3. Energy Efficient Mobility Systems

To strengthen national security, enable future economic growth, support energy dominance, and increase transportation energy affordability for Americans, the Vehicle Technologies Office (VTO) funds early-stage, high-risk research. The research will generate knowledge that industry can advance to deploy innovative energy technologies to support affordable, secure, reliable and efficient transportation systems across America. VTO leverages the unique capabilities and world-class expertise of the national laboratory system and works with partners across industry and academia to develop new innovations in electrification, including advanced battery technologies; advanced combustion engines and fuels, including co-optimized systems; advanced materials for lighter-weight vehicle structures and better powertrains; and energy efficient mobility technologies and systems, including connected and automated vehicles as well as innovations in connected infrastructure for significant systems-level energy efficiency improvement. VTO is uniquely positioned to address early-stage challenges due to its strategic research partnerships with industry (e.g., the U.S. DRIVE and 21st Century Truck Partnerships) that leverage relevant technical and market expertise. These partnerships prevent duplication of effort, focus U.S. Department of Energy (DOE) research on the most critical research and development (R&D) barriers, and accelerate progress. VTO focuses on research that industry either does not have the technical capability to undertake on its own— usually because there is a high degree of scientific or technical uncertainty—or it is too far from market realization to merit sufficient industry emphasis and resources.

The Energy Efficient Mobility Systems (EEMS) subprogram supports early-stage research to enable industry innovation that improves the efficiency of the overall transportation mobility system. Initial analysis by DOE indicates that the future energy impact of connected and automated vehicles (CAV) is highly uncertain and may be quite large, ranging from a potential 60% reduction in overall transportation energy use to a 200% increase in energy consumption. EEMS will apply complex modeling and simulation expertise, experience with big data, and high-performance computing (HPC) capabilities unique to DOE national laboratories to explore the energy impact of emerging disruptive technologies such as CAV, information-based mobility-as-a-service platforms, and advanced powertrain technologies to identify and develop innovative mobility solutions that improve energy efficiency, lower costs for families and business, and enable the use of secure, domestic energy sources. The EEMS subprogram consists of two primary activities, the SMART Mobility National Laboratory Consortium and HPC-enabled data analytics, which build upon VTO's work in advanced powertrains, controls, and electric vehicle (EV) charging. The subprogram's overall goal is to identify pathways and develop innovative technologies and systems that can dramatically improve mobility energy productivity when adopted at scale. The EEMS subprogram is currently developing a quantitative metric to measure mobility energy productivity, or the value derived from the mobility system per unit of energy consumed, which will be required to evaluate program success.

Subprogram Feedback

DOE received feedback on the overall technical subprogram areas presented during the 2018 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.

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: eems918
Presentation Title: Energy-Efficient Mobility Systems (EEMS) Overview
Principal Investigator: David Anderson

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

Reviewer 1:
The reviewer responded positively and commented that the Program Manager did a great job explaining the overall strategy and structure setting up successful environment for oral and poster presentations from the team.

Reviewer 2:
The overall program objectives were very clear to this reviewer, who also noted a detailed overview of the program.

Reviewer 3:
This reviewer stated yes.

Reviewer 4:
The reviewer thought that the program area, including overall strategy, was adequately covered. Further, the Program Manager expressed a lot of passion for such a new area of emphasis to the U.S. Department of Energy (DOE) that this reviewer described as very refreshing.

Reviewer 5:
This reviewer remarked that the program area overall was covered well and noted that the current high-level strategy was discussed in pretty broad terms. Although there was sufficient content at the highest levels, and sufficient content at the most detailed, project accomplishment levels, there did not seem to be the bridging slides between the two levels that the reviewer hoped to see.

Reviewer 6:
The reviewer indicated yes, in part, but could not understand how the various program initiatives connected together for the greater goals of the EEMS program. As a staunch believer in system understanding of technologies, this reviewer did not hear from the presentation about the chosen systems that need to be solved and inquired about the following: whether they are light-duty, and if so, what are the goals of light-duty improvement; whether they are related to emissions, travelled miles, or travel time; whether there is a goal for freight efficiency and what is the definition of that system; and whether they are based on carbon dioxide (CO_2) reduction, tonnage moved, or cost.

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

Reviewer 1:
This reviewer observed an excellent balance that showed the value this newer group brings to the rapidly changing technology environment.

Reviewer 2:
Although difficult with such a new area, the reviewer thought that there was an appropriate balance between near-, mid-, and long-term research and development. The reviewer referenced last mile comments that show the importance of analyzing longer-term opportunities sooner to avoid getting boxed into something undesirable down the road.

Reviewer 3:
The reviewer commented that there was not a lot of information presented on how the goals are different between near-, mid-, and long-term. The three strategic goals were listed, but the reviewer indicated that there was a gap with the envisioned stages, phases, and timing for meeting each of these strategic goals.

Reviewer 4:
This reviewer remarked that the push for vehicle connectivity and mobility is at a fast pace and noted the important of having data with respect to driver behavior. Although the balance is there, the reviewer expressed concern that the infrastructure is lagging.

Reviewer 5:
The reviewer opined that more near-term development would have been better; too many of the high impact items are at the end of the program or classified as future work.

Reviewer 6:
Timing of the research was difficult for this reviewer to ascertain from the presentation material. A general categorization of technology readiness level (TRL) status was not presented, but the reviewer suggested this could be helpful in the future.

Question 3: Were important issues and challenges identified?

Reviewer 1:
Considering the current conditions, this reviewer indicated yes and added that important issues and challenges were identified very thoroughly.

Reviewer 2:
This reviewer stated yes; modeling and accurate sensitivity analysis are important and the impact of rideshare and autonomy is essential. Accessing real commercial data is difficult, but the reviewer opined that it is important to avoid drawing the wrong conclusions.

Reviewer 3:
The reviewer remarked yes and explained that a variety of issues and challenges were presented, which mostly reflected light-duty automotive transportation. The reviewer recommended that more information regarding public transportation and freight movement should be defined.

Reviewer 4:
This reviewer was unsure and commented that important issues and challenges may emerge more concretely over the next few years.

Reviewer 5:
Issues and challenges were not really addressed in the presentation, though this reviewer strongly suspected that these are articulated in detail within each of the projects in the Energy Efficient Mobility Systems (EEMS) space. The broad challenge that the reviewer thought should appear in this presentation was how the projects are broadly planning to influence future implementation. It came across more as, "We think all of these analyses are important to complete because connected autonomous vehicles (CAVs) and mobility are the future direction in transportation," but the presentation was missing the "why" these are being completed and the "how" they will be used to influence policy, original equipment manufacturers (OEMs), standards, etc.

Reviewer 6:
Question 4: Are plans identified for addressing issues and challenges?

Reviewer 1:
The reviewer responded positively and offered the Program Manager's comment on rapid disruptive change as an example. This reviewer noted that transportation options are immense and that charts were helpful in the Program Manager's messaging concerning CAVs.

Reviewer 2:
This reviewer responded that the presentations were clear on identifying the challenges and described available data to support integration of the technology as a main one. The connected vehicle protocols and standards are not mature yet and the reviewer commented that this is an area needing more focus.

Reviewer 3:
The reviewer stated yes and described the presentation as clear and relatable, highlighting the enjoyable soccer team comparison.

Reviewer 4:
Other than listing some of the example projects and initiatives, this reviewer indicated that there were not many plans able to be reviewed given the short presentation timeframe.

Reviewer 5:
This reviewer opined that plans for addressing issues and challenges were not really identified because issues and challenges were missing from the presentation in the first place and as far as the reviewer could discern.

Reviewer 6:
The reviewer could not see that plans were identified for addressing issues and challenges.

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

Reviewer 1:
This reviewer indicated yes; evolution is highlighted with the addition of the Integration Team.

Reviewer 2:
The reviewer observed a series of example accomplishments mentioned from specific projects, but there was not really a progress report at the program level. Also, the reviewer explained that there are really two ways of benchmarking this progress: use where the performance year started as the baseline and report out on accomplishments since that baseline; or quantify the accomplishments reported at last year's AMR and compare them to this year's accomplishments. This reviewer concluded that the presentation showed more of the former, but could benefit from more content within both the former and considering incorporation of the latter.

Reviewer 3:
This reviewer noted more awareness of connected vehicles and better understanding of driver behavior and acceptance.

Reviewer 4:
Although the reviewer commented that progress was not really clearly benchmarked against the previous year, the reviewer acknowledged that the program is so new.

Reviewer 5:
The reviewer responded negatively, but indicated that this appears to be a relatively new program.

This reviewer stated no.

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:
This reviewer thought the projects in this technology area align with the larger scope of VTO objectives.

Reviewer 2:
The reviewer indicated yes; this is a system level area versus technology ones such as batteries. Further, this reviewer noted that it was good, important, and helpful to share vision, mission and goals. The Program Manager spoke quickly and with obvious passion. Although the reviewer knew that the Program Manager wanted to catch up some time, it was not his fault that the program was more than 20 minutes behind.

Reviewer 3:
This reviewer asserted that the EEMS group can play the key role in evolving the work of other VTO groups into real-world solutions.

Reviewer 4:
The reviewer stated yes.

Reviewer 5:
This reviewer remarked yes, largely; the broad problems and barriers are addressed, overall, but weaving in the safety constraints and metrics remains a gap. It would have been beneficial to see a high-level articulated strategy with phases showing how each individual project feeds into an overall approach. For example, the reviewer was unsure how much overlap there was in models or problem statements to assess this well.

Reviewer 6:
Referring to Question 1 and a lack of the overall program objective definitions, the reviewer answered that it was hard to tell. However, this reviewer noted that there appeared to be an interesting set of projects dealing with many aspects of mobility systems.

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

Reviewer 1:
The reviewer remarked yes; there is a feel for having a good understanding of what needs to be done, especially in the one-on-one exchange.

Reviewer 2:
This reviewer indicated yes and observed good modelling integration work and data analysis.

Reviewer 3:
This reviewer commented yes and opined that the Program Manager is passionate about the vision and knows the importance of teamwork. This came through well in the Program Manager's presentation.

Reviewer 4:
The reviewer stated yes.

Reviewer 5:
This reviewer described the program area as very focused. Although the reviewer saw improvements during the past year in duplicated efforts, there are still redundancies that should be evaluated to leverage staff most efficiently.

Reviewer 6:

As mentioned previously, it did not seem to this reviewer that there was an opportunity to better focus and integrate the various projects into one cohesive plan. The reviewer observed an overall set of VTO needs/goals and the individual projects, but suggested that a slide demonstrating a sound connection between the two levels would be very helpful. In generating such a slide, the reviewer suspected that duplication may end up being identified, which could be addressed before the next AMR.

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 realization that energy efficient mobility systems are an important and crucial way to solve the nation's energy challenges in transportation was described by this reviewer as a key strength of the program. It also seemed that the electric technology and data analytics areas are key strengths. Although conceptual examples should be a strength, the reviewer further commented that conceptual city mobility examples seem to be less focused and a clear understanding of what that program delivers was not communicated.

Reviewer 2:

This reviewer remarked that the overall strategy is complete and can be key in real-world action and solutions. The reviewer further commented that duplication of efforts amongst national laboratories could be reduced and seeking more input from private sector fleet users would give a more complete perspective in modeling and demonstration projects.

Reviewer 3:

The reviewer described good modeling and pulling together data sources as strengths, while lack of development of new data sources as weaknesses.

Reviewer 4:

It was difficult for the reviewer to highlight a project that stands out on either end of the spectrum because the presentation really did not provide an exploration into every single project. The primary strength as seen by this reviewer is that the analyses and projects do appear to be addressing very important questions that have arisen or are likely to reveal themselves in the near future. The weakness is in tying the projects together cohesively, in projecting how exactly these will influence the future, and how the projects weave in all of the safety work and expertise. On the final point, the reviewer explained that there is a risk that a lot of interesting conclusions are generated that all become notably less relevant once safety and/or comfort are factored in later as outputs.

Reviewer 5:

This reviewer referenced Mobility Energy Productivity (MEP) and described it as confusing, though the metric schematic helped to explain it, which is crucial. The reviewer commented that users will not buy into it if it is not explained in a way that users understand. Further, the reviewer exclaimed that this was really helpful; well done.

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

Reviewer 1:

This reviewer pointed out that the e-mobility projects are especially chartering new territory.

Reviewer 2:

The reviewer stated yes and observed that most of the projects result in very appropriate tools being developed for decisions regarding current and future mobility conditions and solutions.

This reviewer indicated a clear yes as the work is formulating.

Reviewer 4:
The reviewer opined that the projects and their approaches do appear to be very innovative and novel, and that they all build on past innovative DOE models that are then tuned and adapted to their particular problem statement. However, the reviewer did think there is room for innovation on the "next steps" front in terms of how to influence the future policy and technology landscape in ways that are not overly intrusive, meet administration/national goals, and are safe/robust.

Reviewer 5:
This reviewer stated maybe, in general, but it was hard to tell from the short presentation.

Reviewer 6:
Nothing really novel was observed by this reviewer, who also noted standard modeling technology.

Question 10: Has the program area engaged appropriate partners?

Reviewer 1:
The reviewer commented that most of them do.

Reviewer 2:
This reviewer stated yes, although more private sector engagement would be a benefit.

Reviewer 3:
Broadly speaking, the reviewer reported that engagement is mostly within DOE and their national laboratories as well as universities. There is some initial connection with OEMs and other federal agencies, but more engagement with the private sector and cross-agency would clearly enhance the EEMS program. The reviewer acknowledged that partnering with too many can result in "too many cooks in the kitchen," but noted there is a happy medium that is not satisfied until more are partners involved.

Reviewer 4:
This reviewer opined that commercial rideshare could play a bigger role, but indicated this is difficult because of competitive reasons. More large-scale service pilots would be helpful.

Reviewer 5:
The reviewer expressed uncertainty regarding this, but it appears that more partnerships are needed and will emerge.

Reviewer 6:
This reviewer did not think the program area engaged appropriate partners because system solutions are being implemented. The reviewer explained that these can and should be elaborate system approaches that deal with a broad variety of government agencies, communities, corporations and policy stakeholders, but did not see that type of discussion.

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

Reviewer 1:
The reviewer replied positively and emphatically asserted that the agency is doing a good job collaborating, for the partners that are defined.

Reviewer 2:
This reviewer remarked that it seems that the program area is collaborating effectively.

Reviewer 3:
The reviewer stated yes and recommended that more with the private fleet sector would be beneficial.

Reviewer 4:
Although this reviewer strongly suspected that the existing partnerships are very robust (mostly universities and within DOE), the presentation did not articulate enough information to judge collaboration effectiveness.

Reviewer 5:
The reviewer expressed that it was difficult to say from the information presented.

Reviewer 6:
This reviewer described it as varying because some of the ELT projects lack clear roles of the collaboration partners. The reviewer further noted concerns with battery supply and being on time.

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

Reviewer 1:
At this point, the reviewer could see no gaps in the portfolio for this technology area.

Reviewer 2:
The reviewer thought things are on track with the push to expand the Advanced Driver Assistance Systems (ADAS) and connectivity. This reviewer also suggested that having projects look into dynamic charging might be beneficial in the future.

Reviewer 3:
Although there were no portfolio gaps for this technology area that were currently obvious, the reviewer was unsure how Core Evaluation and Simulation and Living Labs really fit into the system. The reviewer explained that systems cannot be tested on benches; real-world piloted projects and examples are needed. Furthermore, this reviewer highlighted the following: Truck Platooning Testing—Transport Canada, PIT; Columbus, Ohio freight tour-based modeling—UPS; Level 4 High Automation (L4) and Level 5 Full Automation (L5) for cars; and the traveler role is really interesting (i.e., EEMS001, EEMS023, EEMS043). The reviewer described collaborating Automated, Connected, Efficient, and Shared (ACES) with the U.S. Department of Transportation (DOT) as very interesting and expressed interest in hearing more because the Program Manager brushed over this a bit too quickly.

Reviewer 4:
This reviewer commented that more effort on collection and curation of good data is needed.

Reviewer 5:
The main gap observed by this reviewer is weaving in safety and comfort into the analyses, which also can come by virtue of enhanced partnering. The risk is that analyzing mostly on the energy side could yield results that are unrealistic when later constrained by safety or comfort considerations.

Reviewer 6:
This reviewer noticed that the main gap is the need to structure system concepts for properly defining the technologies needed to satisfy program goals. Although it would prove very worthwhile, the reviewer acknowledged that it is a difficult task and would take a tremendous analysis effort just to understand how to establish conceptual systems that can make the biggest impact.

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

Reviewer 1:
This reviewer indicated that no major topics are missing; the technologies that require verification within mobility systems are correct, unless one wishes to consider rail and shipping solutions.

Reviewer 2:
The reviewer did not notice any topics that are being addressed inadequately.

Reviewer 3:
This reviewer did not think there are topics that are inadequately addressed.

Reviewer 4:
Better data collection technology and methodology were recommended by this reviewer.

Reviewer 5:
Mobility of delivered goods within inner cities did not seem to be an area of focus to this reviewer, who opined that it will be a more significant factor in mobility moving forward.

Reviewer 6:
The reviewer referenced prior comments.

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

Reviewer 1:
This reviewer referenced prior comments regarding gaps and expanding partnerships, and reiterated that all of these should be considered for more funding or a shift in funding depending on the project.

Reviewer 2:
The reviewer suggested more focus on infrastructure in terms of vehicle traffic control, dynamic charging, and L5 ADAS.

Reviewer 3:
Satellite imagery for transit data collection was indicated by this reviewer.

Reviewer 4:
This reviewer expressed that greater focus on real-world demonstration projects to conclude, validate, and adjust modeling tools would add value.

Reviewer 5:
The reviewer thought that keeping a focus on last mile is important.

Reviewer 6:
The reviewer referenced prior comments.

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

Reviewer 1:
At this time, the reviewer was unable to recommend new ways to approach the barriers addressed by this program area.

Reviewer 2:
The reviewer stated not at this time.

Reviewer 3:

This reviewer suggested better collaboration (private sector, other agencies, etc.), using existing models outside the DOE when appropriate (universities, other agencies, etc.); and not checking safety at the end of projects, but rather weaving it in as both an input and an output. The reviewer added that there might be redundancy between the various models, approaches, and goals, and that it would be great to show a slide showing the complementary nature of all projects with respect to each other. Further, the reviewer recommended eliminating or thoughtfully identifying projects when redundancies are detected (e.g., the bake-off mentality where the best chef wins).

Reviewer 4:

The reviewer proposed having a structured set of deliverables along with a timeline for every project that outlines targets and objectives, and pointed out that some of the projects lacked that level of detail.

Reviewer 5:

This reviewer recommended developing mobile application platforms that enable new transit services.

Reviewer 6:

The reviewer referenced prior comments and an approach to spend efforts defining what and how to set up the mobility systems that need verification.

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

Reviewer 1:

This reviewer stated no; this is an important program area and perhaps the most difficult one to prepare and define.

Reviewer 2:

The reviewer noted that there was a wide range of ability to communicate amongst the various project presenters, and that it might be worth weighing the possibility of using a deputy or consciously choosing a good communicator for each project rather than defaulting to the Principal Investigator (PI).

Reviewer 3:

This reviewer opined that DOT participation DOT will be beneficial to provide insight on infrastructure and how e-mobility will be a factor on how the transportation portfolio is or needs to be.

Reviewer 4:

The reviewer suggested standards for a national transportation app that enables any transit company to integrate their mobile app routing, scheduling, and payment with real-time flexibility and passenger tracking for autonomous use.

Reviewer 5:

The reviewer was considering this and would provide ideas to the team.

Reviewer 6:

This reviewer referenced prior comments.

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 3-1—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 (CAVs)	Huei Peng (U. of Michigan)	3-17	3.20	3.20	3.00	3.10	3.16
eems007	Mobility Data and Models Informing Smart Cities	Joshua Sperling (NREL)	3-21	3.00	2.67	3.17	2.67	2.81
eems009	Modeling and Simulation of Automated Mobility Districts	Venu Garikapati (NREL)	3-25	3.33	3.08	3.25	3.25	3.19
eems011	Energy Travel Behavior Modeling in Urban Areas using Behavior, and Autonomy Mobility (BEAM)	Colin Sheppard (LBNL)	3-29	3.30	3.30	3.00	3.00	3.23
eems013	Integrated Framework to Quantify the Energy Impact of New Mobility Technologies from Individual Vehicle to Metropolitan Areas	Aymeric Rousseau (ANL)	3-33	3.20	3.40	3.30	3.00	3.29
eems016	Energy-Efficient Connected and Automated Vehicles (CAVs)	Dominik Karbowski (ANL)	3-37	3.14	3.21	2.93	2.93	3.13
eems017	Impact of Connected and Automated Vehicle (CAV) Technologies on Travel Demand and Energy	Josh Auld (ANL)	3-43	3.07	3.07	3.21	2.86	3.06
eems019	Smart Urban Signal Infrastructure and Control	H. M. Abdul Aziz (ORNL)	3-48	3.13	3.38	3.13	2.75	3.20

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems020	Multi-Scenario Assessment of Optimization Opportunities due to Connectivity and Automation	Jackeline Rios-Torres (ORNL)	3-52	3.00	2.83	3.00	2.92	2.91
eems023	Whole Traveler Survey on Life Trajectories and Mobility Decisions	Anna Spurlock (LBNL)	3-58	3.10	3.10	3.00	3.00	3.08
eems024	Synergy Market Acceptance of Advanced Automotive Technologies (MA3T)—Mobility Choice: Analyzing the Competition, and Adoption of Fuel and Mobility Technologies †	Zhenhong Lin (ORNL)	3-63	3.50	3.33	3.67	3.33	3.42
eems026	Expanding Regional Simulations of Connected and Automated Vehicles (CAVs) to the National Level and Assessing Uncertainties	Tom Stephens (ANL)	3-66	3.20	3.10	3.50	2.80	3.14
eems027	National Scale Multi-Modal Energy Analysis for Freight †	Kevin Walkowicz (NREL)	3-72	3.63	3.25	3.13	3.50	3.36
eems028	Developing an Eco-Cooperative Automated Control System (Eco-CAC)	Hesham Rakha (Virginia Tech)	3-75	3.00	3.08	2.67	3.17	3.02
eems029	Boosting Energy Efficiency of Heterogeneous Connected and Automated Vehicle (CAV) Fleets via Anticipative and Cooperative Vehicle Guidance	Ardalan Vahidi (Clemson U.)	3-80	3.29	3.29	3.07	3.36	3.27
eems030	Experimental Evaluation of Eco-Driving Strategies	Huadong Meng (Joshua) (LBNL)	3-85	2.67	2.33	2.75	2.25	2.46

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems031	Traffic Micro-Simulation of Energy Impacts of CAV Concepts at Various Market Penetrations	Xiao Yun-Lu- (LBNL)	3-90	2.57	2.64	2.64	2.50	2.61
eems032	Evaluating Energy-Efficiency Opportunities from Connected and Automated Vehicle (CAV) Deployments Coupled with Shared Mobility in California	Matthew Barth (UC-Riverside)	3-95	3.25	3.00	3.67	3.33	3.19
eems033	Truck Cooperative Adaptive Cruise Control/Platooning Testing: Measuring Energy Savings and Aerodynamic Interactions	Xiao Yun-Lu (LBNL)	3-100	3.40	3.50	3.20	3.10	3.39
eems034	Optimization of Intra-City Freight Movement and New Delivery Methods	Amy Moore (ORNL)	3-104	3.30	3.20	3.30	3.00	3.21
eems035	Coupling Land-Use Models and Network-Flow Models	Paul Waddell (UC-Berkeley)	3-108	3.50	3.30	3.20	3.10	3.31
eems036	Reinforcement Learning-Based Traffic Control to Optimize Energy Usage and Throughput	Tom Karnowski (ORNL)	3-112	3.25	3.00	3.17	3.08	3.09
eems037	High-Performance Computing (HPC) and Big Data Solutions for Mobility Design and Planning	Jane Macfarlane (LBNL)	3-117	3.25	3.25	3.25	3.25	3.25
eems038	Fuel Selection of Privately Owned Shared Vehicles	Shawn Salisbury (INL)	3-121	3.25	3.38	3.38	3.13	3.31
eems039	Commercially Fuel Selection for Fully Automated Owned Taxi Fleet	Timothy Lipman (LBNL)	3-124	3.00	3.00	2.75	2.63	2.92

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems040	Fuel Selection in Automated Mobility Districts/Dynamic Wireless Power Transfer Feasibility	Omer Omar (ORNL)	3-128	2.88	2.88	2.63	2.75	2.83
eems041	Hardware-Focused Connected and Automated Vehicle (CAV) Research: Experimental Results and Benefit Analysis	Eric Rask (ANL)	3-132	3.50	3.25	3.17	3.17	3.29
eems042	High-Performance Computing (HPC) Enabled Computation of Demand Models at Scale to Predict the Energy Impacts of Emerging Mobility Solutions	Jane Macfarlane (LBNL)	3-136	3.50	3.38	3.38	3.25	3.39
eems043	Mobility Behavioral Responses to Transportation Network Company Services	Alejandro Henao (NREL)	3-140	3.00	2.83	3.33	2.67	2.92
eems044	Estimation of Potential National Benefits of Advanced Fueling Infrastructure Deployment †	Joann Zhou (ANL)	3-144	3.17	3.50	3.67	3.50	3.44
eems045	Focused Validation of Select SMART Simulation Activities †	Erik Rask (ANL)	3-147	2.90	2.90	3.10	2.70	2.90
eems046	Understanding Connected and Automated Vehicles in Automated Mobility Districts †	Matt Shirk (Idaho National Laboratory)	3-150	3.30	3.10	3.40	3.40	3.23
eems047	An Estimation of Energy Impacts of Various Policies on Personal Travel Model in the San Francisco Bay Area †	Tom Wenzel (LBNL)	3-153	3.13	3.13	2.75	3.00	3.06

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems048	An Analysis of the Spatial Distribution and Impacts of One-Way Car-Sharing Programs on Transit Ridership and Energy Use †	Susan Shaheen (LBNL)	3-156	3.50	3.25	3.50	3.38	3.36
eems049	Vehicle Modeling and Data Analysis: Transportation Secure Data Center (TSDC), FleetDNA and FASTSim †	Jeff Gonder (NREL)	3-160	2.88	3.00	2.75	3.00	2.94
eems051	SMART Mobility Modeling for Typical Mid-Size City †	Andrew Duvall (NREL)	3-163	3.40	3.30	3.70	3.40	3.39
eems052	Resiliency Analysis for Automated Mobility Systems †	Joanne Wendelberger (LANL)	3-168	3.20	3.20	3.20	3.00	3.18
eems053	Infrastructure Spatial Sensing at Intersections †	Stan Young (NREL)	3-174	3.13	3.13	3.50	3.25	3.19
eems054	Infrastructure Impacts of SMART Technology: Data Analyses on Energy Use †	John Beck (INL)	3-179	2.50	2.50	2.75	2.75	2.56
eems055	Simulation Model Results for Energy and Mobility Impact of Behavioral Scenarios in POLARIS †	Josh Auld (ANL)	3-181	3.25	3.25	3.50	3.42	3.30
Overall Average				3.17	3.11	3.15	3.04	3.12

† Denotes a poster presentation.

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

Presenter
Huei Peng, University of Michigan

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer remarked that the project really stood out for having taken an excellent approach to developing both models and demonstrating real-world results and data in a robust setting.

Reviewer 2:
The reviewer observed a good timing plan with structure and clear deliverables.

Reviewer 3:
The reviewer acknowledged good plans to address all barriers.

Reviewer 4:
While it is a worthy goal to develop the models required for transportation analysis, and items such as driver behavior are an important aspect, the reviewer did not see the manner in which the 4.5 million miles of data are intended to assist with the model. The reviewer also found unclear what the project intended with the driver behavior model, and questioned whether the goal was to change it or to simulate changing behavior based on certain inputs. Lastly, the reviewer did not see a categorization of drivers listed.

Reviewer 5:
The reviewer stated that the project approach grew less impressive with the completion of each review cycle, and noted that each of the tasks appeared to be scratching the surface of several very large knowledge domains.
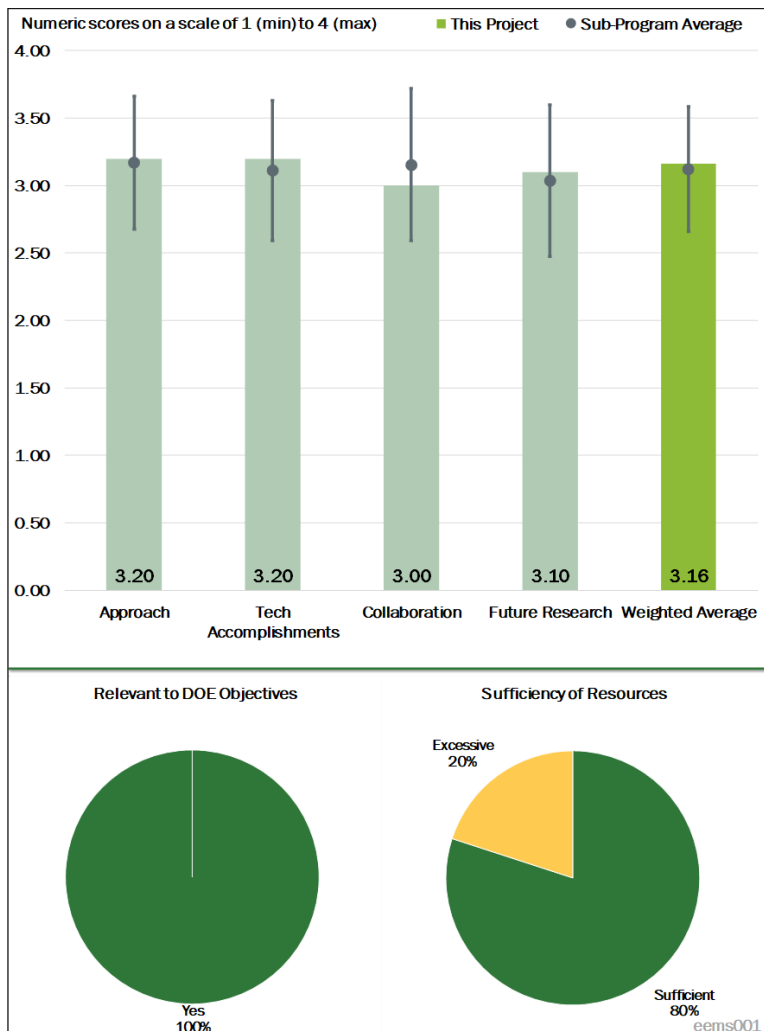

Figure 3-1 - Presentation Number: eems001 Presentation Title: Energy Impact of Connected and Automated Vehicles (CAVs) Principal Investigator: Huei Peng (University of Michigan

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer noted that the accomplishments, particularly compared to last year when data were just starting to trickle in, were excellent. The reviewer added that it was clear there was significant depth to the results and findings well beyond the presentation, and that having 4.5 million miles of data is no small accomplishment. The reviewer indicated, however, that some of the accomplishments as presented in the slides were a little thin. For example, Task 2 had an excellent approach using the random forest approach, but a slide on the highlights of what was found and predicted for this task was missing. Nevertheless, other tasks did show interesting results.

Reviewer 2:
The reviewer remarked that work done to date is on target, and suggested having the same driver evaluate different types of cars and comparing economy versus performance to see the difference in behavior.

Reviewer 3:
The reviewer indicated that technical issues have been met for cars.

Reviewer 4:
The reviewer observed that acceptable progress is being made, though it appears that a completion might be difficult with only six months left in the project.

Reviewer 5:
The reviewer is concerned that the most-clearly highlighted technical results were for Task 5 and those results were from a different project (i.e., the China study). The reviewer remarked that the collection of 4.5 million miles of driver behavior data sounded impressive, but inquired about evidence showing return on investment (ROI) for the data collection. The reviewer added that there is not much time left on the project to exploit the data.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer said the project has good partners and that they are all relevant.

Reviewer 2:
The reviewer commented that the work done with the University of Michigan is critical to achieving the metrics.

Reviewer 3:
The reviewer observed that all project partners appear to be performing work according to a coordinated schedule.

Reviewer 4:
The reviewer found it unfortunate that partners beyond the national laboratories could not be established.

Reviewer 5:
The reviewer pointed out that the collaboration is missing a private sector representative as well as cross-agency expertise (e.g., National Highway Traffic Safety Administration [NHTSA], Federal Motor Carrier Safety Administration [FMCSA], U.S. Department of Transportation [DOT]). Otherwise, the reviewer added, the collaboration with the two national laboratories and the University of Michigan seems to be very strong.

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 future work looks to be excellent and useful for the U.S. Department of Energy (DOE) in terms of gathering more data, completing or refining several models (including through the use of machine learning approaches), and moving forward with implementing adaptive traffic signal algorithms in Ann Arbor. All of these threads will be valuable and of great interest again at next year's AMR. The reviewer observed that continual improvement is targeted.

Reviewer 2:

The reviewer indicated that future work is logical in that it is a continuation of the previous and current work. The reviewer stated, however, that these efforts are just scratching the surface and appear to be the first—perhaps random—steps in a very long journey.

Reviewer 3:

The reviewer asked where it is possible to include test sites other than Ann Arbor to measure different traffic/driver scenarios and behavior.

Reviewer 4:

The reviewer observed that a few future challenges were listed, but not much time was spent discussing the possibilities.

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

Reviewer 1:

The reviewer acknowledged that the work is highly relevant and becomes more so each year despite being the original EEMS project.

Reviewer 2:

The reviewer is interested in the outcome of the work and its impact on driver behavior.

Reviewer 3:

The reviewer said this level of detail research is needed to move CAV development forward.

Reviewer 4:

The reviewer agreed that the work is moving in a general direction to support DOE's overall objectives, but that it may be some time before these efforts are mature enough to bear significant fruit.

Reviewer 5:

While fundamental research of driver choices and behavior is required, the reviewer saw no effort in this project to categorize the types of drivers or statistically report on these behaviors.

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 at over $2 million, there is no doubt that a significant amount of funding has been allocated for this project, though the results speak for themselves. The reviewer observed that it is plausible to reduce funding going forward with robust accomplishments continuing, but that maintaining the funding at this level will enhance the deliverables significantly now that the project has matured to this point.

Reviewer 2:

The reviewer observed no issue with project resources.

Reviewer 3:

The reviewer asserted that the project team has what is needed to complete project.

Reviewer 4:

The reviewer indicated that the ROI for the resource investment on this project was unclear.

Presentation Number: eems007
Presentation Title: Mobility Data and Models Informing Smart Cities
Principal Investigator: Joshua Sperling (National Renewable Energy Laboratory)

Presenter

Joshua Sperling, National Renewable Energy Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:

The reviewer remarked that the project attempts to address key research questions including human behavior, infrastructure, energy, travel, congestion, parking, and land use. The reviewer added that a complete list of research questions was presented, but that the disruptions the technology may impart to any of these areas must be analyzed and understood.

Reviewer 2:

The reviewer commented that the project smartly focused on gathering much-needed data to help the research community answer many important questions on automated, connected, efficient, and shared (ACES) mobility. As such, it has a somewhat unclear set of objectives because the creation and/or gathering of necessary data is highly uncertain. The reviewer expressed appreciation for this challenge, and noted that the direction seems to be good and logical nevertheless.

