SHRP2 study results could provide benefits.

Reviewer 4:
The reviewer pointed out that the fiscal year timeline, milestones, and deliverables provide a yearly highlight. However, the reviewer noted, it would be helpful to have seen a more detailed timeline with milestones that assess major work products. The reviewer suggested the following key milestones: traffic data collection complete, model calibration and validation complete, scenario simulation and metric evaluation complete, etc.

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

Reviewer 1:
The reviewer remarked that this project helps model the effects of traffic patterns and will integrate synthetic populations and energy usage. The reviewer said that it will help inform decision makers and policy makers what effect changes will have to petroleum usage and allow informed decisions.

Reviewer 2:
The reviewer said that it can be understood how this work will support the DOE objectives of petroleum displacement. However, the reviewer noted, it is not clear how this will be demonstrated. The reviewer asked what the control variables are in the simulation that will impact petroleum displacement (fleet mix, transportation planning, etc.). The reviewer requested that the team make a clear connection among the simulation variables and how they will be able to demonstrate key decisions or factors that will impact petroleum displacement.

Reviewer 3:
The reviewer commented that while the project is relevant to DOE goals, it is not as well aligned as it could be. The reviewer said that if the model could be used as a real-time operational tool, that might have significant value for cities. However, the reviewer noted, it is not really clear what kinds of measured outputs the model will provide; at this point, based on the presentation, it appears to be primarily just a visual simulation. The reviewer said that while this is certainly helpful and can be a useful and thought-provoking tool, it is not clear that this should be a high priority.

Reviewer 4:
The reviewer stated that this is an ambitious study that barely meets the petroleum displacement goals because the approach is primarily modeling with no applicable actions. The reviewer said that it does provide insight though for policy makers.

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 the resources to be sufficient.

Reviewer 2:
The reviewer said that the resources could be leveraged with cooperation with other research agencies within the DOT.

Reviewer 3:
The reviewer commented that the researchers identified partners/collaborator but the resources/effort to complete tasks and milestones are not identified. The reviewer said that it is unclear what skillsets are supported by team members for each task and that it would be helpful to have some insights into the resource plan for the project.

Reviewer 4:
The reviewer said that based on the funding, it appears to be a relatively low-level, part-time effort that will not be complete until the end of FY 2019. The reviewer suggested that a better approach might be to provide more funding upfront and connect this project more directly with other modeling and simulation efforts to make sure they are fully harmonized and work toward common goals.

Presentation Number: eems019 Presentation Title: Smart Urban Signal Infrastructure and Control Principal Investigator: H. M. Abdul Aziz (Oak Ridge National Laboratory)

Presenter
H. M. Abdul Aziz, Oak Ridge National Laboratory

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

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

Reviewer 1:
The reviewer said that the approach to this project is very solid with a methodically laid out plan with milestones and deliverables identified and that the approach seems feasible and is integrated with other efforts.

Reviewer 2:
The reviewer remarked that the approach is logical in its understanding of and sensitivity to the question of "take up" rate for the technology and the difficulty in dealing with this transition.

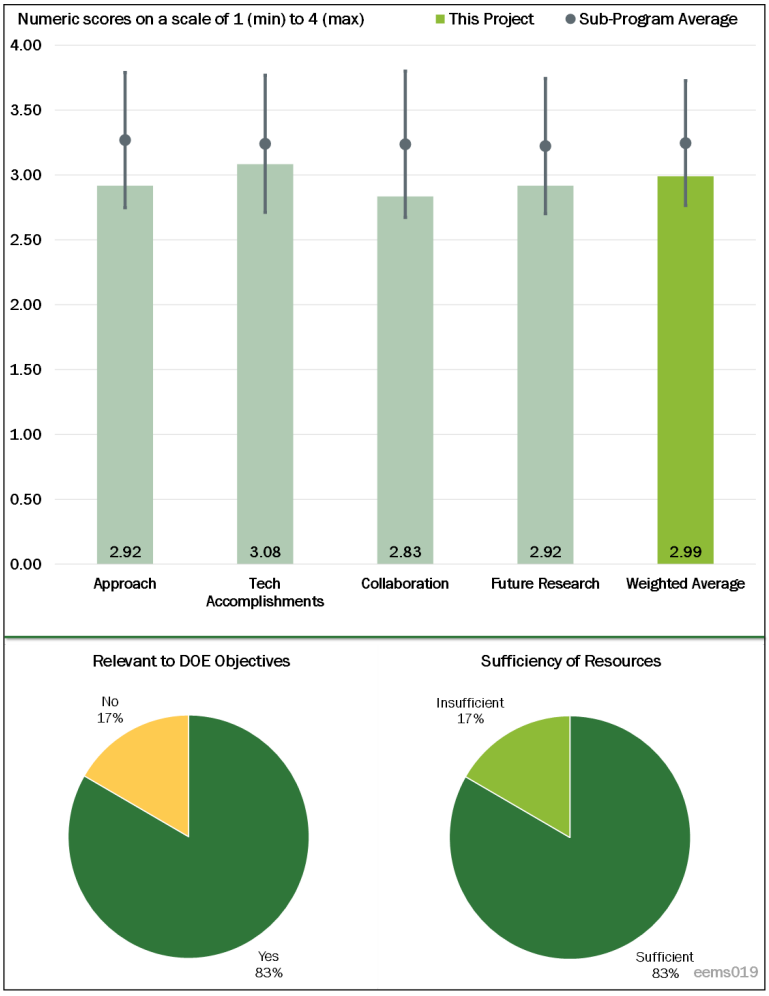

Figure 4-19 - Presentation Number: eems019 Presentation Title: Smart Urban Signal Infrastructure and Control Principal Investigator: H.M. Abdul Aziz (Oak Ridge National Laboratory)

Reviewer 3:
The reviewer pointed out that the project's objective is to investigate the role of traffic signal infrastructure in the connected environment in terms of energy, mobility, and level of service and to develop signal control schemes for optimizing mobility and energy use for CAVs. The reviewer saw that the research team had laid out a reasonable research plan involving a synthesis study to compile existing practice and technology for supporting control scheme development later in the project. The reviewer said that the research team will engage with Smart City Challenge participants to develop relevant scenarios for smart signal systems and to assess future control system needs for CAVs. The research team plans to define simulation tools, while final scenario development is currently less well defined, it will be clarified in collaboration with SMART Mobility Consortium members in later phases of the project.

Reviewer 4:
The reviewer stated that the researcher explained that a modeling approach will be taken to simulate the control algorithms to impact vehicle mobility and energy utilization; the researcher explained that a small-scale analysis (single or local intersection) will be used to evaluate the algorithms and controls, which then could be scaled up to larger systems. However, the reviewer noted, the control variables and analysis metrics were not

well defined. The reviewer said that it would be helpful to have additional details around these technical aspects to provide further clarification on the modeling, simulation, and technical metrics.

Reviewer 5:

The reviewer suggested that the collaborative work to develop initial scenarios and the deliverable "Scenarios relevant to the future SMART signal infrastructure" should be moved to the fourth quarter of FY 2017. The reviewer said that the fourth quarter of FY 2017 milestones are outlining the requirements for SMART signal infrastructure and the scenarios are a part of defining those requirements. The reviewer stated that it also does not make sense to develop tools until after the majority of critical scenario functions that need to be modeled by the tools is defined. The reviewer cautioned that the current approach schedule has significant risks because it lists tool development and scenario development as concurrent development tasks for FY 2018.

Reviewer 6:

The reviewer observed that the project did not address barriers or implementation challenges in the approach and that the approach has the majority of the work biased to the end of the project. The reviewer cautioned that the project is at high risk of not finishing within the time scheduled and that the project is not integrated with other projects at this time. The reviewer noticed that the project has reducing energy usage listed as two goals, with level of service and mobility as other goals. The reviewer said that the approach does not appear to be focused on the energy usage; it is too broad and concentrating on small pieces that do not happen very often (emergency vehicles at signals). The reviewer commented that the modeling activity has the potential to feed into other DOE models, but is not focused on that; the project needs more focus on DOE objectives and needs to start the work quickly in order to finish on time. The reviewer indicated that the project is currently behind schedule due to the approach.

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

Reviewer 1:

The reviewer stated that the project has already delivered a successful synthesis study in its short execution and that the project has identified the barriers, objectives, and key elements.

Reviewer 2:

The reviewer said that it is very early in the project, but noted that progress had been made and multiple milestones have been identified in 2017 while outgoing years only have full year objectives. The reviewer recommended that milestones within the larger task be identified in years two and three also.

Reviewer 3:

The reviewer observed that the researcher explained that the most significant accomplishment was the completion of the synthesis study and that the study provided a baseline analysis of existing signal control infrastructure and variables. However, the reviewer noted, it would be more insightful to have provided a clear connection between the synthesis study and the impact on the model and control algorithm. The reviewer questioned how the findings from the synthesis study impact the intersection model and the control parameters for the control algorithm.

Reviewer 4:

The reviewer remarked that according to the ORNL PI, the second quarter deliverable of "a complete report including evidences and existing case studies from major cities" that was due on March 31, 2017, to the DOE client had not yet been delivered (as of on June 8, 2017). The reviewer learned that the report was still in the internal review process at ORNL and as mentioned in the approach section, the development of the requirements for the signal systems scenarios needs to be moved forward into FY 2017.

Reviewer 5:
The reviewer commented that the researchers claimed to be 15% complete in conducting the research plan as of the end of the second quarter of FY 2017 and that the researchers stated that they are on- rack in completing the remaining FY 2017 milestones and deliverables. The reviewer stated that the results of the synthesis report provide some valuable insights into current smart signal control systems, costs, automated traffic signal performance management systems), high-resolution control data collection, control system potential errors, and fault tolerance.

Reviewer 6:
The reviewer found progress to be slow on the project and 15% of the work to be complete with 30% of the project time gone. The reviewer commented that collaborations from cities and other organizations that may be able to use the data have not happened and that the building of the base simulation code has not started yet. The reviewer said that a study of signal controls has been written and is in the process of being released; points described in this project brief about the study appeared to be focused on EPA and DOT goals more than DOE goals.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that the collaboration is limited in this project, but not necessarily a negative at this stage. The reviewer recommended further collaboration with others who are likely developing this or who have expertise in traffic flow and control.

Reviewer 2:
The reviewer commented that the research seems to have a good level of collaboration and coordination with other national laboratories and with Smart City candidates. However, the reviewer noted, it would be informative to understand what the roles and responsibilities for the laboratory partners are as well as the key metrics to assess the Smart City candidates.

Reviewer 3:
The reviewer saw that collaboration exists but the brief fails to explain the roles and responsibilities of the partners effectively.

Reviewer 4:
The reviewer pointed out that the evidence for providing detailed feedback regarding collaboration and coordination is sparse in the project presentation and that there is some basic information outlining the players and their roles.

Reviewer 5:
The reviewer stated that the researchers have identified PNNL and NREL as collaboration partners in the context of the SMART Mobility Consortium; researchers have also identified the University of Tennessee as a partner for supporting research activities in the fourth quarter of FY 2017. The reviewer said that the research team has also collaborated with several Smart City Challenge participants as input to the Synthesis Study report and will be collaborating with one or more in developing relevant smart signal operational scenarios. The reviewer said that the project has been accepted for a presentation at the Institute for Transportation Engineers/Canadian Institute for Transportation Engineers 2017 conference entitled, “Opportunities and Challenges in Traffic Signal Operations and Infrastructure Deployment in the Era of Connected and Automated Vehicles.”

Reviewer 6:
The reviewer noted that there is a division of tasks with other research laboratories and that the project is still trying to get a city partner (ongoing task). The reviewer pointed out that a major weakness is that project this does not appear to feed into the other similar simulation projects that DOE is working on.

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

Reviewer 1:
The reviewer said that the project has a very detailed plan of future work that includes milestones and deliverables while considering barriers to realization of the proposed technology.

Reviewer 2:
The reviewer stated that this project has a natural conclusion with full CVs and intersections so future work beyond that is unnecessary to identify.

Reviewer 3:
The reviewer commented that a better project plan for the future research would be more useful and that a suggestion would be to identify key work packages and milestones to provide high-level visibility to the project activities and risks.

Reviewer 4:
The reviewer indicated that the planned future work logically flows from the work that will be completed in FY 2017. The reviewer would have preferred some early indications of possible simulation tools that might be used in the fiscal year, rather than a reliance on future collaboration with SMART Mobility Consortium and project partners. The reviewer said that the researchers have identified significant challenges for their future work including developing signal control schemes for mixed traffic environments, development of a simulation platform for large-scale networks of signalized intersections, and integration of energy reduction objectives into an overall signal control optimization framework. However, the reviewer noted, the researchers did not intimate additional pathways or mitigation methods in the future research for addressing these challenges other than reliance on collaborative efforts with partners.

Reviewer 5:
The reviewer observed that the project did not provide decision points and that the future work is not listed in a logical manner. The reviewer suggested that the simulation should be able to be started now with enough fidelity to enter in various use cases. The reviewer mentioned that the simulation tool is not scheduled to be selected until next year with implementation after that, and that there is a high risk of the schedule slipping as the main work is compressed to the end of the project. The reviewer pointed out that the challenges listed were really project tasks, but barriers to completing the tasks were not presented. The reviewer also noted that there was not any risk mitigation presented.

Reviewer 6:
The reviewer remarked that during the poster presentation of this project, the PI indicated that this analysis would likely include representation of many intersections being represented by a Markhov model with each intersection represented by a node in the Markhov matrix; the Markhov model representations would be introduced in the late phase of the project. The reviewer cautioned that the late introduction of Markhov representations to be used in a complex network model introduces unnecessary risk to the project, and it would be desirable that the Markhov representations begin to be introduced/developed in the very near future of the work schedule. The reviewer urged that these representations should first address the state transitions of a single intersection for the baseline (current technology) signal system and that as the SMART Mobility concepts are defined, they should be represented as additions or modifications to the single intersection baseline Markhov state transition model. The reviewer said that after the state transitions have been mastered for the simple cases, they can be generalized for the larger network and finally the network optimization can be addressed.

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

Reviewer 1:
The reviewer said, that, yes, this project is relevant as there are huge gains that can be had by optimizing the signals based on desired parameters to include fuel savings.

Reviewer 2:
The reviewer stated that the project supports overall DOE objectives in reviewing the role of smart signal infrastructure in a CAV environment, assessing the state of current technology, and developing possible signal control schemes for integrating within overall CAV control architectures.

Reviewer 3:
The reviewer said that the successful development of signal infrastructure that enables minimum energy transportation networks supports the DOE's objective of petroleum displacement. The reviewer noted that smart signals have the potential to minimize the number of stops and maximize the flow of traffic resulting in higher fuel efficiency and lower fuel consumption.

Reviewer 4:
The reviewer understood how this project supports the DOE objective of petroleum displacement; however, the reviewer recommended that a clear explanation/illustration of how this will be measured or demonstrated in the project be provided. The reviewer questioned how the intersection simulation showcases how CAVs or the control algorithm will improve energy efficiency and what the hypothesis is for the research.

Reviewer 5:
The reviewer observed that the relevance is uncertain as the presenter is not certain that petroleum will be displaced in heavy traffic areas, but the reviewer believed it is likely in the vast majority of locations, which would offset any areas where traffic volume increased vehicle idling and associated fuel use. The reviewer commented that by the time this technology reaches the potential identified in the project plan, most vehicles will be fueled by something other than petroleum anyway.

Reviewer 6:
The reviewer saw that a small part of this project supports the overall DOE objective of petroleum displacement. The reviewer noted that if delays are reduced for cars, then there could be some petroleum reduction. The reviewer stated that the main focus of this project appears to cross into civil engineering and the DOT (instead of DOE) realm, and that the majority of traffic controls being modeled are for larger social issues (pedestrian crossing, emergency vehicle prioritization, automated vehicle/hybrid vehicle priority). The reviewer mentioned that all of these would have some effect on fuel consumption (more fuel/energy consumption at a macro level for most of the cases).

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 resources for this project seem to be sufficient as there is a detailed plan laid out for the given project and there is proposed future work if additional funding becomes available.

Reviewer 2:
The reviewer found the resources to be sufficient.

Reviewer 3:
The reviewer said that the project appears to be adequately funded, both for the current fiscal year as well as future years based on the planned activities and period of performance.

Reviewer 4:
The reviewer noted that the resources provided are sufficient for the project to make substantial progress on defining requirements and modeling a limited set of SMART Mobility concepts/scenarios and SMART signal infrastructure solutions. The reviewer said that narrowing the scenarios to be addressed early in the timeline will help ensure that the resources are matched to the project scope.

Reviewer 5:
The reviewer saw nothing to indicate that the resources are insufficient at this time but recommended additional collaboration.

Reviewer 6:
The reviewer said that there is no clear resource plan for the project and that it would helpful to have an illustration of key work packages and timing with the associated effort. The reviewer indicated that this will help to identify the skillsets and team members for each task and their responsibilities for completing the project.

Presentation Number: eems020
Presentation Title: Energy Impact of Different Penetrations of Connected and Automated Vehicles
Principal Investigator: Jackeline Rios-Torres (Oak Ridge National Laboratory)

Presenter
Jackeline Rios-Torres, Oak Ridge National Laboratory

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

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

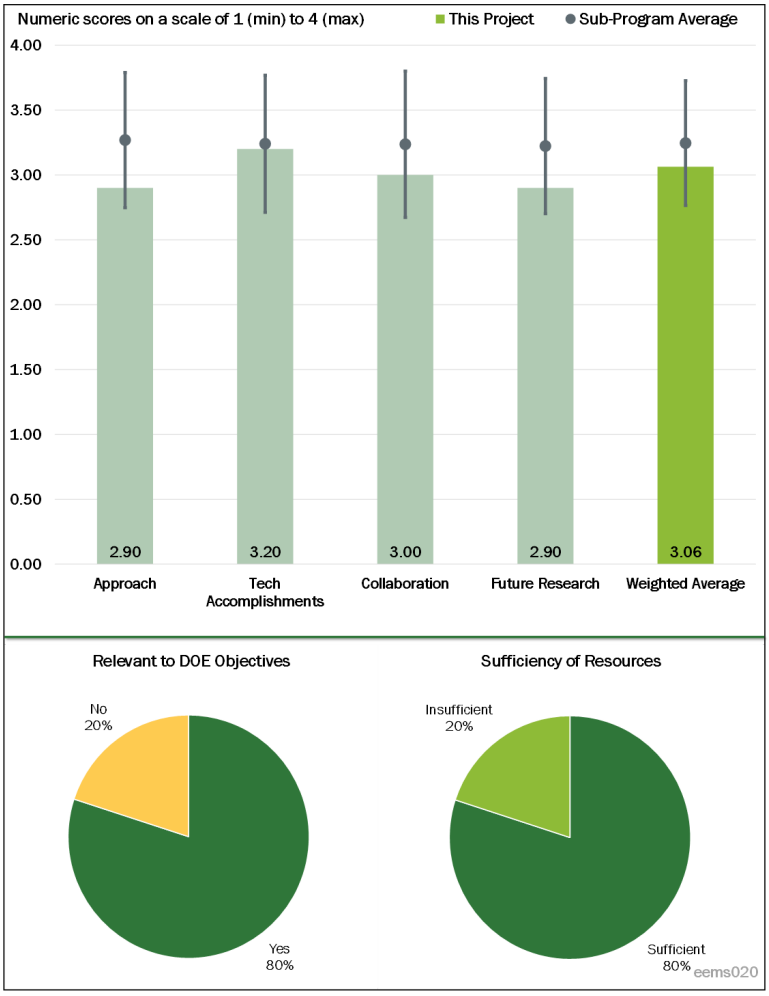

Figure 4-20 - Presentation Number: eems020 Presentation Title: Energy Impact of Different Penetrations of Connected and Automated Vehicles Principal Investigator: Jackeline Rios-Torres (Oak Ridge National Laboratory)

Reviewer 1:
The reviewer commented that the research takes a similar approach to other projects in this AMR cycle on CAV energy and mobility analysis and that the research has taken a reasonable approach by initially starting with a simplified traffic model (highway merge scenario) to address control and simulation complexities before eventually working up to additional scenarios and regional framework. The reviewer said that the proposed investigation of vehicle communication and sensor error impacts on CAV control in mixed traffic environments should provide interesting results.

Reviewer 2:
The reviewer remarked that the current approach is pure model-based and that some actual data input either as final model validation or model tuning may be helpful.

Reviewer 3:
The reviewed said that only analyzing one traffic flow is rather simplistic.

Reviewer 4:
The reviewer said that the barriers that are mentioned are very vague with no real detail although the project does seem well designed with objectives and specific tasks laid out.

Reviewer 5:
The reviewer pointed out that, in giving this project a "Good" rating for the approach, the researchers are being given the "benefit of the doubt" because they have not fully described the goals or the technical barriers or why they have selected the variables they are exploring in preference to other potential variables. The reviewer said

that the researchers state the goals fairly clearly but they talk about assessing impacts (of CAV penetration rates) on energy use, mobility, and safety, and also about developing frameworks for driver feedback systems and for optimal CAV control algorithms; these are a lot of diverse objectives. The reviewer stated that the poster deals mainly with the energy and mobility issues and imposes a safety constraint rather than studying issues that affect safety. The reviewer suspected that really addressing all the goals/objectives is beyond the scope of this effort so the reviewer thought the project could be improved by thinking more carefully about the barriers, goals, and objectives and then defining a smaller set of objectives in a more measurable and quantifiable way.

Similarly, the reviewer noted, the poster identifies a large number of collaboration partners but offers no information about the role of each participant or the interaction among them. The reviewer said that it would help to know what each participant is bringing to the project, how their work fits together, and what information or data they are sharing. The reviewer gave the researchers the "benefit of the doubt" but the researchers need to clarify roles to justify continuation.

The reviewer found the question of whether the project is well designed to be an interesting one that the reviewer cannot fully assess from the poster. The reviewer mentioned that the poster talks about assessing impacts (of CAV penetration rates) on energy use, mobility, and safety, but it does not seem to include some relevant parameters that surely have impacts on all of these factors. The reviewer said that it would seem that reaction time for drivers in heavy-duty vehicles (HDVs) would be a critical parameter to consider, but that the reviewer did not see it mentioned. Similarly, the reviewer noted, there should be some way of simulating other parameters such as driver skill, distracted driving, or the assistance of various types of sensors. The reviewer indicated that not all human drivers are the same and so there should be a distribution of skill or "risk tolerance" (e.g., preferred following distance, speed over the limit, etc.) or reaction times that should characterize the HDVs. It should then be possible to show their impact on energy use, mobility, and safety. The reviewer was sure that some of the largest fleets use models of driver behavior both to train drivers and to assess the impacts of driving skill on energy use and safety: the present research does not show an awareness of this type of work or an attempt to connect with it.

The reviewer realized that the intent of the project is to understand the impact of CAVs and not to perfectly model HDVs, yet it seemed to this reviewer that it is difficult to assess the improvements made possible by CAVs without modeling them in a similar way and then systematically comparing their performance to a scenario of 100% HDVs. The reviewer remarked that if humans instantly absorbed all available data, had infinitely fast reactions, and were never distracted, then they would presumably perform as well or better than CAVs and that it is the potential improvement in driving performance by CAVs that presumably results in positive impacts on energy use, mobility, and safety. Yet, the reviewer did not see anything in the poster that talked about the differences between CAVs and HDVs in these aspects. The reviewer mentioned that it seems that these are the interesting issues when one considers interspersing CAVs with HDVs and not just assuming a single performance level for each of these types of vehicles.

In summary, the reviewer would like to have seen the researchers first define a small set of variables whose impact they want to study and then construct their model to make this possible. The reviewer did not believe this set of variables is well defined at the moment.

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

Reviewer 1:
The reviewer found the progress of the project to be outstanding as six technical accomplishments were explained in great detail to include formulas used, results, and graphed data.

Reviewer 2:
The reviewer saw that both the HDVs model and the CAVs model were implemented and that the energy impacts of CAVs in mixed traffic were assessed.

Reviewer 3:
The reviewer said that the researcher estimated project completion at 15% as of the AMR, which seems reasonable at roughly a mid-point in FY 2017, and that the researcher has demonstrated significant progress toward the first FY 2017 milestone identified in the research plan (i.e., analysis of CAV penetration in a merging scenario). The reviewer stated that key FY 2017 progress to date has included evaluation and implementation of CAV and human-driven vehicle (HDV) models, integration of CAV and HDV models with initial simulation framework for the merging scenario, assessment of energy impacts for varying CAV penetration rates under merging scenario conditions, and early assessment of CAV penetration under the merging scenario in high traffic density conditions. The reviewer noted that planned activities for later in FY 2017 include CAV penetration analysis for regional traffic scenario and initial work on assessing communication and sensor error impacts on CAV control.

Reviewer 4:
The reviewer commented that the researchers seem to have made reasonably good progress in setting up their HDV and CAV models and in assessing the impact of different penetration rates of CAVs on energy use and mobility (travel time). The reviewer noted that while this is a good start, it seems like a fairly simplistic set of results and a clearer plan for studying the impact of some crucial variables is needed. The reviewer thought that this type of model would be very useful for studying the impact of a host of sensors and communications parameters and that the effects of different penetration rates for things like adaptive cruise control, lane departure warning systems, or automatic collision avoidance systems should all be within the model's capability and should all be very interesting. The reviewer asked what penetration rate of CAVs is needed to have a desired impact on safety (number of collisions) or on energy use. The reviewer inquired if these same impacts could be reached by other means, and questioned if the impact of CAVs is greater in mixed traffic, urban traffic, or open road traffic. The reviewer said that there are many questions that could be explored and many parameters whose effects could be studied, and the reviewer thought that the researchers need to do a better job of defining what questions they want to answer and what parameters they want to evaluate. The reviewer said that this will help focus the future work better.

Reviewer 5:
The reviewer noted that one merged piece of traffic is rather simplistic. The summary, going to the graphs on Slide 11, says "show significant fuel consumption benefits" whereas the reviewer's initial look at the data for the one-lane flow shows a decrease in fuel consumption at 25% CAVs, but marginal as percentages of CAVs increase. The reviewer asked why increase the percentages of CAVs on the road. Also, the reviewer noted, the total travel time, as shown by total travel time (seconds) versus percentage CAVs graph, shows only a slight decrease in travel time whereas the summary describes it as "significant reductions in travel time." Again, the reviewer begged to differ on summary of the analysis on one merger lane. This is the reviewer's whole concern with this write up.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer stated that the project seems to have good collaboration, but the details on the collaboration are not provided.