Reviewer 3:

The reviewer stated that the project purports to focus on data collection, analysis, and utilization for the purpose of better understanding changes in mobility infrastructure and operations. The reviewer indicated, however, that the presentation never made it clear exactly what data were being sought from what sources to probe what questions. The presentation talked about data from Systems and Modeling for Accelerated Research in Transportation (SMART) Cities, but never made clear which cities were involved—saying that there were seven finalists yet only mentioned six cities—or who was collecting what data. The presentation talked about some interesting data from Austin, Texas and Columbus, Ohio, but never made it clear if these data sets were collected in a consistent manner or if they are comparable in any way.
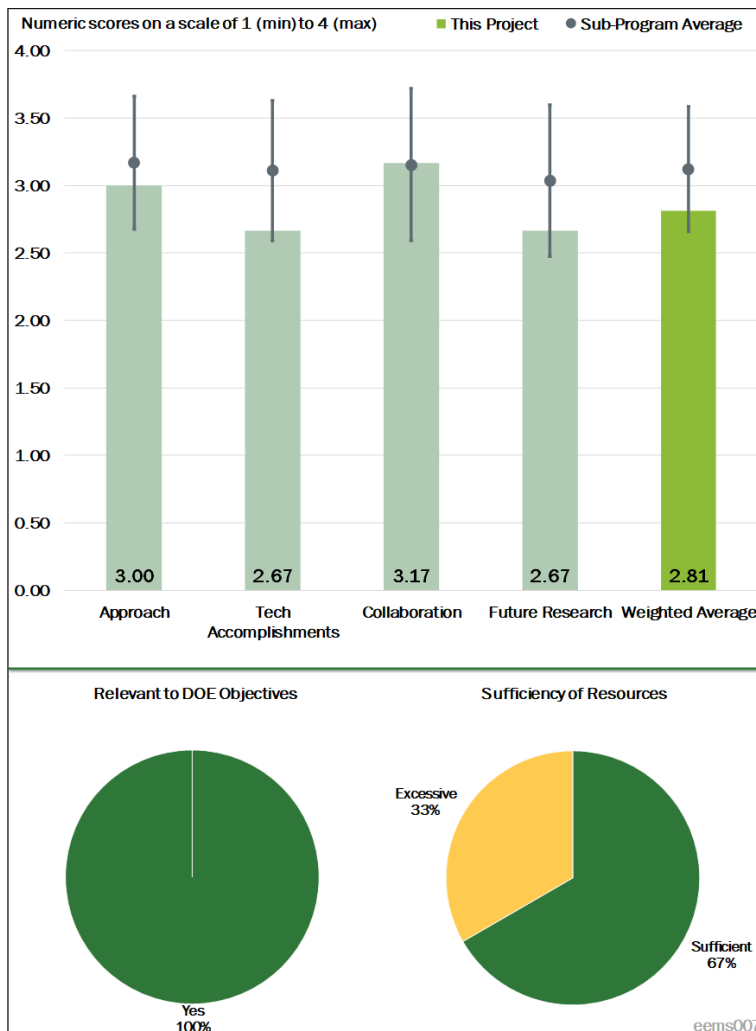

Figure 3-2 - Presentation Number: eems007 Presentation Title: Mobility Data and Models Informing Smart Cities Principal Investigator: Joshua Sperling (National Renewable Energy Laboratory

To make a worthwhile contribution to the field, the reviewer noted that the research team needs to do a better job of identifying what very specific questions to answer, what data would provide insight into answering those questions, and then formulate the best approach possible for gathering that data given the constraints imposed by time, funding, and lack of cooperation from participants/subjects. The reviewer indicated that at least a dozen potential sources of data could have been considered and either tried or ignored, but this presentation did not identify any specific sources of data other than vehicle registrations.

The reviewer said the research team needs to identify specific worthwhile questions and then identify potential sources of data that would provide insight or partial answers. As examples, this reviewer inquired about changes in the number of on-road cars at these times in this city over the last 2 years since Transportation Network Companies (TNC) began operating; the number of vehicle miles travelled in that time; the average number of passengers; and how that changed. Sources of data could be car rental companies, TNC, urban transit companies, taxi fleets, airport ground transportation companies, hotels, existing phone applications such as Google Maps and Waze, car dealers or car selling services such as CarMax or Car Gurus, surveys of fleet drivers—either online or paper—or employer-enforced phone company data on location/movement of smart phones, vehicle registrations, oil change records, other research projects, or car manufacturers or leasing companies. Regarding car manufacturers or leasing companies, this reviewer asked whether there is a change in car mileage at the end of their leases.

The reviewer added that if such data are not accessible, then more direct means of collecting data could be considered, such as instrumentation of a subset of all cars or creation of an application that could be downloaded to a subset of drivers to track their movement and number of passengers. All of these have some level of practicality, but the presentation does not make clear what sources of data were considered—other than vehicle registration and SMART Cities sources—or identify what data are needed in what quantity or fidelity to be useful. The reviewer concluded that these issues need to be addressed to have a well-conceived project.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer remarked that the use of the SMART City partners in obtaining data on urban models is particularly insightful. The reviewer added that the analysis will be favorable to future decisions despite being challenging due to lead/lag enablers.

Reviewer 2:
As the project is a bit unclear on its exact roadmap for collecting and cataloging its data, the reviewer found it hard to objectively measure progress. The reviewer expressed that, subjectively, there appear to be many reasonable steps and choices. The reviewer added that, given how little data on ACES exist in the public domain, or even under non-disclosure agreements (NDAs), it is understandable that the project is casting a wide net. The reviewer stated that it would also be helpful to have a clearer documentation of failures, such as, "We tried to gather this, but ran into these roadblocks." This would, in many cases, help the research community understand what has been done and avoid duplication of this project's efforts.

Reviewer 3:
The reviewer could not tell how much progress has been made or what kind of progress it has been, adding that while the presentation included several slides that used the words "Technical Accomplishments," the project team was unclear about specific accomplishments. The reviewer could not tell if the slides were just repeating data and conclusions from other prior studies, or if they were presenting new results and conclusions. The reviewer noted that the slides were a collection of differing formats and contents, some with bullet points and incomplete thoughts while others had long paragraphs that seemed to describe problems and not accomplishments. The reviewer added that other slides had tables that are virtually incomprehensible. The

reviewer stated that while the team has analyzed something and identified some trends or changes, such as those summarized on Slide 16, there is no consistent summary of accomplishments towards any clearly defined goals.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer commented that the project collaboration brings together excellent skills and data potential, particularly with the SMART City partners.

Reviewer 2:
The reviewer expressed that the team appears to have been very successful in identifying and networking with those that do have data and are willing to share. The reviewer commended attempts to come up with a common set of metrics across metro areas.

Reviewer 3:
The reviewer stated that there appears to be some collaboration between team members simply because some slides refer to different members of the team, but that the presentation never makes clear who is supposed to being doing what for what reason. The reviewer noted that, based on the presentation, all team members are vaguely defined and seem to be doing exactly the same thing for the same reasons. The reviewer concluded that the roles of the different team members need to be defined (i.e., identify who is doing what and why).

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

Reviewer 1:
The reviewer observed that future work described in this project appears to be focused on achieving the stated objectives of the project, adding that data will be necessary to advance the predictive or decision-making capabilities.

Reviewer 2:
The reviewer expressed that the general direction of the project is good despite the understandable lack of certainty in that certain data can be collected and synthesized. In addition to collecting data from partnerships with various metro areas, the reviewer encouraged the team to think deeply about how to create additional data, especially on the usage of TNC vehicles. The RideAustin data are valuable, but it is just one metro area for one period of time. While Uber and Lyft may not want to share data, there are other TNCs that may be more willing to share (or sell) their data.

Reviewer 3:
The reviewer indicated that the plan for the future, as stated in the presentation, revolves around data, yet only a vague description of the potential sources of that data are provided. The reviewer added that the phrases "upscaling urban data integration" and "new emerging data and models" tell the observer almost nothing, adding that this is not surprising given that the presentation never defines what data are required nor how they might be collected. As a result, the reviewer observed, the future plans are very general.

The reviewer also remarked that the research questions posed on Slide 20 are all much too vague and high-level to be of value. The questions must be much more specific to provide guidance for the future, and there are no decision points or thoughts about mitigating risks because there is no clear path that this work is following. The reviewer affirmed that the project team is trying to do something useful with limited inputs, but that the team needs to do a better job of defining where the project is going and why. Once this is defined, the

project plan will describe how to get there. The reviewer warned that none of that seems to exist in any concise form at the moment.

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

Reviewer 1:
The reviewer asserted that DOE objectives are clearly being met by sponsoring this analytical project.

Reviewer 2:
The reviewer noted that a clear lack of data remains one of the biggest issues for EEMS, and that this project is taking that challenge on directly. If successful, the reviewer added, the project will help other EEMS groups working narrower projects.

Reviewer 3:
The reviewer stated that DOE has an objective of better understanding SMART mobility and assessing how it will impact energy use and infrastructure requirements in the future. The reviewer commented that the project might help provide insights toward that objective if it were better planned and executed. Although the project is operating in the right topic area to support DOE's objectives, this reviewer emphasized that it is currently doing very poorly because the research plan is deficient.

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

Reviewer 1:
The reviewer stated that this project appears well funded for successful completion.

Reviewer 2:
The reviewer expressed that it is hard to know how and where the money is being spent as no specific budget was included. The reviewer noted that, nevertheless, purchasing or creating data needs to be considered even if this meant an increase in budget.

Reviewer 3:
The reviewer noted that the appropriateness of the resources and their allocation on this project are not clear. While Slide 2 indicates an overall project funding of $1.65 million, the slide states that funding in Fiscal Year (FY) 2017 and FY 2018 is only $220,000. The reviewer thus questioned where the rest of the funding is going, whether it has been spent already or being held for 2019, or whether it is being spent by other team members.

Based on the muddled work plan, the reviewer believed that the funding is not being put to good use and that the fact that the roles for the different team members are not clearly defined reinforces this. The reviewer remarked that a budget of $1.65 million should be sufficient to do some interesting things from a data collection standpoint, such as generating surveys, developing applications, paying drivers to collect data, paying private companies for data, or even instrumenting a subset of vehicles with data collection devices. The work plan mentions none of these techniques, making an observer believe that the project team is hoping to obtain data collected by someone else and then evaluate it to see what it might say. The reviewer warned that this approach may be inadequate and, unless the project team can devise a better plan, the resources devoted to this are excessive.

**Presentation Number: eems009
Presentation Title: Modeling and
Simulation of Automated Mobility
Districts
Principal Investigator: Venu
Garikapati (National Renewable
Energy Laboratory)**

Presenter
Venu Garikapati, 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 and well-
planned.**

Reviewer 1:
The reviewer noted that the approach is
good for a complicated task.

Reviewer 2:
The reviewer observed that the
approach to studying and evaluating
Automated Mobility Districts (AMD)
by the detailed study of one such area is
compelling. The reviewer believes that
this more limited analysis—as opposed
to some very large-scale, all-inclusive
models—will give accurate insight to
the benefits of an AMD during these
developmental periods of time.

Figure 3-3 - Presentation Number: eems009 Presentation Title: Modeling
and Simulation of Automated Mobility Districts Principal Investigator: Venu
Garikapati (National Renewable Energy Laboratory)

Reviewer 3:
The reviewer remarked that the approach seems aligned with how municipal entities can utilize the modelling
capability.

Reviewer 4:
The reviewer stated that the overall design of the study is well-focused and does a good job at addressing the
questions at hand. The reviewer looks forward to more detailed results in the coming year.

Reviewer 5:
The reviewer remarked that the approach and objectives are well laid out, clear, and focused.

Reviewer 6:
The reviewer found it unclear how preliminary AMD simulation is correlated to real-world AMD and whether
the results from the simulations provide value. The limited size of the automated electric shuttles (AES) fleet
may make it difficult to correlate the effect of the AES on the AMD. Because customer awareness and
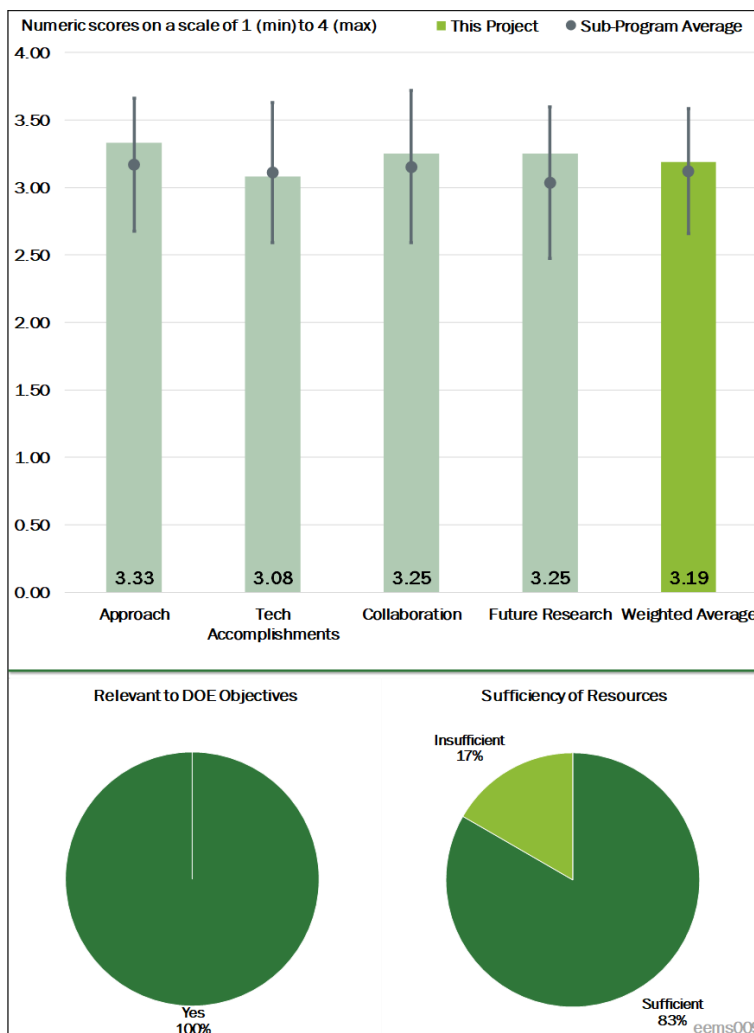
acceptance are large factors to the usage behavior, the reviewer recommended providing an overview of the initiatives in these areas.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer observed good accomplishments so far.

Reviewer 2:
The reviewer did not have any serious concerns thus far, and noted that the amount of output appears to be on track with the plan.

Reviewer 3:
The reviewer indicated that progress appears to be good, but suggested it may have been better with greater, earlier cooperation of Greenville model boundaries (appears to be commonly confronted Memorandum of Understanding [MOU] negotiations). The reviewer noted that human choice behaviors do not appear to be analyzed in the project, adding that as difficult as they are to predict, the human element is the most variable to the transportation efficiency.

Reviewer 4:
The reviewer reported good progress. Regarding the mode share, the reviewer questioned which assumptions were used to create the third scenario, and asked whether a similar mode shift from TNCs was assumed.

Reviewer 5:
The reviewer found unclear how relevant the preliminary AMD simulation results are. The reviewer observed that a relationship between the transition from walking to automated shuttle use and the corresponding change in vehicle average travel time (VATT)—including walking—seems integral to the quantification of net mobility, yet it has not been demonstrated. The reviewer added that fuel consumption should include an equivalent value for electricity consumed to power the AES vehicles.

Reviewer 6:
The reviewer stated that progress was a bit difficult to evaluate with the information provided, but that it looks good overall.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer stated that a good team was assembled.

Reviewer 2:
The reviewer commented that the addition of these transportation districts since last year will bring added benefit to the analysis. The reviewer remarked that the SMART Mobility Laboratory Consortium is an extremely talented base of collaborators, and is almost assured of a successful completion to this project.

Reviewer 3:
The reviewer commended collaboration across military, education, cities, and government laboratories.

Reviewer 4:
The reviewer expressed no concerns with the project team, and applauded the interaction with Greenville. The reviewer stated that Slide 9 mentions Austin, but that no further details were provided and it is unclear whether that was a mistake in the slides.

Reviewer 5:

The reviewer suggested the project team collaborate with the Federal Transit Administration for any nexus with their research on automated buses and shuttles. The reviewer questioned whether the project team had coordinated with other transit agencies that are attempting to pilot automated shuttles.

Reviewer 6:

The reviewer stated that the extent or effectiveness of collaborations was not possible to determine from the slides presented. For example, the reviewer was not able to determine what data are being provided by City of Greenville, how do those data fit into the simulations, and how data privacy is being addressed.

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 future research and developments will be very valuable.

Reviewer 2:

The reviewer stated that the proof of the techniques' effectiveness will be assessed in the Greenville study, and that, if successful and valuable, the expanded use of this analysis could be used for broader analysis as planned.

Reviewer 3:

The reviewer expressed that accomplishing the proposed future research would be essential to demonstrating some value of the research done thus far, adding that the proposed research looks appropriate and impactful.

Reviewer 4:

The reviewer indicated the plan looks good and that the next phase is when the project starts getting interesting results. Although perhaps beyond this project's scope, this reviewer suggested some discussion of how this AMD modeling might be extended over larger geographies in the future.

Reviewer 5:

The reviewer affirmed that the FY 2019 work provides a good focus on applicability and usability of the product.

Reviewer 6:

The reviewer commented that the integration of the Future Automotive Systems Technology Simulator (FASTSim) to perform energy analysis is not clear. The reviewer added that fulfilling the main project objective of quantifying energy impacts of ACES deployed in dense urban districts requires greater analysis than indicated.

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

Reviewer 1:

The reviewer observed that, once applied, the project will save fuel and reduce congestion.

Reviewer 2:

The reviewer noted that, similar to other EEMS programs, the analysis is essential for studying and identifying areas for public policy needed to reduce energy use and provide the public with clean and efficient mobility options.

Reviewer 3:

The reviewer commented that it seems plausible that the earlier, real-world, highly automated mobility-as-a-service (MaaS) would occur in a limited campus or district. These modeling tools could then be used to check against a ground truth that actually exists. The reviewer added that further thought should go into broadening the AMD work to larger geographies, though that may be out of scope for the current project.

Reviewer 4:

The reviewer noted that there is a clear connection to energy consumption.

Reviewer 5:

The reviewer stated that the project supports overall DOE objectives by developing modeling capabilities to estimate impact of AMDs.

Reviewer 6:

The reviewer observed that the project objectives are a restatement of the overall DOE objectives for this program.

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

Reviewer 1:

The reviewer warned that resources appear to be insufficient to cover the large scope in determining impact of AMDs, and that with larger funding more sites could be explored and modeling correlation could be more robust.

Reviewer 2:

The reviewer affirmed that the project has sufficient resources.

Reviewer 3:

The reviewer stated that resources are in line with what is required for this type of effort.

Reviewer 4:

The reviewer observed that no detailed budget was provided, but that overall budget appears reasonable for the scope of the project.

Reviewer 5:

The reviewer remarked that nothing in the presentation indicated anything other than sufficient resources.

Reviewer 6:

The reviewer expressed difficulty in assessing resources needed for the project, and added that no mention of deficiencies were presented nor explained.

Presentation Number: eems011
Presentation Title: Travel Behavior Modeling in Urban Areas using Behavior, Energy, Autonomy, and Mobility (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 and well-planned.

Reviewer 1:
The reviewer remarked that this is a challenging multi-discipline project, and expressed that the approach of enhancing the model, validating it, and then conducting analysis seems solid.

Reviewer 2:
The reviewer noted that this is a highly skilled effort to simulate multiple variable transportation mode selection and optimization for energy efficiency. The models being developed, though analyzing energy use, must attempt to project scalable future decisions (i.e., behaviors) of users (i.e., agents) in a changing environment of needs and choices.
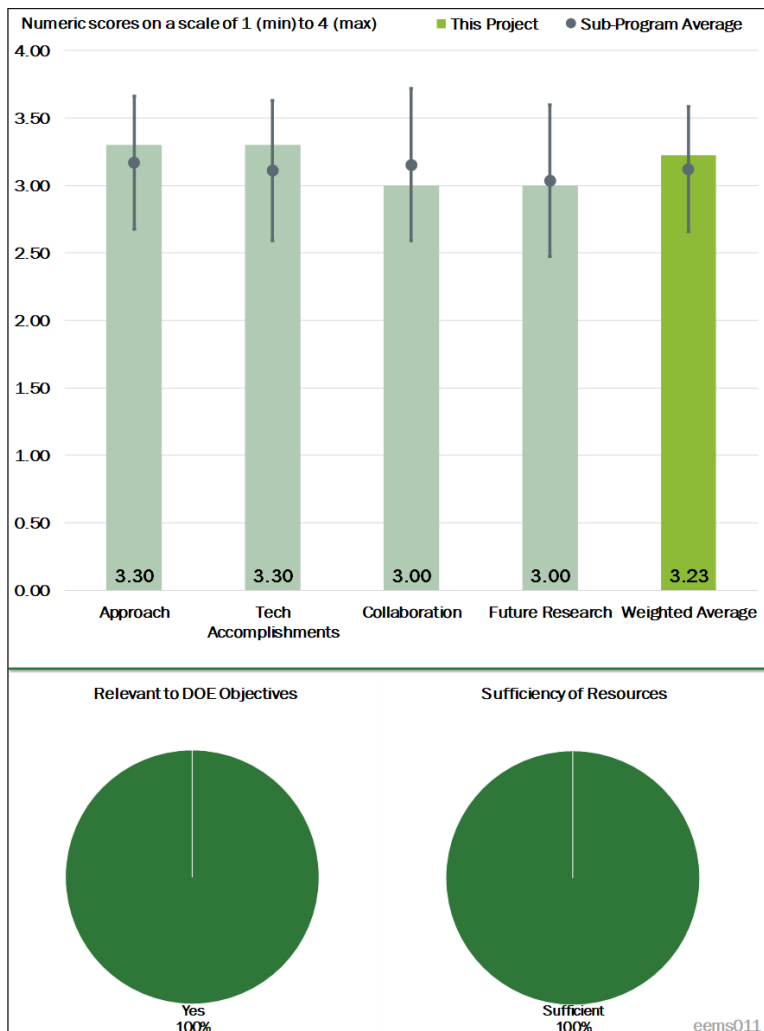

Figure 3-4 - Presentation Number: eems011 Presentation Title: Travel Behavior Modeling in Urban Areas using Behavior, Energy, Autonomy, and Mobility (BEAM) Principal Investigator: Colin Sheppard (Lawrence Berkeley National Laboratory)

Reviewer 3:
The reviewer stated that, overall, this is a rational, measured approach focused on incremental improvements to models. The reviewer commented that the transportation system is becoming more complex, and this project is attempting to reflect—and thus model—this more effectively in order to obtain energy consumption and other impacts. The reviewer said that the only concern might be that, given that this project is focused on addressing an increasingly complex area, there could be an argument made for a continuous, on-going project long beyond the currently-identified schedule.

Reviewer 4:
The reviewer remarked that the focus on incorporating behavioral insights in modeling is valuable, but pointed out that the reliability of validation and other methodological elements is unclear given the qualitative differences between existing and emerging mobility options. The reviewer concluded that the treatment of the value of time looks simplistic as it does not appear to reflect the ability to be productive in transit.

Reviewer 5:

The reviewer observed that the project aims to endogenize traveler behavior in Behavior, Energy, Autonomy, and Mobility (BEAM)—a fully multimodal and scalable urban simulation tool—to understand the impact of behavior on regional energy outcomes. The reviewer added that the project will enable a full range of multimodal travel decision making in agent-based transportation system models. The reviewer stated that the project is intended to continue to develop BEAM, but there is no listing presented of the individual travel decisions that are included in the previous model development. Therefore, while the approach may be technically able to progress, there is no way to determine whether the approach has included the necessary current and future modes of travel since only those elements to be added are listed.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer remarked that the project appears to be on schedule and has made significant progress towards its goals and addressing its barriers.

Reviewer 2:

The reviewer asserted that the project has an excellent assembly of resource markets to simulate behavioral transportation behavior, and that considerable variable input boundaries have been included for meaningful analysis.

Reviewer 3:

The reviewer commented that technical accomplishments are significant and consistent with project objectives.

Reviewer 4:

The reviewer observed that, over the past year, a number of modules have been added to attempt to reflect more elements of the overall picture, particularly more recent items like ride-hailing. In particular, the team added necessary constraints to the system in the areas of road/vehicle capacity, parking/refueling access, and TNC capacity.

Reviewer 5:

With respect to Slide 8, the reviewer pointed out that the project is adding many new elements to BEAM. The reviewer stated that the full features model will happen later in 2018, but that only what has been added was reported and instead of the full features that will be available. The reviewer questioned whether it was assumed that reviewers were all intimately familiar with BEAM, adding that it should have showed both what was already there and what is to be added in order to evaluate if it would truly be a full-featured system at year end.

Regarding Slide 9 and BEAM, the reviewer asked how this product would be used and by whom, saying that it seems to be a tool for academic use and not one useful for transport planners. The reviewer said that the project is too math-oriented and very academic, leaving uncertainties as to how it would be used in the real world.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer noted that coordination with team members, as well as with related research EEMS017, was clear.

Reviewer 2:

The reviewer said that while the presentation did not elaborate on the exact contributions of each team, based on both the progress and skill sets it appears that the teams are collaborating very well.

Reviewer 3:

The reviewer observed that there seems to be good collaboration between the project members. The reviewer believed input from local city representatives for San Francisco, Chicago and DOT would be valuable. It was not clear to the reviewer whether the team had looked into that collaboration or coordination, if even it was just to get feedback on the results thus far.

Reviewer 4:

The reviewer acknowledged that the project team, led by Lawrence Berkeley National Laboratory (LBNL), also includes other involved laboratories, a university, and an industry partner who supports local planners. The reviewer offered that it might have been interesting to have included a local government or two in order to provide a stronger and more direct link to real-world data and issues, as well as smoothing the path to implementation.

Reviewer 5:

The reviewer indicated that there are only internal collaborations and no collaborators outside of DOE. The reviewer stated that this is a transportation modeling tool, and asked where the inputs of the transportation planners and providers of transportation services are in order to bring reality to the tool.

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

Reviewer 1:

The reviewer believed the future research is within the project scope and milestones, and affirmed that the project will focus on San Francisco and Chicago. The reviewer expressed that it would be good to understand how effective the model would be for other cities with different population densities.

Reviewer 2:

The reviewer stated that the FY 2019 work shown in the presentation described a logical progression of the project.

Reviewer 3:

The reviewer noted that future incorporation of Whole Traveler results and multiple impact assessments looks reasonable.

Reviewer 4:

The reviewer stated that, overall, the proposed future efforts seem to make sense and are focused on incremental improvements and additions to the model. The reviewer found the calibration and validation of particular interest, as they will determine the ultimate accuracy of the model. Because these efforts have only begun, the reviewer was unclear on how effectively these functions will be completed. The reviewer was also unclear on the periods of time (i.e., duration span of the data) that will be used to ensure accuracy.

Reviewer 5:

The reviewer remarked that, without collaborations outside of the national laboratories and academic circles, the future research will make the end-product only marginal in applicability. The reviewer questioned when the user community would join this project.

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

Reviewer 1:

The reviewer stated that all EEMS projects address reduced petroleum dependence.

Reviewer 2:

The reviewer noted that the project is focused on improving models for determining energy consumption impacts based upon transportation implementation, including both technologies and behavior. The reviewer commented that the hope would be that, once calibrated and validated, such models could be used to determine the energy impacts of different policies, technologies, or behaviors introduced into implementation.

Reviewer 3:

The reviewer indicated that the models must provide insight on future transportation decisions, which will greatly affect the transportation efficiency and thus energy efficiency of society.

Reviewer 4:

The reviewer affirmed that the project supports DOE's objective of petroleum consumption reduction and EEMS's objective of decoupling mobility from energy use.

Reviewer 5:

The reviewer agreed that the subject matter is relevant, but remarked that the approach and lack of collaborations makes it marginally useful in the real world. In that light, the reviewer affirmed that the question of whether the project is a good investment looms.

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, based on the project's progress with the funding provided, project resources seem to be sufficient.

Reviewer 2:

The reviewer noted that the resources look reasonable.

Reviewer 3:

The reviewer said the resources appear sufficient for now. The reviewer questioned whether this project's efforts are more of a continuous nature and would thus go on past the currently-identified schedule, requiring additional resources.

Reviewer 4:

The reviewer indicated that, although resources were not elaborated upon during the presentation, it appears that there is significant progress at the allocated budget.

Reviewer 5:

The reviewer expressed difficulty in stating whether resources are sufficient when the outcome appears to be flawed. The reviewer stated that the problems are due to lack of a good plan that needed broader collaborative partners, and suggested the program office assess whether this is a lack of resources or simply bad planning.

**Presentation Number: eems013
Presentation Title: Integrated
Framework to Quantify the Energy
Impact of New Mobility Technologies
from Individual Vehicle to
Metropolitan Areas
Principal Investigator: Aymeric
Rousseau (Argonne National
Laboratory)**

Presenter
Aymeric Rousseau, 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 and well-
planned.**

Reviewer 1:
The reviewer said the project seems like
an interesting integration of analysis
tools.

Reviewer 2:
The reviewer stated that the project
continues to expand the capabilities of
the simulation tool suite in a
comprehensive manner and noted that
the features added are highly relevant to
DOE's Vehicle Technologies Office
(VTO) projects and improve analytical
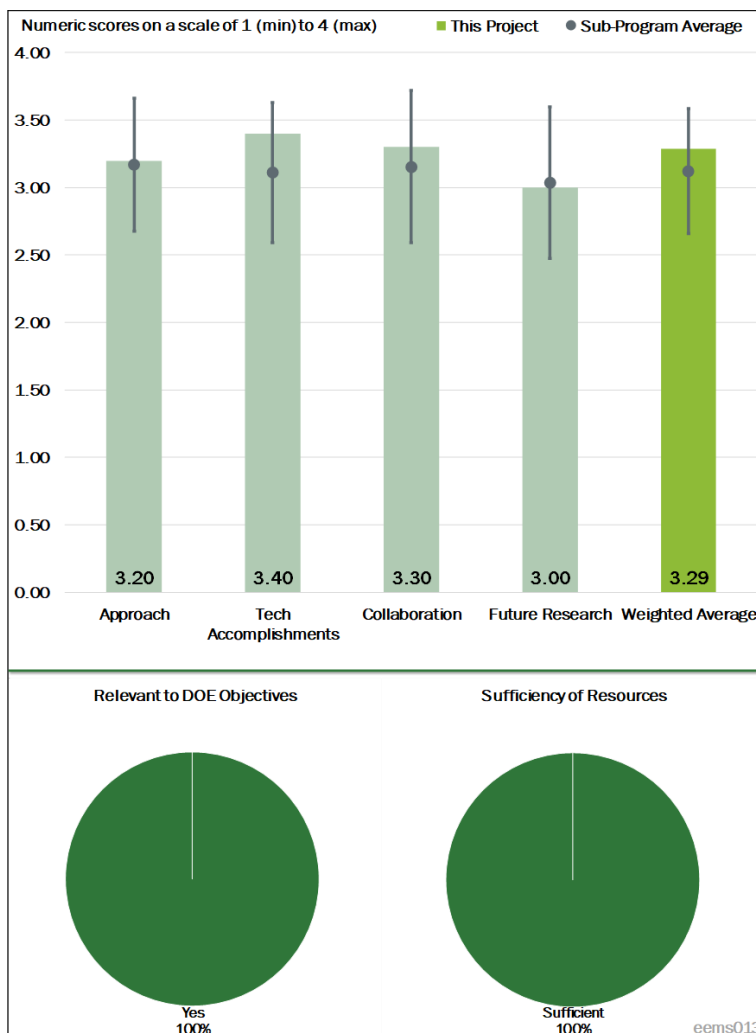capabilities.

Figure 3-5 - Presentation Number: eems013 Presentation Title: Integrated
Framework to Quantify the Energy Impact of New Mobility Technologies
from Individual Vehicle to Metropolitan Areas Principal Investigator: Aymeric
Rousseau (Argonne National Laboratory)

Reviewer 3:
The reviewer liked that that the project team is progressing the tools, but noted that it was a very generalized
presentation.

Reviewer 4:
The reviewer acknowledged that the project team developed the Advanced Model Based Engineering Resource
(AMBER) workflow manager—a new transportation system level simulation tool developed by Argonne
National Laboratory (ANL)—that includes: Autonomie, a vehicle level simulation based on powertrain;
RoadRunner, a multi-vehicle corridor travel simulation; Stochastic Vehicle Trip (SVTrip), a commercial tool;
and the Planning and Operations Language for Agent-based Regional Integrated Simulation (POLARIS), a
DOT agent-based transportation network system.

Reviewer 5:

The reviewer stated that the approach is overall good as integrating models will be essential to answering system-wide questions. The big missing piece is on demand, where many of the most important effects to model will be. The reviewer understood that this is not necessarily in scope now, but noted that the approach needs to include efforts to make it easy to integrate with demand models that are being developed in the future, and represent important feedback such as cost and time of travel.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer remarked that impressive progress and important technical work have been achieved, primarily as tool development to support novel research.

Reviewer 2:

The reviewer indicated that the project is on track, and that progress on enhancing POLARIS is impressive.

Reviewer 3:

The reviewer affirmed that the project team developed vehicle models for the latest technologies (more than 125 xEVs by analyzing powertrain by OEM) and significantly expanded medium- and heavy-duty vehicle model capabilities (13 vehicle classes representing more than 50% of the U.S. truck population and a large number of test cycles). The main studies developed include Advanced Combustion Engine targets updates, Co-Optima benefits quantification, and real-world fuel economy predictions. This reviewer further observed updated RoadRunner process automation, expanded POLARIS capabilities (to share study results with research community), and migration to Linux for HPC.

Reviewer 4:

The reviewer would have found it useful knowing what the project team actually spent its money on, and reported that it is just a large number—$4.5 million over FY 2015-2018. The reviewer asked whether the project team accomplished all of its goals, whether everything went as planned, and if there were any issues.

Reviewer 5:

The reviewer found it hard to assess the technical accomplishment and progress from this presentation, adding that the presenter went through the material too quickly and was unable to finish in time.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer stated that there are many users and a strong consortium.

Reviewer 2:

The reviewer noted an impressive number of collaborative organizations, and indicated that the necessary linkages for tool design input are in place.

Reviewer 3:

The reviewer observed numerous users from government, industry, and academia supporting a number of DOE programs, including VTO program areas, the Advanced Research Projects Agency-Energy (ARPA-E), and the corporate average fuel economy (CAFE). The reviewer added that there are various university, DOE national laboratories, and government agency partner collaborations.

Reviewer 4:

The reviewer would have liked to see a responsibility assignment chart showing what each partner actually did. The reviewer would have also liked to know whether users were interviewed and what their concerns were, how much money was spent with outside companies, and what the team's expected budget going forward is.

Reviewer 5:

The reviewer indicated that only a list of many companies was provided without details.

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

Reviewer 1:

The reviewer noted that the project is 95% complete (started in FY 2015 and ended in September 2018), and the proposed future research is to continue to develop and apply tools to estimate mobility and energy impact of new technologies in support of EEMS programs. The reviewer added that specific topics include traveler decisions, building energy, charging network and usage, new mobility services, and metropolitan areas.

Reviewer 2:

The reviewer noted that the project is nearly complete, but should include some plan for integrating with models that can represent travel behavior.

Reviewer 3:

The reviewer indicated that the proposed future research description is generally good, but could be improved with more specific goals and tasks.

Reviewer 4:

The reviewer asked exactly what the project team is looking at to support EEMS activities. The reviewer would have liked more planning what is expected next. The reviewer would have also found it helpful to show what vehicles and powertrains were modeled, and whether any proposed new powertrain combinations will be modeled.

Reviewer 5:

The reviewer strongly declared that the presenter ran out of time.

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

Reviewer 1:

The reviewer said the project is a good development of analysis tools and models.

Reviewer 2:

The reviewer commented that this a core project on DOE EEMS goals.

Reviewer 3:

The reviewer affirmed the project's tools are critical for energy analysis of DOE projects exploring technologies or policies to reduce energy consumption.

Reviewer 4:

The reviewer stated that the project simulation tools and results support a number of VTO projects as well as organizations throughout the world to define research and development (R&D) targets, evaluate the benefits of advanced technologies, and provide R&D guidance which all contributes to DOE objectives of reducing petroleum use and dependence to increase U.S. energy security.

The reviewer loved all of this modeling and simulation for supporting DOE objectives, including "what if" powertrains in the future. However, the reviewer did not see that in this project. The reviewer asked if the project team is planning to do that, and what technologies, battery efficiencies, and break-throughs would need to be in play to do this. The reviewer further inquired about how much it would take to do the R&D for these breakthroughs.

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

Reviewer 1:
The reviewer indicated that resources seem sufficient.

Reviewer 2:
The reviewer stated that $1.5 million in FY 2018 funding and $4.5 million from FY 2015 to FY 2018 seem appropriate given the wide breadth of simulation tools that this project supports and connects in the new AMBER simulation tool framework.

Reviewer 3:
The reviewer noted that the budget allocation has been steady and the proposed work is being completed within the assigned resources.

Reviewer 4:
The reviewer could not tell from the presentation if the project team's resources were sufficient or not. The reviewer asked what the project team really accomplished versus its goals, and what was not accomplished. The reviewer concluded that a good self-assessment was lacking here and cannot be assessed by a reviewer.

Reviewer 5:
The reviewer assumed that resources were sufficient, as it was not brought up in the presentation.

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

Presenter
Dominik Karbowski, Argonne 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 and well-planned.

Reviewer 1:
The reviewer observed that modeling tools being developed are appropriate to the task. The reviewer said the RoadRunner solution is a good approach to tackling the simulation requirements, and suggested making it more flexible so that it can be more easily adapted to other vehicle simulation tools. The reviewer also commented that the theoretical optimization study is useful to obtain upper bound on benefits attainable with eco-routing.
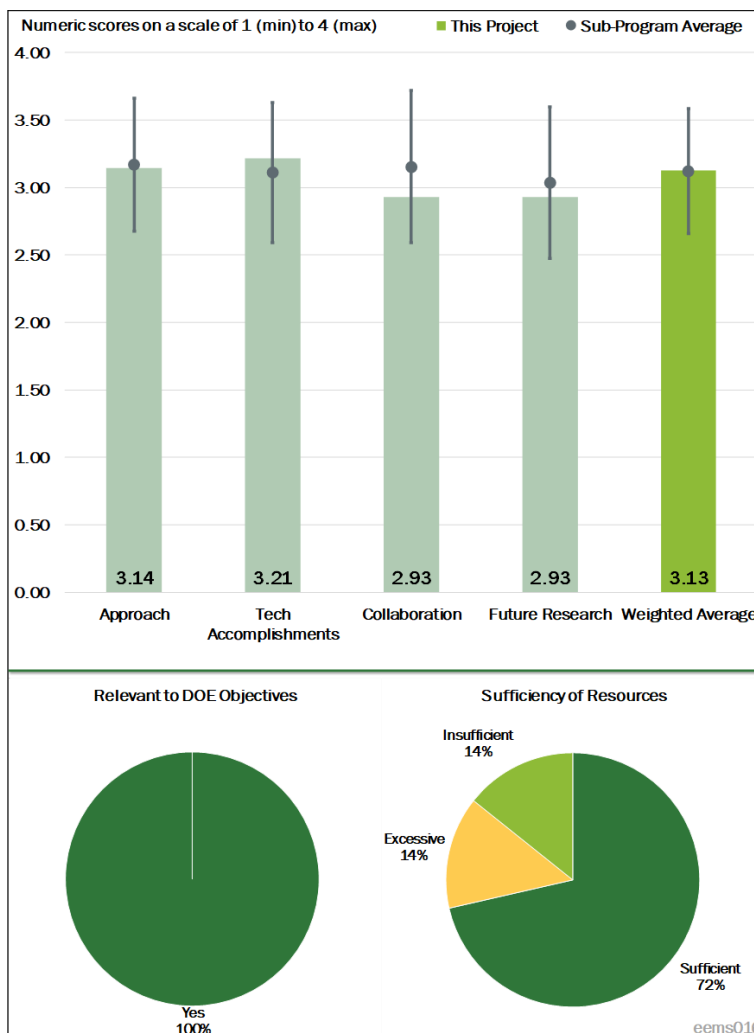

Figure 3-6 - Presentation Number: eems016 Presentation Title: Energy-Efficient Connected and Automated Vehicles (CAVs) Principal Investigator: Dominik Karbowski (Argonne National Laboratory)

Reviewer 2:
The reviewer said the research is well thought out and progressive. The reviewer observed that the approach focused on eco-driving research for optimal and predictive CAV speed and powertrain control for best fuel efficiency, and on the development of a multi-CAV simulation framework (i.e., RoadRunner) for varying powertrain and traffic scenarios. The reviewer remarked that the approach utilizes existing tools like the Autonomie model, and ties with data and work others are producing in the area. The reviewer noted that the research team plans to eventually release RoadRunner to the public as a CAV research tool.

Reviewer 3:
The reviewer would like to see a comparison between POLARIS and RoadRunner and the value that each of these approaches brings to estimating energy savings for connected and automated vehicles (CAV). The reviewer inquired as to why both tools are needed, and observed that both tools seem to use Automonie as a calculating engine for fuel use.

Reviewer 4:

The reviewer stated that the project is well scoped and methodological for addressing the technical barriers. The reviewer suggested that further improvements would be to comprehend the sensitivity of dynamic speed control and the acceptance by passengers and impacted human drivers of surrounding vehicles.

Reviewer 5:

The reviewer remarked that this is an interesting project that fits well in the overall theme of the SMART Mobility Consortium, though the approach taken is rather confusing. The reviewer was not clear on why both an offline (i.e., optimization) and online (i.e., model predictive control [MOC]) framework had been used.

The reviewer was also confused as to why the principal investigators (PIs) developed a car-following model at a time when there are so many well-documented models available in the literature, e.g., Gibbs, Widemann. The reviewer inquired as to how the proposed car-following model is different from the aforementioned ones, how the RoadRunner is associated with the vehicle controller, and which assumptions were used.

Reviewer 6:

The reviewer stated that, at a macro level, the work covered important factors, though it was unclear how large the simulated system is. The reviewer commented that, while it is reasonable to start with a limited number of vehicles and limit complexity, there remains a need to understand the limits of this output and structure a pathway to model complexity of systems with orders of magnitude more vehicles.

Reviewer 7:

The reviewer observed that the project is trying to improve an existing analysis tool, RoadRunner, and that the overall intent was stated as having a system that may be incorporated in salable vehicles. The reviewer noted that there are many more parameters that need to be included before any established vehicle company would even consider using the control system.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer observed that progress seems to be excellent, with the stated sub-goals substantially completed on time.

Reviewer 2:

The reviewer appreciated the approach shown on Slides 6 and 7 to address the situations that are trying to be proven. The reviewer found the 3%-7% shown on Slide 17 reasonable when balancing all drive cycles together. For stating CAV potential savings, the reviewer prefers this approach over stating large fuel economy improvements for very specific situations. The reviewer did not see accessory load assumptions listed in the material.

Reviewer 3:

The reviewer observed that the researcher indicated the project was 40% complete as of the AMR, which appears to be a little behind schedule for a three-year project that started in October 2016. The reviewer noted that FY 2018 accomplishments included completion of a closed loop eco-driving controller with predictive control, as well as case study development of eco-driving strategy energy impacts for conventional and hybrid electric vehicle (HEV) powertrains and further development of the RoadRunner framework, including validation and case studies. The reviewer further noted that framework development efforts include further integration with Automonie algorithms and collaboration with HERE for roadway route data and updating human driver models. The reviewer also noted that research implemented model-predictive control (MPC) in RoadRunner as a first step to next year's work.

Reviewer 4:

The reviewer indicated that progress is very good, and that it would be helpful to understand the assumptions underlying the baseline human driver and what data/research were used in developing the driver models. The reviewer said that in-use driving is much different than driver models developed for certification testing, and suggested that the additional mass, aero-, and electrical load increases be quantified and compared to the benefits for each type of automated driving system.

Reviewer 5:

The reviewer stated that, while the PIs have made progress to date, it was not quite clear from the presentation where the benefits come from, e.g., powertrain optimization, speed profile optimization. The reviewer suggested the PIs create a table and list the benefits against the powertrain optimization or CAV applications, among others.

Reviewer 6:

The reviewer stated that the researchers are on track and have accomplished a fair amount. The problem is complex and needs a wide range of scenarios to fully assess and overcome the barriers. Although the project is making progress, this reviewer commented that it will need to sustain the work, which is not an endorsement to continue the work after this funding expires. More emphasis on understanding what leads to the outcomes, as opposed to just showing the outputs, would be more helpful and improve usability of the output. The reviewer further commented that shortcomings in this area will make it hard to actualize or implement from theory to practice, and that the current output as presented does not translate well to real-world use. The reviewer indicated that the research team needs to be more grounded and clearer in what fundamental knowledge it will generate, versus showing results from a model.

Reviewer 7:

The reviewer stated that what was described in the presentation was not clear and concise, and that it was not clear how the development of a control strategy or model system for use in vehicles developed by this organization could be reduced to practice by vehicle companies.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer indicated that the research team appeared to have excellent collaborative efforts with other laboratories and outside organizations, including SMART Mobility Consortium members, Lawrence Livermore National Laboratory (LLNL) for aerodynamic drag three-dimensional modeling and wind tunnel data, LBNL for real-world truck platooning test data, and the National Renewable Energy Laboratory (NREL) for reports and insights on truck platooning testing. The reviewer added that the team is also working with Auburn University and the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) for truck platooning data and RoadRunner model validation, and HERE for roadway data. During the questions and answers (Q&A) period of the presentation, the reviewer continued, the presenter also indicated that discussions had been held with an OEM to gain additional insights and understanding of vehicle control systems and how they can be integrated into RoadRunner.

Reviewer 2:

The reviewer observed good collaboration with outside groups. While it was not in the review material, the reviewer said it was good to hear that the team is working with OEMs to find useful partners for the work done so far.

Reviewer 3:

The reviewer indicated that, based on Slide 19, the team appears to be working with a good set of relevant partners. The reviewer thinks there is some room for improvement if an OEM could be engaged, and that there should be some attachment to researching any industry standards that are being framed that could affect the final results of the work.

The reviewer noted that there seems to be coordination, and that collaboration, while not covered in detail, appeared sufficient. The reviewer commented that additional attention to this in the slide deck and presentation would have helped.

Reviewer 5:

The reviewer stated there was no evidence in the presentation regarding any well-established collaboration between the different organizations, and suggested the PIs explicitly state their roles and contributions across all tasks.

Reviewer 6:

The reviewer said increased collaboration with OEMs is needed to ensure optimal control assumptions are possible in a production setting, and to correlate results with currently developed CAV systems.

Reviewer 7:

The reviewer inquired as to how a control system can be developed without some collaborations with a vehicle company or a system supplier, and added that this is unthinkable. The reviewer suggested there be more sources of system requirements and data for the end product to be credible.

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

Reviewer 1:

The reviewer noted that the next steps are appropriate, and the examination of uncertainty in the projected savings from Eco-Routing should be particularly useful.

Reviewer 2:

The reviewer stated that the topics for future research are appropriate, but it was not sufficiently clear how this work would be done (i.e., the approach).

Reviewer 3:

The reviewer thought the future work should be focused on getting this work out on the road. The reviewer commented that industry collaboration in this aspect would be key, yet it is missing. The reviewer concluded that there has been enough work done on the simulation level and it is time to move these technologies to the real word to evaluate the impact.

Reviewer 4:

The reviewer observed that planned future work builds off earlier efforts and results, and includes: the completion of eco-driving optimal control theory for multiple CAV scenarios and implementation of optimized predictive control for all variables; case study quantification of energy impact uncertainties and benefits for various powertrains; further development of RoadRunner, such as improving the human driver model and validation with real-word driving data; and development and validation of CAV scenario libraries. An FY 2019 objective of the research team is to release a version of RoadRunner to the public.

Reviewer 5:

The reviewer commented that the simulation environment and tools created will provide a foundation for not only ANL, but also across academia, government, and OEMs. The proposed case studies will provide valuable insight into common questions asked by those in the emerging CAV field.

Reviewer 6:

Acknowledging it is difficult to do in this research environment, the reviewer asked whether there is any method to estimate or balance against customer acceptability of any eco-driving theories. The reviewer also asked whether passengers will accept platooning scenarios where the follow distance is close or request to have more separation.

Reviewer 7:

The reviewer indicated that without collaboration for full system requirements, the future research can only be considered to be academic in nature rather than for development of a usable control system as is stated.

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

Reviewer 1:

The reviewer affirmed the work is directly related to DOE's mission as it addresses questions related to energy implications of CAVs.

Reviewer 2:

The reviewer stated that the project supports DOE's SMART Mobility and EEMS program objectives in conducting early-stage research on energy impacts of CAVs and developing a CAV control simulation tool that can be used by researchers for assessing the impacts of CAV implementation.

Reviewer 3:

The reviewer said the simulation environment provides a cornerstone for many other DOE projects.

Reviewer 4:

The reviewer noted the project studied the potential vehicle energy consumption reduction via new and emerging technologies not previously widely available.

Reviewer 5:

The reviewer stated that, while the project is aligned with the objectives, there remains an appreciable gap between the model and informing practice and actual outcomes.

Reviewer 6:

The reviewer indicated that the concept of the project is relevant, but the way it is being developed it has limited chance for successful application.

Reviewer 7:

The reviewer observed that the research is trying to address the question of forecasting future fuel use (i.e., energy use) should connected vehicles become adopted.

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 collaboration resources are needed.

Reviewer 2:

The reviewer indicated that the research team did not mention any project activities deferred due to inadequate or unavailable resources, and therefore concluded the project needs were being met.

Reviewer 3:

The reviewer affirmed that the resources are sufficient, and that additional resources will not effectively or efficiently help overcome the gaps in the research.

The reviewer noted that $1.5 million in funding should be enough to perform significant model development and data collection.

Reviewer 5:
It seemed to the reviewer that resources are more than what would be needed for the simulation work. The reviewer remarked that at this level of funding there should be also milestones for vehicle testing and validation.

Reviewer 6:
The reviewer stated that the research appears to have sufficient resources to complete the proposed activities.

Reviewer 7:
The reviewer indicated that resources appear sufficient to achieve milestones and objectives.

Presentation Number: eems017
Presentation Title: Impact of Connected and Automated Vehicle (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 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 and well-planned.

Reviewer 1:
The reviewer remarked that the project approach was very good.

Reviewer 2:
The reviewer noted that the project enables analysis of CAV impacts at the transportation system level. The approach is well-designed, with first studies being of privately-owned CAVs. The reviewer presumed a future task would also incorporate TNC CAVs.

Reviewer 3:
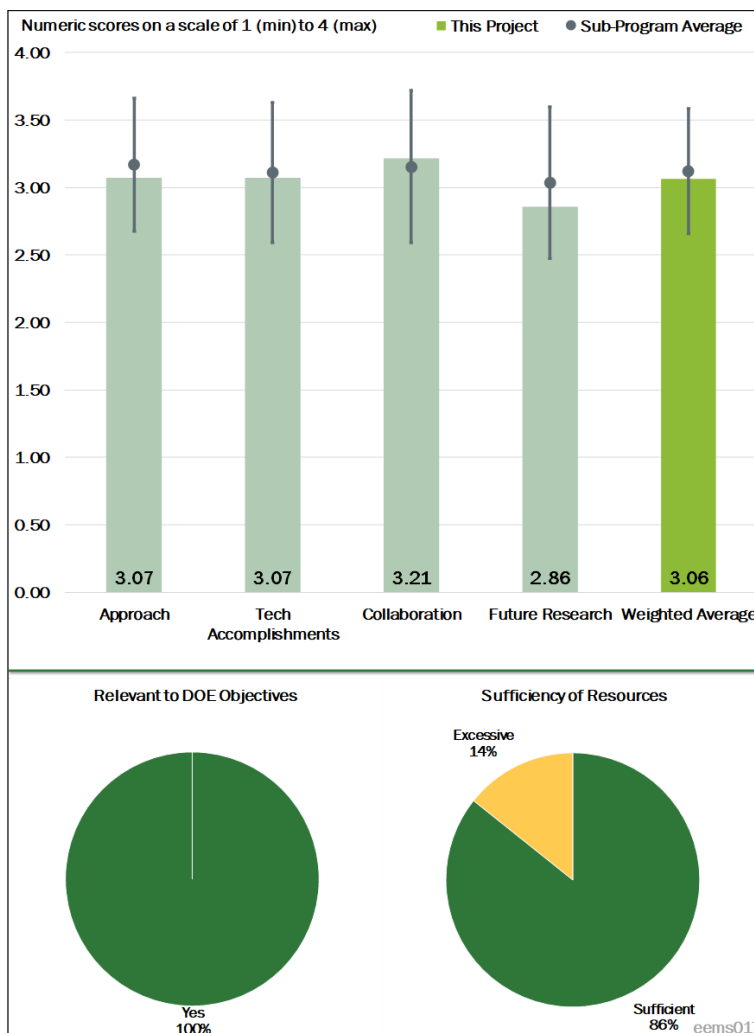The reviewer stated that this was a well-laid out project.

Figure 3-7 - Presentation Number: eems017 Presentation Title: Impact of Connected and Automated Vehicle (CAV) Technologies on Travel Demand and Energy Principal Investigator: Josh Auld (Argonne National Laboratory)

Reviewer 4:
The reviewer appreciated the technical approach to the main question and commented that attacking this research as statistically as possible is good. The reviewer indicated that modeling customer choice, especially for future choices based in introduction of new choices, is not exact. The reviewer inquired as to how valuable the conclusions to planning for national energy use in 2040 are, as seen in the bandwidth of fuel and electrical energy use on Slide 19.

Reviewer 5:
The reviewer observed an overall strong approach to a novel problem, and noted that the use of activity-based modeling is appropriate. The reviewer had two suggestions for improving the approach if there are time and resources. The first is to consider adding a stochastic-based element to the analysis. Each variable could be given a range and then results would have error bars to demonstrate the sensitivity to inputs, none of which are certain. The second, and more important, is to give consideration for how this model of a limited geographic region might be scaled to address state- or national-level questions (e.g., data needs that would be required, or

whether a more heuristic-based approach could be used). The reviewer said that, as is, this tool cannot address the question of national-level energy impacts and it is not clear if it could be expanded to do so.

Reviewer 6:

The reviewer noted that the approach starts out with a desire to develop a modeling tool that accommodates the mobility elements of the future, but that it surprisingly lacks any work to build the modeling tool to accurately perform on the mobility system of today before adding the new mobility elements. The reviewer stated that if this is being done it was certainly not reported, and without baseline validation of the new tool being employed, it is very concerning whether this tool will ever be accepted or useful by transportation system development agencies.

Reviewer 7:

The reviewer stated that the project fails to address the primary EEMS metric of Mobile Energy Productivity, and therefore the work has an improper focus. Producing measures of uncertainty are not useful unless they address the proper metrics. The reviewer also noted that EERE Leadership stated during the Q&A that this project should address the MEP metric during next year's work. The reviewer suggested that this project needs the participation of a couple of economists to inform the proper consideration of a utility model for evaluating the MEP metric.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer remarked that progress is excellent, and the main tasks for FY 2018 have been successfully completed.

Reviewer 2:

The reviewer noted that strong progress had been achieved and includes several important yet nuanced topics, such as estimates of energy impacts at lower levels of automation, effect on empty miles, and accessory load (which is an often-ignored parameter). The reviewer suggested that the project could be improved with some links to validation compared to experimental results, such as whether estimates of low-level impacts agree with experiments so far.

Reviewer 3:

The reviewer indicated that the project is only at the second quarter of FY 2018 per Slide 9, but that the regional impact analysis in the third quarter of FY 2018 would be quite interesting.

Reviewer 4:

The reviewer asserted that the approach of developing POLARIS appears to be very complete, and getting to the point of trusting the bandwidth data input and narrowing it to reach probability of energy use scenarios will be an interesting next step. The reviewer did not see the source of the 20% improvement in aerodynamics for platooning nor the source of the bandwidth of CAV accessory loading in the presentation.

Reviewer 5:

The reviewer expressed that the progress on creating a functional, integrated simulation framework for analysis of regional transportation characteristics is good, and it is likely that the framework can be adapted to producing useful results in the future. The reviewer said, however, that results to date indicate that the progress made misses the target objective of contributing to assessments of Mobility Energy Productivity.

Reviewer 6:

The reviewer remarked that, while accomplishments of the analyses were good, the project was very analytical and less oriented towards real-world application, similar to other reviewed projects.

Reviewer 7:

The reviewer commented that, based on the approach stated, the project team is making some but not great progress. The reviewer added that, because the approach is not considered great, technical accomplishment should have started with modeling the current system and validating it before embarking on modeling new elements.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The remarked excellent collaborative effort.

Reviewer 2:

The reviewer applauded the wide and impressive array of collaborators that were used to get the required data for implementing the study tasks.

Reviewer 3:

The reviewer commented that Slide 22 nicely laid out who was doing what. The reviewer would have loved to see the cost by partnership for this project.

Reviewer 4:

The reviewer observed that, based on Slide 22, the project team looks to be working with a good set of relevant partners. The reviewer thinks there is some room for improvement if an OEM could be engaged, and some attachment to researching any industry standards that are being framed that could affect the final results of the work.

Reviewer 5:

The reviewer affirmed that the project team has collaborated with other team members to produce this year's results.

Reviewer 6:

The reviewer noted that a list of collaborators was provided but without explanation.

Reviewer 7:

The reviewer observed that the project team is only collaborating with internal projects and with academic institutions, and that no transportation agencies or vehicle user groups. It was not clear to the reviewer where the appropriate number of use cases may come from to complete the modeling exercise, i.e., how many different ways would users plan to include a CAV in their household. One was shown but many other possible options need to be included. The reviewer said there is just not enough breadth of input parameters to assume this POLARIS product will be capable of the outcomes intended.

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 next steps are appropriate and expand on the current work, and, per Q&A at project presentation, uncertainty analysis of the results will be tackled.

Reviewer 2:

The reviewer noted that everything the team suggested on Slide 24 appears to be improvements to the fidelity of the output.

Reviewer 3:

The reviewer expressed that future work is okay but may be incomplete to achieve the intended results. The reviewer said the end product of POLARIS from this project is not likely to be complete enough for general use for reasons previously stated.

Reviewer 4:

The reviewer observed a good proposed set of next steps that could be improved with incorporation of suggestions in both approach and progress sections.

Reviewer 5:

The reviewer stated that the project is absent of meaningful decision points where the work has sufficient forcing functions to change course based on feedback. The reviewer said the work plan indicated what is planned and has insufficient mechanisms for making significant course adjustments.

Reviewer 6:

The reviewer was puzzled by the comment that there are not enough data. The reviewer would have liked to see more simulations based on the team's assumptions on Slide 12. The reviewer asked why a value of time of $10/hour was used, where that came from, whether it is really $10, and whether it is a different number based on type of person, such as an executive who has limited free time. The reviewer found it interesting that the team utilized Bloomington, Indiana, but inquired about how many other cities are like Bloomington—perhaps this city is a good study point. The reviewer did not understand the family of graphs on Slide 21. Regarding Slide 20, the reviewer asked what the electrical load would look like for the city if Bloomington, Indiana was picked, and the reviewer suggested the team drill down there. The reviewer thought there is some more research that can be done just in this space, let alone moving into coordinated platooning.

Reviewer 7:

The reviewer noted that only a vague description of what is next was provided.

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

Reviewer 1:

The reviewer highlighted that this is a great project, well laid out with assumptions, how to accomplish the questions posed, and then the results. The reviewer inquired whether there is a way to do better metrics across all of these projects such as the Red/Yellow/Green system used in the automotive world.

Reviewer 2:

The reviewer asserted the project is highly relevant to DOE EEMS objectives.

Reviewer 3:

The reviewer affirmed that determining the energy impact of CAVs is one of the key VTO objectives, and that the project is a big step forward in providing the required analytical tools.

Reviewer 4:

This reviewer is on the fence regarding the relevance of this project to support DOE objectives. The project appears to be consuming a significant amount of EEMS resources and should be producing meaningful results for the program. The reviewer commented that overall DOE objectives are to assess impacts of advanced mobility concepts in terms of Mobility Energy Productivity, and this project is missing the mark and will continue to miss the mark if it continues on its current trajectory.

Reviewer 5:

The reviewer said the project supports overall DOE objectives, but should be more practical real-world application as opposed to theoretical.

Reviewer 6:

The reviewer stated that the research is trying to address the question of forecasting future fuel use (i.e., energy use) should connected vehicles become adopted. The reviewer questioned how useful the results will be for this spending. If the bandwidth of expected energy use says that fuel use in 2040 will be anywhere between 0% and 80% reduced, and the use of electricity will be anywhere between 4000% and 11000% increased, the reviewer would question the usefulness of the results and the relevance of proceeding with the project.

Reviewer 7:

The reviewer stated that developing POLARIS is totally relevant, but getting it to a level where it can be very useful in this project is not clear.

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

Reviewer 1:

The reviewer asserted that the project is on track with the given budget and resources.

Reviewer 2:

The reviewer indicated that materials did not appear to reference level of resources provided, but that progress seems in line with goals.

Reviewer 3:

The reviewer encouraged the project team to keep going and to figure out what has been learned so far and where to dive further with analysis, such as determining the number of cities in the United States that are like Bloomington, Indiana and diving down on the electrical grid side for the city. The reviewer further encouraged the team to keep going and stay organized like it already is.

Reviewer 4:

The reviewer could not really assess the resources well because the approach is not great. Within the current plan, the reviewer believed the current level of resources is sufficient.

Reviewer 5:

The reviewer commented that $1.9 million in funding should be enough to perform a significant model development and apply that model to create forecasts.

Reviewer 6:

The reviewer acknowledged that incorporating the results from other studies and expanding the phenomenology modeled required significant resources, and stated that the significant resources this project receives may need to be re-evaluated with respect to whether they can be used to more effectively address EEMS metrics.

Reviewer 7:

The reviewer assumed resources are sufficient, but was not clear on the remaining work and what resources are in place.

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 four reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer indicated that the research plan is reasonable for investigating the energy and mobility aspects of signal control schemes for a mixed CAV environment, with the final goal of developing a control system for control of a network of signalized intersections. The reviewer indicated that the primary objectives for FY 2018 were to develop signal control algorithms for energy reduction and assessing the impacts of CAV penetration levels on their performance, which seems in line with this progression.
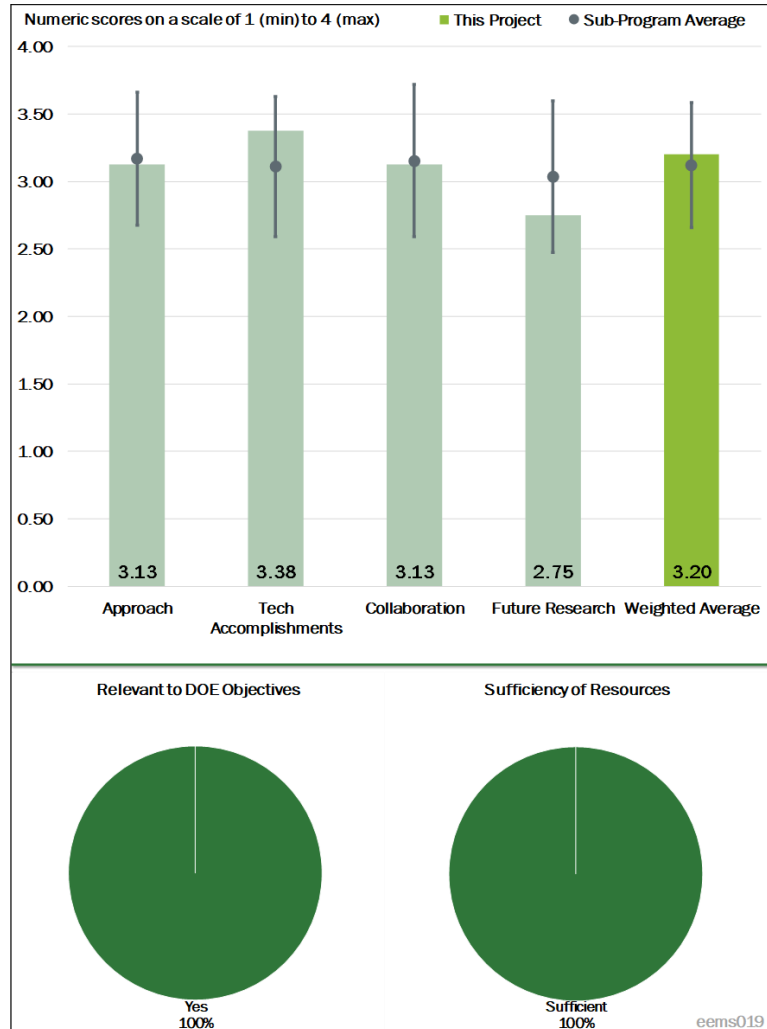

Figure 3-8 - Presentation Number: eems019 Presentation Title: Smart Urban Signal Infrastructure and Control Principal Investigator: H. M. Abdul Aziz (Oak Ridge National Laboratory)

Reviewer 2:
The reviewer stated that, overall, the control methodology and reinforcement learning (RL) techniques are sound and creating usable results. The reviewer added that, now that the heavy lifting is complete, the project would benefit from considering several real-world challenges, including the large delay in the control loop if communication is performed only using dedicated short-range communications (DSRC) vehicle-to-infrastructure (V2I), various levels of vehicle adoption of the vehicles communicating (i.e., when DSRC is less than 100% deployed), and the energy impacts for HEV, plug-in hybrid electric vehicles (PHEV), and battery electric vehicles (BEV).

Reviewer 3:
The reviewer indicated that the modeling approach has been successful in establishing the necessary parameters for the traffic signal control algorithms, and that the true test will come in the ability of first the modeling tools and then the algorithm applications to address the much higher complexity of a large-scale roadway grid with an integrated traffic signal system. The reviewer anticipates that this challenge can be met and the project is feasible. The reviewer suggested that the processing time of large networks using VisSim could create a production issue of case study work.

The reviewer noted that the prerogative of local traffic engineers in the responsible local government agencies will determine the operational priority of energy consumption, travel time and ultimately capacity of the roadway system. The reviewer recommended adding these types of operational management entities to the partners/collaborators in the final year of work to have meaningful input, which will help ensure that the signal control algorithms are suitably utilitarian.

Reviewer 4:

The reviewer commented that the project approach of using simulation to learn about traffic signal control algorithms that can implement energy minimization strategies is useful for adding to the EEMS knowledge base. The reviewer said that the bounding analysis that the team performed is a good first step. The reviewer would like to see a mapping of the entire scenario/experiment space. Without that mapping, this project comes off as a simulation tool building exercise.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer said the project has produced some initial results that show that it is capable of producing relevant analysis results. The reviewer added that the tasks that the team is working on include a mix of practical technology features and fundamental controls analysis.

Reviewer 2:

The reviewer noted that the project has generated quite a few papers and provides a strong theoretical framework for intersection timing control for either energy-minimizing, time-minimizing, or some hybrid approaches. The reviewer added that this was one of the more math-heavy presentations among EEMS projects, and that the project members have demonstrated appreciated mastery of their RL tools.

Reviewer 3:

The researcher stated that project completion stands at 55% as of the AMR conference, which seems appropriate for a 3-year project starting in October 2016. In FY 2018, the research team completed a report on stochastic control algorithms and is on track to complete activities on stochastic control schema for corridor application and development of machine-learning control for energy and mobility goals. On the latter, the team has produced initial results and will be submitting a paper on results using the VisSim traffic simulator tool later in the year. The reviewer remarked that initial results were a little surprising from the standpoint of delay time associated with energy reduction achieved, but the team will be investigating ways to achieve energy/delay balance. The reviewer concluded that project output is reportedly strong, with five papers on research results submitted thus far.

Reviewer 4:

The reviewer expressed concern of the case study turn-around time to apply the reinforcement learning methodology, saying it will become much more difficult with the significantly more complicated large-scale traffic networks that are needed. The reviewer stated that this simple fact could jeopardize the schedule as the whole analytical process slows down, and strategies to address this issue would be important to address if the researchers agree this is a problem. The reviewer found the stochastic approach aspects confusing as it appeared this more conventional stochastic approach was a separate research project. However, the summary slide defined the FY 2018 approach to include both reinforcement learning and stochastic control theory work, so this understanding may be wrong, but this was not clear to the reviewer.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer stated that, from this point forward, the addition of a few selected City Traffic Engineers to the collaboration process should be considered as the project phase moves into the application of the algorithms to

traffic signal control. This practical insight would provide a better chance that the results of the study are used and applied in a manner that actually accomplished the purpose of energy efficiency, in light of the necessary tradeoffs between energy and delay time.

Reviewer 2:

The reviewer reported that, while the presenter stated work with Smart Mobility Consortium members, Pacific Northwest National Laboratory (PNNL), and NREL, no significant details were provided in terms of partner roles or the transfer of knowledge and benefits. PNNL is supporting the stochastic control work, while NREL is providing technical guidance. The reviewer indicated that the project is also getting assistance from Washington State University. The reviewer commented that last year the presenter discussed possible engagement with Smart City Challenge participants to develop relevant scenarios for smart signal systems and assess future control system needs for CAVs, but this did not look like it was accomplished to date.

Reviewer 3:

The reviewer commented that there is not much information relative to who is doing what on this project, and that it is difficult to accurately assess the collaboration and coordination attributes of this project.

Reviewer 4:

The reviewer stated that collaboration and coordination across the project team is hard to assess, as the balance between the two PIs and their institutions is not explicitly shown. The reviewer suggested that, although perhaps out of scope for this particular project, exploring real-world testing opportunities should be considered.