Reviewer 2:
The reviewer said that this project is supported by the SMART Mobility Consortium, which leverages expertise of different national laboratories.

Reviewer 3:
The reviewer gave the project a "Good" rating in this area simply because of the interaction with the SMART Mobility Consortium and with a few universities, but commented that it would help if the nature of the interactions and the roles for each participant were defined. The reviewer thought that it would also be useful for the researchers to interact with some private companies who have an interest in the results of this work. Whether the companies involved with automated vehicles (Google, Uber, Big 3, etc.) would participate is an open question, but it would be good to know that they were contacted. The reviewer said that there are fleet owners who would also be interested and should be contacted (e.g., UPS, FedEx, Frito-Lay, etc.) and that there may be others, such as the U.S. Postal Service (USPS), taxis, or over-the-road carriers. The reviewer stated that if the model shows that substantial energy use savings accrue from long road trains of CAVs behind a Class 8 HDV leader, then it would help to know what the issues are for the leader, his company, and for the following vehicles. Similarly, it would be interesting to know if an Uber fleet or taxi fleet were 100% CAVs versus 100% HDVs, then what would be the impacts on energy use and safety. The reviewer said that these may not be the goals of the current project, but that interactions with some private companies would add some immediate and long-term relevance to the work.

Reviewer 4:
The reviewer remarked that the researcher indicated that collaboration on the project thus far has been limited to the SMART Mobility Consortium member meetings; however, the researcher does plan on increasing collaboration once the research is further underway. The reviewer noted that this includes working with several universities although this planned collaboration is not well described in the presentation. The reviewer observed that there appears to be plenty of collaborative opportunities as this project progresses in the areas of CAV and HDV models, simulation framework development, and vehicle-to-vehicle and vehicle-to-infrastructure communication impacts on optimal CAV control in mixed traffic environments.

Reviewer 5:
The reviewer said that, basically, this is coordinating within DOE, and the reviewer would like to have seen coordination with DOT to see whether one-lane merger is realistic or what the right combination of complexity should be for modeling.

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

Reviewer 1:
The reviewer stated that the project provides specific details on the future work that is being proposed for all the out-years along with milestones and decision points.

Reviewer 2:
The reviewer said that the proposed future research seems reasonable but lacks details.

Reviewer 3:
The reviewer noted that the proposed research plans progressively build off accomplishments to date and increased collaboration will benefit from parallel research being conducted; for the remainder of FY 2017, the researcher will look to expand previous analysis of CAV traffic merging scenarios and investigate CAV penetration in regional/highway corridor scenarios. The reviewer said that the planned future work for FY 2018 on vehicle communication and sensor errors/delays and their impacts on CAV control and operation will be very relevant, especially for future mixed traffic (CAV and conventional vehicles). The reviewer added that additional or preliminary details on this aspect of the research, at least as known today, would have been useful in the presentation in terms of approach and that the work will culminate in FY 2019 with development of

driver feedback systems for optimal interaction with mixed traffic environments, also a very relevant barrier to near-term CAV implementation.

Reviewer 4:

The reviewer thought the plans for future research are satisfactory but could be improved. Part of that improvement could be effected by simply making the plans more quantifiable and measurable. The reviewer said that the descriptions of the future work use words like "large scale" analysis and "optimal" interaction and that the plans would be improved if such terms were more clearly and realistically defined. The reviewer asked what is meant by "large scale" and asked who is defining the term "large." The reviewer wanted to know what is meant by "optimal," and questioned what is being optimized. The reviewer thought the project would be much improved if the researchers stated that the team was going to evaluate the impact of sensors A, B, and C on outputs X, Y, and Z, or if the team said they were going to explore variables one, two, and three in the human driver model and compare them against "best available" performance for the same variable in the CAV model. The reviewer said that clearer goals and a clearer set of parameters to be studied are needed to devise a research path that has decision points and that recognizes risks; the plans, as currently stated, do not allow for a critique of the research path or for any discussion of risk or risk mitigation.

Reviewer 5:

The reviewer referenced prior comments on trying to figure out what is realistic for merges and number of merges on a typical drive into work. The reviewer's quick analysis was that the reviewer would save 6 minutes driving to work, which does not make the reviewer want to have a CAV. The reviewer would be better off leaving earlier in the morning, which would decrease commuting time.

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

Reviewer 1:

The reviewer said that, yes, the goal of the project is to study the energy impacts of optimal control algorithms in CAVs and their operation in a mixed traffic environment.

Reviewer 2:

The reviewer answered that, yes, the project supports the overall DOE objectives of petroleum displacement and that it provides fuel consumption benefits along with associated travel times.

Reviewer 3:

The reviewer responded that this research is relevant to DOE objectives as related to SMART Mobility and EEMS and that the project is investigating CAV control in mixed traffic environment and the resulting impacts on energy and safety.

Reviewer 4:

The reviewer stated that this project can have an impact on petroleum displacement by assessing the impacts of CAVs on energy use. However, the reviewer said that this work also gets into other areas such as safety and productivity/mobility so it would be appropriate if some of the funding came from other sources (such as the DOT or the Transportation Research Board [TRB]). The reviewer commented that if the project is going to continue for another 2 years and all of the funding is to come from DOE, then perhaps the focus should be narrowed to just impacts on energy use, but this would seem to neglect some potentially useful insights on safety.

If the focus is mainly on energy use and petroleum displacement, then the reviewer thought it would be best to look at a variety of traffic situations in the simulator to see where CAVs can have the most impact. For example, questions to ask include do CAVs help more in congested urban driving or in mixed urban/highway driving; do they allow higher speed limits or greater traffic flow, and if so, what is the impact on energy; and do they reduce congestion/backups. Again, if so, the reviewer would like to know what the impact on energy is

and what types of vehicles would have the greatest impact on energy/petroleum displacement if they were switched to CAVs. As examples, the reviewer pointed out taxis, delivery trucks, HDVs, or others. The reviewer said that these are the types of questions that could be addressed with clearer goals and a stronger focus on energy use and petroleum displacement.

Reviewer 5:
The reviewer thought that this is a good start to helping to model what would be DOE objectives for moving to CAVs, but that using the word "significantly reduces" in the summary undercuts what would be a good start. The reviewer said that this project needs to be "re-thought" with some real-world facts and figures for traffic.

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

Reviewer 1:
The reviewer said that the current budget and resources are sufficient for this type of model-based research.

Reviewer 2:
The reviewer said that the project seems to have sufficient resources for FY 2017 but fails to state the funding for the out-years beyond FY 2017.

Reviewer 3:
The reviewer stated that only FY 2017 funding allocation was reported by the researcher but the reported level appears to be sufficient for the proposed activities.

Reviewer 4:
The reviewer commented that this question is a bit difficult to answer without more knowledge of how the funds are distributed. The reviewer said that if the stated amount of funding is spent only on one or two people doing research at ANL, then the level of resources is adequate or about right; if this funding has to be shared with any of the other research partners or collaborators, then the funding is too little. However, the reviewer noted, it is not clear whether the $364,000 budget is being spent entirely in one year at ANL, or if that funding has to carry the project through to completion in 2019. The reviewer did not think the level of funding is excessive, but that is based on the assumption that the $364,000 is only for ANL staff and that it may need to cover multiple years.

The reviewer thought that the funding should be adequate to continue to make progress toward the goals, but that the goals should be made clearer by DOE and ANL and then the resource needs may need to be reassessed. The reviewer said that the interactions with private industry might bring some additional funding, or at least in-kind data or insight contributions, and that both of those would help in meeting the milestones.

Reviewer 5:
The reviewer said that this is under-thought as a project and asked if that is because of resources put on this project.

Presentation Number: eems022
Presentation Title: A Model to Assess Impacts on Fleet-Wide Energy Use from Multi-Modal Opportunities—Freight Fleet-Level Energy Estimation Tool (FFLEET)
Principal Investigator: Tim LaClair (Oak Ridge National Laboratory)

Presenter
Tim LaClair, Oak Ridge National Laboratory

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

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

Reviewer 1:
The reviewer noted that the approach of the project seems have an outstanding lock on the critical barriers that exist and that project is well designed, very feasible, and integrated with other efforts.

Reviewer 2:
The reviewer said that the approach is a logical and simple web tool that takes simple input and provides simple savings calculations that will meet the need and the project's objective.

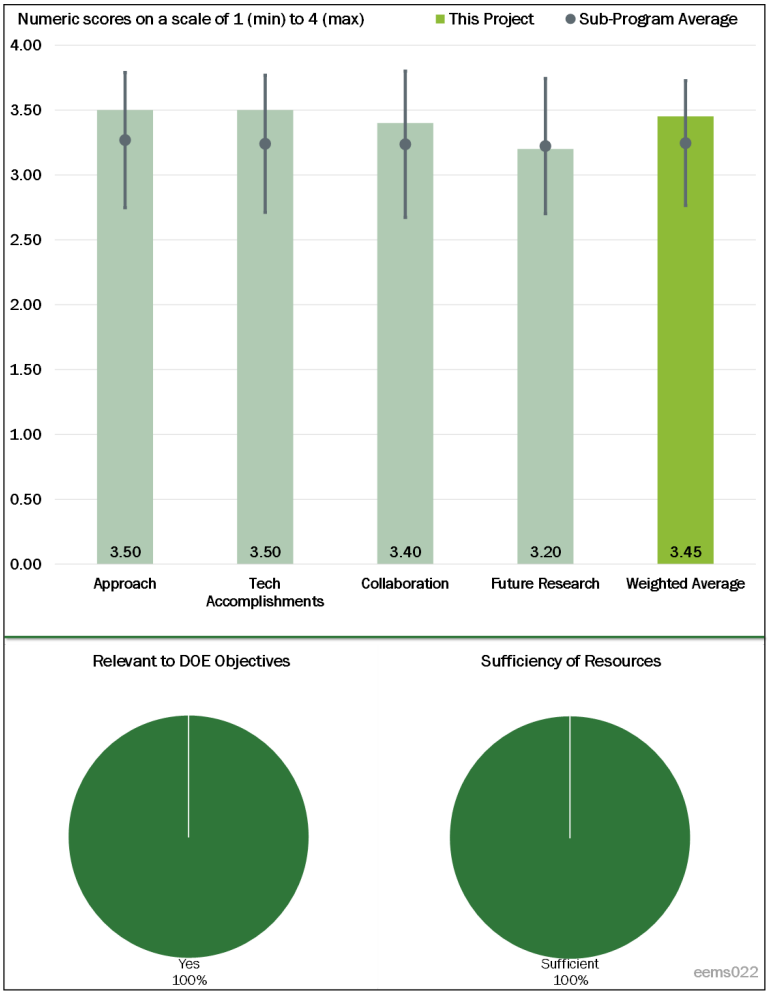

Figure 4-21 - Presentation Number: eems022 Presentation Title: A Model to Assess Impacts on Fleet-Wide Energy Use from Multi-Modal Opportunities – Freight Fleet-Level Energy Estimation Tool Principal Investigator: Tim LaClair (Oak Ridge National Laboratory)

Reviewer 3:
The reviewer said that the current project leverages the existing technologies to develop a web-based evaluation tool to allow trucking fleets to estimate the energy savings due to SMART Mobility systems, alternative fuel technologies, and freight modal shifts. The project also loops in UPS to perform an assessment at its newly renovated Midwest distribution center in Columbus, Ohio.

Reviewer 4:
The reviewer commented that the approach is a good one with data collection and modeling and then refining, but that the model does not appear to capture some relevant data, such as population/housing/business density, type of district (business, light industrial, industrial, residential apartments, housing, etc.), and demographics (i.e., elderly population may embrace the use of shared automated vehicles more readily as an alternative to walking to a public transit location). The reviewer pointed out that without these data there will most likely be substantial variation among the various cities being used for data, and it will be more difficult to predict routes. The reviewer said that the project is well integrated with other efforts, both by being populated by data from other projects and by being able to support predictions for other projects.

Reviewer 5:
The reviewer stated that the approach is not well documented, but the reviewer applauded the idea of making the complicated analysis available for fleet users. However, how that will happen is not clear.

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

Reviewer 1:
The reviewer thought that the project has made excellent progress in a short period of time.

Reviewer 2:
The reviewer said that the project has made great progress to date with only starting in October 2016. The project has locked in collaboration partners and has acquired a large fleet operator to provide data and evaluate the tools being developed under this effort.

Reviewer 3:
The reviewer mentioned that the project is progressing on schedule with the initial model almost complete.

Reviewer 4:
The reviewer indicated that the project is making progress at the right pace.

Reviewer 5:
The reviewer said that the documented progress is a literature review and energy consumption models.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that the project seems to have appropriate collaboration partners and has a large fleet operator to provide data and evaluate the tool's performance.

Reviewer 2:
The reviewer commented that there are sufficient and appropriate collaborators

Reviewer 3:
The reviewer said that the project gets contribution from national laboratories and UPS.