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 diversity of the future work is good, and the project plans to explore the signal control algorithm's features regarding scalability, fault tolerance, and advanced powertrain energy impacts.

Reviewer 2:

The reviewer commented that the future work planned for the project is appropriate concerning the original scope and approach, and involves additional sensitivity analysis of the energy/delay paradigm for the traffic control system, assessing the impact of advanced vehicle technologies such as start-stop within the context of the control system, and assessing the impacts of mixed traffic flows. For FY 2019, the team will be implementing the simulation platform for handling large-scale networks of signalized intersections and assessing the attributes for fault-tolerant signal control, and laying out sensor and data needs for real-world large-scale signal control systems. The reviewer reported that the research team will generate three paper deliverables in FY 2019 associated with these activities.

Reviewer 3:

It appeared to the reviewer that there needs to be a specific strategy for the machine learning application with the VisSim processing time for large-scale network models.

Reviewer 4:

The reviewer expressed that the overall feeling of the presentation is one of solid application of stochastic control and reinforcement learning to an overly simplified problem definition. The reviewer noted that planned ongoing (Slide 18) and future work (Slide 21) fails to consider more practical questions, such as performance under less-than complete vehicle penetration of DSRC and impacts of HEV/PEV powertrains, which differ significantly from internal combustion engine (ICE) cars in the stop-and-go environment under question. The reviewer said that no plans for a real-world—or even real-vehicle—testing are discussed.

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

Reviewer 1:
The reviewer remarked that options for applying energy conservation to traffic signal control algorithms are in line with DOE objectives.

Reviewer 2:
The reviewer affirmed that the project supports DOE's objectives by beginning to explore automated control strategies for traffic signals, and that the work is showing that it can provide incremental contributions to the EEMS knowledge base.

Reviewer 3:
The reviewer noted that the project supports overall DOE EEMS objectives in developing a large-scale signal control algorithm for CAV control.

Reviewer 4:
The reviewer commented that the work provides a good theoretical framework for stop-light control, and as such can evaluate various energy-minimizing or time-minimizing strategies. The reviewer observed that the focus appears to be on connected vehicles, despite all of the control taking place at the stop light instead of speed instructions directly to the vehicle. The reviewer affirmed this is certainly in scope for DOE and EEMS, but the project should consider other technologies such as automated driving and vehicle electrification.

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

Reviewer 1:
The reviewer noted that the project team is meeting its milestones using the budget provided.

Reviewer 2:
It appeared to the reviewer that the project is adequately funded for the activities presented.

Reviewer 3:
The reviewer stated that the budget seems reasonable for work focused on control theory and simulations. The reviewer suggested that a real-world testing proposal would naturally require more resources, but may be out of scope for the current project.

Reviewer 4:
The reviewer warned that the computational horsepower to perform iterative processing necessary for the machine-learning methodology may be a challenge for the research team. The reviewer suggested that DOE's emphasis on HPC could be a means of addressing the problem.

Presentation Number: eems020
Presentation Title: Multi-Scenario Assessment of Optimization Opportunities due to Connectivity and Automation
Principal Investigator: Jackeline Rios-Torres (Oak Ridge National Laboratory)

Presenter
Jackeline Rios-Torres, 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 and well-planned.

Reviewer 1:
The reviewer commented that many of the questions or concerns held when previewing the slides were addressed in the presentation. Overall, the reviewer saw how this approach, particularly with how the project is trending (involving OEMs, bringing in safety metrics as an output rather than just as an input constraint, etc.), is robust overall.

Reviewer 2:
The reviewer stated that this project aims to develop optimal coordination strategies for CAVs to increase the mobility energy productivity. The reviewer commented that the existing six tasks and quarterly milestones are appropriate to achieve the project objectives.

Reviewer 3:
The reviewer noted that many elements of the work are good. The reviewer commented that, as shown on Slide 10, the simplification of fuel used to a surface should really help get to reasonable estimates much quicker than attaching an optimizer to Autonomie. Its drawback is that it is not able to get to the change in improvements due to various vehicle types and technologies. The reviewer remarked that as connected technologies are introduced, if they devalue the effectiveness of electrification, those technologies may get removed from the fleet for lack of cost benefit and the overall savings suggested from research projects like this one will not be realized.

Reviewer 4:
The reviewer noted that FY 2018 efforts have expanded to include additional highway scenarios beyond the initial highway merging scenario of last year. These additional scenarios will provide more insight on CAV
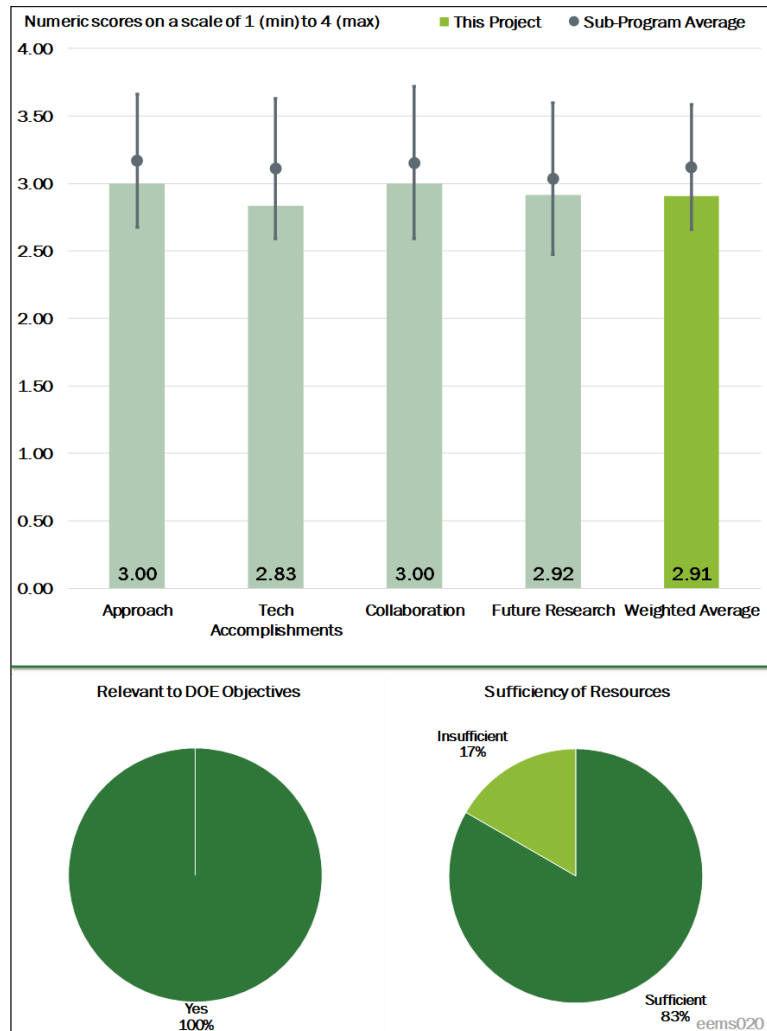

Figure 3-9 - Presentation Number: eems020 Presentation Title: Multi-Scenario Assessment of Optimization Opportunities due to Connectivity and Automation Principal Investigator: Jackeline Rios-Torres (Oak Ridge National Laboratory)

energy impacts, especially in mixed traffic environments (less than 100% CAV penetration). The reviewer stated that the development of polynomial models that include additional powertrains for expressing system energy consumption should complement other work being done in the SMART Mobility space. The proposed investigation of vehicle communication instabilities on CAV control in mixed traffic environments for next year should be a key piece of work with possible synergies with other researcher's results in the area.

Reviewer 5:

The reviewer stated that the overall value and productivity derived from the connected driving is not clearly defined. The reviewer suggested that the magnitude of fuel and time savings for a given scenario needs to be described as part of bigger picture (i.e., answer the question of whether aggregate 40% fuel savings per event equals 0.5% or 5% of savings on an average total trip).

Reviewer 6:

The reviewer noted that this project seems to be using some useful tools and is exploring some relevant topics in sensible ways; however, the reviewer mentioned that the specific questions the work is trying to answer could be much more narrowly and clearly defined. A more thorough attempt to refine the questions and define the barriers would help the project team focus its efforts in a more meaningful way. The reviewer remarked that, for example, instead of saying the team is going to assess the implications of full or partial penetration of optimally connected CAVs in various traffic situations, take the definition of the goal to the next, deeper step by instead researching why full penetration of CAVs save energy and drive time in a heavy traffic scenario. The reviewer stated that researchers can then determine whether it is because the CAVs can follow closer, react more quickly, or accelerate more rapidly. From there the project team can vary those parameters to see their effect on CAV penetration in the overall vehicle population.

The reviewer noted that defining four or five main questions, in addition to sub or side questions, would add significantly more direction to this work and increase its impact. The reviewer stated that it currently seems like the project team is just running the models for some different traffic scenarios and waiting to see what pops out. The reviewer said that it would be better if the project team generated a list of questions they want to answer, collected data, and ran the models with the purpose of answering those questions.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer remarked the team has developed a CAV optimal coordination algorithm that enables fuel consumption savings in diverse traffic conditions. Results for different scenarios show potential for up to 40% fuel consumption savings and up to 50% travel time reduction for full CAV penetration. The reviewer stated that low-traffic demand results in fuel savings, but medium- and high-traffic demand increases fuel.

Reviewer 2:

The reviewer stated that fuel comparison estimates need to include the added accessory loads for CAV. The reviewer noted that the lack of this is overstating the benefit. The reviewer expressed interest in seeing the stated improvements based on a more comprehensive driving pattern, and opined that, suggesting a 60% fuel saving for an on-ramp maneuver is overstating the true effectiveness of CAV technology.

Reviewer 3:

The reviewer estimated that this project to be about 40% complete as of the AMR conference. The reviewer observed that progress seems a little low given a project start date of October 2016. The reviewer pointed out that technical progress to date in FY 2018 included: introducing additional highway/traffic scenarios into the simulation model; assessing impacts of full CAV penetration for various optimally coordinated highway segments (merging roadway, intersection, roundabout, and speed reduction zones); developing insights on partial CAV penetrations of optimally coordinated segments; and developing various polynomial fuel consumption models based on Autonomie model data. Planned activities for the remainder of FY 2018 include

a preliminary report on findings to date and initial work on assessing communication instabilities on CAV control.

Reviewer 4:

The reviewer remarked that mechanisms for fuel savings and time savings should be identified and quantified. Differences in fuel consumption meta-model for alternative powertrains should be highlighted, along with any work that attempts to quantify the benefit for electrified powertrains. The reviewer commented that the impact of communication instabilities should be comprehended in the overall noise factor assessment (weather, human driver behavior, etc.).

Reviewer 5:

The reviewer remarked that the results are very interesting so far, but not yet thorough, rigorous, or comprehensive in the reviewer's judgment. For example, the reviewer stated that there needs to be more outputs for safety (i.e., how is safety decreased, if at all, when fuel savings increases), as well as a number of human factors considerations (e.g., different types of drivers, how effectively CAVs can communicate with non-CAVs with respect to merging since so much of this is human to human today). Some of the apparent gains in fuel savings may be offset significantly by these considerations. Finally, the reviewer noted that controller/driver "effort" should be considered for the shrinking headways. In other words, if we assume the merge is safe for a moment even with smaller headways, there is still the possibility that to merge and maintain a particular headway, more vehicle jerking (as in the derivative of acceleration) may be required. The reviewer remarked that this jerking could become unacceptable to many passengers and drivers and therefore might need to be controlled in the analysis.

Reviewer 6:

The reviewer noted that the project has generated some insights about the impact of optimally coordinated CAVs on traffic flow, travel times, and energy use, but the presentation does not make clear exactly what the presentation meant by "optimally coordinated" or how deviations from the optimum would affect the results. The reviewer wondered how "optimal" is defined in this situation. The reviewer stated that the project also does not offer any evidence that the questions it is exploring are the right ones or even useful ones if answered correctly. The reviewer remarked that the progress is satisfactory given the fact that the overall purpose is not well defined, but if the purpose of the work were defined more narrowly then the reviewer thinks the accomplishments would seem much more impactful. For example, the reviewer suggested that the project team research what happens when a more realistic distribution of driver attributes is inserted into the model. The reviewer inquired as to whether the existing traffic flow would accommodate CAVs better or worse. The reviewer also suggested that the project team research if traffic flow would be improved or impeded if CAVs were programmed to keep a space between vehicles that is half what an average human driver would leave. The reviewer acknowledged that these may not be the right questions to identify, but the project team should be able to formulate better questions with the help of the U.S. Department of Energy (DOE) leaders. The reviewer commented that this would improve the technical accomplishments for the rest of the project from its current acceptable, but unimpressive, level.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer commented that there seems to be strong collaboration among the overall project team. The reviewer's assessment increases from good to excellent based on the active pursuit of an OEM's involvement. The reviewer does, however, strongly think a tie to transportation and CAV safety expertise is very much needed for the ultimate results to be useful and relevant.

Reviewer 2:

The reviewer noted that this project is part of EEMS SMART Mobility Consortium and includes collaboration with NREL, Idaho National Laboratory (INL), LBNL, and Argonne National Laboratory (ANL). Other

partners include the University of Delaware and the University of Tennessee. The reviewer noted that the project team is in active discussions with an OEM on potential collaboration for some validation work and discussion with Lyft for potential data sharing.

Reviewer 3:

The reviewer commented that the partnerships with government institutions in the SMART Consortium are good.

Reviewer 4:

The reviewer stated that per Slide 19, the project team looks to be working with a good set of relevant partners. The reviewer noted that there is some room for improvement if an OEM could be engaged, and some attachment to researching any industry standards that are being framed that could affect the final results of the work.

Reviewer 5:

Although working within the Smart Mobility Consortium was indicated by the researcher, this reviewer commented that specific collaboration with other laboratories within the Consortium was unclear. The reviewer stated that the project team is working with the University of Delaware on data from human in the loop testing for simulation validation, as well as the University of Tennessee regarding control communication-related issues. The project team did respond to a comment from last year's AMR recommending OEM collaboration, reporting that active discussions have been held with an OEM regarding validation work as well with Lyft on data sharing.

Reviewer 6:

The reviewer commented that it is great that there are several different laboratories and universities involved, but that just as another reviewer from last year said, there appears to be little coordination between participants. The reviewer echoed last year's comment, noting that it would be much better if the team would identify their roles and how they fit together. The project team should be able to say which laboratories are working on improving the fuel consumption algorithm, gathering data from industry and putting it in a usable format, and simplifying the code to make it run faster, etc. The reviewer noted that right now, there is no indication of who is doing what and why.

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 appropriate future work is planned, including analyzing traffic flow/time/energy implications considering multiple lanes, heterogeneous traffic, interconnected scenarios and partial market penetrations. FY 2019 proposed activities include adding validation with human and hardware in the loop and strategies to improve efficiency under partial penetration and heavy traffic conditions.

Reviewer 2:

The reviewer pointed out that the proposed research shows a nice progression of work, expanding off previous results and focusing on new areas of interest. The research has progressively expanded highway/traffic modeling scenarios with the goal towards assessing integrated, regional highway systems. For FY 2019, the reviewer noted that the research will focus on CAV communication impacts on control and assessing optimal control framework for varying powertrains and CAV penetration levels in the context of additional highway/traffic scenarios. The project team also plans to validate the model with additional data obtained through outside collaborations. The reviewer stated that the project team should also look for additional collaborative opportunities with other laboratories with common work areas to leverage overall results and objectives.

Reviewer 3:

The reviewer referenced prior comments and remarked that the future work slide is largely on target, but could benefit from some of the previously mentioned enhancements. For example, while the project team acknowledged the need to incorporate more safety metrics in the analysis, including as an output to the various scenarios, the future work slide text did not mention this.

Reviewer 4:

The reviewer remarked that the suggested work in Slide 21 looks good provided that accessory loading is different for automated vehicles (AV) compared to non-AV vehicles, where for some scenarios the extra electrical load will outweigh the benefit for connected driving. The reviewer would like there to be clearer statements of the conclusions of the project team. There are many good graphs on CAV penetrations and traffic volumes, but no statements on critical mass of CAV or traffic volumes where effectiveness is rapidly increased or decreased.

Reviewer 5:

The reviewer noted that vehicle validation work is currently projected to be completed at the end of the project, which may be too late to integrate required learnings. Findings on actual energy and time savings as a result of vehicle response, propulsion system response, and behavioral constraints should be incorporated up-front in the analysis.

Reviewer 6:

The reviewer remarked that the project team has indicated how they want to expand the model by adding the capability of analyzing more complex traffic scenarios, such as multiple lanes, more heterogeneous traffic, and communication instabilities, to name just a few. The reviewer thinks these are fine, but it is impossible to know if these are the right enhancements of the model because the project team still does not know the specific questions they are trying to answer with the model. The reviewer stated that if that issue of better defining the technical barriers were addressed then the future research would align itself in a better way to address those barriers. The project team may be proposing the right future research, but there may be simpler efforts that would produce better insights.

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

Reviewer 1:

The reviewer noted that this project is relevant to the overall DOE objectives of petroleum savings as it is exploring optimization scenarios for CAV integration that would result in energy efficiency improvements.

Reviewer 2:

The reviewer commented that the research is trying to address the question of forecasting future fuel use (energy use) should connected vehicles become adopted.

Reviewer 3:

The reviewer remarked that this research does support DOE EEMS and SMART Mobility objectives.

Reviewer 4:

The reviewer commented yes, the energy impact of CAV requires a coordinated effort from DOE and its partners.

Reviewer 5:

The reviewer stated that clearly this is relevant to both assess and potentially reduce fuel usage for future EEMS/CAV scenarios. The gap may be that there is not a very direct link to how these analyses will directly influence future policy and or assist technology developers in their work. The reviewer remarked that without strengthening this link, the relevance is more limited than it could be.

Reviewer 6:

The reviewer stated that if overall DOE objectives include understanding the impact of CAVs on general issues involving mobility, then the answer is yes. The reviewer said that the project team could do better and make the results much more relevant if they thought more about the questions/barriers up front, turned those into very detailed questions, and then collected the data and ran the models to answer those questions. The project team might fail to provide definitive answers, but the reviewer thinks the contribution to DOE's work on understanding the role of CAV's in future mobility would be greater.

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 additional resources could lead to an improvement in scenarios analyzed and be used to engage outside partners (OEMS, national laboratories) for vehicle validation and data correlation.

Reviewer 2:

The reviewer said that it seemed as though the project team has been successful, and will likely remain successful in the future, based on the current funding level of approximately $340,000 per FY.

Reviewer 3:

The reviewer stated that this project has been funded around $350,000 per year for FY 2017 and FY 2018, which seems appropriate given its objectives and accomplishments.

Reviewer 4:

The reviewer remarked that the presentation did not list the 2019 forecasted budget. The reviewer noted that the $700,000 in funding for 2017 and 2018 total should be enough to perform a significant model development and analysis of this type. The funds appear to be in a good relative proportion to the more heavily funded, but also more complex projects, involving RoadRunner and Polaris.

Reviewer 5:

The reviewer stated that the FY 2018 funding level appears to be sufficient for the efforts prescribed.

Reviewer 6:

The reviewer remarked that the question of adequate resources is difficult to answer because it is not clear if one lab is using all of the approximate $330,000 per year, spread among several, or if there will be an increase in future funding. This level of funding should support a few people working part time on this project, which seems barely enough to support all the tasks if they include data collection, model development, and model utilization. Unfortunately, this reviewer cannot recommend providing more funding for this work until the goals and approach are more clearly defined. Only then can one assess whether the funding is adequate or not.

Presentation Number: eems023
Presentation Title: Whole Traveler Survey on Life Trajectories and Mobility Decisions
Principal Investigator: Anna Spurlock (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 and well-planned.

Reviewer 1:

The reviewer commented that this project had a good approach to personal dynamics related to transport.

Reviewer 2:

The reviewer stated that the phase one approach is to conduct a 20-minute consumer survey followed by phase two to collect global positioning system (GPS) based consumer travel data using Google location history for one week per person in the San Francisco area. This approach seems appropriate to the reviewer to obtain the desired 900
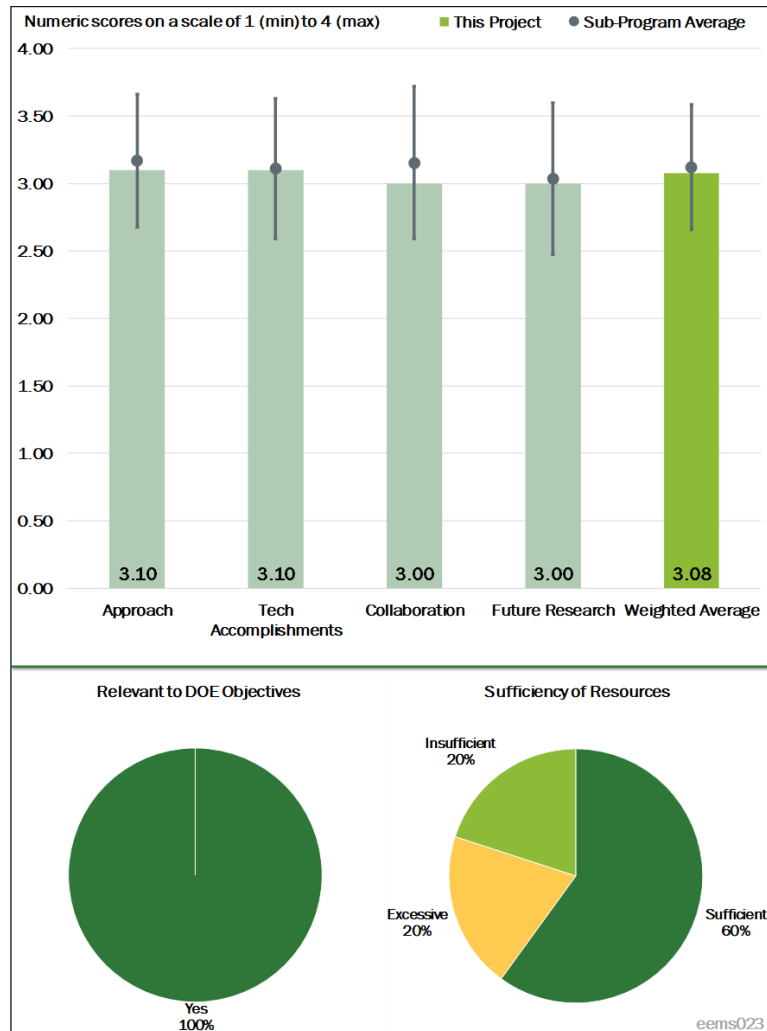

Figure 3-10 - Presentation Number: eems023 Presentation Title: Whole Traveler Survey on Life Trajectories and Mobility Decisions Principal Investigator: Anna Spurlock (Lawrence Berkeley National Laboratory)

survey responses (3% anticipated response rate) and targeting 200 travel location participants. The reviewer commented that while this is good characterization of a specific urban area, it is not clear how transferable that data would be to other metropolitan regions. The project team should consider investigating how to apply the survey outcomes to other existing consumer datasets to extract EEMS-relevant information.

Reviewer 3:

The reviewer noted that the project team is looking at some important questions, such as how will future consumers make transportation mode choices, what types of personalities will adopt new technologies, and how will consumer choices about travel change over their lifetime. This focus on the people who are driving the demand for mobility is a somewhat new dimension for VTO research which has typically focused more on the vehicles and the technologies. The reviewer remarked that this project's approach addresses behavioral questions much more directly than other VTO research. The interaction between mode choices, technologies, and traveler preferences is complex, and this work is likely to raise as many questions for future study as it answers. Although not discussed at the AMR, the role of e-commerce in future travel demand is important to study as it may (or may not) be a disruptor for transportation.

The reviewer stated that the approach of targeting the San Francisco Bay Area counties with surveys and data collections is reasonable given the other project considerations (alignment with existing models, variety of consumers that may represent future trends, and concentrated regional coverage). The PI demonstrated awareness of the limitations of the survey effort, both from a geographic standpoint and a survey response truthfulness standpoint, and indicated that conclusions drawn from the data would take this into account—which is important. The reviewer noted that the response rate expectations were reasonable for a random survey of this type. The reviewer said that the use of Google Locational History data collection efforts is a useful way of collecting GPS data without the need for additional hardware (assuming the survey respondent consistently carries the relevant Google-associated device). Depending on the accuracy needed, the reviewer commented that this could be used across other EEMS projects seeking to track the movements of a "mobility consumer" rather than tracking the movement of a vehicle.

Reviewer 4:

The reviewer stated that the process where survey and GPS data are "normalized" for use in other DOE research projects will be a challenge. Data collection and processing for other regions may be required to achieve full usefulness. The reviewer noted that the project is feasible for the development location of the San Francisco Bay Area.

Reviewer 5:

The reviewer commented that the primary objective of this project is to understand travel choice patterns, preferences, and decision-making processes with the advent of new mobility technologies across multiple time-scales. The project aims to understand how these patterns interrelate with multiple dimensions of heterogeneity across the population with regards to characteristics that do not change over time (e.g., personality characteristics) and change in predictable ways (e.g., lifecycle stage). Additionally, the reviewer noted that the project looks to provide insights and resources to improve the accuracy and flexibility of transportation system simulation models and reduce uncertainty associated with behavioral and human factors in transportation-as-a-system modeling and scenario analysis. The reviewer stated that the project presents two principal approaches, including survey-based data collection and cutting-edge analytics. The focus is on the impact of long-run lifecycle trajectory patterns, psychological and personality characteristics, and risk and time preferences. The reviewer remarked that it would have been beneficial if the team provided more detail upfront on the rationale for this approach as most of the discussion is very high level. There is additional information provided in the technical backup slides, especially on Slide 35 for "addressing gaps in current knowledge" and following slides on "life history calendar," "psychological/personality characteristics," and "time and risk preferences."

The reviewer stated that it would have been good for the project team to have explained this in more detail. Additionally, it may be good to include additional focus on economic factors as this is often the key determining factor. The reviewer noted that milestones for the project are provided but given the size and scope of the project, they are somewhat thin and lacking clear definition and high impact. It is not clear to the reviewer whether the project has established any go/no-go milestones, although Slide 31 mentioned a go/no-go milestone to be determined in Q3 FY 2018. The reviewer stated that overall, the project is reasonably well-designed and feasible.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer noted that the project seems to be going well and is ahead of schedule.

Reviewer 2:

The reviewer reported that the survey has been launched after obtaining approvals, and noted higher completion rates for phase one and opt-in for phase two, as well as phase two completion.

Reviewer 3:

The reviewer stated that, in general, the accomplishments to date are appropriate given the scope of work and schedule. The project team has made good progress on completing the two phases of the project and has exceeded its targets for response rates, which is positive (particularly given the often-challenging nature of individual surveys). The sample size has grown to the point that the project team should be able to have enough data to discern the effects they are seeking. The reviewer noted that the project team's in-progress technical papers should be valuable for the broader research community and will be an important product of this work. The project team has worked to address some of the concerns expressed by reviewers in previous years, which should improve the overall quality of the research accomplishments.

Reviewer 4:

The reviewer stated that the progress appears to be ahead of schedule. The generation of papers documenting results and interpretations will be a key set of deliverables. The reviewer noted that the interpretation of data applicability outside of the San Francisco Bay Area—as much as the data allows—will be an important ingredient of project results.

Reviewer 5:

The reviewer said that the overall technical accomplishments and progress to date are satisfactory. Phase one survey activities are well on their way with the survey in the field with phase one completion and phase two opt-in rates higher than expected. The reviewer noted that the survey is on track for approximately 250 phase two submissions (which is greater than anticipated). The reviewer remarked that the team has identified three initial research activities including future-focused modal shift, characteristics of likely adopter, and long-term dynamic lifecycle stages. Research area one will focus on technological innovation as a driver of lower costs—behavioral shifts in choice—implications for the transportation system. Here, the goal is to estimate the effect of substantial decreases in the cost of ride-hailing on travelers' use of less energy-intensive modes or non-motorized modes. The reviewer noted that research area two assesses who is and will likely adopt these technologies and characterizing subpopulations across multiple dimensions of heterogeneity. Research area three focuses upon how barriers to technology adoption and mode choice may change as respondents pass through successive life stages. The reviewer concluded that research areas one and two have begun drafting of paper/analyses while research area three has finalized programming and piloting survey including a life history calendar with an innovated analytic approach for full lifecycle trajectory clustering.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer stated that there is a large team at LBNL with one INL and two NREL contributors. The reviewer noted that the project is also using a subcontractor, Research Systems Group, for transportation survey design.

Reviewer 2:

The reviewer stated that the project team has secured participation from three DOE national laboratories and a research firm. The reviewer commented that the research/survey firm has experience with creating these types of surveys in the past and is an appropriate partner for this work to ensure the maximum amount of information is collected from survey respondents.

Reviewer 3:

The reviewer said that, at this point, overall collaboration and coordination are solid with three participating labs (LBNL, INL, and NREL) and Resource Systems Group, Inc. The reviewer suggested that it may have been beneficial to include an automotive OEM on the project as it is likely they would have excellent insights and marketing analysis into traveler characteristics that define consumer behavior with regards to transportation options. Automotive OEMs have been working in this space for a long time.

Reviewer 4:

The reviewer was not clear on the project's collaboration efforts.

Reviewer 5:

The reviewer stated that the presentation reports that collaboration is challenging but underway.

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

Reviewer 1:

The reviewer stated that the project team looks like they have a plan that will produce good data for next year.

Reviewer 2:

The reviewer noted that survey completion, data analysis and dissemination to appropriate EEMS research areas, and consideration of additional surveys or data analysis are very appropriate future steps.

Reviewer 3:

The reviewer stated that the future research plan is logical and reasonable given that the project is roughly two-thirds complete. The products of the research effort (insights in to other SMART Consortium tasks and public reporting) are appropriate for this type of work. The reviewer remarked that extending the data collection to another region would address one of the limitations of the work to date (single region of data collection) if time, approval processes, and budget allow.

Reviewer 4:

The reviewer noted that the stated objective of data collection in poor and underserved communities was offered in the presentation. The reviewer asked the project team to consider if the population characteristics of Oakland could be suitable for this and if a focused data collection could be possible in FY 2018 for this bus-population. The reviewer commented that this may need to be part of the determination for the go/no-go in FY 2019, but this would allow further analysis of this component of the population while staying within the original study area. Similarly, the reviewer stated that the suburban counties on the north side of the bay may also be a worthy target for additional surveys because these may represent a more common cross-section of the U.S. population.

Reviewer 5:

The reviewer remarked that the project's proposed future research is satisfactory. Several high-level elements are presented including for FY 2018 completing data collection, delivering data to other SMART Consortium tasks, and generating an initial set of analyses and results for Whole Traveler Research activities. The reviewer noted that for FY 2019, the project is planning more extensive analysis and generation of results and insights. The reviewer stated that a more comprehensive listing and discussion of proposed future research would be beneficial, as would incorporation of additional hard decision points. This project is somewhat challenging as it can be difficult to determine what defines impactful progress.

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

Reviewer 1:

This reviewer said that this project is part of the SMART Mobility Lab Consortium and contributes to better understanding of pathways to an energy independent and efficient transportation system.

Reviewer 2:

The reviewer stated that this project is relevant to DOE VTO objectives as it is important to understand the characteristics of the ultimate customers of DOE-developed technologies. Understanding who is likely to adopt

these technologies and gaining insight as to why they would adopt them is critical in creating energy efficient vehicle technologies that will make inroads to the vehicle market.

Reviewer 3:

The reviewer stated that this project should support the nonphysical aspects of understanding transport decision making. This is an area the reviewer personally sees lacking. When this reviewer speaks with people in research areas, they seem not to be in touch with the realities of how people make decisions and what modes offset others and why.

Reviewer 4:

The reviewer noted that understanding of the "Life Trajectories" will be very important to apply in the numerous other research projects needing these data for travel and trip inputs to operational studies of future years, and the associated energy implications.

Reviewer 5:

The reviewer commented that this project is relevant to DOE's overall objectives to reduce energy use and improve mobility energy productivity. The reviewer noted that is important to understand (and ultimately respond to) individual traveler behavior and economic drivers to successfully influence future consumer receptiveness to and adoption of emerging and transformative transportation technologies and services.

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 when the applicability of the methodology to data collection in other regions and part of the U.S. are considered, the additional funding to use the survey tools and analysis methods in a better cross-section of the American population is an important step. The reviewer recommended additional funding.

Reviewer 2:

The reviewer stated that the $3.35 million in funding for the three national laboratories participating in this project over 3 years seems appropriate given the large scope of the survey and the planned data analysis.

Reviewer 3:

The reviewer said that the funding resources should be sufficient to complete the project scope as described in the presentation. The data collection/survey geographic scope is sufficiently narrow for ensuring the project can collect data within its funding limitations.

Reviewer 4:

The reviewer assumed resources are sufficient for the project to achieve the stated milestones in a timely fashion, but resources are unclear.

Reviewer 5:

The reviewer commented that this is a significant project spanning 3 years with a budget of $3.35 million. Given the project's size, scope, objectives, and milestones as defined, the budget seems somewhat excessive. The reviewer noted that the project may benefit from identification of much sharper and definitive milestones and deliverables, especially with regards to supporting other SMART Mobility project tasks.

Presentation Number: eems024
Presentation Title: Market Acceptance of Advanced Automotive Technologies (MA3T)—Mobility Choice: 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 three reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer remarked that the approach outlined is appropriate for achieving the work scope. The new choice modeling approach builds on Oak Ridge National Laboratory's (ORNL) well-established market acceptance of advanced automotive technologies (MA3T) model framework, which is likely more cost-effective than creating an entirely new model. The reviewer stated that for the long-term choices, including the "not buy" option is very important particularly in light of some concerns that future vehicle technologies will be too costly for many vehicle buyers to adopt. The project team has included a useful coordination/calibration aspect to its approach to take advantage of other EEMS research results.
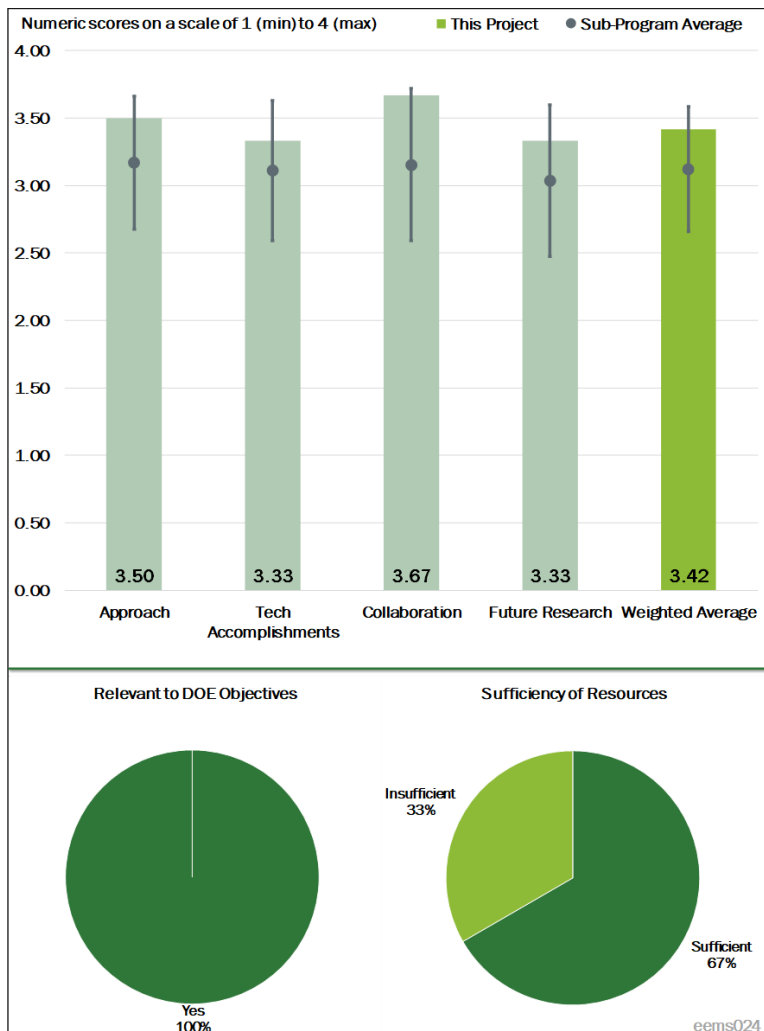

Figure 3-11 - Presentation Number: eems024 Presentation Title: Market Acceptance of Advanced Automotive Technologies (MA3T)—Mobility Choice: Analyzing the Competition, Synergy, and Adoption of Fuel and Mobility Technologies Principal Investigator: Zhenhong Lin (Oak Ridge National Laboratory)

Reviewer 2:
This reviewer stated that the project has an excellent approach for accelerating the acceptance transition to new mobility technologies. The project is modeling business cases associated with various levels of penetration of EVs and AVs. The reviewer noted that the project leverages several years of previous development of the MA3T model and uses cost data from ANL.

Reviewer 3:
The reviewer noted that the project team is using an analytical approach to understand future penetration and acceptance of electrification, shared, and autonomous transportation using various consumer choice models,

etc. The reviewer said that this rational approach is likely to provide a good forecast of future scenarios and their relative probabilities.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer said that the accomplishments to date are good given that the project is less than a year old. The project team has already made initial model runs to explore market uptake of automated vehicles by fuel type, including the number of plug-in electric vehicle (PEV) and HEV systems being adopted in the automated vehicle market (of interest because of the general belief that electrification and automation have opportunities for synergies in a number of areas). The reviewer noted that the project team is using the models to explore interesting effects such as the benefits to human drivers of reduced congestion through automation (and the implications for further automated vehicle uptake), which should add to the discussions and understanding around automated vehicle effects.

Reviewer 2:
The reviewer stated that the project analysis results present a clear story regarding what the team has estimated and the significance of each of the results.

Reviewer 3:
The reviewer said that the project team has presented several interesting plots of future fuel types, future market shares of various technologies, etc. The reviewer stated that these interesting results offer a nice preview of how transportation preferences may evolve in the future.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer commented that the project team is taking good advantage of the full suite of SMART Mobility project results as inputs and the national laboratories/universities associated with those activities. No other collaborations are explicitly listed (all the work is done at ORNL).

Reviewer 2:
The reviewer remarked that the project presentation showed that all the partners are contributing significantly to the work products.

Reviewer 3:
The reviewer stated that several of the results and accomplishments are joint with other national laboratory teams as well as university partners. The reviewer remarked that this shows good coordination and collaboration.

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

Reviewer 1:
The reviewer stated that the future work to complete the development of the model and its planned functionality and refine the model as needed is logical. The reviewer remarked that the project team should have the necessary expertise and resources to complete this work.

Reviewer 2:

The reviewer noted that the project's future work plans are primarily to refine its assumptions and representations. The project team will likely continue to improve the value of their quality work products.

Reviewer 3:

The reviewer stated that the project team has proposed interesting future work on the value of commute time and the supply of shared mobility.

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

Reviewer 1:

The reviewer stated that understanding how consumers make choices about vehicle technologies is very relevant to DOE VTO goals as these technologies do not improve energy efficiency if consumers do not ultimately adopt them. The reviewer said that exploring multiple scenarios and identifying the range of results is very important to bracket the problem.

Reviewer 2:

The reviewer commented that building models of autonomous vehicle business cases and penetration scenarios is directly relevant to achieving the EEMS program objectives.

Reviewer 3:

The reviewer stated that EEMS aims to study ways to reduce future transportation energy use by all means possible (shared, AV, electrification, multi-mode, etc.) This project supports this objective by studying market acceptance and adoption of these innovations.

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

Reviewer 1:

The reviewer remarked that this project may be deserving of more resources. The project team has produced strong results with the limited resources given.

Reviewer 2:

The reviewer stated that the resources listed do appear to be sufficient to complete the work described.

Reviewer 3:

The reviewer commented that the project team has made good progress with the allotted resources and they expect the team will handle the future work adequately.

Presentation Number: eems026
Presentation Title: Expanding Regional Simulations of Connected and Automated Vehicles (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 and well-planned.

Reviewer 1:
The reviewer commented that the approach is logical and will provide the desired improved understanding of CAV energy impacts. The combination of bottom-up and top-down analysis efforts makes the overall results more defensible as the team can show multiple approaches to identifying the high-level CAV impact and explore more scenarios to define the space better. The reviewer stated that the team is making good progress in integrating these formerly-separate projects together. The step to review the existing literature is very important to ensuring that the research is focused on filling the most critical knowledge gaps. The reviewer said that given the pace of technology development and the likelihood of CAV technology uptake in commercial medium-duty (MD)/heavy-duty (HD) trucks, including HD vehicles as part of the analysis for this task is welcomed.

The project team appears to be working well to incorporate the results of other EEMS research and taking advantage of this body of work (making efficient use of overall VTO funding). The reviewer remarked that the project team is looking at both vehicle miles traveled (VMT) (energy impact) and passenger miles traveled (mobility service demanded) and both are important to understanding the impacts of CAVs.

Reviewer 2:
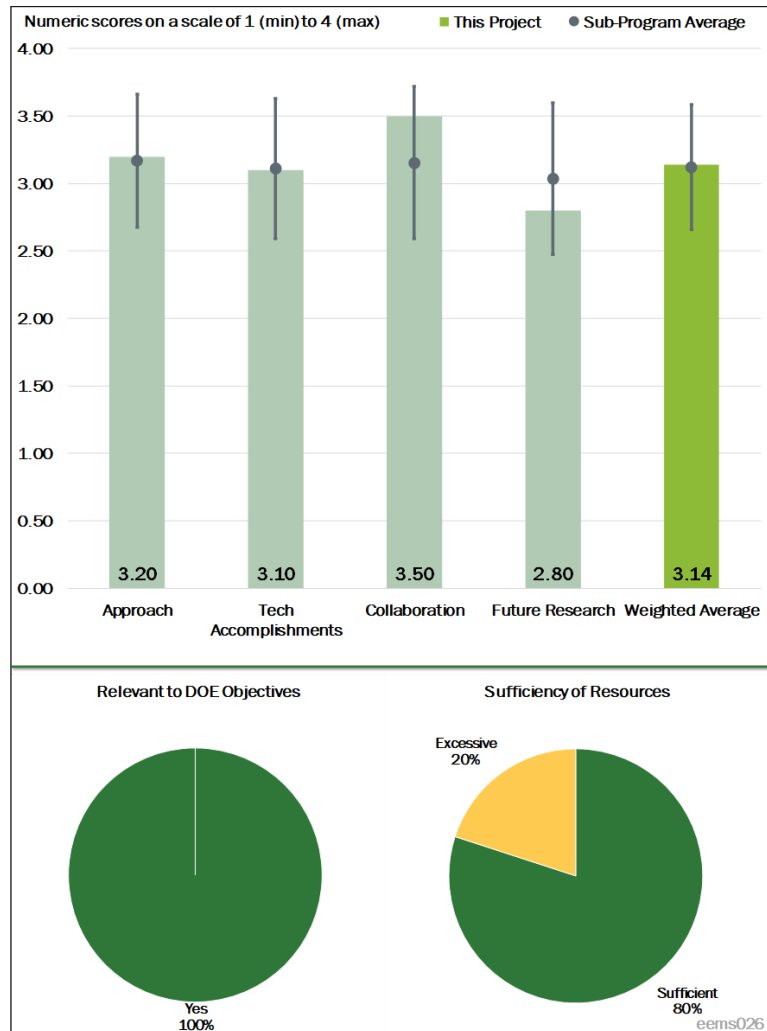The reviewer noted that the project team has chosen a bottom-up and top-down approach.

Figure 3-12 - Presentation Number: eems026 Presentation Title: Expanding Regional Simulations of Connected and Automated Vehicles (CAVs) to the National Level and Assessing Uncertainties Principal Investigator: Tom Stephens (Argonne National Laboratory)

Reviewer 3:

The reviewer remarked that the project aims to address gaps in understanding and estimating potential energy and mobility impacts of CAVs at the national level. Specifically, the reviewer pointed out that the task aims to develop methods to estimate potential CAVs technology adoption rates, develop methods to aggregate detailed results of case studies to the national level, develop response-surface/reduced form methods to give technical/behavioral outcomes at the regional/national level, and apply methods and deliver estimates of national level energy and mobility impacts of CAVs. The reviewer stated that project approach encompasses a literature review and conducting two approaches to national-level analysis including bottom-up (including estimates of CAV adoption and traveler and vehicle simulations) and top-down (economic modelling and energy/travel effects from results and response functions from larger, disaggregated spatial models). Use cases include cooperative adaptive cruise control (CACC), highly automated passenger vehicles (private/shared), and HD vehicles.

The reviewer noted that given the inherent uncertainties of predicting future scenarios and the degree and impacts of CAV adoption, it is good to assess from several directions including bottom-up and top-down. However, the reviewer would have benefited from a more thorough explanation of how the two approaches are best merged together and assimilated to provide more robust and defensible assessments and predictions. Later in the presentation (Slide 17), the presentation mentioned that CACC penetration levels in a fleet are compared with that predicted by the 2017 Annual Energy Outlook (with different methodology and some assumption differences). The reviewer remarked that it may be beneficial to do more of these "sanity checks" in a number of areas with other sources to refine and validate the approaches being used in this project.

Reviewer 4:

The reviewer remarked that this is an ambitious project. The approach to addressing computational complexity is plausible, but the adequacy of the bottoms up methodology to reproduce national-level activity is not entirely clear. The reviewer noted that it is important to clarify whether the goal of this project is to generate sound results (less likely) or useful analytical approaches that could be further developed (more likely). The large AV advantage due to range extension (Slide 11) appears to assume battery costs that are very high in 2050.

Reviewer 5:

The reviewer liked this project's approach of using both a bottom-up and top-down process to calculate estimates for some key parameters, such as fuel use and VMT. These different approaches can then be compared and evaluated for whether they are producing results that make sense. The reviewer noted that could be done by comparing the predictions for nationwide fuel use in transportation with actual data regarding the amount of fuel sold by fueling stations or provided by the oil companies, which should be available. However, the reviewer did not feel that at least two of the barriers identified in the presentation are either real barriers or are well-posed. Neither the "computational difficulty of accurately modeling large-scale transportation systems" nor the "complex role of human decision-making processes" is really a barrier. The reviewer noted that the first is the reason we need models and the second is one of the things we need to model.

The reviewer said this project would be improved if the research team would better define exactly what it is they want to model, what it is they want to learn from the model, and what barriers need to be overcome that are making this difficult. The reviewer stated that saying that something is "complex" is not sufficiently specific. The reviewer suggested that a better set of goals and barriers could be modeling energy use by CAVs (and conventional vehicles) in several canonical driving scenarios (urban, rural, etc.) and applying these at a national scale so that the project team can learn whether CAVs will increase or decrease energy use and how that relationship between adoption level and energy use changes with level of CAV adoption. However, the reviewer noted that there are no accurate data yet on how CAVs interact with conventional vehicles (or vice versa) so the project team may need to make assumptions or estimates about this interaction and then test these assumptions on small sets of vehicles. The reviewer remarked that this same line of thinking could be applied to predicting travel times or traffic flow or other parameters of potential interest. While the current approach

has some merit, it could be made much better if the goals and barriers were expressed better using more specific language. Without that, the reviewer stated that it hard, if not impossible, to comment on feasibility.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer stated that the project has demonstrated a number of accomplishments, including development of initial national-level impacts from top-down analyses; using the MA3T-Mobility Choice model to identify and establish critical insights on the market dynamics of vehicle electrification, automation, and sharing; establishing that travel patterns (travel demand and VMT) can be transferred to similar households; using VMT transferability modeling to expand detailed travel simulation results to the national level; establishment and initial testing of a national-level aggregation framework; and exercising the framework through hypothetical examples. The reviewer concluded that the project appears to be roughly on schedule.

Reviewer 2:
The reviewer commented that the project team has made solid progress on evaluating the national level impacts (top-down)—fuel use versus fuel incremental cost; VMT versus VMT incremental cost; market dynamics of vehicle electrification, automation, and sharing; and transferability of travel patterns to households with similar characteristics.

Reviewer 3:
The reviewer noted that the project seems to be on schedule, although the presentation makes reference to awaiting results from other SMART Mobility tasks.

Reviewer 4:
The reviewer commented that, in general, the accomplishments seem to be reasonable given that the team is around 60% complete on a schedule basis. The consideration of purchasing decisions is an important aspect of CAV technology that will drive the uptake and resulting energy use. Both technology choice and decisions about buying or not buying a vehicle are essential options to examine to understand CAV markets. The reviewer noted that any effort by the team (or EEMS in general) to expand the choice models to MD/HD vehicles would be useful as purchase decision processes for MD/HD are different from light-duty (LD) and must be understood. The examination of VMT-based pricing is particularly interesting and shows some intriguing but probably expected trends (consumers will request more VMT if it is less expensive per mile).

The reviewer remarked that including insurance cost is valuable as this is relatively unexplored in CAV technology. This reviewer hoped the team can review results with an insurance company as a reality check if they have not done so already. The transferability analysis seems reasonable but is easy to dispute. The project team should be able to demonstrate how this process provides reasonably accurate answers (and it appears the team has done this work although there is limited time in these presentations to provide such details). The project team has made good attempts at responding to reviewer comments with thoughtful answers and adjustments to work where necessary.

Reviewer 5:
The reviewer commented that it is difficult to tell from this presentation precisely which accomplishments this work produced and which ones were produced by other, related projects. For example, regarding the graphs shown on Slide 10, the reviewer asked if they were from this work or some other project. The information on most of the slides labeled as containing accomplishments is not phrased in a manner that suggests they are really accomplishments. Phrases such as "quantify utility to consumers" and "transfer results from" seem to indicate what the project team is currently doing, not what they have completed or accomplished. The reviewer remarked that if the work is trying to predict when consumers will choose a CAV or what their adoption rate will be, then there needs to be some model or criteria for consumer decision-making. The reviewer noted that this is never defined. The reviewer asked if it is based purely on an economic calculation; if there is a benefit-

cost ratio where the decision turns in favor of the CAV; if there is a societal benefits part of this calculation or just personal benefits; if these different benefits are weighted the same; if there are historical precedents for such decisions; and if government regulation requiring CAV adoption would produce more societal benefits more quickly. The answers to these questions could signify technical accomplishments. The reviewer stated that the project seems to be producing some information through the modeling, but because it does not seem to be aimed at specific goals or questions, it is hard to call these accomplishments.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer commented that the project integrates work across team members through the top-down and bottom-up approaches. It also makes use of and feeds into other EEMS/SMART tasks, as well as informal collaboration with other institutions.

Reviewer 2:
The reviewer noted that the project team has been making good progress in integrating this work with activities at other EEMS-related national laboratories (ORNL, NREL) and universities (University of Illinois at Chicago). The team is drawing on work from others rather than recreating it wherever appropriate (a good use of resources) and sharing results back with other national laboratories doing work in this area.

Reviewer 3:
The reviewer stated that the project team has shown good coordination between ORNL, NREL, ANL and University of Illinois at Chicago (UIC).

Reviewer 4:
The reviewer remarked that overall, the collaboration and coordination are excellent for the project. The project has three primary national laboratory participants (ANL, NREL, and ORNL), the UIC, and the University of Maine. The reviewer noted that the project is also working to incorporate outputs from additional SMART Mobility performers (LBNL and INL), as well as informal collaborations with University of Michigan, Vanderbilt, and the U.S. Environmental Protection Agency (EPA) Office of Transportation Air Quality. The reviewer concluded that the project could possibly benefit from a private sector participant to provide a commercial perspective and sanity check.

Reviewer 5:
The reviewer stated that the project seems to be receiving results or predictions from other projects or collaborators so the reviewer is giving it the benefit of the doubt that the coordination is good. However, it would be much better if the presentation identified exactly which collaborator (or team member) is doing what and exactly what information each member produces and who is transferring what to whom. Slide 8 hints at this but it is never clarified on the other slides and slides like Slide 16 leave the reviewer wondering where that information was generated. The reviewer noted that this project needs regional-level information from other projects, which the reviewer has to assume it is getting or there would be very little to present, but it would be much better if the project team members could or would be clearer about exactly what they are producing and transferring to each other and why.

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 proposed work includes incorporating behavioral research results, which will be important to ensuring value of this work. The reviewer pointed out that it was not specified how those results will be incorporated.

Reviewer 2:

The reviewer commented that the future work proposed by the project team seems to be reasonable and will round out the accomplishments to date. As noted elsewhere, including MD/HD trucks is very important in understanding the overall energy impact of CAVs. The reviewer stated that the sensitivity analysis to explore the analysis' response to assumptions is also important in increasing confidence in the overall results.

Reviewer 3:

The reviewer stated that future plans include applying aggregation methods to CACC scenarios, estimating the potential for CAVs by market segment, etc. The reviewer said that these are all good objectives.

Reviewer 4:

The reviewer noted that the project defines a somewhat broad scope of proposed future work for FY 2018 and FY 2019, ostensibly addressing many of the remaining challenges and barriers as identified on Slide 20. However, the reviewer said that the scope may be too expansive and it may be beneficial to narrow it somewhat. Focusing more heavily upon further testing and validation of the approach may help build confidence in its validity and applicability. The reviewer pointed out that there is little discussion of appropriate decision points nor methods to reduce risk by providing alternate development pathways for future work.

Reviewer 5:

The reviewer noted that many slides are poorly prepared. The reviewer commented that, for example, every bullet point should use the same verb tense in Slides 20 and 21, instead of using words like "validating" or "extending" in some places and "expand" or "analyze" in others. The reviewer stated that the simple tense (will validate) is preferable to the progressive tense (will be validating).

Secondly, the reviewer stated the project team should use complete sentences and complete thoughts. The reader/reviewer wants to know what the researcher is going to do, so the reviewer suggested saying something like "in the next year we will…," not "validating transferability of VMT." And in formulating those complete thoughts, the reviewer advised that the project team avoid using undefined words and phrases. Phrases like "expansion aggregation methods" and "simulation results for CACC scenario" need to be clearly defined. The reviewer remarked that the project team put a lot of bullet points on Slides 20 and 21 so it seems that considerable thought had been given to what the project team wants to do next. Unfortunately, the slides do not clearly communicate what that is or how it relates to the goals or why those funding the research should care about it.

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

Reviewer 1:

The reviewer stated that this project supports DOE objective of reducing petroleum consumption and the EEMS objective of decoupling mobility from energy use.

Reviewer 2:

The reviewer remarked that understanding the impacts of CAV technology at a broad system level is very relevant to DOE objectives, especially because the initial estimates of impact are quite uncertain. It will be very important to scale-up detailed case studies and simulations to assess national-level impacts to help inform DOE research. The reviewer commented that it is critical for VTO to understand CAV technology impact in light of its mission of national energy security.

Reviewer 3:

The reviewer stated that aggregating local effects to national totals in the area of adoption of electrification, sharing, and autonomous technologies supports the EEMS objective of reducing energy consumption via a full system approach.

Reviewer 4:

The reviewer commented that yes, the project is relevant to overall DOE objectives in that it aims to estimate the potential energy and mobility impacts of CAVs at the national level. This information is needed to help provide knowledge and insights as to which CAV technologies within specific applications offer the greatest potential to help address the nation's transportation energy and mobility challenges.

Reviewer 5:

The reviewer remarked that DOE clearly wants a better understanding of the future impact of CAVs on the transportation and energy systems. This project is trying to create some models at the national level that address that. However, the reviewer stated that the goals of this project need to be much more specific and the research questions need to be much clearer before one can say whether this project is providing DOE with valuable insights on the impact of CAVs. It is not exactly clear whether the project is trying to model consumer purchase decision making with respect to CAV's and then use this to predict their adoption rate or if it is simply assuming adoption rates and trying to predict their impact on energy use and mobility. The reviewer stated that either approach might have some value, but the project is not clearly addressing one or the other objective or both or something else. The language describing the work is too vague.

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

Reviewer 1:

The reviewer remarked that this is an ambitious project, but the project team plans to take advantage of results from other projects, so resources may be sufficient.

Reviewer 2:

The reviewer commented that the resource level appears sufficient to achieve the goals of the project.

Reviewer 3:

The reviewer remarked that the resources are adequate for the stated objectives.

Reviewer 4:

The reviewer commented that from the presentation, it appears that DOE has provided a total in FY 2017 and FY 2018 of approximately $1.2 million for the project. The project is scheduled to conclude in September 2019. The reviewer said that not knowing what FY 2019 allocations are likely to be, it is somewhat difficult to assess if the resources are sufficient. However, assuming that FY 2019 funding will be in the neighborhood of $500,000, it would appear that funding resources are sufficient for the identified project scope.

Reviewer 5:

The reviewer commented that these questions about resources on the EEMS projects are almost impossible to answer based on the information that is provided in most of the presentations. The budget for this work seems to be rising from about $400,000 in 2017 to $760,000 in 2018. But it is not clear how these funds are divided between researchers and institutions or if there are additional funds beyond these that the other team members are receiving. In either case, the reviewer concluded that this is significant funding for a project that is not generating its own data but is receiving inputs from other programs and simply finding ways to scale these to a national level through modeling. The reviewer does not think the resources are wildly excessive, but they seem a little high for such an effort. The reviewer stated that a clearer picture of the precise research goals, the roles of the other team members, and the budget allocation for each team member would be needed before providing a better answer to this question.

Presentation Number: eems027
Presentation Title: National Scale Multi-Modal Energy Analysis for Freight
Principal Investigator: Kevin Walkowicz (National Renewable Energy Laboratory)

Presenter
Kevin Walkowicz, National Renewable Energy Laboratory

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer commented that the approach is right on track.

Reviewer 2:
The reviewer remarked that the approach is logical and well-defined by the project team in the poster information. The approach is designed to take advantage of existing data sources and partnerships to identify scenarios and quantify assumptions, a valuable use of NREL's connections in the industry. The reviewer said that the project team has identified some logical and useful near-term milestones to guide the work.

Reviewer 3:
The reviewer remarked that this project has excellent potential for actual fleet demonstrations in the future.

Reviewer 4:
The reviewer stated that this project seems sound and follows a reasonable process in terms of evaluation.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
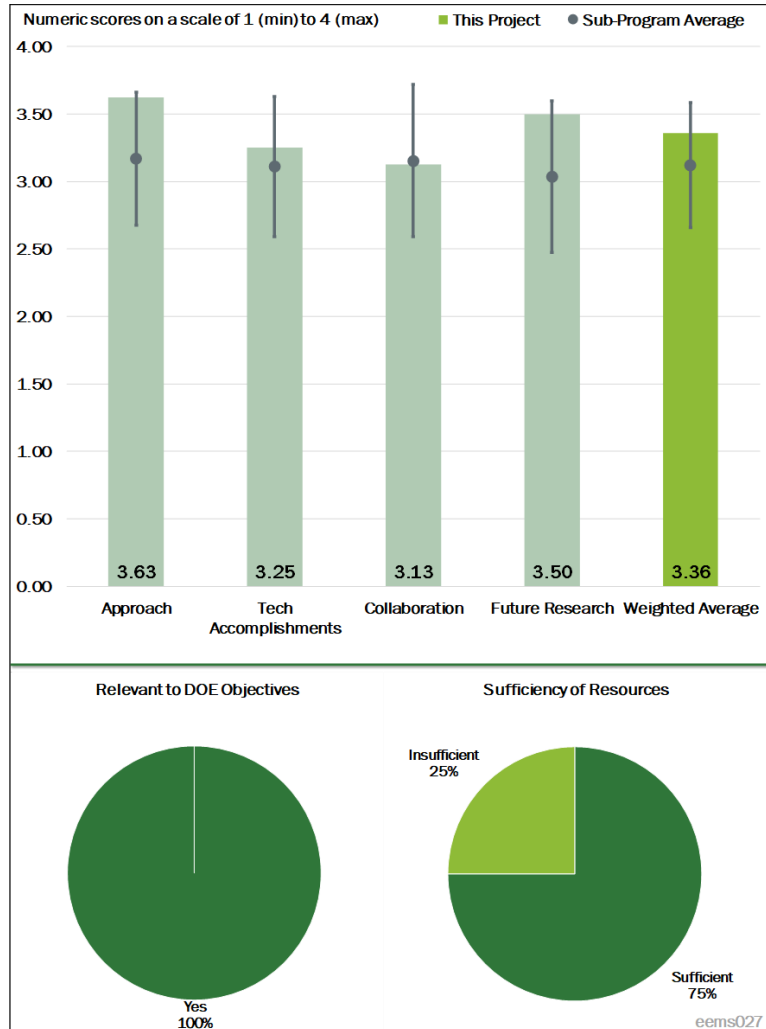The reviewer stated that the project has made good work and progress to date.

Figure 3-13 - Presentation Number: eems027 Presentation Title: National Scale Multi-Modal Energy Analysis for Freight Principal Investigator: Kevin Walkowicz (National Renewable Energy Laboratory)

Reviewer 2:

The reviewer remarked that the accomplishments to date are good building blocks toward the ultimate goal of quantifying modal shift freight efficiency impacts: truck technology efficiency levels, key scenarios, and modeling frameworks. The reviewer stated that the accomplishments show a good balance of work among the laboratory team members. The exploration of multi-modal origin-destination pathways should be useful in understanding how freight will move in the future. The reviewer said that scenarios for future freight technology and freight volumes/modes seem to be appropriate for exploring the parameter space.

Reviewer 3:

The reviewer commented that the project's progress is very good at this stage and shows high potential.

Reviewer 4:

The reviewer remarked that establishing the energy impacts of mode switch and platooning comprehensively will be key to engaging with freight deliverers and cities in terms of seeing these results in action. The reviewer concluded that the project has so far only quantified impacts from a very limited set of freight approaches and still has a long way to go in terms of addressing the universe of applications.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer stated that although improvements are being made from past years, the reviewer believed the poster sessions highlighted some synergies that could be leveraged.

Reviewer 2:

The reviewer remarked that the project team is a nice multi-stakeholder combination of national laboratories, agencies, freight providers, and cities. The project has a good testing ground, and also considers multiple stakeholder views.

Reviewer 3:

The reviewer remarked that there is good collaboration across the project team, but needs more commercial partners.

Reviewer 4:

The reviewer reported that the project team has an extensive list of DOE national laboratory and other partners, including a potential conduit to Columbus Smart City data (Mid-Ohio Regional Planning Commission [MORPC]). The project team is collaborating with the other DOE-funded SMART Mobility Consortium members. The reviewer stated that the team only includes one industry partner at the moment (UPS), so it would be potentially valuable to add to that list (something the team does acknowledge to be the case). This reviewer agreed that additional freight shipping company partners would add to the project. One potential partner/advisor for future freight mode shifts would be the economists/analysts at the American Trucking Associations who publish annual freight forecasts that might add a perspective to better understand the project results.

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 data collected will help overall routing and reduce congestion.

Reviewer 2:

The reviewer commented that future research efforts represent a logical pathway to completing the project scope as described by the project team. The results from this future research plan should provide helpful insights to VTO on future freight movement technologies and their impacts.

Reviewer 3:

The reviewer stated that this project will serve as an important basis for vast decisions regarding transportation solutions in the future.

Reviewer 4:

The reviewer commented that the next steps seem reasonable. The reviewer noted that it would also be interesting to see how these tech-enabled freight solutions and mode shift strategies can impact urban freight delivery.

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

Reviewer 1:

The reviewer noted that this project will produce data to reduce fuel usage congestion.

Reviewer 2:

The reviewer remarked that this project is highly relevant to DOE VTO goals and EEMS goals by facilitating an understanding of freight movements. Freight will be a critical driver of future energy use in transportation and gaining a thorough understanding of the complex potential shifts in freight movement (and the impacts of technology on these shifts) will enable DOE to make better early-stage research decisions.

Reviewer 3:

The reviewer noted that this project is very relevant as it is a high impact area of energy use for the nation.

Reviewer 4:

The reviewer pointed out that addressing freight energy use will be key to making the American freight sector competitive and also efficient.

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 given the pace of this project and what has been accomplished to date, it seems entirely possible that the associated budget will not be sufficient to last the rest of the project.

Reviewer 2:

The reviewer stated that this project should consider for more funding to complete project.

Reviewer 3:

The reviewer concluded that the resources appear to be sufficient for the specified work objectives with the inclusion of the (uncosted) data provided by others.

Reviewer 4:

The reviewer noted that looking for more collaboration and reduction of repetition amongst national laboratories would leverage resources more effectively. This is an area of improvement but has more room for improvement.

**Presentation Number: eems028
Presentation Title: Developing an Eco-Cooperative Automated Control System (Eco-CAC)
Principal Investigator: Hesham Rakha (Virginia Tech University)**

Presenter
Hesham Rakha, Virginia Tech University

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 and well-planned.

Reviewer 1:
The reviewer remarked that the approach is in line with the objectives.

Reviewer 2:
The reviewer remarked that speed harmonization offers tangible energy impacts. Including automated vehicles (i.e. fully compliant to speed requests from server) should provide even better results. The reviewer said that the work is designed to work over large physical areas as well as multiple powertrains.

Reviewer 3:
The reviewer noted that the project team has developed a systematic two-level control strategy and are executing the building blocks of this strategy.
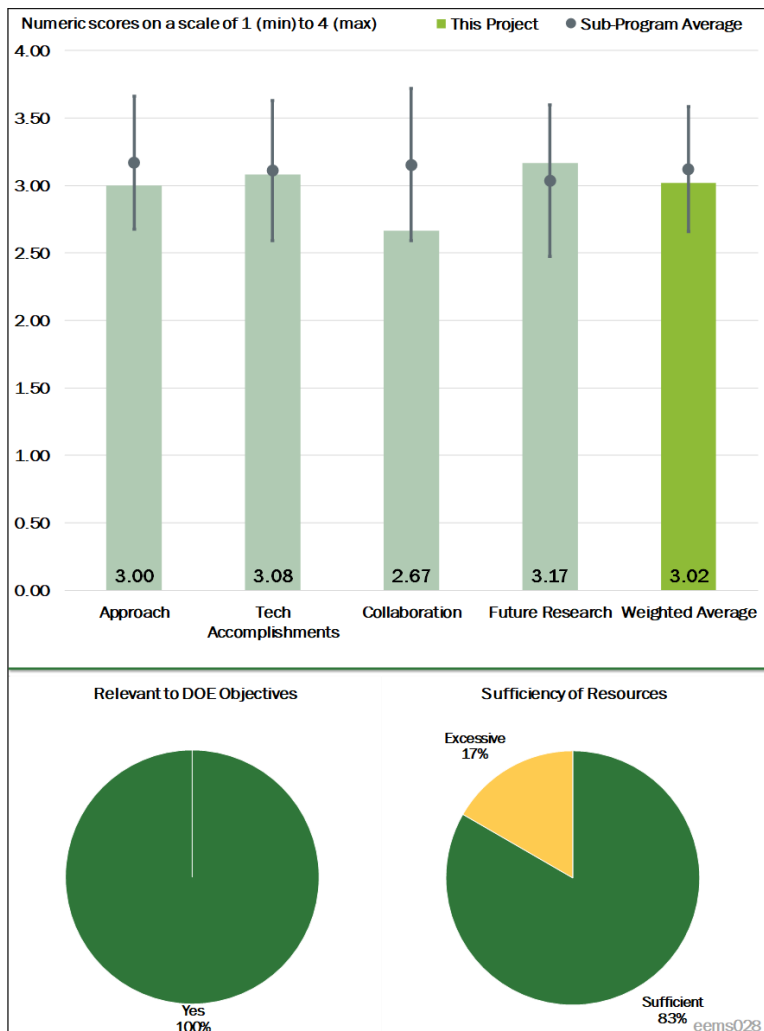

Figure 3-14 - Presentation Number: eems028 Presentation Title: Developing an Eco-Cooperative Automated Control System (Eco-CAC) Principal Investigator: Hesham Rakha (Virginia Tech University)

Reviewer 4:
The reviewer commented that the approach to modeling of individual vehicles is clear and well-designed. The combination of all tasks to a cohesive final project is unclear, particularly the inclusion of the Macroscopic Fundamental Diagrams to regulate system-wide traffic flow. The reviewer stated that the focus on computational speed is appropriate, as it is necessary for use in complex road networks. The presented error in the fuel consumption of an HEV is surprisingly high (10% on slides, 6% said verbally). In particular, the reviewer would expect that the steady state calculation should be independent of regenerative braking and have a very small error. The reviewer noted that specific regions are explored as congested zones, which are potential candidates for perimeter control. When balancing the roadway traffic across all nodes in a network, the reviewer asked how the team will guarantee that fuel consumption and travel time will be reduced, i.e., that the reduction in congestion will not be countered by the additional travel length and driving time.

Reviewer 5:

The reviewer remarked it appears that the project is focused on developing a wide range of models and algorithms; many of them have been previously developed and available. Rather than redeveloping all models (e.g., vehicle energy consumption), the reviewer suggested that the project team consider using existing validated tools so they can focus on the core development of the project (control). The reviewer also recommended that the authors use/reference previous work performed on routing algorithm and highlight the differences of their work.

Reviewer 6:

The reviewer commented that the fundamental building block of any CAV analysis project is the vehicle and propulsion control models and assumptions—both for baseline and CAV scenarios. Rather than using existing trusted high-fidelity models (such as Autonomie), simpler developed models appear to be used, which are likely unable to demonstrate true CAV benefit through driving behavior and powertrain control changes.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer noted that the outline of the tasks and accomplishments is clear and concise.

Reviewer 2:

The reviewer noted that the overall framework is farther along than expected, if indeed the work began in October 2017 and was not started under a previous project.

Reviewer 3:

The reviewer stated that the project team has completed portions of the build blocks of the control strategy such as eco-routing, network monitoring algorithm, Eco-Cooperative Adaptive Cruise Control-I (eco-CACC-I) controller, etc.

Reviewer 4:

The reviewer noted that progress seems appropriate for the short time the project has been funded. Many of the results are finding important parameters of interest for continued research; however, many of the results seem to be too coarse. The reviewer pointed out that, for example, the comparisons of coasting seem overly theoretical and unrealistic. Taking 300 seconds to coast to a stop can be useful as a bounding case, but does not match real-world travel behavior.