Reviewer 4:
The reviewer observed that the project has a good team with municipality, research laboratories, and a fleet owner/operator involved, but that having an additional fleet owner/operator as a partner would be a little better \as fleets may operate a little differently.

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

Reviewer 1:
The reviewer stated that there was good clarification of progressive use of technologies and the impact on fuel consumption with their use.

Reviewer 2:
The reviewer said that the impact of CAV technologies will be analyzed using results from both literature and updated results from the CAVs pillar. Data on vehicle operations and modal selections in Columbus will be obtained from UPS for evaluation. The reviewer remarked that this sounds like a good plan.

Reviewer 3:
The reviewer expressed worry about data sources for this effort and that maybe the researchers just need to present more example datasets that are going to inform the work. The reviewer said that it sounded like the literature search was not so fruitful and asked for more detail.

Reviewer 4:
The reviewer observed that the project shows good detail for FY 2017 and for future work in FY 2018, but does not state any plans for FY 2019.

Reviewer 5:
The reviewer noticed that the proposed research is to deploy and further refine the tool and that as more information and technologies are built into the tool, it will become ever more important to DOE. The reviewer pointed out that the barriers listed are administrative, which can be overcome with time, and that the project could try to find an additional end-use fleet operator so there is not just one fleet being modeled and to mitigate the risk of non-disclosure agreements being signed.

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

Reviewer 1:
The reviewer said that, yes, this project has great potential to make a big impact on fleet companies as they can invest minimal time to research whether the potential business case for different technologies available is cost effective to implement in their fleet. The reviewer pointed out that because most technologies are optimized for certain duty cycles, a theoretical best fit can be potentially determined prior to any purchase of hardware.

Reviewer 2:
The reviewer acknowledged that, yes, the tool that will be developed will help truck manufacturers and fleets to understand the benefits from fleet-level implementation of SMART Mobility technology options and modal choices by shippers.

Reviewer 3:
The reviewer commented that clearly the benefit from this dissemination of information on these technologies supports DOE efforts to reduce petroleum consumption.

Reviewer 4:
The reviewers noted that, yes, this project supports the overall DOE objective of petroleum displacement.

Reviewer 5:
The reviewer said that this project is a tool for fleet owners, DOE, and municipalities to see what the impact is on fleet fuel efficiency when new vehicle technologies are introduced. The reviewer said that convincing fleet owners of a payback when they ultimately purchase and implement the tool will help DOE meet the objective of reduced petroleum usage.

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

Reviewer 1:
The reviewer said that there is no indication that resources are excessive or insufficient.

Reviewer 2:
The reviewer found funding to be sufficient to effectively achieve the stated milestones in a timely fashion.

Reviewer 3:
The reviewer noted that the resources appear to be sufficient.

Reviewer 4:
The reviewer commented that the resources provided to the current project are sufficient.

Presentation Number: eems023
Presentation Title: WholeTraveler Survey on Life Trajectories and Mobility Decisions
Principal Investigator: Anand Gopal (Lawrence Berkeley National Laboratory)

Presenter
Anna Spurlock, Lawrence Berkeley National Laboratory

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

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

Reviewer 1:
The reviewer commented that developing an understanding of individual consumer travel preferences is a challenging task and that the project team has developed what appears to be a novel approach that uses simple tools to collect time history data on travel preferences and uses existing resources (cell phone GPS data) to interlink consumer preferences and actions. The reviewer said that the approach is good and uses resources efficiently to achieve the stated goals; the focus on local travelers in the Bay Area is appropriate given the locations of the project partners.

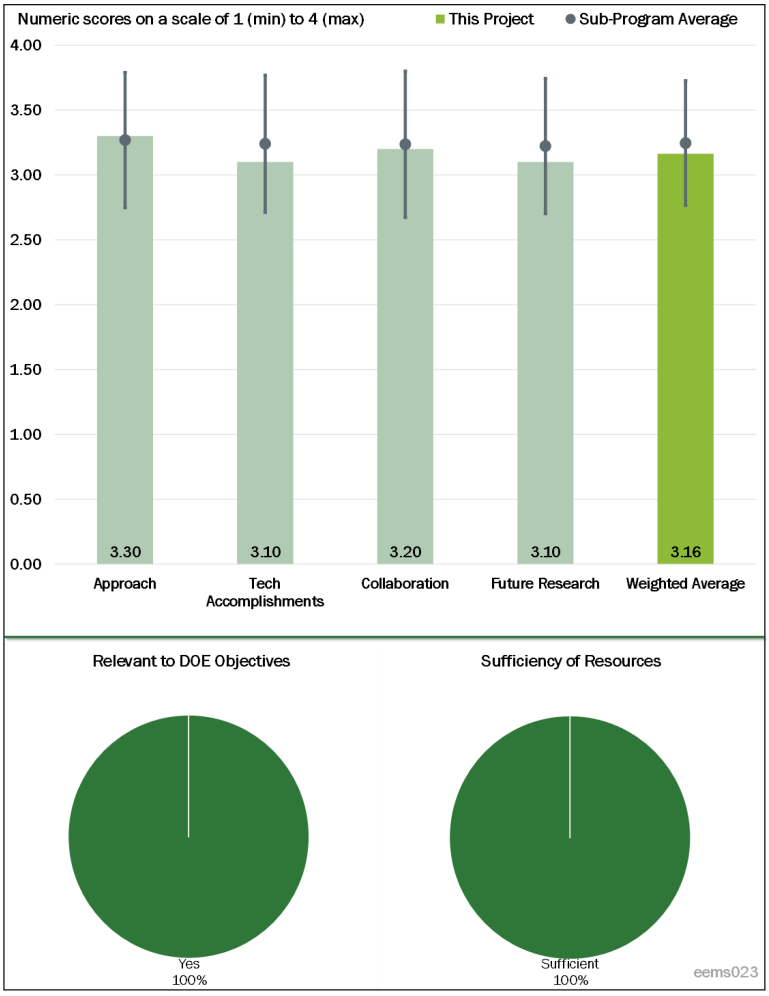

Figure 4-22 - Presentation Number: eems023 Presentation Title: WholeTraveler Survey on Life Trajectories and Mobility Decisions Principal Investigator: Anand Gopal (Lawrence Berkeley National Laboratory)

Reviewer 2:
The reviewer observed that the project targets surveying of individuals in the San Francisco Bay area to determine their life history, transportation trends, and preferences and tendencies regarding new mobility options. The effort will develop and integrate innovative survey methods, GPS data collection mechanisms, and cutting edge analytics to collect information on long-run life-cycle trajectory patterns, psychological and personality characteristics, and risk and time preferences.

The reviewer stated that the goal is to better understand people's tendencies and then use this information to inform the other SMART Mobility pillars (specifically CAVs, Multi-Modal, and Urban Science), including agent models, and produce a series of white papers. The reviewer noted that other studies have looked at portions of these areas, but none has examined the broad picture and unified things together. This project will develop a comprehensive understanding of travel choice patterns, preferences, and decision-making processes across different time scales (future-oriented, long-, medium-, and short-run) to better understand how these patterns interrelate with other personality characteristics and circumstantial constraints.

The reviewer mentioned remaining challenges and barriers including: Institutional Review Board Human Subjects Review; successful collection of sample data; and uncertainty in the timing for review and approval steps, which may present a challenge leading to project delays. The reviewer said that substantial details on the technical barriers are not provided, nor are specific methods to address or mitigate them. For example, it is mentioned that a significant response is not expected for the Phase 2 GPS location data. The reviewer asked how this challenge can be overcome.

The reviewer said that a few other questions also arise, including whether a survey of the San Francisco area accurately represents drivers and their expected behavior and preferences across the country and whether another locale would be more representative of a typical, representative city. Additionally, it is mentioned that only online survey instruments will be used. The reviewer asked if this will accurately encompass the population, especially older respondents.

The reviewer remarked that the presentation provides an adequate project plan and schedule through FY 2018 and that it mentions a number of previous studies being tapped to provide the basis and theoretical underpinnings in the areas of life history calendars, psychological /personality characteristics, and time and risk preferences.

Reviewer 3:

The reviewer pointed out that the development of innovative survey methods, GPS data collection mechanisms, and advanced analytics, while fitting work for the Mobility Decision Science pillar of EEMS, is a significant departure from traditional VTO-funded activities, which focus more directly on development of petroleum use reduction technologies. The reviewer said that the information being collected and derived is focused on impact of long-run, life-cycle trajectory patterns.

Reviewer 4:

The reviewer noted that given the overall approach—to use surveys to "reduce uncertainty associated with behavioral and human factors in transportation as a system modeling and analysis"—the methodology appears to be about as good as one could hope. The reviewer also found it to be very thorough, comprehensive, and well thought out.

On the other hand, the reviewer brought up that such stated-preference surveys face a very steep challenge when trying to understand the impact of completely new technologies. The reviewer said that the obvious analogy comes from the famous quote attributed to Henry Ford: "If I had asked people what they wanted, they would have said faster horses." The reviewer said that users themselves may have no idea how they will use the product until they actually start using it (or some very high-quality prototype or simulation).

However, the reviewer mentioned, the extreme limitations of stated preference surveys could be addressed to a degree by focusing more on questions that do not require as much imagination—i.e., focusing more on what is known about current behaviors and decision making and less on potential actions under different scenarios. To its credit, the reviewer said, this project appears to adopt some of the latter approach. For the short-, medium-, and long-run questions, the focus appears to be on behaviors that survey respondents should be familiar with and be able to answer without too much extrapolation or imagination (e.g., what makes one use a certain mode over another, or the reasoning for having purchased one's current car, etc.). The reviewer noted that a good approach might be for the project to focus on developing and elaborating on a framework of decision- making based on those facts (or at least more-solid beliefs), then apply the much-less certain questions to this framework to predict people's preferences more accurately than they would predict them themselves. The reviewer said that the presenter did not make this very clear but that does appear, on more careful review, to be part of the project's intent.

The reviewer indicated that, in terms of integration with other efforts, it would be very helpful to combine this broad-and-shallow survey approach with a "narrow-but-deep" approach. The reviewer remarked that the

presenter explained that the program did not have the resources for a longitudinal study—it was not clear whether she meant "resources" in terms of time or funding. The reviewer said that this appears to be a fairly large, well-funded project so it would seem that more value might have come from integrating these efforts with something more longitudinal or observational in nature.

The reviewer found the bibliography provided for survey methodology and theoretical underpinnings to be helpful in establishing what the team has consulted, considered, and how well they have thought through the whole approach.

Reviewer 5:

The reviewer said that the precept to this project is good, but the reviewer questioned the role of this project team doing what appears to be consumer analysis of new technologies whereas there are excellent firms out there in the United States that do similar work.

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

Reviewer 1:

The reviewer commented that the team has achieved quite a bit in the first year of activity—the life history survey is a very interesting method for collecting basic household mobility information. The reviewer said that the questions regarding mobility as a service and online shopping will likely get at the critical question of whether these new paradigms represent the replacement of or addition to traditional mobility. The reviewer noted that the use of existing smartphone GPS data could be useful in the future as it does not require any on-vehicle hardware and records the movement of the travelers themselves (which will be more important in a mobility-as-a-service world where people are buying mobility, not vehicles).

Reviewer 2:

The reviewer indicated that the project completed a study plan, designed an innovative survey, and submitted human subjects' protocol for review.

Reviewer 3:

The reviewer pointed out that in the 6-9 months since inception, the project appears on schedule and has achieved several technical accomplishments, including completion of the study plan, design of a two-phase survey with innovative features, and submission to LBNL's Human Subjects Protocol for review.

The reviewer mentioned that an innovative life history calendar (recently pioneered in Europe and Japan for transportation behavior) has been developed, which enables recall of retrospective information in a single shot survey. Basically, this looks at key factors as a function of longitudinal time scales. The reviewer said that an approach to address the issue of stated versus revealed (or actual) preferences has also been developed. This includes establishing an innovative GPS system to conveniently link and assess respondent's actual vehicle use. The reviewer stated that this GPS system allows participants to quickly and efficiently (in a secure fashion) upload their GPS data to LBNL servers, thereby reducing error and improving data collection. Subsequently, the reviewer noted, this daily transportation behavior will be compared to survey responses to develop better predictive models.

Reviewer 4:

The reviewer commented that this was interesting to see up to Slide 7, and then the reviewer began to wonder if enough people were surveyed. This reviewer also inquired about how the project team might turn the graph on Slide 7 into something and how the team might forecast what people will do in the future.

Reviewer 5:

The reviewer said that the use of the "life history calendar" appears to be a valuable and innovative way to obtain longitudinal data without the time and expense of a true longitudinal study and that the innovative questions provided seem to move in a good direction: putting people in scenarios where they can easily imagine their behavior.

However, the reviewer remarked, a significant weakness here is in how the questions are worded. The reviewer said that if the aim is to get someone's honest ("gut") reaction, the respondent needs to be kept in a low-key conversational frame of mind and where the respondent can react quickly, non-verbally, the way most people make snap decisions when planning a discretionary trip. The reviewer posited that when details like cents-per-mile are included, along with other factors that increase the cognitive load, the respondents' awareness is likely to be shifted away from their normal decision-making frame of mind. For example, rather than ask a very long, multi-part question such as: "Imagine that you recently learned that it will cost $0.20 a mile to take a ridesharing service, such as Uber or Lyft. So if your destination is 10 miles away, this would mean.…" The reviewer suggested that maybe it should be broken down into very simple, easily digestible pieces. For example: "If you could pay $2 to be driven door-to-door to your doctor's appointment 10 miles away, would you do it, or would you drive your own car?" Also, the reviewer noted using terms like "ridesharing" and using names like "Uber" and "Lyft" are very likely to prejudice people's answers, especially those who may be biased by negative news about these companies. Ultimately, the reviewer proposed, to get the most honest answer, the respondent should be encouraged to adopt the kind of frame of mind that they will be in when they make those decisions. In other words, they should not imagine themselves counting pennies, or calculating the impact of different cents-per-mile figures, or considering what their long-term habits would/should be. And, the reviewed noted, generally, the language needs to be precise, but the more conversational it can be, the more likely people will answer in an unguarded, honest way.

As another example, a question could better be framed as: "How many times last week did you drive to a store or restaurant?" and "How many times last week did you walk or bike to a store or restaurant?" instead of "Please fill in how many times during the past two weeks that you or someone in your household took a vehicle (car, truck van, etc.) to a …" The reviewer said that the more tangled, convoluted wording of the latter example (the one used by the project) is likely to fatigue the respondent.

The reviewer brought up the fact that the "innovative features" described also suggest that the project is trying to squeeze as much value as possible from the survey and that combining this approach with revealed preferences from GPS data is also a very useful leveraging of inexpensive data. However, the reviewer stated, it is not entirely clear how this ability to compare stated and revealed preferences will be used—whether the project team will develop some calibration mechanism or if the team will simply use it to throw out outliers whose stated/revealed preferences are too divergent.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:

The reviewer mentioned that the collaborations shown in the presentation are appropriate given the scope and context of the project within the SMART Mobility framework. The reviewer said that the team has made good use of the transportation survey research subcontractor.

Reviewer 2:

The reviewer saw the collaboration with INL and NREL and subcontracting with a transportation survey research firm as appropriate for the nature of proposed project, given a very high-perspective investigation of lifelong transportation decisions (i.e., there do not seem to be many entities with directly relevant experience).

Reviewer 3:

The reviewer said that the Resource Systems Group appears to be an excellent choice for collaboration on survey design as they are a well-established and respected player in the field and widely used by transportation

planners and public agencies for travel surveys. The reviewer noted that they also have a solid reputation for in-house expertise that would suggest they are more than up to the task of developing innovative surveys.

Reviewer 4:

The reviewer said that the project appears to be demonstrating adequate coordination and supports the research of all pillars within the SMART Mobility Initiative; to date, the team members from LBNL, INL, and NREL have been integral to the design and execution of project activities. The reviewer indicated that a subcontractor to LBNL (Resource Systems Group, Inc.) with extensive experience in transportation research is programming and implementing the survey.

The reviewer noted, as mentioned earlier, some previous studies looked at some similar areas, but none examined and integrated the whole picture. The reviewer asked whether the results of some of the previous studies could be used to augment or potentially serve as a substitute for some elements of this effort, thereby freeing up resources for additional activities.

Reviewer 5:

The reviewer affirmed that DOE is coordinating with DOT. The reviewer asked where the outreach is to those experts in consumer behavior in industry, advertising, or in advanced product planning (e.g., even technology companies).

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

Reviewer 1:

The reviewer said that the future work is focused on survey implementation and analysis of results.

Reviewer 2:

The reviewer found the future research set forth by the team to be a logical result of the research plan and noted that it would be interesting to have seen this Whole Traveler process applied to other regions of the United States (other cities and perhaps less urbanized areas) to see if the broad trends in the demand for mobility are consistent across regions or if there are differences. The reviewer said that the future work will add to the understanding of how individual consumers are beginning to think about mobility.

Reviewer 3:

The reviewer commented that the future research, as described, seems to fit well in line with the project goals and that it will be very interesting to see how this interfaces with the five pillars. The reviewer acknowledged that, if at all possible, it would be great to see future research in this area integrated with more focused, observational studies. The reviewer said that one might suspect that some well-targeted combination of (very expensive) observational studies with the survey might provide a powerful opportunity to calibrate the (much more affordable) survey data and thereby squeeze much more value from it. For example, one simple observational tool could be to give a small sample of people access to Uber/Lyft at a very low cost (in order to simulate a CAV taxi service that does not have to pay a driver) and then let them use this service for 6 months or so to see how their behavior adapts. Similarly (but even more expensive) would be to provide full-time, on-demand car service that operates like a private limousine where the user only pays for gas. The user could also pay a monthly fee similar to what the expected lease-price of a private AV would be and then get a "simulated AV" in return, with a full-time driver (perhaps even hidden behind a screen). Of course, the reviewer noted, this is likely to be prohibitively expensive, but it would provide behavioral data that would be impossible to get any other way. Based on that, the reviewer pointed out, it would seem that there should be opportunities for substantial collaboration with industry to collaborate on ways to obtain and share these kinds of data. The reviewer suggested that a model similar to NREL's National Fuel Cell Technology Evaluation Center (formerly Hydrogen Secure Data Center) might be worth considering.

Reviewer 4:
The reviewer said that the proposed future research presented is adequate, if somewhat generic. The reviewer noted that it provides the proposed basic activities for the rest of FY 2017 and all of FY 2018, and the reviewer assumed that the results of these activities will determine project plans for FY 2019. The reviewer stated that it would have been informative if greater detail could have been provided, possibly further touching on specific technical issues to be addressed with regard to implementation/analysis of the survey, highly salient questions that would be answered, specific trends that are being looked for, and/or a hint at potentially determinative items regarding the establishment of FY 2019 activities.

Reviewer 5:
The reviewer saw the concept as good but as a baby set that is set forth here in this project.

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

Reviewer 1:
The reviewer indicated that understanding how individual consumers are making mobility decisions will be critical for developing the energy efficient vehicle systems of the future that consumers will choose. The reviewer said that, ultimately, the consumers will drive the uptake of efficient mobility and DOE needs to understand the consumer motivation in order to achieve petroleum displacement.

Reviewer 2:
The reviewer said that the migration to smart mobility requires not only technical progress on multiple fronts but also an understanding of and change in consumer attitudes and behaviors. The reviewer said that to encourage the positive evolution of consumer behavior toward Smart Mobility, a thorough understanding of their past and present perspectives and tendencies is needed and that this project aims to better understand behavioral and human factors, apply it to modeling and analyses to improve predictive capabilities, and subsequently inform future strategy and planning development.

Reviewer 3:
The reviewer stated that this project does contribute to better understanding of programmatic pathways to an energy independent and efficient transportation system and that it is an enabler for better understanding of Mobility Decision Science (a pillar in DOE SMART Mobility Consortium), but the project does not directly impact petroleum use reduction.

Reviewer 4:
The reviewer said that very strong and well-thought out connections are drawn among the survey outcomes and the five pillars and that, as a baseline from which to build on, this appears to lay a very solid, broad foundation. The reviewer remarked that as these data will help support the goals of those pillars at many levels, there is clear value in this work toward supporting the overarching goal of displacing petroleum and that it would be unrealistic to think that any significant long-term petroleum displacement efforts will be successful without the kind of understanding of behavior and choices that this project is aiming to establish.

However, the reviewer cautioned as to the limits of these data and how far they should or could be extrapolated. The reviewer noted that new mobility innovations, such as CVs and/or AVs, can be such a radical departure from current experience that it may be impossible to draw any meaningful conclusions from even the best survey. As one example of these limitations, the reviewer recalled a survey from a year or two ago where most parents said they would never send their child unaccompanied in an automated car. The reviewer noted that that is easy to say, from the position of calmly taking a survey, but in the midst of a chaotic school day, when one child is sick, the other has missed the bus, and the parents are late for work, it is very likely that their risk tolerance will suddenly stretch to allow them to send a child to school in an autonomous vehicle. The reviewer noted that, after doing that once or twice, the behavior (which initially seemed totally unacceptable) may become part of everyday life.

Reviewer 5:
The reviewer indicated that this is an interesting project and that consumer adoption of a new technology is always an interesting topic. The reviewer said that, as we look at modes of transportation, it can be an expensive investment by say, the federal government, the local government, and for industry. The reviewer expressed uncertainty if a small survey of people in San Francisco gets the answer that the project is seeking.

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

Reviewer 1:
The reviewer said that the project appears to be on schedule to date and has not indicated any funding deficiencies; therefore, it is assumed that funding resources are sufficient. The reviewer noted that the project partners have the technical expertise, equipment, and facilities necessary to successfully complete the project on schedule.

Reviewer 2:
The reviewer found the resources to be sufficient for the work plan set forth in the presentation.

Reviewer 3:
The reviewer acknowledged not being intimately familiar with the costs involved in designing and executing large surveys of this type. The reviewer said that it could be hoped, however, that some of the up-front costs incurred in designing this innovative survey could be leveraged later on as the survey might be modified and adapted to answer different questions.

Reviewer 4:
The review remarked that this is a chicken-and-egg scenario—the resources may be sufficient for what is outlined as a project--but asked what type of answer the project team is seeking, and whether the team has really thought about how to go about it. The reviewer wondered if the team's survey of San Francisco will spool up to other parts of the country. The reviewer pointed to Detroit, where there is very little mass transportation, and mass transportation has been voted down.

Reviewer 5:
The reviewer said that this project like all EEMS activities in current VTO portfolio is 100% DOE funded. The reviewer commented that $2.4 million over 3 years is a significant amount of funding for a survey that will hopefully provide results that will be of good use in future EEMS modeling activities.

Presentation Number: eems024
Presentation Title: MA3T-MobilityChoice: Analyzing the Competition, Synergy and Adoption of Fuel and Mobility Technologies
Principal Investigator: Zhenhong Lin (Oak Ridge National Laboratory)

Presenter
Zhenhong Lin, Oak Ridge National Laboratory

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

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

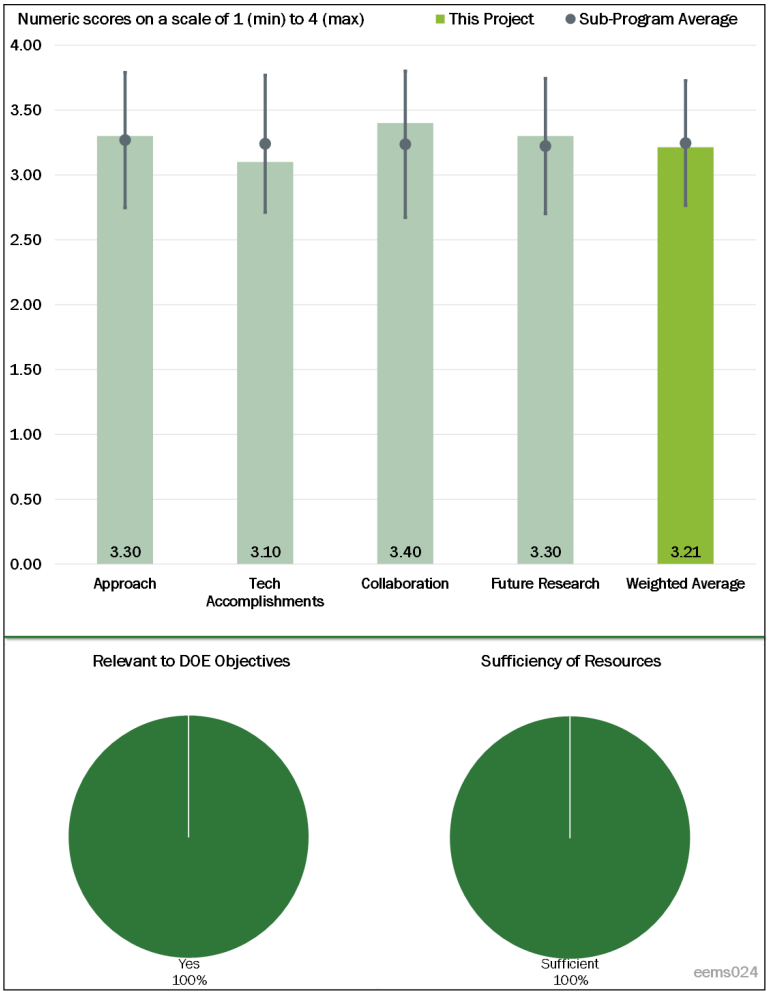

Figure 4-23 – Presentation Number: eems024 Presentation Title: MA3T-MobilityChoice: Analyzing the Competition, Synergy and Adoption of Fuel and Mobility Technologies Principal Investigator: Zhenhong Lin (Oak Ridge National Laboratory)

Reviewer 1:
The reviewer said that the approach the team is taking for this project appears logical—modeling how individual consumers make mobility choices and modeling these consumers at a relatively high level of detail (many consumer types). The reviewer stated that the models will also begin to explore how these mobility choices will influence energy efficiency, which is the critical question for DOE to answer in the efficient mobility space. The reviewer noted that the team is taking advantage of existing sources of survey information on consumer preferences and modeling efforts, which ensures efficient use of resources.

Reviewer 2:
The reviewer remarked that this project seems to have a great approach and plan and that it is well integrated with other efforts.