Reviewer 5:

The reviewer said that the project is in its early state (6 months), so the reviewer expected that few results will be available. For the Eco-routing task, it is good that each individual vehicle build their own route depending on powertrain. The reviewer stated that the team has selected eight variables to define the routes. It is, however, not clear why or how those variables were selected and if this approach has been validated with high-fidelity models. The reviewer commented that it would also be good for the project team to describe the smoothing procedure that is currently part of the process and whether or not this has been validated with a higher fidelity approach. For 5% traffic, the preliminary energy impact is 6.9% for a 24% increase in travel time. The reviewer would recommend adding some constraints on acceptable time increase as 24% would likely not be acceptable to drivers. Related to vehicle model development and validation, the reviewer would encourage the project team to validate the model under real world driving conditions instead of simply the urban dynamometer driving schedule (UDDS) and highway fuel economy test (HWFET) as those driving cycles are not representative of real world. In addition, if not already the case, the project team should consider proper accessory loads for real-world conditions when estimating vehicle energy consumption. The reviewer recommended the project team consider the uncertainty of their power based model related to CACC. As an example, using a constant value for electric machine efficiency will lead to overestimating the impact of

CACC as the technology will lead to lower operating conditions. Similar comments are valid for conventional, HEVs, and PHEVs.

Reviewer 6:
The reviewer stated that it is difficult to measure the progress of the project due to the short time since inception. However, the reviewer strongly recommended that if high-fidelity vehicle plant models and corresponding controls are not available, the study should focus on the reduction in tractive energy due to driver behavior changes only. The reviewer said that in validating the HEV modelling error—the methodology should be improved to comprehend the statistical divergence in time (or root mean square [RMS]) of the error—not the error of a drive cycle overall. As presented, the reviewer remarked that the total error versus drive schedules is not accurately presented.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer commented that the project has limited partners.

Reviewer 2:
The reviewer noted that the project team has shown good collaboration with Morgan State University and Palo Alto Research Center.

Reviewer 3:
The reviewer remarked that the proposed collaborations seem appropriate, but have not yet started as of this review. The DOE-funded portion is in one research group and is internally coordinated well.

Reviewer 4:
The reviewer commented that Slide 17 describes collaborations, which so far appear to be minimal, however, the project just started. More detail of the work with Palo Alto Research Center and other partners should be evident by next year.

Reviewer 5:
The reviewer said that there does not seem to be any current collaboration other than leveraging existing ones from other projects. The reviewer recommended that the project team reach out to others to reuse existing work rather than trying to redevelop every model internally.

Reviewer 6:
The reviewer noted that the lack of collaboration and coordination with institutions directly will impact the success of this project. The reviewer strongly suggested that the project team collaborate with the members of the SMART Mobility Consortium.

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 there are no issues and that the project is in line with the objectives.

Reviewer 2:
The reviewer stated that, while the project is early on, there appears to be a credible path to reasonable results, thanks in part by the clear vision of the project. If successful, the reviewer expects that this project will provide good, defendable estimates for the potential energy improvements of a well-regulated car network.

Reviewer 3:

The reviewer commented that future work includes an eco-routing development, eco-CACC development, integrated eco-cooperative automated control (CAC) system assessment, eco-CAC prototype evaluation, etc. These are all good building blocks for efficient transportation systems of the future.

Reviewer 4:

The reviewer noted that the proposed future research for each task is appropriate. The reviewer commented, however, that risk mitigation (in case some of the research does not work out) was not clearly explained, and it is not clear how all of the tasks will join together into a cohesive product at the end of the project.

Reviewer 5:

The reviewer noted that the project's overall objective and process are very relevant. The reviewer recommended that the project team reach out to re-use existing models and work to make sure the project focuses on the added value.

Reviewer 6:

The reviewer stated that the exact deliverables for the future work are not clearly defined. The reviewer noted that the future work requires the simultaneous creation of systems, controllers, and models, which present a substantial risk for high-fidelity and meaningful results. It leaves the final work subject to large variance as the underlying assumptions mature and the outputs of individual components change due to continued development.

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

Reviewer 1:

The reviewer remarked that the project has importance in the advent of connected vehicles and their impact on traffic routing.

Reviewer 2:

The reviewer commented that ideas on how automation will likely impact energy usage have been given a lot of thought, but rarely with the rigor and specificity shown here. Whether such large-scale regional speed harmonization is likely from a single controlling entity may be difficult, the results here give us some plausible, defendable estimates on energy impacts of a more smoothly operating vehicle transportation system.

Reviewer 3:

The reviewer stated that this project lines up nicely with the energy saving and commute time reduction objectives of EEMS.

Reviewer 4:

The reviewer stated that the project aligns very well with the current DOE objectives by looking at the impact of eco-routing and CACC on the energy at the system level.

Reviewer 5:

The reviewer noted that the project supports DOE objectives with its overarching goals and barriers to overcome; however, the method in which it is being executed may not support DOE objectives efficiently.

Reviewer 6:

The reviewer noted that while the project supports DOE objectives, within EEMS, the focus is on system-level energy use. The project team noted that the vehicles strive toward a Nash equilibrium for energy use, where all vehicles are optimizing their own fuel efficiency. Therefore, it is possible that optimizing each individual vehicle will be less efficient for the system as a whole. Further, the preliminary results presented led to pretty large increases in travel time (20+%). The reviewer said it is unclear if a typical driver will be willing to tolerate such large increases in travel time, which may prevent fuel efficiency gains from being realized.

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

Reviewer 1:
The reviewer had no issues with resources.

Reviewer 2:
The reviewer said that it appears the resources are sufficient to achieve the stated milestones as planned.

Reviewer 3:
The reviewer noted that the resources adequately match the work done so far as well as the proposed future work.

Reviewer 4:
The reviewer stated that the resources are sufficient.

Reviewer 5:
The reviewer noted that the budget seems quite large for a (mostly) university-led project with few high-cost capital needs. However, the project team has made quick progress, so perhaps there is a large team at Virginia Tech. Not having the budget breakdown, the reviewer is not comfortable calling it "excessive." but the reviewer would be curious to see the numbers.

Reviewer 6:
The reviewer stated that it is not clear what the large amount of funding is being spent on in this project. As presented, the focus has been mainly on simulation activities, which do not appear to justify the high cost.

Presentation Number: eems029
Presentation Title: Boosting Energy Efficiency of Heterogeneous Connected and Automated Vehicle (CAV) Fleets via Anticipative and Cooperative Vehicle Guidance
Principal Investigator: Ardalan Vahidi (Clemson University)

Presenter
Ardalan Vahidi, Clemson University

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 and well-planned.

Reviewer 1:
The reviewer stated that this is a very logical approach with well-defined tasks and corresponding inputs/outputs. The reviewer said that there are appropriate go/no-go decision points based on realistic metrics. The vehicle-in-the-loop (VIL) work presents increased opportunities beyond typical vehicle/model correlation.

Reviewer 2:
The reviewer commented that the approach is generally excellent. The reviewer suggested introducing metrics to measure smoothness/comfort (e.g., vehicle jerk, proximity to lead vehicle, etc.) as well as safety (e.g., probability of impact x severity under various scenarios).

Reviewer 3:
The reviewer noted that the project team covered all aspects that were relevant.

Reviewer 4:
The reviewer pointed out that the project is well-designed and planned. The PI has a good plan to address technical barriers with a clear focus on ultimately field testing on real-world applications.

Reviewer 5:
The reviewer said that the authors could better specify the objectives of the design of CAV guidance schemes in order to clarify whether there are multiple objectives or energy use minimization is the sole objective.
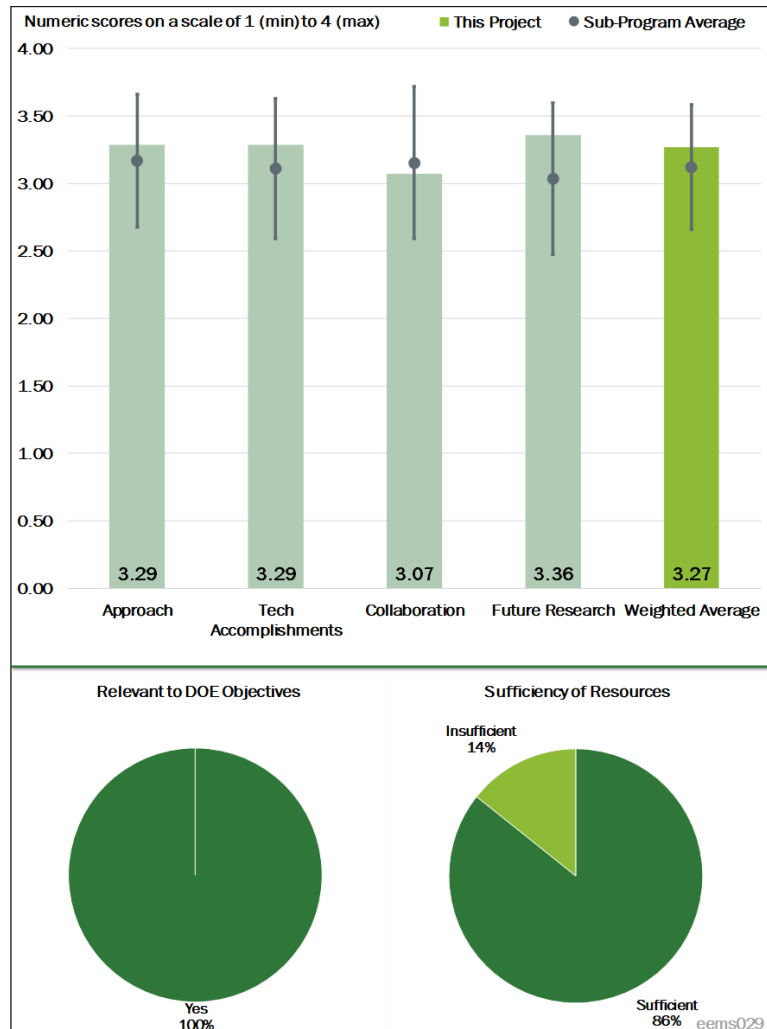

Figure 3-15 - Presentation Number: eems029 Presentation Title: Boosting Energy Efficiency of Heterogeneous Connected and Automated Vehicle (CAV) Fleets via Anticipative and Cooperative Vehicle Guidance Principal Investigator: Ardalan Vahidi (Clemson University)

Reviewer 6:

The reviewer remarked that the simulation of predictive and anticipative algorithms is an important step forward for CAV analysis. The approach has initially omitted position uncertainties/error of CAVs (perfect knowledge) and assumed no communication latencies. The reviewer noted that the positional uncertainties and data latency have the potential to change the simulation results.

Reviewer 7:

The reviewer stated that the project team's approach steps through an appropriate process to build up to "real-world" testing. However, the test track is not "real-world." The reviewer said that it is an important step in the process, but as described, is still limited in terms of capturing and validating the behavior under fully complex scenarios. This will inherently limit the applicability of the output against the desired end state of the objectives. The reviewer stated that more attention should be given to evaluating the effects of the uncertainty in prediction in the pathway and what this means under different contexts. As the PI acknowledged, this needs to be made clearer in terms of how it is accommodated and what the effects are.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer remarked that the accomplishments are great overall. The prediction algorithm (i.e., where surrounding vehicles will be in the next x seconds) is difficult as the project team mentioned. The reviewer suggested adding/analyzing not just the prediction, but also adding error bars around these predictions as well as some defendable analysis for what constitutes unacceptable results in the real world.

Reviewer 2:

The reviewer noted that the project team is working in line with industry and realistic timelines/goals.

Reviewer 3:

The reviewer stated that the project started last September; however, the project team has made good progress to date and the team is on track to accomplish their milestones.

Reviewer 4:

The reviewer stated that based on the presentation results, the team has made strong progress in the first few months. The project team presented results that showed fuel efficiency improvements for various percentages of CAVS penetration that employed the predictive algorithms described. The reviewer noted that the project team also showed a visualization of the lane prediction algorithm that was useful for communicating the progress.

Reviewer 5:

The reviewer said that the technical accomplishments are very good considering the short time since the work has been started.

Reviewer 6:

The reviewer stated that the work is on schedule and the demonstrated potential for energy efficiency gain is significant. However, the reviewer remarked that the position prediction may not be sufficiently accurate for real-world application (although performance may meet a reasonable benchmark) and the project team noted that latency in communications had yet to be accounted for.

Reviewer 7:

The reviewer stated that the completed work might be technically valid, but it is not clear how it is relevant. Simulation using a test cycle like the US06 (high speed, high acceleration drive cycle) is very rigid and does not capture relevant and important variations and complexity that occur under actual driving conditions. The reviewer said that it is probably an important step for building knowledge, but that is the limit. Improvements

in efficiency do not mean much in this context until the underlying principles and behavior can be connected to larger systems or the purpose of the output is more narrowly bounded.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer stated that the presentation showed a clear division of labor across the team.

Reviewer 2:
The reviewer remarked that the project is mainly between Clemson University and the International Transportation Innovation Center (iTiC). It seems that there is a good collaboration between these two organizations. The reviewer stated that it is not quite clear how PTV Group is involved in the project beyond that VISSIM is used. ANL has a very limited participation using Autonomie to estimate energy efficiency.

Reviewer 3:
The reviewer stated the fact that the team is showing energy analysis results indicates the Clemson team has collaborated with the PTV Group to exercise the VISSIM tool to produce initial energy consumption results.

Reviewer 4:
The reviewer noted that the collaboration with identified partners is very good in terms of number and scope.

Reviewer 5:
The reviewer remarked that collaborations are satisfactory but are also quite limited in number (only three) and type (university, DOE national laboratory, international center). The collaboration lacks private sector participation as well as other Federal entities with jurisdiction and expertise in this area (e.g. Intelligent Transportation System Joint Program Office [ITS-JPO]).

Reviewer 6:
The reviewer noted that the project team should have more HD Class 8 truck participation.

Reviewer 7:
The reviewer said that the project team did not adequately cover the collaboration. The presentation included a slide, but a lack of sufficient information was provided to assess the quality of the collaboration. The reviewer stated that this is a problem given the complexity of the work and a lack of incorporation of existing microsimulation that exists either with the partners, or other centers.

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

Reviewer 1:
The reviewer noted that the remaining technical challenges are significant and the likelihood of success is unclear, but it is still early in the project.

Reviewer 2:
The reviewer said that the future work seems well-planned. There are well-thought milestones regarding the field testing (including two vehicles) and comparison against the simulation results.

Reviewer 3:
The reviewer noted that the project team covered all areas of concern.

Reviewer 4:

The reviewer commented that the project work plan is logical and includes two major decision points. The reviewer noted that the team has been developing vehicle hardware in parallel to the simulations. One thing missing is feeding the test track results back into simulation which may improve the accuracy of the simulation results/energy analysis.

Reviewer 5:

The reviewer noted that future work plans appears to be organized very logically. The reviewer would appreciate more information on the VIL testbed in order to determine the risks associated with the learning objectives tied to this activity.

Reviewer 6:

The reviewer stated that the future work seems reasonable given the accomplishments from the last year. It may be worth setting up either a formal or informal network of other laboratories using test tracks for CAV work, because it sounded like other laboratories may not have had insurance issues. The reviewer said that perhaps there are some lessons to be learned from others here.

Reviewer 7:

The reviewer commented that the proposal is logical—there is just a lot to do relative to the objective. The reviewer stated that the work seems to progress on an assumption that each task will be accomplished. Given the serial nature of the research proposal, it is unclear how the work can progress if challenges arise or specific results do not yield the requisite outcome.

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

Reviewer 1:

The reviewer stated that the project is examining both physical measurements and modeling space for CAV energy efficiency gains along with the other considerations; therefore, it clearly supports the overall DOE objectives.

Reviewer 2:

The reviewer commented that yes, it is imperative that we find solutions to congestion and the energy use it causes. This will also improve safety for all of the driving public.

Reviewer 3:

The reviewer stated that the project supports DOE objective of petroleum consumption reduction.

Reviewer 4:

The reviewer noted that the project is directly related to DOE's mission and objectives as it addresses the impact on energy usage of connected and automated vehicles and the implications of different penetrations.

Reviewer 5:

The reviewer stated that the project support DOE's objective to measure the potential benefits of CAV technologies with regard to energy consumption.

Reviewer 6:

The reviewer noted that yes, this project is very relevant, not only in fulfilling the stated objectives but also in establishing a framework and process for analysis that others could benefit from.

Reviewer 7:

The reviewer said that the project is aligned as an objective with the goal. The project is multi-faceted and complex. The reviewer noted that the concern or risk is that the output will not yield complete results.

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

Reviewer 1:
The reviewer noted that the project appears to be making great progress with the allocated resources. The merits of the project would justify additional resources if required.

Reviewer 2:
The reviewer noted that quite a lot of resources have been sent the way of this project, but because the project involves test tracks, heavily instrumented vehicles (including with actuators), the relatively high funding level is probably warranted.

Reviewer 3:
The reviewer stated that the resources look sufficient.

Reviewer 4:
The reviewer commented that there are sufficient resources for the collaborative organizations to achieve the milestones and goals of this project.

Reviewer 5:
The reviewer stated that the project should include HD subject matter experts.

Reviewer 6:
The reviewer noted that the resources are sufficient. Their primary question relates to the overall scope. The reviewer questioned if the project is attempting to do too much and asked if the team should focus on more robust outputs in specific areas as part of a path to build up critical knowledge.

Reviewer 7:
The reviewer noted that the project team commented that test track insurance costs had not be properly accounted for in the initial budget. Because the project team indicated that the insurance was a significant cost, the team should take note of how this money is going to somehow impact the project.

**Presentation Number: eems030
Presentation Title: Experimental
Evaluation of Eco-Driving Strategies
Principal Investigator: Huadong
(Joshua) Meng (Lawrence Berkeley
National Laboratory)**

Presenter
Huadong (Joshua) Meng, 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 and well-
planned.**

Reviewer 1:
The reviewer stated that the project one
approach of investigating real-world
(rather than ideal) benefits of eco-
driving is useful. The project two
approach sounds reasonable.

Reviewer 2:
The reviewer disagreed with the
statement on Slide 18 that "The energy
impact of passenger car [CACC] and
Platooning can only be determined
through physical experiments and
should be quantified to highlight two
key effects: changes to aerodynamic
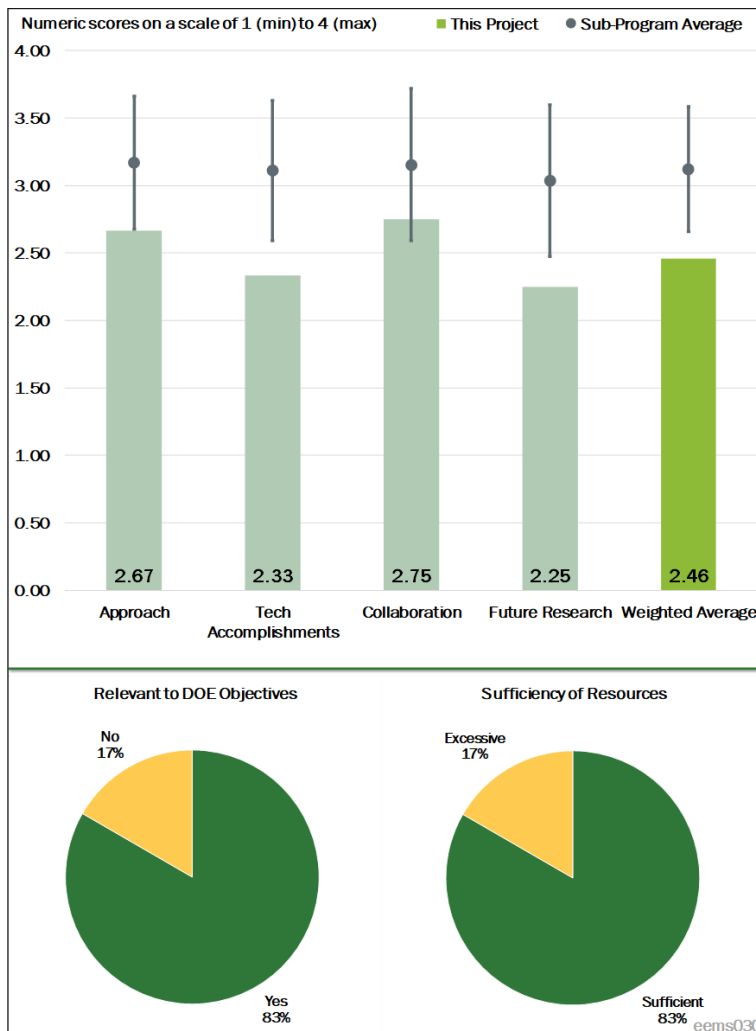drag and variations in vehicle speed."

Figure 3-16 - Presentation Number: eems030 Presentation Title:
Experimental Evaluation of Eco-Driving Strategies Principal Investigator:
Huadong (Joshua) Meng (Lawrence Berkeley National Laboratory)

The reviewer noted that the bulk of the other projects on display at this AMR justify that modeling has a place
within the activities of forecasting CAV and CACC technologies. In terms of model validation or correlation
that can occur with the test data, this reviewer would not state that five luxury sport utility vehicles (SUV)
would be representative of all the combinations of vehicle interaction within CACC.

Reviewer 3:
The reviewer said that the proposed approach is rather questionable and confusing. The eco-approach and
departure has been explored in simulation extensively in the last few years. So, the scope of the 2018 goals
seems reductant. The reviewer stated that the PIs should just take the lessons learned in this area, which is
well-documented in the literature, and focus on the objectives of FY 2019, which is field-testing. It was not
quite clear how this project advances the state of the art.

Reviewer 4:
The reviewer commented that for the first project, the reviewer is okay with the analytical evaluation of eco-
driving strategies; however, the reviewer is not sure that given the level of funding, there is much expected
from the experimental evaluation of eco-driving strategies.

Once the "real world" is brought in to the picture, there are far too many sources of variability. This coupled with the fact that the project team is trying to evaluate the (small) fuel saving potential over a relatively short driving range (over which not too much fuel is consumed to start with) makes for a hard problem to solve. The reviewer noted that the number of (measured) datasets that will be needed to quantify the fuel saving benefit with a reasonable confidence level would be prohibitive.

The reviewer noted that in light of the fact that the project team would be looking at an experimental evaluation as well (Slide 11), the trajectory planning algorithm appears to be too precise—multiple repeats with the same vehicle would not yield a consistent answer. As the test is repeated, the under hood will likely warm up, and component efficiencies will change, perhaps leading to a different optimum solution. The reviewer said that other factors over which the experimenter has no control could be the weather—wind speed, rain, etc.

The reviewer remarked that for the second project, with five vehicles, if you wish to run a full factorial design of experiments (DoE), you would have 5-120 runs, without repetitions. Assuming at least 3 repetitions (probably more are needed for significance), you would have 360 runs—unless the PI plans to run a fractional factorial DoE. The reviewer noted that there will be variations in fuel consumption between the five vehicles, there will be measurement error involving fuel flow measurements, there will be variation in tire rolling resistance, the weather will change over the course of the tests, there will be the inevitable bugs in the software, etc. The reviewer is not sure that the project team will be able to accomplish everything within budget.

Trying not to be a naysayer, the reviewer acknowledged facing similar situations at work, and there is always the future manager who says that if you put your mind to it you can do it (or something to that effect)—and that may be true—the Laser Interferometer Gravitational-wave Observatory (LIGO), of which the reviewer is a huge fan, is a prime example—and it richly deserved the Nobel Prize. However, it also needed, if the reviewer remembers right, about $600 million. So, according to the reviewer for this project to yield any conclusive results, it needs a much stronger (test) plan, quantification of the sources of variability, and input from a statistician to ensure that the overall (statistical) methodology is sound—perhaps it exists and the project team did not share the complete details. If so, this reviewer stands corrected.

Reviewer 5:
The reviewer noted that two projects were presented, however, it was not very clear what the approach is between the two.

Reviewer 6:
The reviewer remarked that there are two parts to this project. The reviewer stated that the second half was confusing. Platooning in urban environments at city speed has minimal drag reduction benefits relative to energy for accelerations, but appeared to be conveyed as a major factor. The reviewer noted that it was unclear what the value of the objective was based on the presentation (as given). The reviewer asked if for part one the objective is to evaluate under real-world the total system benefits, or the individual benefits without measuring the impact on other vehicles or throughput of the system.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer stated that the projects have just begun, so technical accomplishments are limited. The reviewer noted that there are no clear impediments to progress.

Reviewer 2:
The reviewer remarked that both sub-projects in this item are just beginning. It is therefore difficult to place a rating on this question.

Reviewer 3:

The reviewer noted that the project started recently but there has been some progress. It does not seem, however, that there is a clear focus on what the outcome should be.

Reviewer 4:

The reviewer referenced prior comments and stated that because the project just started in March 2018, there is not a lot of progress to share. However, there is ample time to refine the project scope and method to yield useful results.

Reviewer 5:

The reviewer commented that the project lacked clarity on what exactly has been done to-date as well as the next steps.

Reviewer 6:

The reviewer noted that the work lacks clarity and does not appear to advance the state of the literature or knowledge very much. This is especially true for the simulation part. The reviewer commented that the project team needs to more clearly articulate the objectives and purpose. This was partially done during the Q&A but was not sufficient and raises concerns over the clarity and focus of the work and how the output may be used.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer noted that per Slide 23, the project team looks to be working with a good set of relevant partners. INL is a good partner and has a good history in being successful with this type of work.

Reviewer 2:

The reviewer commented that it seems that this is a collaborative project between LBNL and Saxton Lab (by providing the cars). The reviewer stated that INL's role should be better clarified.

Reviewer 3:

The reviewer commented that perhaps the project team could benefit a great deal from discussions with the Advanced Powertrain Research Facility (APRF) team—understanding measurement variability, accuracy of controller area network (CAN) signals, etc. are critical to the success of this project. Any variability that the LBNL team sees in its testing can only be worse than what the APRF team has seen on the dynamometer.

Reviewer 4:

The reviewer noted that this work needs a precise plan on what needs to be achieved for the two respective projects.

Reviewer 5:

The reviewer remarked the presentation showed the roles of team members; however, actual collaborations remain to be seen.

Reviewer 6:

The reviewer stated that the collaboration appears to exist for the sake of collaboration. It does not appear to add any value, and probably only adds complexity and cost to the project.

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

Reviewer 1:
The reviewer referenced prior comments and remarked that the work is just beginning.

Reviewer 2:
The reviewer remarked that this project is a little weak on the details.

Reviewer 3:
The reviewer stated that the planned work for next FY is to be determined. The project team is awaiting funding availability. The reviewer said that this is a concern as to the value of the project.

Reviewer 4:
The reviewer commented that the presentation did not cover this topic.

Reviewer 5:
The reviewer did not believe that using five luxury sedans driving together at various speeds and distances will give a robust surface to use in the modelling part of this project. On-road fuel estimates, climate, and other vehicle operating variability will all add to potential inaccuracies in the fuel prediction surface.

Reviewer 6:
The reviewer noted that there is no clear plan for future work but rather some generic objectives.

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

Reviewer 1:
The reviewer remarked that this project supports DOE objective of petroleum consumption reduction.

Reviewer 2:
The reviewer noted that the research is trying to address the question of forecasting future fuel use (energy use) should connected vehicles become adopted.

Reviewer 3:
The reviewer stated that the project is relevant to DOE's mission and objectives as it addressed the energy impact of connected and automated vehicles.

Reviewer 4:
The reviewer said that the eco-driving strategy could definitely be considered a part of the EEMS program, although the coverage of this project is rather narrow.

Reviewer 5:
The reviewer remarked that the project itself has value but was unsure it is being executed properly.

Reviewer 6:
The reviewer noted that the objective is poorly articulated and at too high of a level to add or have confidence that it will add value. The reviewer concluded that as presented, this is a poorly formulated project.

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

Reviewer 1:
The reviewer noted that the resources could become an issue depending upon funding.

Reviewer 2:
The reviewer remarked that the resources look reasonable.

Reviewer 3:
The reviewer stated that the scope of this project in terms of the overall EEMS goal of improving Mobility Energy Productivity (MEP) is relatively narrow, and the funding should be sufficient.

Reviewer 4:
The reviewer commented that $700,000 in funding should be enough to perform a significant amount of data collection. The modeling portion appears to be much less resource intensive than the projects working RoadRunner and Polaris, so the funding amount appears proportionally correct.

Reviewer 5:
The reviewer stated that it seems that the project has more than the required resources to achieve the milestones and objectives as they are stated.

Reviewer 6:
Although funds are sufficient to conduct the work, the value of the work is the bigger question posed by this reviewer.

Presentation Number: eems031
Presentation Title: Traffic Micro-Simulation of Energy Impacts of CAV Concepts at Various Market Penetrations
Principal Investigator: Xiao-Yun Lu (Lawrence Berkeley National Laboratory)

Presenter
Xiao-Yun Lu, Lawrence Berkeley 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 and well-planned.

Reviewer 1:
The reviewer stated that the work is well-vetted within the DOE research community, drawing from past studies and collaborating with other researchers. This project is well-suited to address the remaining challenges, which are still significant with respect to the realistic incorporation of active traffic management (ATM) features within a mixed CAV and manual driven vehicle environment, in particular.

Reviewer 2:
The reviewer liked the concept and the approach, but is not thrilled with the reporting of the results—hence, a satisfactory.

Reviewer 3:
The reviewer had difficulty really understanding the project's approach. The speaker was unfortunately not a great communicator.

Reviewer 4:
The reviewer commented that the FY 2017 energy modeling approach relies on the motor Vehicle Emission Simulator (MOVES) model curve fit for fuel consumption. Given the dynamic nature of the system being simulated, the reviewer asked if this approach is sufficiently detailed. This point is apparently being addressed in FY 2018.
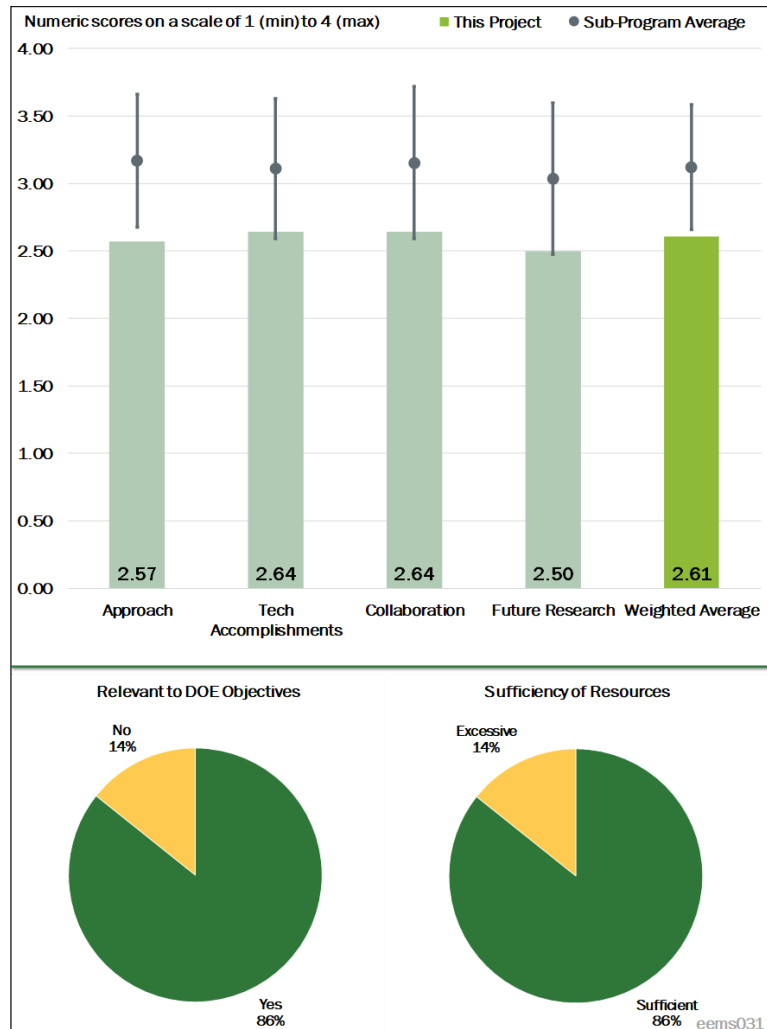

Figure 3-17 - Presentation Number: eems031 Presentation Title: Traffic Micro-Simulation of Energy Impacts of CAV Concepts at Various Market Penetrations Principal Investigator: Xiao-Yun Lu (Lawrence Berkeley National Laboratory)

Reviewer 5:

The reviewer stated that the modeling approach does not seem to align well with the objectives. The idealized and oversimplified control constraints do not lead to useful output, and the MOVES model is probably not the right simulation tool based on how it manages inputs.

Reviewer 6:

The reviewer commented that the approach taken in this project is confusing and raises several questions. It seems that there is an overlap with the project EEMS030. It is not clear who the distinct contributors of these two projects are. The reviewer noted that there are no technical details about the different scenarios used, e.g., vehicle coordination in merging, speed harmonization, etc. On the same note, these scenarios have presented in other EEMS projects. The reviewer asked how this project is different from the other efforts. It seems that the project focused on simulation while it should be clearly focusing on field testing and validation in real-world scenarios.

Reviewer 7:

The reviewer noted that the research focuses on simulating the effect of CACC vehicles at different market penetration rate. The author mentioned that the CACC vehicles are operating in an environment when various Traffic Management technologies exist. The reviewer commented that the human model part of this work should be explained more clearly. For example, this reviewer inquired about how the vehicles interact with other vehicles when they are not CACC, how they interact with ATM systems, and whether the project team has real data to confirm these human behavior models as accurate. The "simple vehicle following model" was built to describe the CACC vehicle behavior. The reviewer noted that equations were given, but observed no validation or justification regarding whether or not these simple models are accurate enough. The reviewer asked if time delay/lag in the powertrain was considered as it was not clearly shown in the equations. The reviewer also asked if the desired CACC truck T-gap of 1.2 or 1.5 seconds is safe and what would happen if the lead passenger car braked hard.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer remarked that carefully managed progress toward the objectives of the work appears evident in the project team's presentation and explanation of the progress achieved.

Reviewer 2:

The reviewer noted that the project appears to be progressing well for the FY 2018 tasks. Using a 16-month schedule is somewhat confusing; it appears FY 2019 work is also shown.

Reviewer 3:

The reviewer acknowledged the possibility of misunderstanding the work, but commented that the overall project was confusing and not well presented or explained. Either the results are accurate, but not precise, or they are not. They cannot be directionally correct and not accurate. Directionally correct is accurate, just not precise. The reviewer said that if the project team cannot sufficiently explain what is happening, and do not understand what or why, it is hard to have confidence in the output and progress of the work.

Reviewer 4:

Although it is great that a real highway corridor is modeled, this reviewer observed no "model validation" work. It was not explained why fuel economy of cars reduces with higher CACC truck penetration rate. The reviewer remarked that it was also not explained why a CACC truck should be used at intersections—they should operate only on highways.

Reviewer 5:

The reviewer commented that it looks like the project team made technical results, but they do not jump out in the documents nor in the presentation. The accomplishments need to be simply stated.

Reviewer 6:

The reviewer commented that the project team has made some progress to date toward achieving their milestones and goals of the project; however, the results are questionable and not well-justified.