Reviewer 3:
The reviewer liked this project. Additionally, the reviewer noted that it was addressing how other DOE projects interact and that the complexity was interesting.

Reviewer 4:
The reviewer commented that the approach is well thought out, albeit extremely complex, with many interdependencies and that future collaborations will be critical to success.

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

Reviewer 1:
The reviewer indicated that the progress looks good and should lead to a useful tool ready to integrate with other efforts.

Reviewer 2:
The reviewer said that the work is on schedule and preliminary outputs have been developed. The reviewer also noted that collaborations will be critical going forward.

Reviewer 3:
The reviewer stated that the technical accomplishments are good given that the project is in its first year and that the characterization of individual household mobility parameters should yield some interesting results—the results to date are certainly logical and not unexpected. The reviewer noted that the initial modeling appears to provide confirmation of the positive synergies between automation and electrification.

Reviewer 4:
The reviewer pointed out that the project has to be careful to say that there are technical accomplishments. The reviewer saw this more as an accomplishment of a study, but does think this study raised an interesting thought: specifically, if transportation is made easier and adds more autonomy, would one actually drive more miles and cause more emissions, especially because studies show increasing distances that are being driven.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer noted that the project team draws on an extensive list of collaborators in the national laboratory and academic spaces and that the division of tasks among collaborators appears to take advantage of individual areas of expertise.

Reviewer 2:
The reviewer said that this is a fundamentally collaborative project that is well integrated with other parallel projects.

Reviewer 3:
The reviewer commented that this was not just engaged at DOE national laboratories and the reviewer liked the additional collaborator institutions (see Slide 15).

Reviewer 4:
The reviewer thought that significant collaboration has occurred with other SMART Mobility projects.

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 really liked Slide 17 of the presentation (the outline of future research) in particular because it quantifies the four EEMS future narratives of mobility. The review said to keep moving forward on this one.

Reviewer 2:
The reviewer stated that this project appears to be well planned and appears to be configured to address potential barriers.

Reviewer 3:
The reviewer remarked that the PI has a good handle on the challenges of integrating outputs with other CAV and SMART Mobility projects.

Reviewer 4:
The reviewer said that the future work set forth by the team is logical and addresses the key questions for the analysis, specifically in quantifying several future mobility scenarios.

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

Reviewer 1:
The reviewer observed that we have put so much effort into various powertrain technologies and costs and that this is an excellent project to start putting on all of the powertrains and possibilities together.

Reviewer 2:
The reviewer mentioned that integrating fuel and powertrain options with new mobility options to maintain or increase fuel use reductions is critical to continuation of the DOE mission of energy independence.

Reviewer 3:
The reviewer said that understanding how consumers are likely to make mobility choices in the future is critical for ensuring that these consumers choose highly efficient vehicles that will displace petroleum for their mobility services.

Reviewer 4:
The reviewer said that improving efficiency and switching fuels will reduce petroleum usage.

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 funding levels to be appropriate.

Reviewer 2:
The reviewer said that the resources seem sufficient and the reviewer liked the thought process on this one. The reviewer asked what the resources would need to be to make this an even more useful project.

Reviewer 3:
The reviewer said that until data are available to allow calibration and validation of models, resources seem to be sufficient.

Reviewer 4:
The reviewer stated that the resources appear to be sufficient to complete the analysis and modeling described by the team.

Presentation Number: eems025
Presentation Title: National Scale Multi-Modal Energy and GHG Analysis of Inter-City Freight
Principal Investigator: Yan Zhou (Argonne National Laboratory)

Presenter
Yan Zhou, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer said that it is a very good approach.

Reviewer 2:
The reviewer remarked that the objective is to analyze national level energy and emissions impacts of inter-city freight due to use of smart technologies and mode shifts utilizing literature, real-world data, and simulation/modeling results. The reviewer noted that the FY 2017 focus is on the high-level national impact of low-level automation (i.e., platooning).

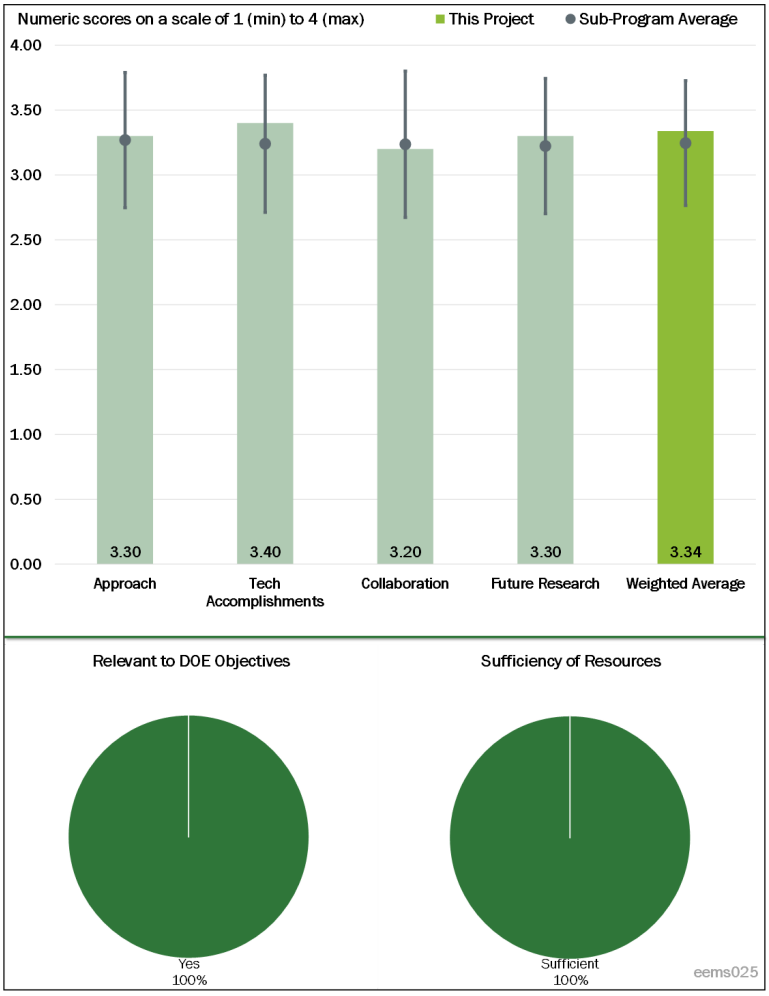

Figure 4-24 - Presentation Number: eems025 Presentation Title: National Scale Multi-Modal Energy and GHG Analysis of Inter-City Freight Principal Investigator: Yan Zhou (Argonne National Laboratory)

Reviewer 3:
The reviewer stated that the approach for this work is reasonable and logical and that the team is analyzing an important future aspect of improving freight transportation efficiency through this work. The reviewer commented that the approach combines existing state-of-the-art research information and existing model resources to develop the results.

Reviewer 4:
The reviewer explained that the overall objective is to analyze national level energy and emissions impacts of inter-city freight due to smart technologies using ANL's non-light-duty energy and greenhouse gas (GHG) accounting tool (NEAT) model. The reviewer added that this effort is largely based on identification and compilation of information via literature reviews, real-world data, and simulation and modeling results from other pillars within SMART Mobility.

The reviewer indicated that this effort is working with NREL, ORNL, and INL to identify and frame the potential of futuristic inter-city operations and smart technologies including modal efficiencies and freight

mode shares. The reviewer said that this is important as it helps bound the energy savings potential of various smart approaches and technologies and can inform the direction of future research and implementation.

The reviewer acknowledged that in FY 2017, the focus is on high-level impacts of low-level automation (platooning) and that, from the outset, it is good to focus on smart options that can lead to nearer-term and quantifiable benefits for inter-city freight operations.

The reviewer said that ultimately, the intent is for ANL's NEAT model to identify the "size of the prize" for inter-city freight from a variety of factors including potential mode shift' improved efficiency' demand changes by commodity' increased use of alternative fuels' and alternative economic, regulatory, and policy scenarios.

The reviewer noted that the challenges and barriers have been identified including the lack of real-world freight data with smart technologies, hard-to-quantify impacts on freight efficiency and mode shares by commodity type, and uncertainty on how smart technologies would affect freight operation costs. The reviewer pointed out that this issue of the effect of smart technologies on freight operation costs is particularly compelling and should be heavily focused upon; this will ultimately determine the success or failure regarding the adoption of smart technologies in freight operations.

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

Reviewer 1:
The reviewer noted that the completed preliminary impact quantification of long-haul freight energy has implications.

Reviewer 2:
The reviewer commented that the team's accomplishments are good given that the project has been underway for less than a year and that the work in summarizing the current literature on truck platooning is very helpful and essential to guide the modeling efforts. The reviewer stated that the team has made good use of limited literature data to obtain preliminary results on the long-term effect of truck platooning on overall freight energy consumption.

Reviewer 3:
The reviewer saw this as a very important project with a good start.

Reviewer 4:
The reviewer said that, given the relatively recent start and modest budget, the project has achieved a number of accomplishments.

The reviewer remarked that in FY 2017, the project has identified a number of research gaps and areas in which limited data are available including truck efficiency change by commodity type and various information deficiencies regarding building a knowledge base for platooning.

The reviewer stated that, regarding platooning, the project has identified and compiled statistics on fuel savings via platooning depending upon numbers, spacing, mass, and positioning. The reviewer said that the project found that it is more efficient to be part of a platoon even accounting for requirements for splitting and merging.

The reviewer observed that a number of other important parameters regarding platooning have been identified, including platoonable miles by time thresholds, truck speed adjustments, and the effects of road saturation on platooning opportunities.

The reviewer remarked that the project has framed and quantified the energy and concomitant GHG benefits of modal shifting and platooning at the national level.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that the project has a good team.

Reviewer 2:
The reviewer reported collaboration with INL, NREL, and ORNL on data collection and identifying research needs and that it could be useful to look to truck industry groups (i.e., Truck Manufacturers Association) and other relevant agencies like DOT to understand availability of any complementary datasets. Also, the reviewer noted that connecting with truck manufacturers who have a lot of trip information available from their customers (if it could be shared at an aggregated or anonymized level) could provide additional insights.

Reviewer 3:
The reviewer stated that the collaborations appear to be reasonable but are limited to DOE national laboratories and that direct feedback from industry partners (particularly those involved in platooning or vehicle automation) could add to the collaboration and potentially improve assumptions and results.

Reviewer 4:
The reviewer saw that the project is collaborating with INL, NREL, and ORNL on data collection, identifying research needs, and modeling and simulation to produce more robust information on which to base analysis. The reviewer said that real-world data identification, availability, and collection are a challenge and that, as mentioned under remaining challenges and barriers, collaborations are needed with other organizations to address these data challenges. The reviewer noted that the researcher mentioned that efforts will be undertaken to work with UPS via INL.

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

Reviewer 1:
The reviewer remarked that there is a good plan for future research.

Reviewer 2:
The reviewer found the future work to be appropriate, with the key being incorporating results and data from other members of multi-modal and CAVs pillars that will hopefully include organizations beyond just the national laboratories.

Reviewer 3:
The reviewer said that the future research plans are logical and will address several key questions within the freight mobility sector. The reviewer noticed that the team is covering the major areas—freight logistics efficiency improvement, shifts in freight demand due to broader macro-trends, conversion of energy savings to freight efficiency (ton-miles)--and that depending on data availability, it might be interesting to look at cubic foot-mile metrics as this may be more relevant for some commodities (although data on cubic feet of cargo shipped may be difficult to obtain).

Reviewer 4:
The reviewer stated that a number of items for planned and proposed future work are presented including converting platoon information into more industry accepted terminology, fuel savings by commodity, and

incorporation of data and information from other members of the Multi-Modal and CAVs pillars as well as identifying future inter-city freight demand due to increasing fast/guaranteed shipping.

The reviewer noted that one of particular interest was to "identify efficiency improvement due to smart technologies other than platooning, such as better logistic operations." The reviewer said that it is good to expand options of smart technologies for freight movement beyond platooning. However, the reviewer went on to say, a question arises: whether transportation/distribution companies would already have been looking at this for a long time to improve the efficiency and lower the cost of their operations. The reviewer suggested that the "logistics areas" that may be untapped are ones that potentially cross the boundaries of more than one distribution firm (as platooning potentially does) and that shared company depots or hubs may be possibilities to explore because individual firms are unlikely to consider that on their own.

The reviewer indicated that one of the areas mentioned for future research is to better understand how the type of community affects the benefits of platooning.

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

Reviewer 1:
The reviewer stated that platooning of Class 8 over-the-road equipment has the potential for significant petroleum displacement.

Reviewer 2:
The reviewer said that yes, this project supports the overall DOE objectives of petroleum displacement.

Reviewer 3:
The reviewer remarked that this project supports the EEMS Multi-Modal pillar efforts and contributes to the understanding (does not directly impact it as it strictly involves analysis) of freight energy use at a national level.

Reviewer 4:
The reviewer pointed out that future freight transport is likely to drive overall petroleum use in the future, particularly in light of strides made in light-duty vehicle (LDV) efficiency. The reviewer noted that addressing the potential energy savings of future mobility systems for the freight sector is a critical part of getting the full petroleum displacement picture of SMART Mobility.