Reviewer 7:

The reviewer stated that the graphs (e.g., on Slide 12) were both confusing and contradictory with other slides. The reviewer did not believe in being the only reviewer who was somewhat lost. There was also some concern that MOVES was not an appropriate model to use in microsimulations such as this. The reviewer pointed out that the project team also claimed that adaptive cruise control (ACC) only looks one vehicle ahead versus how humans (and perhaps CACC) have knowledge of multiple vehicles around or ahead. While this is mostly true today, this assumption is likely not valid in the future, even for ACC, since sensors and data processing keep advancing, and it is not inconceivable for these non CACC systems soon gaining the ability to see multiple vehicles ahead just as human drivers do (e.g., Subaru EyeSight with more advanced image processing).

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer stated that the extent of collaboration and coordination with other DOE research national laboratories and research projects is evident from the project team's presentation.

Reviewer 2:

The reviewer stated that despite logos from five national laboratories appearing on the title slide, the actual collaboration seems minimal. From Slide 16, the actual coordination was really a limited correspondence with ANL (Aymeric) who delivered some code.

Reviewer 3:

The reviewer stated that the main collaboration is with ANL involving data sharing and Autonomie usage. As described, it sounds like an arms-length relationship. The reviewer commented that a closer collaboration (e.g., for the investigation into using Autonomie instead of a MOVES-based model) might be beneficial.

Reviewer 4:

The reviewer stated that much information was given on the feedback and coordination. Autonomie is generally well-received and has achieved a good level of robustness, buy-in, and support from industry. The reviewer noted that it is not clear what feedback this project has received from Aymeric or others, or if the researchers understand what was provided.

Reviewer 5:

The reviewer said it seems there is a collaboration between the national laboratories participating in this project. It is not quite clear though what the role is of the University of California-Berkeley.

Reviewer 6:

The reviewer commented that it is not clear how the research work was done at various partner sites and how the team is collaborating.

Reviewer 7:

Again, with collaboration, albeit only LBNL, University of California-Berkeley, and ANL, the reviewer would have liked to see a RASIC (responsible, approves, supports, is informed, is consulted) chart as to what coordination is really happening. The project's total funding was $390,000, and this reviewer asked who received funding and what was really done with the funds.

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 FY 2019 proposed work will help to refine results obtained so far.

Reviewer 2:

The reviewer stated that there should be clear effort in model validation and establishing "the reference," i.e., non-CACC fuel economy behavior, including how human driver interacts with ATMs.

Reviewer 3:

The reviewer pointed out that the project team listed next steps, but did not explain how the team will further the objective, or provide sufficient detail on the actual work and methodology. The project team says what they will do, but not how, or why.

Reviewer 4:

First, according to the reviewer, this project was not evaluated last year. There are results for the 2017 calendar year, but they were not clearly stated. Then there is some work for the 2018 calendar year, but it was not clearly stated. The reviewer would like to see the team "quantify" its results before going further.

Reviewer 5:

The reviewer stated that the progression of operating environment complexity and scale shows attention to adequate, achievable steps of analysis. The source of empirical data noted during the question and answer period concerning the impacts of manually operated vehicle imposing dynamic perturbations to the ACC and CACC operations was important. The reviewer stated that this should be noted in reports and the objective of achieving an ability to model such perturbations and the system recovery in future simulations should be noted. This may impact further the rate at which energy efficiency goals are realized as the percentage penetration increases and manually operated vehicles assume a safe AV response to aggressive driving maneuvers.

Reviewer 6:

The reviewer commented that the future work in FY 2018 is rather generic. There should be a clear focus and details on field testing and experimental validation.

Reviewer 7:

The reviewer remarked that it is very difficult to assess future research plans (primarily Slide 18 and 20) without a better understanding of the overall project state. These slides do not articulate what will truly be gained by completing this work.

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

Reviewer 1:

The reviewer stated that the project supports the energy consumption reduction mission. It investigates emerging technologies that can have an impact on reducing vehicle fuel consumption.

Reviewer 2:

The reviewer remarked that the project does support the overall DOE objectives in that it is bringing a dose of real-world insight into energy efficiency conclusions as CAV technology begins to increase in percentage penetration in what will remain an operating mix heavily weighted toward manual vehicle operations for the next few decades.

Reviewer 3:

The reviewer stated that the project is relevant to DOE's mission and objectives as it addresses the energy impact of different technologies and approaches of connected and automated vehicles.

Reviewer 4:

The reviewer remarked that as best as can be ascertained, this project does examine fuel efficiency resulting from various traffic scenarios, so yes this is relevant to DOE objectives.

Reviewer 5:

Per the reviewer, this reviewer cannot clearly and succinctly tell if this project supports DOE results with its current report-out.

Reviewer 6:

The reviewer commented that while the work indeed studies the "system," beyond just simulating vehicles, there is no clear effort towards validating the behavior of ATMs, including how other vehicles interact with these ATMs. Therefore, it is not clear the developed model is useful.

Reviewer 7:

The reviewer commented that this work, in its current state, lacks clarity. The objectives are good. The reviewer stated that there needs to be a better explanation of the work and how the output fundamentally answers questions and generates useful actionable knowledge.

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

Reviewer 1:

The reviewer stated that the project is drawing effectively from other work and leveraging the available resources across DOE national laboratories. Resource deficiency may become evident as time goes on because the most challenging part of the work (developing simulations that reasonably represent the mixed operations of CAV and MOV traffic) is ongoing.

Reviewer 2:

The reviewer said that the overall funding level is pretty low, but for simulation-only research it should be enough.

Reviewer 3:

The reviewer commented that the project has sufficient resources to accomplish the milestones and goals.

Reviewer 4:

The reviewer stated that the funding for FY 2018 is adequate. Should the project continue, FY 2019 work shows no funding allocation.

Reviewer 5:

The reviewer stated that the funds are sufficient; however, how the work is being conducted is not sufficient.

Reviewer 6:

The reviewer reiterated that the project received $390,000, and asked what the team really accomplished. Put it in energy terms, in dollar terms, etc. The reviewer suggested reading the University of Chicago's book *Freakonomics* and report out as such.

Reviewer 7:

The reviewer commented that without a better defense or justification of this work, it is difficult to see the rationale for funding this further.

**Presentation Number: eems032
Presentation Title: Evaluating Energy-Efficiency Opportunities from Connected and Automated Vehicle (CAV) Deployments Coupled with Shared Mobility in California
Principal Investigator: Matthew Barth (University of California-Riverside)**

Presenter
Matthew Barth, University of California-Riverside

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 and well-planned.

Reviewer 1:

The reviewer stated that the project addresses critical questions and barriers by quantifying the energy impact of disruptive technologies. The approach is solid with a balanced list of tasks including, simulation, field testing, and using experimental data. The reviewer commented that the PI has also considered a solid plan to address eco approach and departure in cases of different penetration and when multiple vehicles are involved. The project significantly advances the state of the art.
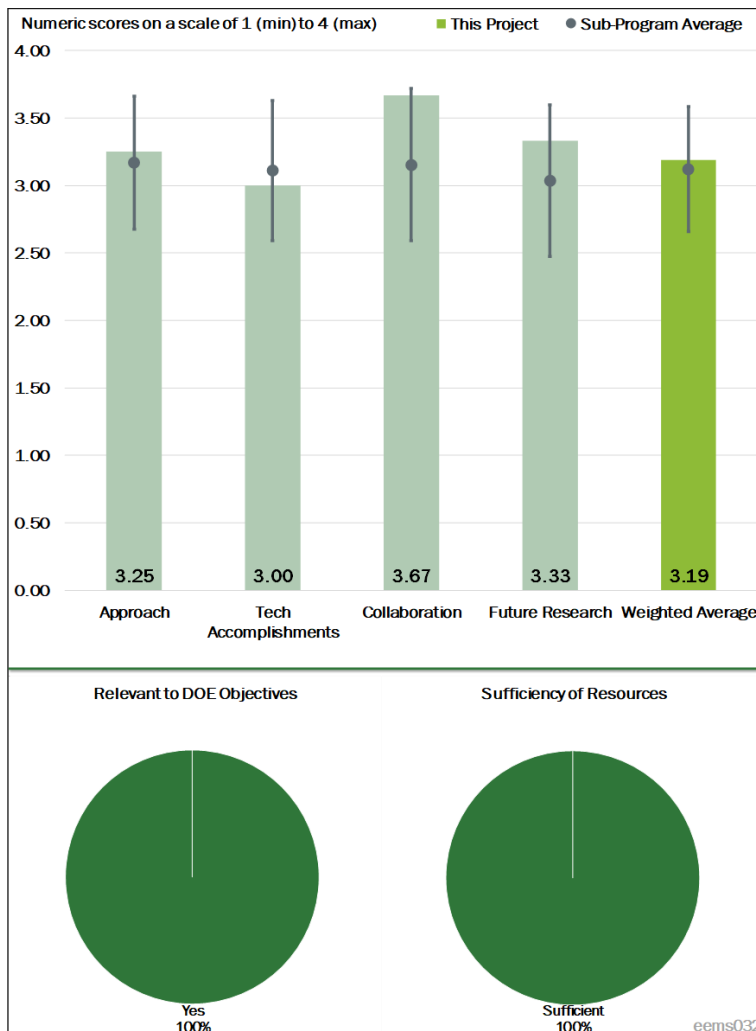

Figure 3-18 - Presentation Number: eems032 Presentation Title: Evaluating Energy-Efficiency Opportunities from Connected and Automated Vehicle (CAV) Deployments Coupled with Shared Mobility in California Principal Investigator: Matthew Barth (University of California-Riverside)

Reviewer 2:

The reviewer commented that this is a strong approach from an accomplished research team. Efforts to date mostly focus on data gathering. The reviewer said that the model framework makes sense but still needs significant work to add detail. The project especially needs more work on behavioral elements such as value of travel time and other hedonics.

Reviewer 3:

The reviewer said that the project can only achieve its objectives if it is able to collect far more, and better, data than reported. Slide 5 indicates that there are no automation real-world data available to the project. The reviewer noted that CAV data sources on Slide 8 are primarily focused on safety application, with no plan described for determining energy impacts. MaaS data described on Slide 10 are short on details, and several other researchers are already studying the data from NYC Taxi and RideAustin. The reviewer stated that crowd-sourced data from shared mobility applications mentioned on Slide 13 is not detailed. The reviewer is

concerned that there is no clear plan to fill the data gaps needed for this work to produce significant new results.

The reviewer stated that overall the approach is good. However, the reviewer asked how the project will factor in mode shifts (to transit, to biking, to walking, etc.). It is not entirely clear if the focus is mainly on energy impacts from mode shifts or from the potential for shared vehicles to be electric. The reviewer asked if the project touches on the potential for increases in electric vehicles does it address the needed charging infrastructure as a barrier.

The reviewer stated that the work to obtain data from real-world and simulation modeling across a range of international sources is very, very good. The remaining challenge of obtaining adequate data from transportation network companies (TNC), which operate the large majority of shared ride services, is daunting because of the proprietary nature of these data. However, the reviewer said that the project team is mining other sources in place of Uber/Lyft data. The reviewer asked how the team will incorporate empty vehicle movements into the analysis, when most travel demand and traffic assignment modeling tools do not include these vehicles. Slide 10 makes simple reference to this factor, but the presentation gave no details or discussion. The reviewer concluded that for the results to be truly representative of future scenarios with a proliferation of shared-ride trips, the empty vehicle movements of these fleet operations (as well as potentially the private vehicle empty movements over the long term) must be modeled in as rigorous a manner as other travel classification/trip purpose trips.

It is good to study in small chuck, and not proposed a vast and incompletely scope, like the list on Slide 8. The reviewer struggled with Slide 9 in that it lists as an accomplishment the collection of results from other studies. The reviewer concluded that the proposed future work lists most of the items in this presentation that will become useable information.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

The reviewer said that this project appears to be on schedule per the status presented.

The reviewer stated that the project team has made significant progress to date and it seems they are on track to accomplish their milestones and objectives of this project.

The reviewer stated that, as described on the previous question, the difficulties for gaining data are noted, but few clear plans are given to gain the necessary data.

The reviewer noted that Slides 9 and 10 are the only ones that list any types of results, and they are from previous studies. At 30% complete, the bulk of the useful results are still to be generated.

The reviewer remarked that the project seems to be struggling a bit with the data gathering portion—many of the sources mentioned have been used before, or targeted by other research efforts without success. The project team should identify firm data partners soon if data will be a roadblock—and it is usually the biggest challenge to these sorts of projects.

Reviewer 6:

The reviewer pointed out that the modeling objectives appear daunting to accomplish within the next year, when the framework of incorporating multiple different modeling platforms is addressed. The reviewer asserted that it is feasible to accomplish this within the schedule and budget, if the work is efficiently managed and the modeling framework proves to be adequate for the modeling/simulation tools selected.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer commented that there are good partners, especially in California.

Reviewer 2:

The reviewer commented that the collaborative effort is very high, as shown by the excellent data collection from a number of past studies and data collection efforts.

Reviewer 3:

The reviewer stated that there is a well-established collaborative relationship between the University of California, Riverside and NREL.

Reviewer 4:

The reviewer remarked that per Slide 12, the project team appears to be working with a good set of relevant partners. The reviewer believes that there is some room for improvement if an OEM could be engaged. There is also room for improvement if the project team researches whether there are any industry standards that are being framed that could affect the final results of the work.

Reviewer 5:

The reviewer noted that the project appears to have good breadth of collaborators. The presentation could be more explicit on how and when the collaborators are contributing.

Reviewer 6:

The reviewer said that the set of collaborators are fine choices for this topic, but little was explained about how the interactions are closing the data gaps mentioned before.

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

Reviewer 1:

The reviewer stated that the project team has a good plan moving forward to FY 2018. The team should explicitly link the proposed tasks and objectives to the milestones of the project.

Reviewer 2:

The reviewer concluded that the next steps make sense, but again may be challenged by data availability.

Reviewer 3:

The reviewer stated that the presentation did not convincingly address the plan to collect the needed data. It is hard to see how the future goals of the project can be met without progress on a data collection plan.

Reviewer 4:

The reviewer commented that this project could be strengthened by adding in how the resulting product will be put into practice or use, what it will look like, and whether they will get end-user input.

Reviewer 5:
The reviewer said that, assuming success and good correlation to the test data, the list of proposed future work appears to be relevant to potential energy savings.

Reviewer 6:
The reviewer remarked that the scale of modeling that is anticipated in the future research (Slide 14) is very large, and there may be a decision tree needed to scale back some aspects—depending upon how the incorporation of modeling tools into the modeling framework (Slide 11) plays out. The reviewer concluded that it is better to accomplish a little less and do it thoroughly than attempt too much and end the work with incomplete results at any level.

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

Reviewer 1:
The reviewer commented that the project is making a direct contribution to DOE/EEMS goals.

Reviewer 2:
The reviewer stated that the topic is very relevant to the goals of EEMS, especially issues relating to energy efficiency of MaaS transportation.

Reviewer 3:
The reviewer noted that the research is trying to address the question of forecasting future fuel use (energy use) should connected vehicles become adopted.

Reviewer 4:
The reviewer stated that the focus on shared-ride services as a key and integral part of the travel demand and modal transport operations is very important, because this will show key information about vehicle occupancies and empty vehicle movements as an inherent aspect of their use. This aspect of typical regional modeling and transportation planning is very lacking in typical metropolitan regions.

Reviewer 5:
The reviewer concluded that this project is relevant to DOE's mission and objectives as it evaluate energy efficiency opportunities from large-scale deployments of connected and automated vehicles.

Reviewer 6:
The reviewer stated that the relevance to EEMS is clearly articulated in 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 commented that the resources seem at least sufficient for the project based on progress to date.

Reviewer 2:
The reviewer said that the $1.1 million in funding should be enough to perform a significant model development and data collection.

Reviewer 3:
The reviewer noted that the financial resources and the laboratory teams are quite sufficient to accomplish the objectives, but with consideration of the comments to the other questions.

Reviewer 4:
The reviewer stated that the project has sufficient resources towards accomplishing its goals.

Reviewer 5:

The reviewer pointed out that resources appear sufficient based on what was presented.

Reviewer 6:

The reviewer noted that the resources are sufficient given the plan as described. The reviewer stated, however, that too little is shared about the methods to get the needed data. Collecting data can be expensive, but also needs a plan, which was not clearly shown.

Presentation Number: eems033
Presentation Title: Truck Cooperative Adaptive Cruise Control/Platooning Testing: Measuring Energy Savings and Aerodynamic Interactions Principal Investigator: Xiao-Yun Lu (Lawrence Berkeley National Laboratory)

Presenter
Xiao-Yun Lu, 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 and well-planned.

Reviewer 1:
The reviewer noted that the project has a very good approach and all barriers were addressed.

Reviewer 2:
The reviewer stated that the project has an excellent approach using combined real-world measurement and sensor data to validate modeling. The range of tested gaps is very impressive and leads to new results. Based on the discussion, some progress is still needed to integrate these. The reviewer pointed out that the experimental work is still well-designed.

Reviewer 3:
The reviewer commented that this is appropriate for this stage of the project.

Reviewer 4:
The reviewer commented that the approach to the work is straightforward and will produce the desired understanding of truck platooning energy effects. The team has chosen an appropriate truck loaded weight (65,000 lbs.) that aligns with DOE SuperTruck parameters and average loaded weights for trucks of this type, so the results should be applicable to the "average" truck and operator. The reviewer pointed out that the team has established an appropriately broad range of speeds, following distances, configurations (two-truck and three-truck), and maneuvers that will help define the energy savings parameter space for platooning. The project team is using the appropriate standardized Society of Automotive Engineers (SAE) fuel economy testing processes as well.
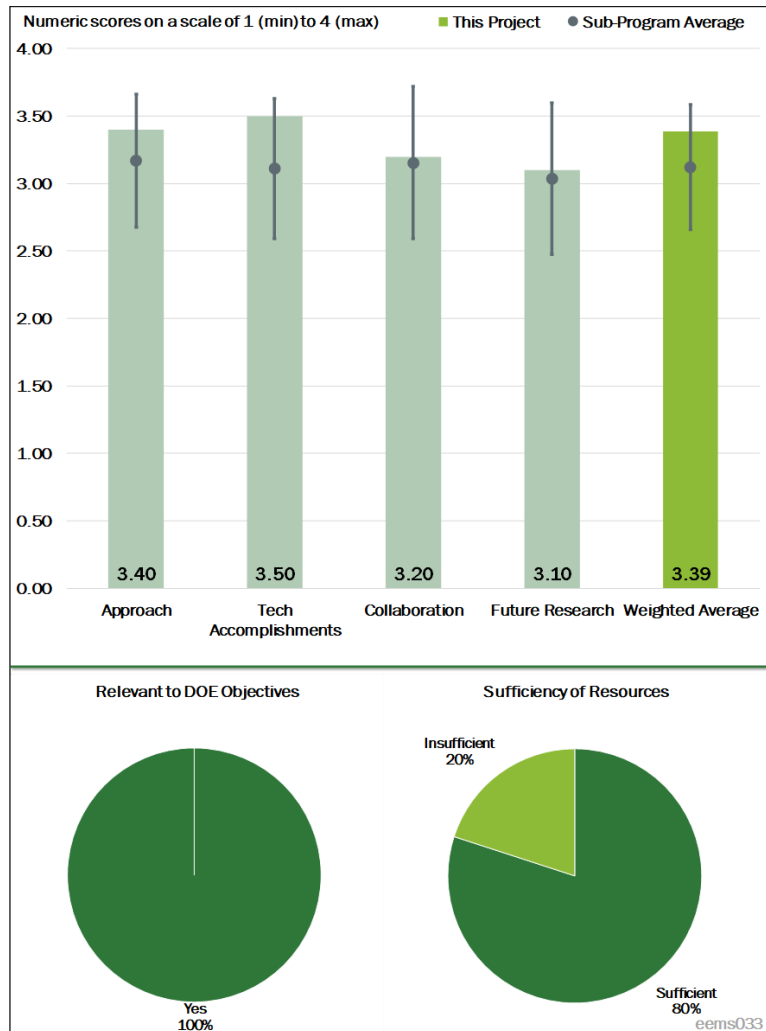

Figure 3-19 - Presentation Number: eems033 Presentation Title: Truck Cooperative Adaptive Cruise Control/Platooning Testing: Measuring Energy Savings and Aerodynamic Interactions Principal Investigator: Xiao-Yun Lu (Lawrence Berkeley National Laboratory)

Reviewer 5:

The reviewer pointed out that the project is well-designed; however, it could be strengthened by explicitly addressing how the industry could benefit from the results and how the results will be conveyed to the industry and put into practice.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer commented that these are world-leading results on energy savings from truck platooning.

Reviewer 2:

The reviewer stated that the project has very good accomplishments and discovery. The reviewer commented that this work should continue.

Reviewer 3:

The reviewer noted that the team has accomplished quite a bit in the year since the project started. The fuel savings behaviors of the trailing trucks are interesting and the team has done a good job of clarifying the complex set of effects by truck. The reviewer said that the team has also done enough testing (in 2016 and 2017) to be able to show the effects of control algorithms on fuel savings potential (an aid for those designing these systems for efficiency). Quantifying the effect of the LD vehicle cut-ins and LD vehicle lead scenarios is important—the fact that these cut-ins can reduce the overall energy savings may be helpful for technology developers to understand and mitigate. The reviewer commented that the correlation between CAN bus fuel consumption estimates and SAE testing was helpful to show—this may help with confidence in results of future on-road testing using CAN bus fuel consumption data collection efforts.

Reviewer 4:

The reviewer remarked that this is appropriate for this stage of the project.

Reviewer 5:

The reviewer pointed out that the project seems well on track to the presented schedule and goals.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer stated that the project has very good collaboration and made a good move bringing in Transport Canada.

Reviewer 2:

The reviewer remarked that the project has excellent international collaboration, but could use better connections to research in related disciplines (e.g., modelers) to help use micro-scale results and sensor data.

Reviewer 3:

The reviewer said that the overall cooperation is good and the team has leveraged Transport Canada interests and funding to further both U.S. and Canada research goals. The project team showed good distribution of tasks among National Research Council of Canada (NRC) and several DOE national laboratories. Although unmentioned by the team in the presentation, the reviewer believed that this project took advantage of platooning-equipped trucks from a previous project with DOT, Volvo, and several other partners, and recommended that the team note this if it is allowable.

Reviewer 4:

The reviewer pointed out that collaboration among the various labs has improved but the project has more potential to leverage completed work.

Reviewer 5:

The reviewer stated that the project appears to have good collaboration and use of partners in carrying out the tests and analyzing the data. It is not clear whether or not partner feedback was used in developing the research goals and approach before the study moved forward. The reviewer pointed out that this upfront, initial feedback can be beneficial down the line.

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 proposed research is needed to complete this important study.

Reviewer 2:

The reviewer questioned the focus on intersection work, which seems relatively unrelated to the progress made here. Other approaches, such as working on optimal tractor-trailer design for platooning, could be considered in addition or in place of this work.

Reviewer 3:

The reviewer commented that the future work plan involves useful extensions of the existing work plan (exploration of fuel savings at signalized intersections and real world highway driving). The specific plans are reasonable for achieving the desired goals assuming that the one year left in the project duration will be sufficient to complete these tests. The reviewer observed that the on-road testing is probably the highest-risk activity and went on to ask if it should be done in one of the previously-defined automated vehicle testing corridors.

Reviewer 4:

The reviewer remarked that this is appropriate for this stage of the project.

Reviewer 5:

The reviewer reiterated that this would be strengthened if the future research factored in how the results would be transferred to the industry, users, etc.

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

Reviewer 1:

The reviewer commented that, yes, this will save fuel and improve road safety.

Reviewer 2:

The reviewer mentioned that the project directly supports DOE / EEMS objectives, especially in the key area of freight.

Reviewer 3:

The reviewer stated that truck platooning is receiving quite a bit of interest in the commercial truck market and understanding of the energy-related effects of this technology is very relevant to DOE national energy efficiency goals. It will be important to understand the impact of these technologies on the overall efficiency of the individual trucks using these systems as the interactions between trucks can be complex. The reviewer pointed out that physical testing of systems in real-world environments is a very good way to understand these effects. The efficiency gains that will drive uptake of platooning technology supported by DOE and others must be clearly understood to convince MD/HD truck buyers to adopt these systems.

Reviewer 4:

The reviewer commented that this is appropriate for this stage of the project.

Reviewer 5:

The reviewer remarked that, yes, the project specifically addresses the potential fuel efficiency benefits of truck platooning.

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 more funding is needed to produce all of the desired results.

Reviewer 2:

The reviewer remarked that the resources appear sufficient.

Reviewer 3:

The reviewer stated that the resources appear to be sufficient for achieving the objectives of this work.

Reviewer 4:

The reviewer commented that the resources listed appear sufficient.

Presentation Number: eems034
Presentation Title: Optimization of Intra-City Freight Movement and New Delivery Methods
Principal Investigator: Amy Moore (Oak Ridge National Laboratory)

Presenter
Amy Moore, 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 and well-planned.

Reviewer 1:
The reviewer commented that the approach for developing estimates of how new freight modes and technologies might affect freight energy efficiency is sound. The project team has engaged several good partners to collect data on freight patterns (most specifically United Parcel Service [UPS]). The reviewer stated that the team is pursuing a useful data-driven dual-model approach (tour-based and freight delivery) that can explore the effects of different parameters on freight movement. The team has incorporated several technologies that are in the forefront of freight efficiency discussions (drones, electric vehicles, Uber-style passenger freight) and this work should be valuable to help ground the discussions around what benefits these technologies will have.

Reviewer 2:
The reviewer noted that the collaboration with UPS to obtain real trip information then build freight delivery demand model is a very good first step of this research. Parcel weight analysis shows the potential of drone delivery. The reviewer commented that the energy consumption experiment seems a little too simplified.

Reviewer 3:
The reviewer noted that the project, being a first for DOE in this topic area, is by nature a bit less concrete in its scope and objectives. It is impressive that the project team has made such progress on the models, scenario planning, and future plans.

Reviewer 4:
The reviewer pointed out that the research plan is sound. The team has focused early efforts on data collection and analysis and assessment of energy reduction for new freight modes. The reviewer commented that the
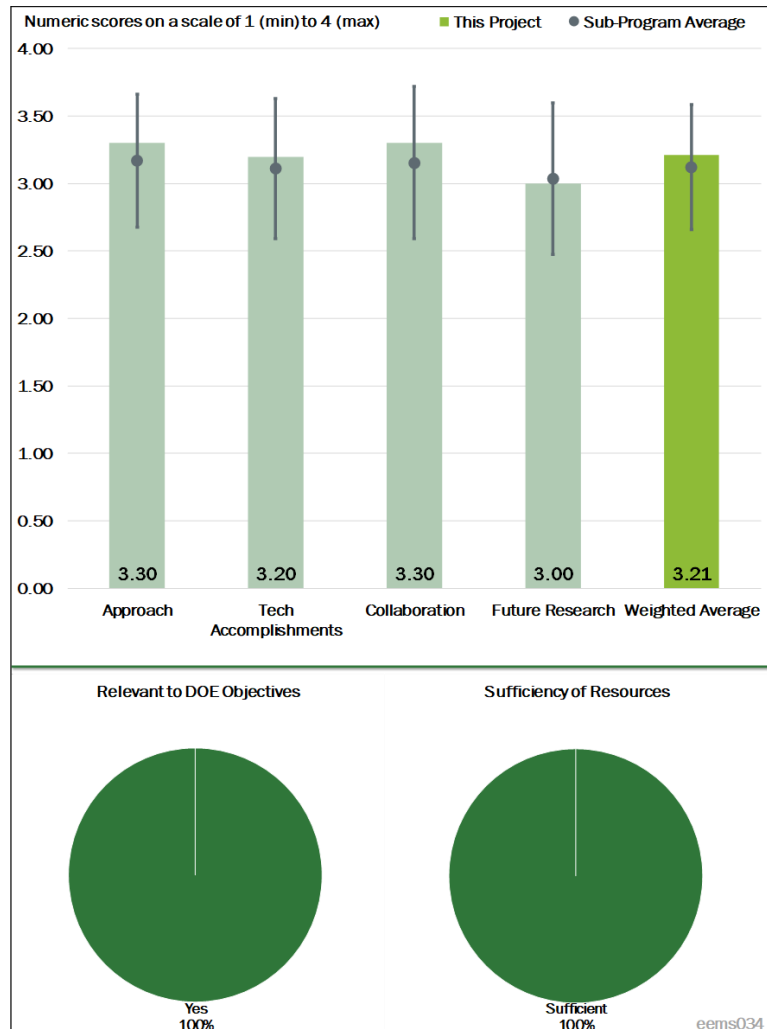

Figure 3-20 - Presentation Number: eems034 Presentation Title: Optimization of Intra-City Freight Movement and New Delivery Methods Principal Investigator: Amy Moore (Oak Ridge National Laboratory)

project activities build towards development of comprehensive tools that can assess the application of new freight modes and technologies on city and regional bases. The research covered new freight modes and technologies including drones, parcel lockers, EVs, and uber-like delivery systems. The reviewer stated that evaluation of additional modes and technologies might also be of interest as budget allows. Further, the delivery scenarios applied in the FY 2018 work were developed in-house; the project team indicated that additional input will be solicited from project partner UPS and other commercial delivery companies for broader coverage of interest to the industry.

Reviewer 5:

The reviewer remarked that technical barriers are also created by the environment and system they must work within. There are a few requirements that need to be checked for a full understanding of the energy impact. One of these is security and the second is the allowable flight path of a drone.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer mentioned that the project team used just one month of UPS data to analyze freight movement in the Columbus metro area—this might be a concern depending on which month was picked (assume UPS picked a representative average month for this project). As package delivery can be cyclical (particularly around the holiday season) an additional month or two to bracket UPS deliveries would be helpful (understanding that second-by-second data for GPS+CAN is a lot of information to process). The project team is discussing this as a remaining challenge and this reviewer would recommend obtaining those additional data. Overall, the reviewer concluded that the team has accomplished a good amount and the results appear to be useful. The team is clearly working diligently to present results to the research community through papers and technical talks, which is very valuable.

Reviewer 2:

The reviewer commented that the project has a good plan, followed up by an excellent analysis.

Reviewer 3:

The reviewer stated that the trip demand should closely depend on income/earning level. It is also known that university students have disproportionally high delivery. If the developed model is to be scalable to other cities, more data need to be obtained in order to build a more robust model. In terms of energy consumption model, the reviewer asked if the project team has considered using "flight time" instead of miles as a key parameter.

Reviewer 4:

The reviewer commented that the duty cycle understanding with UPS was very good, that the project has strong scenarios for consideration, and that the analysis is well done.

Reviewer 5:

The reviewer stated that the project team indicated that the work is about 50% complete as of the AMR conference. This seems appropriate for a 3-year project that started in October 2016. The reviewer said that FY 2018 progress includes the collection and analysis of UPS, CAN, and GPS data for Columbus, development of delivery demand estimation model for Franklin County, and development of delivery scenarios using new freight modes and technologies compared with the current baseline. For this latter effort, the reviewer remarked that some valuable insights have been gained regarding EV and delivery locker benefits. To date, the research has generated 11 presentations and one paper.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer noted that collaboration on the project has been excellent. The research team is working with SMART Mobility Consortium members, NREL (data collection and analysis) and INL (drone characterization and energy use), as well as industry partner UPS (CAN and GPS data for Columbus) and MORPC (socioeconomic and business data for Franklin County). The project team indicated that there will be additional coordination with UPS on Columbus data and input to viable freight modes as well as other parcel delivery companies.

Reviewer 2:
The reviewer noted that the team is collaborating with UPS, which can provide a very good perspective on freight movement. The MORPC Smart City connection is also valuable. Overall, the reviewer concluded that this is a good collaboration between ORNL, NREL, and INL with tasks for each national laboratory logically established.

Reviewer 3:
The reviewer noted that there is a good combination of partners involved to represent this work.

Reviewer 4:
The reviewer commented that there is good collaboration with UPS in obtaining data; however, the team could better explain the collaboration approach among researchers.

Reviewer 5:
The reviewer remarked that the collaboration with UPS is great, but that there is not much collaboration evident with too many others. The reviewer suggested that more partners be included in future work on the last mile.

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

Reviewer 1:
The reviewer noted that working on increasing sample size is good as this will add more depth to the analysis. The drone analysis will be useful as this is a topic that garners a lot of attention in the press, so understanding how these would be used in last mile delivery would make the discussions more rational and fact-based. The reviewer stated that the review of the traffic congestion versus freight issue is also important—freight companies are very in tune with how congestion costs them money (in lost productivity and fuel) and consumers have more and more interest in getting next-day or same-day delivery, both issues that traffic congestion will affect. The per-parcel energy use will be an interesting metric. The reviewer presumes this will be based on the average package size listed in the presentation so it would be good to also express this per cubic foot and per pound as both metrics are of interest to freight companies.

Reviewer 2:
The reviewer said that future potential research should be planned out in more detail and perhaps a deeper discussion with partners and other stakeholders on the government side, i.e., drone regulation per the Federal Aviation Administration (FAA), zoning issues for lockers, etc.

Reviewer 3:
The reviewer remarked that the proposed future work is well laid-out and builds off of earlier activities for achieving overall project objectives. The project team has proposed gathering additional UPS seasonal data for more robust coverage of annual freight demand and movement, developing additional freight movement

scenarios for broader coverage of modes and technologies, creating a MEP metric, performing a closer review of drone use for last mile delivery, refining energy use parameters, and developing a TransCAD-based program using mileage and scenario type inputs.

Reviewer 4:
The reviewer suggested that more partners be included on future work on last mile.

Reviewer 5:
The reviewer commented that the future work described for FY 2018 and FY 2019 is at a very high-level and vague.

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

Reviewer 1:
The reviewer remarked that this project is relevant to DOE goals as energy efficiency opportunities for freight movement are important to VTO. The connection to the Smart City activity in Columbus is also relevant.

Reviewer 2:
The reviewer commented that yes, this project reflects an interesting array of choices for last mile delivery.

Reviewer 3:
The reviewer remarked that last mile is not only a hot topic, but many firms are moving very fast satisfying demands of impatient consumers. The reviewer asked if we are creating another unsustainable form of goods movement. The reviewer was not sure, but it is good to see projects like this one helping to figure it out. Both the extent of the opportunities and the adverse consequences that might come from them.

Reviewer 4:
The reviewer said that this project supports the overall DOE EEMS program objectives in conducting research on energy consumption impacts of novel multi-model freight movement and associated analytical tool development.

Reviewer 5:
The reviewer noted that studying alternative freight delivery mode using drones is a worthwhile extension of the current VTO research portfolio. The energy characterization approach, however, is very simplistic. The reviewer stated that it should take advantage of model science/physics based approach, instead of just be satisfied with curve-fitting test results from a single drone.

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

Reviewer 1:
The reviewer noted that the resources appear to be sufficient to complete the project as described.

Reviewer 2:
The reviewer commented that the resources for FY 2018 are sufficient for the proposed work.

Reviewer 3:
The reviewer stated that the resources are sufficient.

Reviewer 4:
The reviewer said that the project appears sufficiently funded for the activities proposed.