Reviewer 5:
The reviewer said that it is possible for inter-city freight energy use and, by association, criteria and GHG emissions to be reduced by modal shifting and introduction of smart technologies. The reviewer noted that early analysis demonstrates the potential for truck energy consumption and GHG to be reduced by 6% due to mode shifting and by 4.2% from truck platooning while increasing rail energy consumption by only 1.7%.

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

Reviewer 1:
The reviewer stated that the resources appear to be sufficient to achieve the goals of the project.

Reviewer 2:
The reviewer said that only $80,000 for FY 2017 was mentioned in the presentation and it was not clear what the funding might be for FY 2018 and FY 2019 (a 3-year duration was listed). The reviewer noted that there was good progress and a good approach for what seems to be a relatively very small project. The reviewer

commented that due to its size, it might be appropriate to include it for review with other projects in Multi-Modal pillar instead of being a standalone project.

Reviewer 3:
The reviewer remarked that the task as identified is currently on schedule and presumably within budget; thereby, the reviewer assumed that funding for this activity is sufficient.

Presentation Number: eems026
Presentation Title: Expanding Regional Simulations of CAVs to the National Level and Assessing Uncertainties
Principal Investigator: Tom Stephens (Argonne National Laboratory)

Presenter
Tom Stephens, Argonne National Laboratory

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

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

Reviewer 1:
The reviewer commented that the approach for the work is very well thought out and thorough and should be successful in analyzing the impacts of CVs and AVs on energy use in transportation. The reviewer said that the approach leverages a number of tools and related research efforts to provide the "big picture" impacts.

Reviewer 2:
The reviewer said that the approach to national level is appropriately taken by rolling up local-level results.

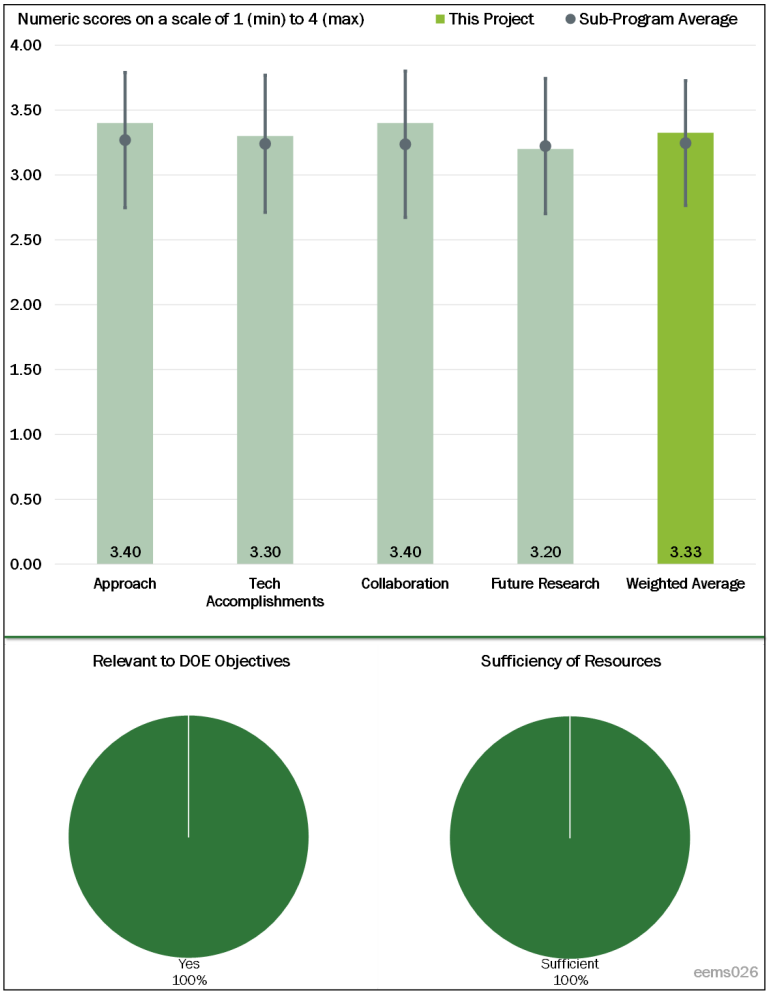

Figure 4-25 - Presentation Number: eems026 Presentation Title: Expanding Regional Simulations of CAVs to the National Level and Assessing Uncertainties Principal Investigator: Tom Stephens (Argonne National Laboratory)

Reviewer 3:
The reviewer said that, whatever answer the team comes up with, it cannot be proven to be either correct or incorrect. The reviewer said that given the reality of the situation, it perhaps makes sense to make absolutely clear beforehand whether the purpose of this project is to develop a model that would predict in an absolute sense or to develop a model that provides a prediction as a function uncertain inputs; the second approach would naturally result in an answer that has an even larger level of uncertainty.

Reviewer 4:
The reviewer remarked that this project aims to estimate the potential changes in petroleum consumption and GHG emissions due to deployment of CAVs at the national level and that the approach entails a five-step process: conduct initial literature review and assessment; develop conceptual calculation flows; implement value component methods to estimate CAV adoption rates; aggregate energy/GHG impacts of CAV features nationally; and use transferability modeling to expand detailed local travel simulation results to the national level.

The reviewer said that it is a feasible and innovative approach to which specific details and solutions are provided as to the challenges facing the project. The reviewer stated that it is noteworthy that early in a slide of the CAV Subproject 2B Roadmap, a number of very salient high-level questions are presented that require resolution. Under each of the five steps of the approach, the reviewer noted, comprehensive details are provided as to the methodology process to address the specific challenges and achieve the objectives therein. The reviewer commented that using transferability modeling is especially interesting as it enables identification of rich, local datasets with subsequent extrapolation nationally based upon households with similar characteristics. As is indicated, validation of this approach is still underway.

Reviewer 5:

The reviewer viewed the extrapolation to national scale as being well defined and logical and saw the decision to purchase a CAV as being very difficult to model. The reviewer expressed uncertainty about what the inputs to MA3T would be to model this. The reviewer noted no data to date and asked if there is a survey. The reviewer remarked that many data inputs to this problem do not exist.

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

Reviewer 1:

The reviewer said that the team has already added to the CAV discussion with its bounding report from 2016 and the work described here builds on those findings. The team has verified its modeling approach and has identified the key questions to answer at a sufficient level of detail to achieve the project goals.

Reviewer 2:

The reviewer commented that in extending the regional data to a national level, it seems that the researchers are relying on very narrow datasets (the reviewer asked if this set is Chicago only) and that it would perhaps utilize the NREL TSDC database in some form to validate the assumptions that move the regional scenario to a national scenario. The reviewer wondered if that perhaps it is already being done, but that it is not quite clear from the presentation.

Reviewer 3:

The reviewer suspected that the accomplishments on a project with such uncertainty are also uncertain and that what may appear to be an accomplishment could very easily be eliminated. The reviewer added that this project is a good exercise where the effort to estimate and project is likely of more value than the resultant projections, which will be very uncertain and or uselessly broad.

Reviewer 4:

The reviewer outlined a number of technical accomplishments for the project under each of the five steps identified in the approach. Regarding the first step of literature review and assessment, bounding of the energy impacts has been established for partial automation, full automation (no rideshare), and full automation (with rideshare) showing a large range from significantly negative to positive energy impacts. For the second step of conceptual calculation flows, the high-level process flow for obtaining the aggregated petroleum and GHG scenario impacts is established. For the third step of implementing value component methods to estimate CAV adoption rates, specific value components (stress, time, energy, mobility, and productivity) are identified including process integration into ORNL's MA3T model including a revised choice structure. For the fourth step of aggregating energy/GHG impacts of CAV features nationally, in short, the approach is to calculate the total national energy use and GHG emissions by incorporating fuel consumption rates and summing VMT for the entire U.S. road network. For the fifth and last step of transferability modeling to expand detailed travel simulation results to the national level, transferability permits the use of rich datasets of local travel patterns that can be transferred to households with similar characteristics nationally. The reviewer said that so far, there

is solid agreement between transferred and observed frequencies and behaviors and that Metropolitan Chicago is being used as the baseline locale.

Additionally, the reviewer noted, a number of key, high-level questions and uncertainties have been identified regarding LDVs (predominately) and HDVs.

Reviewer 5:
The reviewer remarked that the progress is good, but that the timeline as presented in the slides is repetitive/incorrect.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer said that this project is hugely collaborative in its approach, which is appropriate for the scope.

Reviewer 2:
The reviewer was glad to see university collaboration with University of Illinois at Chicago.

Reviewer 3:
The reviewer found the collaborations to be reasonable for achieving the goals of the program with both formal and informal collaborative efforts.

Reviewer 4:
The reviewer stated that the project is closely collaborating on the CAVs pillar tasks with ANL, NREL, and ORNL as well as the Mobility Decision Science pillar. Additionally, the reviewer noted, the project has informal collaborations with the wider research community through a TRB subcommittee and Automated Vehicle Symposium, universities, and the DOT Volpe National Transportation Systems Center.

Reviewer 5:
The reviewer saw a reasonable level of cooperation with the laboratories and suggested that it would make sense to work with more universities, say the University of Michigan, especially because other ANL teams already appear to be working closely with them on projects related to CAVs.

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

Reviewer 1:
The reviewer said that the proposed future work is a logical result of the overall work plan set forth at the outset of the program and the team should achieve its goals through this future work.

Reviewer 2:
The reviewer noted that evaluating additional influences on human behavior in travel and location/re-location provides for many possible areas of future work.

Reviewer 3:
The reviewer stated that the future path appears to be clearly laid out—except that, as mentioned before, all the steps have large uncertainties associated with them. The reviewer said that perhaps a clear statement of the range of uncertainty in the final answer that one can live with will prevent unreasonable expectations. The reviewer indicated that the processes laid out to aggregate existing data and extend them are very interesting.

Reviewer 4:
The reviewer observed that a reasonable presentation of remaining high-level challenges and barriers is provided although it would be beneficial to provide some additional detail. The reviewer commented that future proposed work is provided that includes further information on CAVs scenario simulations and rolling up to the national level.

Reviewer 5:
The reviewer remarked that this is a very large scope and the reviewer is unsure that all will be able to be done with actionable outcomes.

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

Reviewer 1:
The reviewer indicated that identifying the potential efficiency impacts (positive and negative) of CAVs is directly relevant to DOE petroleum displacement goals and that it is essential to determine these positive and negative efficiency impacts now as the technology is still developing and there are opportunities to make adjustments based on the analysis results.

Reviewer 2:
The reviewer responded that, yes, the project does support the overall DOE objectives of petroleum displacement.

Reviewer 3:
The reviewer stated that the presentation makes clear the relevance of the project in supporting DOE objectives.

Reviewer 4:
The reviewer said that CAVs are an important, yet disruptive, element in the move to Smart Mobility. Currently, the reviewer noted, their likely energy and emissions impacts (both positive and negative) are yet to be definitely determined locally or at the national level. The reviewer explained that it is important to identify and understand the key considerations to be addressed to achieve beneficial energy and emissions outcomes while minimizing negative impacts.

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

Reviewer 1:
The reviewer said that the budget appears manageable within the defined project scope and that the project team has the experience, facilities, and equipment to conduct the task successfully within budget and timetable.

Reviewer 2:
The reviewer found the resources to be sufficient to complete the work as described.

Reviewer 3:
The reviewer remarked that there is no indication that funds might be excessive or insufficient.

Reviewer 4:
The reviewer said that the resources are okay.

Presentation Number: eems027
Presentation Title: Opportunities for Improving the Energy Efficiency of Multi-Modal Intra-City Freight Movement
Principal Investigator: Kevin Walkowicz (National Renewable Energy Laboratory)

Presenter
Kevin Walkowicz, National Renewable Energy Laboratory

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

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

Reviewer 1:
The reviewer acknowledged that this was one of their favorite projects to review this year. The reviewer noted that the approach was excellent and that the partners and collaboration are excellent.

Reviewer 2:
The reviewer said that the overall multi-step process to evaluate current baseline freight movement and future modal change scenarios is excellent. The reviewer remarked that the specific areas of work to be accomplished in this project, which is to gather and validate baseline data and develop estimates for technology-based savings, development of an intra-city freight network model, perform simulations of current baseline freight movements, develop future modal network, and explore a range of scenarios and optimize freight movement, provide excellent opportunities to contribute to overcoming the barriers that exist.

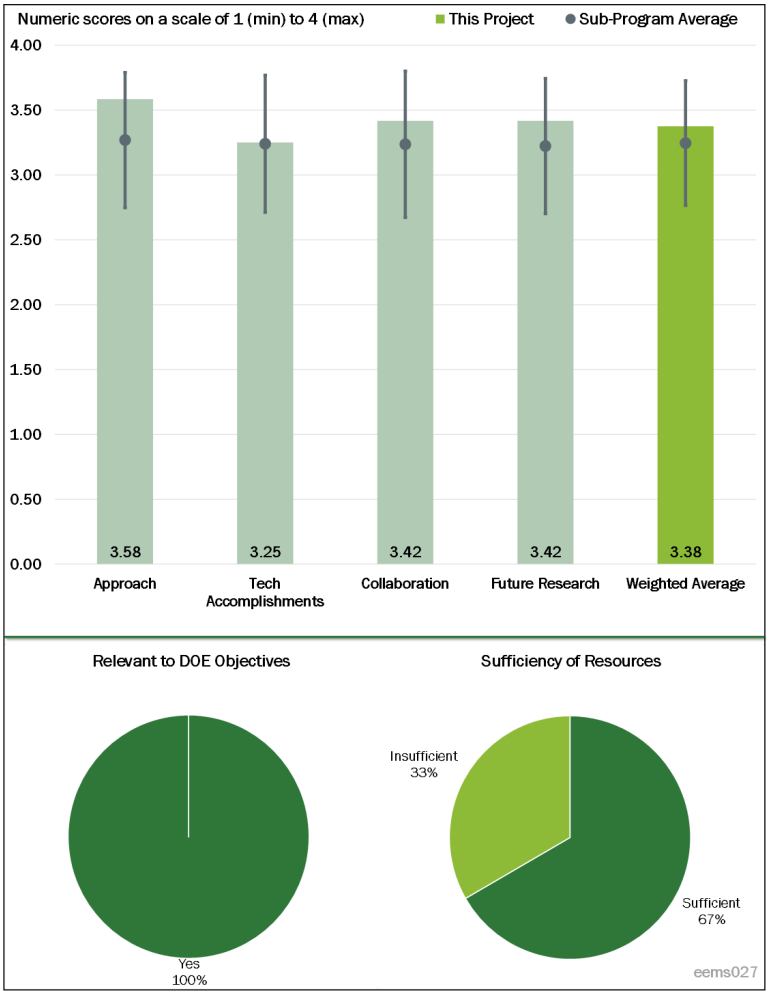

Figure 4-26 - Presentation Number: eems027 Presentation Title: Opportunities for Improving the Energy Efficiency of Multi-Modal Intra-City Freight Movement Principal Investigator: Kevin Walkowicz (National Renewable Energy Laboratory)

Reviewer 3:
The reviewer commented that this project has a well-defined scope and method and that some of the other studies in this section have very large scopes or poorly defined methods. The reviewer pointed out that this project has a mathematical basis and a nice dataset.

Reviewer 4:
The reviewer stated that the barriers and challenges are specifically laid out for this project and that the approach is provided in great detail explaining how the project will be executed.

Reviewer 5:
The reviewer mentioned that the approach is well laid out to address identified barriers for energy modeling intra-city freight movement and that the research team has identified objectives and provided explanations of a multi-step approach. The reviewer said that the research team partner organizations seem to have been appropriately selected to fill in research information and data gaps for supporting the approach, especially as related to new technology deployment and freight modes. The reviewer stated that the overall approach directly supports the intra-city freight delivery elements of the Multi-Modal Pillar Roadmap.

Reviewer 6:
The reviewer indicated that a key aspect of the stated approach is to optimize for energy within cost and time constraints. However, the reviewer noted, it is not clear if the team has fully explored the various relationships between cost and time. The reviewer pointed out that with automated deliveries, there will be some de-coupling of these factors, as a slower trip that burns less fuel may cost less than a faster trip that burns more fuel, while the opposite may have been true before due to drivers' labor costs. The reviewer remarked that it is unclear if these tradeoffs have been fully mapped out and that presumably UPS should have a solid grasp of these issues.

The reviewer found no mention of the dependencies between potential efficiency benefits and route selection (e.g., there will not be much benefit from platooning or reducing aerodynamic drag if a slow-speed, residential route is selected). Similarly, the reviewer commented, fuel savings from idling reduction is not likely to have much impact if the route selected is mostly on uncongested freeways.

The reviewer said that the project identifies shifting from truck to rail as having the "greatest overall potential for energy reduction," but it is not clear how this shift is possible or relevant in intra-city shipping. The reviewer found it hard to see how rail freight plays any role in intra-city movements. On the other hand, the reviewer noted, if rail is to be considered, then it would be even better to consider marine freight, which is the most efficient (1 ton of freight on a ship will move 243 km per liter of fuel compared with 213 km by rail and 35 km by truck).

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

Reviewer 1:
The reviewer liked the baselining and the development of estimates for technology-based savings. The reviewer thought that this project brought together many of the DOE initiatives over the past several years.

Reviewer 2:
The reviewer said that the project is focused on the critical barriers and provides information on how the team has accomplished them, and that the amount of data and work accomplished to date has been provided.

Reviewer 3:
The reviewer pronounced the progress so far to be fine.

Reviewer 4:
The reviewer remarked that the project's technical accomplishments seem to be satisfactory given that the project only started in October of 2016.

Reviewer 5:
The reviewer noted that the research team has identified technical accomplishments to date and estimated the project to be 17% complete. The reviewer commented that this seems to be reasonable progress for FY 2017 to date, especially given budget limits. The reviewer said that researchers have compiled data and information from a variety of reputable sources for Smart City Columbus, Ohio, to validate intra-city freight movement,

operation and energy use. Researchers have also looked into baseline and new technologies and freight modes for characterizing freight vehicles and modal operations. The reviewer added that the team has begun initial development of a route-based, predictive drive- model based on in-house tools and knowledge that will eventually correlate with existing DOE tools for estimating overall energy use along freight routes.

Reviewer 6:
The reviewer acknowledged that it is still very early in the project so there is not much to report as only a few studies have been initiated. However, the rate of progress seems reasonable and appropriate.

Question 3: Collaboration and coordination with other institutions.

Reviewer 1:
The reviewer remarked that the project has outstanding collaboration and seems well coordinated. Each partner is spelled out and identified.

Reviewer 2:
The reviewer said that this project has shown very good collaboration with other institutions and seems to be well coordinated.

Reviewer 3:
The reviewer commented that the researchers have outlined a very nice list of collaborative partners for the project, including identification/use of relevant data sources. The reviewer noted that INRIX is an especially relevant and interesting data partner for traffic data; the research team is working with other SMART Mobility Consortium members and has begun to work with other federal agencies. The reviewer said that the team is also collaborating directly with a freight industry partner to validate baseline model results and an automotive industry market data organization for predicting future technology market penetrations.

Reviewer 4:
The reviewer enjoyed seeing collaborative partners other than DOE, such as UPS, INRIX, MORPC, and other indirect providers. The reviewer asked why the USPS is not part of this because it delivers daily to every household in America (except Sunday and holidays).

Reviewer 5:
The reviewer found the collaboration to be fine.

Reviewer 6:
The reviewer stated that partnering with UPS seems like a major collaborative breakthrough and that it would be difficult to imagine a better source of data and expertise on intra-city freight. The reviewer added that one improvement would be to include a company that moves containers (such as a drayage company) and not just delivers individual packages.

The reviewer said that it is unclear if there was any collaboration with the DOT Office of Freight Management and Operations (within the FHWA's Office of Operations). The reviewer pointed out that such interagency collaborations can be complex and difficult to establish so it is understandable if there were no connection made. However, the reviewer encouraged the PIs to be persistent and pursue such collaborations fully as this office in DOT appears to have substantial relevant expertise; e.g., they are the source of the fully deployed Freight Advanced Traveler Information System.

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

Reviewer 1:
The reviewer said to keep going and expressed interest in seeing how consumers would react to these new technologies, because some people actually pick up their UPS packages, rather than having them delivered to their homes.

Reviewer 2:
The reviewer noted that the project provides detailed plans of future work in a logical manner while addressing its barriers.

Reviewer 3:
The reviewer stated that the proposed future work will adequately address the remaining challenges and barriers identified in the project.

Reviewer 4:
The reviewer commented that it is a good to see that the future research includes work on potential new distribution network models, enabled by automation, the growth of e-commerce, and other technology advances. The reviewer said that such concepts as neighborhood delivery depots could radically change the nature of freight flows through future modal networks.

The reviewer indicated that it is not clear if future research is devoting enough attention to understanding the potential significance of unmanned vehicle operation and the resulting decoupling of labor cost from the cost of operating a vehicle and that this effect may make business models with many more vehicles and many more different sizes actually viable.

Reviewer 5:
The reviewer said that the researchers have considered remaining challenges and barriers in proposing future work, specifically the need for improved freight movement data, characterization of new intra-city freight modes, future technology and new modal adoption rates, energy use rates for new technologies and modes, and further enhancements of tour-based models. The reviewer said that the proposed research plan for the remainder of FY 2017 and all of FY 2018- 2019 includes further identification and characterization on new modes and tour-based models, development of an initial freight movement network model and baseline results, incorporation of new technologies and modes into the network model, and completion of the predictive route-based, drive-cycle model. The reviewer recommended that as part of identification of new intra-city modes, the researchers consider the variety of "Uber-like" delivery concepts that are springing up or planned, such as Amazon Flex. The freight industry partners that are on this project will provide valuable insight to these future concepts.

Reviewer 6:
The reviewer said that it is still early.

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

Reviewer 1:
The reviewer agreed that this project definitely supports the overall DOE objective of petroleum displacement by providing energy savings through emerging, novel, intra-city, goods delivery modes and through data generation to determine emissions, energy, and transit time reduction in intra-city goods delivery in the future.

Reviewer 2:
The reviewer said that, yes, this work is absolutely relevant and that given the potentially dramatic changes in how freight moves within cities in coming decades, understanding the related impacts on energy use will be critical to any efforts at displacing petroleum use.

Reviewer 3:
The reviewer observed that the research is very relevant to addressing DOE objectives under SMART Mobility's Multi-Modal pillar with a focus on future intra-city freight delivery and energy use implications.

Reviewer 4:
The reviewer responded that, yes, the project supports the overall DOE objectives of petroleum displacement by providing a tool to optimize intra-city freight movement, thus reducing petroleum use.

Reviewer 5:
The reviewer said that, yes, the project supports the overall DOE objectives of petroleum displacement.

Reviewer 6:
The reviewer commented that the project has posed some interesting technical solutions to decrease petroleum in the scenarios and that the reviewer would like to see them modeled out further.

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

Reviewer 1:
The reviewer said that the resources for this project seem on the lighter side compared to other projects. The work being done involves a lot of partners, and it seems that additional funding should be required to accomplish the stated objectives.

Reviewer 2:
The reviewer was unsure that the funding level is truly "insufficient" and noted that it just seems a little low, based on the potentially broad scope of the work. However, the reviewer said that if the project can effectively leverage resources from UPS and other partners, it may be sufficient.

Reviewer 3:
The reviewer stated that the project appears to be very cost effective based on the planned project scope for the FY 2017- 2019 period and the available budget.

Reviewer 4:
The reviewer found the resources to be sufficient to complete the tasks involved in this project.

Reviewer 5:
The reviewer remarked that there are resources for this study and asked if the PI were able to model these items further, what it would take in terms of resources.

Reviewer 6:
The reviewer thought that the resources are fine.

Acronyms and Abbreviations

ACC	Automated Cruise Control
AFV	Alternative Fuel Vehicle
AMBER	Advanced Model Based Engineering Resource
AMD	Automated Mobility Districts
AMR	Annual Merit Review
ANL	Argonne National Laboratory
ARPA-E	Advanced Research Projects Agency-Energy
AV	Automated Vehicle
BEAM	Behavior Energy Autonomy Mobility
CACC	Cooperative Adaptive Cruise Control
CAV	Connected and Autonomous Vehicle
CDOT	Colorado Department of Transportation
CNG	Compressed natural gas
CV	Connected Vehicle
DCFC	Direct Current Fast-Charging
DFC	Detroit Future City
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EEMS	Energy-Efficient Mobility Systems
EPA	U.S. Environmental Protection Agency
ESS	Energy Storage Systems
EV	Electric Vehicle
EVSE	Electrical Vehicle Supply Equipment
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FY	Fiscal Year
GHG	Greenhouse Gas

GMU	George Mason University
GPS	Global Positioning System
HDV	Heavy-Duty Vehicle
HPC	High-Performance Computing
Hz	Hertz
INL	Idaho National Laboratory
ITS-JPO	Intelligent Transportation System Joint Program Office
LBNL	Lawrence Berkeley National Laboratory
LDV	Light-duty vehicle
MA3T	Market Acceptance of Advanced Automotive Technologies
MATSim	Multi-Agent Transport Simulation
MORPC	Mid-Ohio Regional Planning Commission
MOU	Memorandum of Understanding
MPC	Model-Predictive Control
NEAT	Non-Light Duty Energy and GHG Emissions Accounting Tool
NREL	National Renewable Energy Laboratory
ODD	Operational Design Domain
OEM	Original Equipment Manufacturer
ORAD	On-Road Automated Driving
ORNL	Oak Ridge National Laboratory
PI	Principal Investigator
PMP	Pontryagin's Minimum Principle
PNNL	Pacific Northwest National Laboratory
POLARIS	Planning and Operations Language for Agent-based Regional Integrated Simulation
PRT	Personal Rapid Transit
R&D	Research and Development
ROI	Return on investment

SAE	Society of Automotive Engineers
SEMCOG	Southeast Michigan Council of Governments
SHRP2	Second Strategic Highway Research Program
SMART	Systems and Modeling for Accelerated Research in Transportation
TNC	Transportation Network Company
TRB	Transportation Research Board
TSDC	Transportation Secure Data Center
TUMS	Toolbox for Urban Mobility Simulation
USPS	U.S. Postal Service
VMT	Vehicle Miles Traveled
VOTT	Value of Travel Time
VTO	Vehicle Technologies Office
WTP	Willingness-to-Pay

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