Presentation Number: eems035
Presentation Title: Coupling Land-Use Models and Network-Flow Models
Principal Investigator: Paul Waddell (University of California-Berkeley)

Presenter

Paul Waddell, University of California-Berkeley

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 and well-planned.

Reviewer 1:

The reviewer stated that the python-based pipeline seems like a feasible and effective method.

Reviewer 2:

The reviewer remarked that this project is very challenging when linking so many different modeling platforms, but it is feasible.

Reviewer 3:

The reviewer commented that the objectives are well laid-out with respect to the barriers; however, the connection to energy consumption could be made clearer and more explicit.
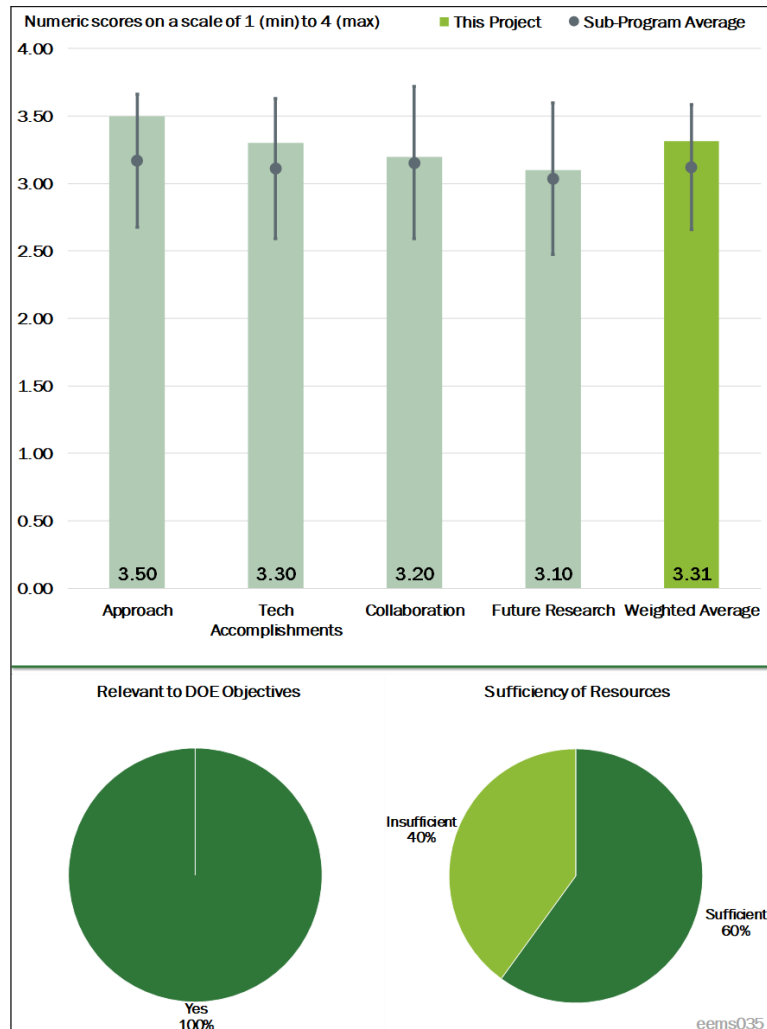

Figure 3-21 - Presentation Number: eems035 Presentation Title: Coupling Land-Use Models and Network-Flow Models Principal Investigator: Paul Waddell (University of California-Berkeley)

Reviewer 4:

The reviewer noted that this project seems to provide a comprehensive solution to understanding how land use planning factors in to transportation decision-making (and the impact it can have on saving energy) as well as how land use must adapt to changing travel models. This question could make or break whether a city can successfully implement sustainable transportation systems.

Reviewer 5:

The reviewer commented that this presentation does a good job of explaining what this project is trying to achieve and why the work is worth doing. Based on the presentation, the work is reasonably well-conceived and definitely well-organized. The reviewer remarked that the PI seems to understand what the team wants to accomplish and what tools and improvements are required to achieve those goals. The PI identified what the other team members are doing and he showed how the work comes together to address the objectives. The PI identified some of the deficiencies in the current tools and how they will be overcome. The reviewer said that the presentation uses a few of the general and ill-defined phrases that seem to be common in these urban mobility modeling efforts, such as "alternative traffic assignment models" but it keeps these to a minimum and

provides a clearer picture of the tasks than most other presentations the reviewer has seen. However, the reviewer thinks it would still be further improved if the PI and the team could provide more details or more examples that help illustrate the issues and approach. Slides like 16, 17, and 18 give reviewers a better idea of how the problems are formulated and then addressed. Slide 13 gives one a feel for the computational intensity involved. The reviewer concluded that more information at this level of detail and beyond would raise this score further.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer stated that progress has been reasonable for the relatively short period of time the project has been active. Getting the architecture of the overall model set and then incorporating the network flow and UrbanSim models seems like an acceptable level of accomplishment. Because the work plan is clearly defined and the work so far has followed the plan, the reviewer has considerable confidence that such progress will continue.

Reviewer 2:
The reviewer commented that the emphasis on speed of processing to rates that match the UrbanSim platform processing is unclear, when 30 year "runs" encompass extremely large periods of time for travel demand when year-by-year data exchange between modes is required. The reviewer stated that the essential aspects of this approach to create integrated models are excellent, but the authors did not really explain the stipulation of processing speed. The reviewer asked if processing 30 years of data takes 8 hours versus 1 hour, is that a fatal flaw to reaching the project goals. The reviewer suggested that going forward, this should be defined in terms of the objective for processing time for a given scale of regional models.

Reviewer 3:
The reviewer stated that the project appears to be on task per the presented schedule.

Reviewer 4:
The reviewer commented that it appears that everything is on track to be complete by the final project deadline.

Reviewer 5:
Regarding full network, this reviewer reported a quarter million nodes, half a million edges, and 53,000 km of streets across 9 counties, which is good progress if this has been accomplished. If not, the reviewer commented that the presentation is misleading.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer remarked that there is a wide variety of partners and stakeholders.

Reviewer 2:
The reviewer noted that the project has a large group of collaborators and all seem to have important roles.

Reviewer 3:
The reviewer stated that there seems to be a good amount of varied collaborators. It is not clear from the presentation the extent of their participation and involvement. The reviewer asked if there are any collaborations with other federal entities.

The reviewer said that collaboration appears to be good because the PI has defined what each participant will be contributing and identified the form of some of the data or models that will be transferred. This score would be even higher if more specific examples of data transfer could be provided, but it is early in the project and the reviewer expects that will happen over time if each team member fulfills its role. The reviewer pointed out that Slide 8 provides some indication of the roles, but more details would justify a higher score

Reviewer 5:
The reviewer was not able to determine an answer to this question from the presentation or the slides.

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 performance and runtime improvements, testing on multiple street networks, testing multiple traffic assignment suites, and code repository to run at scale are all appropriate future research, but quantitative metrics for these would be helpful in evaluating the effectiveness of the project.

Reviewer 2:
The reviewer noted that the proposed future research aspect could be strengthened by discussing how the partners will be used and where they fit in. The reviewer asked if there is a plan for beta testing with potential end-users (planning agencies, etc.) or getting their input as the model is refined.

Reviewer 3:
The reviewer stated that future work involves a number of improvements to the model, replicating for other urban areas, and providing technical documentation, all of which seem like natural extensions of the current research.

Reviewer 4:
The reviewer noted that it is not clear what has already been accomplished or whether the presentation is showing the capabilities of existing platforms that are intended to be linked through the Python pipeline. The reviewer stated that the plan has several options for the traffic assignment component, but the leveraging of the large datasets (other than traffic assignment) is unclear. For example, the rich dataset of multimodal trip components offered in behavior energy autonomy mobility (BEAM) do not seem to be included in the planned "pipeline" approach. The reviewer asked if this a feature that can be added (if not already addressed). The reviewer commented that the benefit of applying BEAM is that even if traffic is all that is used when traffic assignment is the purpose of it application, the empty-vehicle movements of ride-hailing services (and possible private vehicle "send home" trips) will be included in the data pushed through the pipeline.

Reviewer 5:
The reviewer stated that after the project team presented a reasonable overall plan and identified some reasonable accomplishments, the information provided about future work is somewhat disappointing. Future tasks are presented as seemingly independent activities and did not address their interrelationships. The reviewer remarked that it does not appear that the project team created a logical path to overcoming any specific barrier or achieving any specific goal. Milestones were not identified. The reviewer commented that generalities such as "performance improvements" and "scaling up" do not provide anyone with a sense of exactly what will be done, how or why it is challenging, or where it will lead. The project team needs to plan its future work more carefully and describe it more fully.

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

Reviewer 1:
The reviewer noted that the connection to a VTO/EEMS strategic goal is clearly stated and evident.

Reviewer 2:
The reviewer stated that the project description specifies that it "supports VTO/EEMS strategic goal to develop new tools, techniques, and core capabilities to understand and identify the most important levers to improve the energy productivity of future integrated mobility systems."

Reviewer 3:
The reviewer remarked that this project supports DOE's objectives by exploring the relationship between urban development and mobility, and it does so by using some known models (UrbanSim, ActivitySim), integrating them, and then addressing their deficiencies in either processing speed or validation against data. Because of this approach and the modular nature of the model architecture, it appears to the reviewer that this project promises to have more impact and to produce more useful insights than the other projects they have seen.

Reviewer 4:
The reviewer said that the obvious benefit of HPC for such a large amount of computing is understood to be an objective of DOE. The question will be whether non-HPC applications will be possible by a typical metropolitan planning organization (MPO). The reviewer concluded that even so, the objectives of DOE seem to be fulfilled.

Reviewer 5:
The reviewer said that the project evaluates the combined policy impacts of land use and transportation at regional scale over several decades. If this is accomplished, then it will be relevant to DOE objectives. The reviewer concluded that it is difficult to say from the presentation or the slides if this will be accomplished.

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, once again, this is a very difficult question to answer based on the way it is posed and the sparse nature of the budget information provided. The reviewer graded these resources as "insufficient" because the funds going to this work seem fairly low compared to some of the other projects reviewed. Because of the clarity of vision that this project team seem to have, it appears that additional resources might be productively applied, more so than some others.

Reviewer 2:
The reviewer remarked that the objectives for creating such a comprehensive pipeline would appear to be insufficient in dollars and possibly time. The reviewer concluded that incorporating DOE resources such as HPC would appear to need additional funding to be accomplished.

Reviewer 3:
The reviewer said that the resources for this project seem to be in line with the level of effort and expertise required.

Reviewer 4:
The reviewer said that the presentation did not mention any issues with the resources they have.

Reviewer 5:
The reviewer commented that the funding amount seems appropriate for the size and reach of the project.

Presentation Number: eems036
Presentation Title: Reinforcement Learning-Based Traffic Control to Optimize Energy Usage and Throughput
Principal Investigator: Tom Karnowski (Oak Ridge National Laboratory)

Presenter
Tom Karnowski, 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 and well-planned.

Reviewer 1:

The reviewer said that the project has a very practical approach.

Reviewer 2:

The reviewer observed that the project utilizes existing technologies and analytic tools to vehicle classify and estimate fuel consumption, with the aim of optimizing both fuel consumption and vehicle throughput. The project team's methodology seemed clear, relevant, and generally viable, and the team has already acquired datasets for training, vehicle classification, and from a naturalistic driving study. The reviewer would be interested to learn more about their real-world implementation strategies.

Reviewer 3:

The reviewer commented that using video images and vehicle classification are viable and useful concepts for transportation data collection.

Reviewer 4:

The reviewer noted that the project approach is technically sound and well-designed. It is therefore possible that the goals and objectives of the project may be realized. The technical approach, based on the use of machine learning (ML) to estimate and predict fuel consumption using GridSMART cameras, is based on recent successes in ML and the significant computational resources that HPC can bring to solving the challenge. The reviewer commented that using cameras with a wide field of view (fish eye lenses), allows for the capture of sufficient information regarding the vehicles that pass by at the relevant locations. These can replace the inductive loop systems that are in place today. The reviewer stated that utilizing ground systems to capture the images that then can train the ML algorithm, specifically with reinforcement learning, is
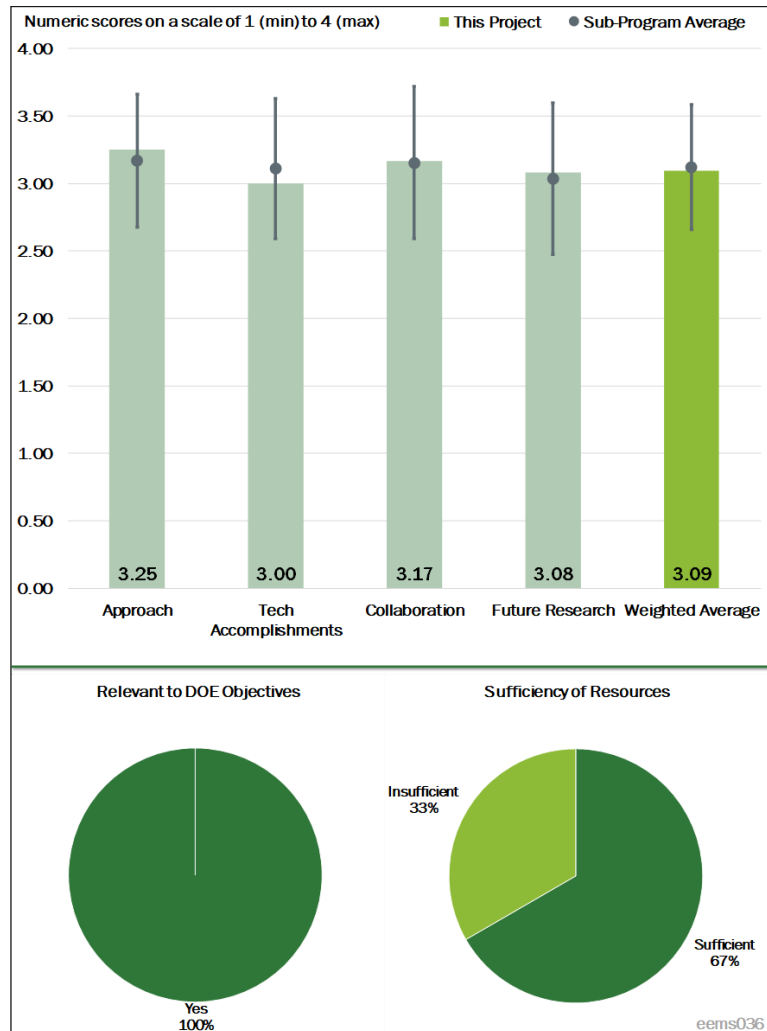

Figure 3-22 - Presentation Number: eems036 Presentation Title: Reinforcement Learning-Based Traffic Control to Optimize Energy Usage and Throughput Principal Investigator: Tom Karnowski (Oak Ridge National Laboratory)

appropriate. The project is based on the relatively mature field of computer vision technology and trends in reinforcement learning. Recent breakthroughs in "deep learning" have challenged computer vision approaches; however, there are continuing challenges in ML with achieving sufficient accuracy of image recognition and the inability to explain the success or otherwise of actions taken through ML experience. The reviewer concluded that the project results can shed light on some of these challenges.

Reviewer 5:
The reviewer conveyed needing much more detail to understand the approach.

Reviewer 6:
The reviewer commented that the ability of GridSMART to deliver an operable system may be a risk. The project is feasible, but the methodology of automated classification should be designed to be transferable to other detection systems to be truly useful. The reviewer remarked that the changes in fuel consumption by vehicle class may require future updating of traffic control algorithms that are more site and operating environment specific. Recognizing that in a 10-minute presentation not many details can be provided, it is unclear how wholly different vehicle classification mixes (unique to each location) are accommodated in the algorithms to be derived, or whether sufficient variations in the case studies will be accomplished in the associated HPC ML runs to provide a complete library of algorithms for any situation. The reviewer noted that further, it is unclear how different control algorithms will be utilized by local traffic management entities or controller manufacturers, or if the family of algorithms would reside in the controller and be dynamically applied as traffic mix changes.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer noted that the project is right on track.

Reviewer 2:
The reviewer stated that with the project only being several months in, the progress appears to be on track.

Reviewer 3:
The reviewer remarked that this project is only 10% complete, although this level of accomplishment and progress appears to have been due to non-technical issues. However, the project has identified the necessary cameras for data collection, acquired datasets for training from ground cameras, the necessary tools for classification of images, and ample vehicle traversals through intersections. Further, the reviewer concluded that HPC designs have been formulated for grid characteristics.

Reviewer 4:
The reviewer said that the project still seems very much in the exploratory phase, but the reviewer is not able to tell based on the current description of the approach.

Reviewer 5:
The reviewer remarked that the project team noted that the project was not reviewed last year and that only a month of work (the initial beta collection and analysis) has gone in to it so far. Having said that, this progress seems consistent with the timeline provided in the team's slides. Specifically, until now their action items have included working on acquiring GridSMART vehicle data, building a training set, and designing/developing HPC software. The reviewer concluded that based on the datasets the team has acquired and the work the team reported having already done towards preparing for the next steps of the project, it seems the team is basically on schedule.

Reviewer 6:
The reviewer noted that the level of completion is not in line with the project age and duration.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer said that this project has a good team assembled. The reviewer commented that the project team should consider a commercial partner.

Reviewer 2:
The reviewer stated that the materials and presentation mentioned partners (existing and potential). Because it is still early in the project, the existing coordination seems sufficient. The reviewer would later be interested to know with which municipalities the project team collaborates and the outcomes of those partnerships.

Reviewer 3:
The reviewer commented that the project is based on the collaborative work with GridSMART and that their provision of camera characteristics and operating parameters is very important. Involving local municipalities will help provide a practical view of the utility of the study results. The reviewer concluded that all of these parties would seem to be highly motivated to support the research project work.

Reviewer 4:
The reviewer stated that the team has identified the necessary collaborator for the success of their project. GridSMART is located in Knoxville, Tennessee. Geographic proximity to the team partner will help with collaboration and coordination of various aspects of the project such as data collection, discussion of technical issues, and effectively utilizing the HPC resources that are available at ORNL. The reviewer commented that additionally, because the team consists of only the company GridSMART and ORNL, the challenges in collaboration and coordination on the project are simplified. The data collected by the GridSMART cameras and the ground cameras represent the key data sources for the project. The reviewer noted that ORNL accomplishes the data processing through computer vision and reinforcement learning based on the HPC resources that exist at the national laboratory. The simplified team structure should help accelerate the project. Other potential partners—municipalities—are mentioned such as Allentown, Pennsylvania, Sevierville, Tennessee, and Chattanooga, Tennessee. The reviewer concluded that these partners can broaden the opportunity for the project.

Reviewer 5:
The reviewer was unable to determine the level of collaboration from the slides or presentation.

Reviewer 6:
The reviewer could not tell the role of each stakeholder from the current description.

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

Reviewer 1:
The reviewer noted that the project has good plans moving forward.

Reviewer 2:
The reviewer stated that the project provided details pertaining to future work focusing on both data and HPC. Given that training data are sufficiently granular and varied, the process the team has laid out for classifying vehicles and estimating energy consumption seems promising. With respect to HPC software, the reviewer is curious to learn more about the parameters that will be applied to simulations. Additionally, the reviewer would be interested to learn more about the real-world deployment strategy of this project and how this system will be implemented. The reviewer asked how the system will prioritize and re-route vehicles once it has been adequately trained to classify and characterize them effectively. The reviewer also asked if, in order to reduce

net emissions/idling time, certain vehicles (and therefore vehicle owners) will be at a disadvantage with respect to routing, etc.

Reviewer 3:
The reviewer noted that the proposed future work and deployment are necessary for the project to be successful.

Reviewer 4:
The reviewer said that the future modeling work on large scale, and the ability of the Reinforcement Learning processing in the HPC application, is of key importance, since, even if the GridSMART technology application proves deficient, the algorithms will be applicable to other means of defining site specific vehicle classification mix.

Reviewer 5:
The reviewer commented that the description needs more detail about specifics. The reviewer asked how the team will approach each of these things.

Reviewer 6:
The reviewer stated that the project proposal for future research is organized into two themes: Data focus and HPC focus. These are complementary to each other. The reviewer said that the planned work is logical in that the training data is critical for the performance of the ML approach and this is shown as one of the early tasks. The team logically placed the proposed milestones in sequence. The reviewer pointed out that decision points are shown as milestones; however, go/no-go metrics are not shown as the project assumes that the proposed approach with computer vision technology and reinforcement learning will be successful (which remains to be seen). Alternate algorithms and approaches are not proposed to mitigate the risks with relying on the proposed methodology.

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

Reviewer 1:
The reviewer commented that this project will help save fuel and reduce congestion.

Reviewer 2:
The reviewer stated that the project includes using connected and automated technology to improve efficiency in the transportation system.

Reviewer 3:
The reviewer pointed out that part of DOE's mission is to address energy and environmental challenges. This project aims to create a technology solution that could help to improve energy productivity/efficiency. The reviewer concluded that it is therefore directly relevant to (and working in support of) the objectives of the DOE.

Reviewer 4:
The reviewer said that the provision of traffic control algorithms that can maximize fuel consumption dynamically as a function of traffic vehicle classification mix is very valuable.

Reviewer 5:
The reviewer commented that this project has sufficient relevance for meeting the overall goals for DOE's VTO. The end goal of saving nearly 6 billion gallons of fuel annually (idling costs) is directly relevant to the goal of energy-efficient mobility. The reviewer said that the innovative approach that the project team has chosen with GridSMART cameras and ML/HPC, leverages significant computational resources that exist at ORNL. Additionally, the use of wide field of view cameras that can potentially replace legacy sensors to provide additional capability in mobility sensing and route planning in the future has significant potential for

the future of vehicle transportation networks. The reviewer concluded that new infrastructure that may be created through this project can be scaled to provide improved energy-efficient mobility throughout the United States and to other countries to increase economic benefits for our nation.

Reviewer 6:

The reviewer stated that methods of collecting high resolution detailed traffic data are needed.

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 if 2018 funding is not secured, $50,000 seems unlikely to be sufficient to complete this work.

Reviewer 2:

The reviewer remarked that completing the HPC processing to accomplish the ML step on sufficiently large networks could be a challenge that requires additional resources. If the other technology aspects are suitably resolved to justify additional HPC modeling implementation resources for this step, the reviewer recommended providing additional resources.

Reviewer 3:

The reviewer said that thus far, the resources seem sufficient. The reviewer thanked the project for presenting and looks forward to learning more about the work and its outcomes.

Reviewer 4:

The reviewer commented that the funding level is consistent with the level of effort and expertise required for this type of work.

Reviewer 5:

The reviewer commented that the project should consider a commercial partner.

Reviewer 6:

The reviewer stated that the resources for the 1-year project with just two teams (GridSMART and ORNL) considering the computational resources that already exist at the national laboratory, seem sufficient. The project aims to demonstrate feasibility of the proposed concept. The reviewer said that as the project has not stated quantitative metrics for accuracy, precision and other technical parameters, a 1-year effort appears to suffice for concept viability. However, the reviewer pointed out that scalability, techno-economic analysis, business case, and other related challenges in commercializing the technology will need to be addressed through future funding beyond the current project.

**Presentation Number: eems037
Presentation Title: High-Performance
Computing (HPC) and Big Data
Solutions for Mobility Design and
Planning
Principal Investigator: Jane
Macfarlane (Lawrence Berkeley
National Laboratory)**

Presenter
Jane Macfarlane, Lawrence Berkeley
National Laboratory

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

**Question 1: Approach to performing
the work—the degree to which
technical barriers are addressed, the
project is well-designed and well-
planned.**

Reviewer 1:
The reviewer noted that this was a very
well laid out project as well as
presentation. What was well done were
the relevance (Slide 3), work breakdown
(Slide 4), milestone (Slide 5), and
approach. The reviewer stated that the
flowcharts were also very easy to
understand.

Reviewer 2:
The reviewer stated that the modelling
approach is global but exploits
parallelism. The reviewer commented
that the approach is robust.

Figure 3-23 - Presentation Number: eems037 Presentation Title: High-
Performance Computing (HPC) and Big Data Solutions for Mobility Design
and Planning Principal Investigator: Jane Macfarlane (Lawrence Berkeley
National Laboratory)

Reviewer 3:
The reviewer remarked that the project is addressing a tremendous challenge in urban scale vehicle networks
with the added complexity of ingesting and analyzing real-world data in near real-time. The technical approach
is based on utilizing HPC resources that are available at the national laboratories. Specifically, the reviewer
stated that the challenge is to develop the right set of tools for rapid modeling of large scale transportation
networks to assess energy productivity and efficiency of vehicle mobility. The energy cost and productivity
loss of congestion are expected as outputs of the analysis. The reviewer commented that a multi-lab effort to
develop the Data Science, and the HPC computational framework for next-generation mobility system models
and operational analytics is envisioned. The project is well-formulated with a systematic approach to include
gap analysis, definition of system architectures, data access and analytics, and identification of ML tools for
HPC. Long short-term memory (LSTM), a thoroughly researched ML approach, is chosen for analysis of
geospatial temporal data. The reviewer said that the project team has given sufficient attention to all aspects of
the project challenge. The team is also realistic about the potential of the success of the project having stated
all the critical assumptions. The reviewer said the impact of assumptions such as the use of flat maps for
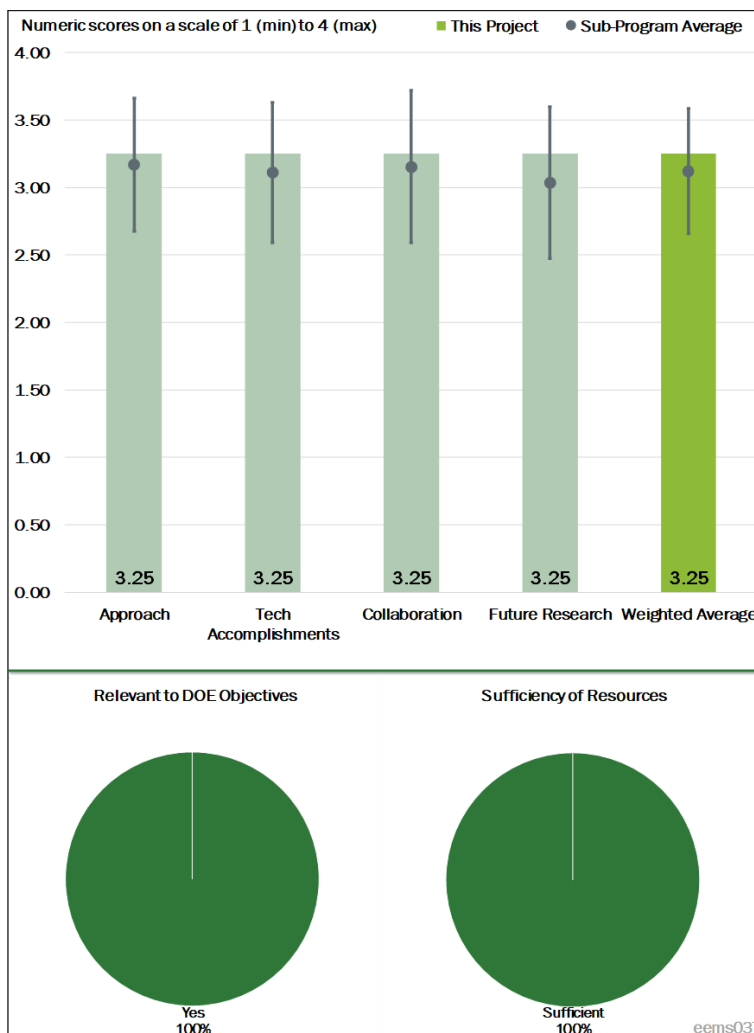
energy consumption for now, and constant speed through each link, are not yet clear and remain to be ascertained.

The reviewer noted that an HPC-based Machine Learning approach to address the proposed challenge is feasible. The question remains as to what the quantitative performance of the proposed solution will be and if it provides insights that may be implemented in alleviating the congestion experienced in real-world situations. The reviewer stated that a related issue is with translating the lessons learned from HPC-based methodologies for Data Center and distributed computing architectures that are relevant to real-world scenarios. With increasing computational resources on vehicles and at the edge of the network, implementing ML approaches on distributed systems will become the norm in the future. The reviewer concluded that a potential solution to this conundrum may be to support a parallel research effort on data-centric systems to compare and contrast the pros and cons of these two methodologies: HPC based and data center-based.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer commented that the goals presented were not clear. The reviewer asked what the ultimate tangible outcome of this work is.

Reviewer 2:
The reviewer commented that it was helpful to see the simulation results, albeit it is just the beginning (Slide 12). The reviewer suggested that if the project team could really get to a simulation of the types of vehicles on the road, along with analysis of fuel consumption during congestion, or without congestion, it could help optimize design/engineering of the vehicles.

Reviewer 3:
The reviewer commented that the results are solid and the schedule appears to be on track.

Reviewer 4:
The reviewer said that the project appears to be on track as seen from the milestones that have been accomplished since project inception. Specifically, PNNL has completed deployment of initial HPC and HPC-ML toolset having selected the initial HPC-ML tools. LBNL is providing project coordination, defining the appropriate role of HPC, ML, and Big Data analytics for transportation, and is also on track to establish organizationally efficient data access processes. LBNL also has the lead on developing asynchronous distributed state HPC transportation network models and have a go/no-go planned for Q4 (FY 2018) on this task. The reviewer stated that ANL has completed selection of initial training dataset from the Connected Corridor, and are on track for demonstrating the viability of the LSTM neural architecture approach for G-T data. ORNL has defined the path for integration of energy models into the HPC framework and have established a go/no-go in Q2 of FY 2019 to evaluate the efficacy of the ML approach and impact of data veracity on energy estimates. The reviewer noted that quantitative estimates are shown for the loss of productivity across links; up to $2,000 loss per 15 minutes on the top congested links for a total daily loss of more than $6 million. Such quantitative measures are significant accomplishments for the overall project and highlight the need for energy efficient mobility solutions.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer stated that the project has good collaboration with Uber travel analysis zone (TAZ) movement data and that there are other good collaborations as well.

Reviewer 2:

The reviewer liked seeing the collaborations and coordination as outlined in the project. The reviewer does think that there are other opportunities to bring available data into this project, which the team may not have thought of.

Reviewer 3:

The reviewer commented that the project team consists of the four DOE national laboratories, LBNL, PNNL, ANL, and ORNL, in collaboration with the Connected Corridor program, University of California-Berkeley, and Cal Trans. Based on the progress made on the project and the interrelated nature of the sub-projects across the various national laboratories, there seems to be excellent collaboration and coordination on the project. The reviewer remarked that each national laboratory has a unique role and contribution that complements their partners, and this approach ensures that there is value-add from each partner on the team. Additionally, the team also has "here" for GPS data for the Connected Corridor Region and Uber for TAZ Movement Data/Validation.

Reviewer 4:

The reviewer said that there were no details presented on collaboration.

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

Reviewer 1:

The reviewer noted that the proposed research seems feasible and high impact in light of the progress.

Reviewer 2:

The reviewer stated that the proposed future research is logically aligned with the ongoing project and accomplishments. The proposed efforts such as automated, data-fusion ML models, dynamic routing, impact of routing on energy, productivity and mobility measures, datasets for large-scale network characterizations, and real-time decision making are important future goals for the project. The reviewer commented that alternate technical development pathways, although not explicitly stated, may be realized through a choice of ML models and other changes/modifications as needed.

Reviewer 3:

The reviewer explained giving the project a satisfactory in hope that it is actually on a good track. The reviewer remarked that the proposed future research was unclear.

Reviewer 4:

The reviewer commented that the project team is just scratching the surface but that the team also has to think of "what the end game" is for analysis. The reviewer asked how much energy can be saved and at what cost for simulation.

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

Reviewer 1:

The reviewer stated that the problem being solved is critical to the type of simulations needed for transportation planning. Reducing computation time is critical if these and other models are going to be useful.

Reviewer 2:

The reviewer remarked that this DOE project based on HPC and ML for EEMS is highly relevant to DOE/VTO's mission. HPC offers unique capabilities as a platform for ML tools that may provide new insights into urban vehicle networks and transportation to address some of the inefficiencies in the system that cannot

be easily solved with traditional analyses and calculations on commonly available tools. The reviewer concluded that a successful outcome for the project can potentially lead to billions of dollars saved annually for the U.S.

Reviewer 3:

The reviewer said that yes, this does support DOE objectives. The reviewer commented that it would be helpful to have an end game in mind for energy savings, which the project team would then show in their simulation. The reviewer asked what the end game looks like.

Reviewer 4:

The reviewer hoped that this project supports DOE's overall objectives, but it is not clear if it does.

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 are typical for this type of effort.

Reviewer 2:

The reviewer stated that the project resources seem to be sufficient considering the resources that the team is utilizing and the tasks/milestones envisioned for the project. At an average cost of $500,000 per DOE national laboratory, the project resources seem realistic and reasonable. The reviewer commented that the project outcomes in the first year can provide additional justification and evidence for the level of resources that are required in subsequent years of the project. A detailed cost plan showing the types of resources required for specific tasks will add further support to sufficiency of resources requested.

Reviewer 3:

The reviewer hoped the project has enough resources to result in a good result; however, it is unclear form the presentation that it does.

Reviewer 4:

The reviewer stated that the project has a rather large budget, $2 million per year—for $6 million in total across 3 years. The reviewer asked if the project team is getting what they need from each of their partners, including the Connected Corridor, University of California-Berkeley, and CalTrans. The reviewer asked what more does the team need to be efficient and what does the team not need. The reviewer reiterated that the project team should determine the end game from an energy savings standpoint.

**Presentation Number: eems038
Presentation Title: Fuel Selection of
Privately Owned Shared Vehicles
Principal Investigator: Shawn
Salisbury (Idaho National Laboratory)**

Presenter
John Smart, Idaho National Laboratory

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

**Question 1: Approach to performing
the work—the degree to which
technical barriers are addressed, the
project is well-designed and well-
planned.**

Reviewer 1:
The reviewer really liked this project
and approach. In particular, the report-
out also was "real world based" and
easy to understand.

Reviewer 2:
The reviewer remarked the approach is
appropriate, and the team has done an
excellent job given the limited data
availability.

Reviewer 3:
The reviewer remarked that the overall
project approach seems focused on
addressing specific issues. One
particularly advantageous element of the
approach is incorporating real-world
data (from multiple sources) to inform the analysis methods. The reviewer pointed out this allowed the project
to estimate potential cost structures for recharging, and it also assisted greatly in determining priorities for
locating recharging equipment (such as utilization rate being more important than cost).

Reviewer 4:
The reviewer commented the relevance of the project relies on the assumption that the adoption of shared
vehicles with EVs could be substantial enough to overwhelm the existing/planned infrastructure for non-shared
vehicles. While the presenter noted data availability is an issue, baseline assumptions using incumbent taxi
fleets should provide a good estimate of shared vehicle contributions to overall VMT. The reviewer pointed
out that projected shared vehicle growth rates and EV adoption rates (both shared and non-shared) would
provide suitable reference points to predict the potential impact. The formal presentation of the anecdotal
examples showing localized deficiencies in charging infrastructure would further demonstrate the relevancy of
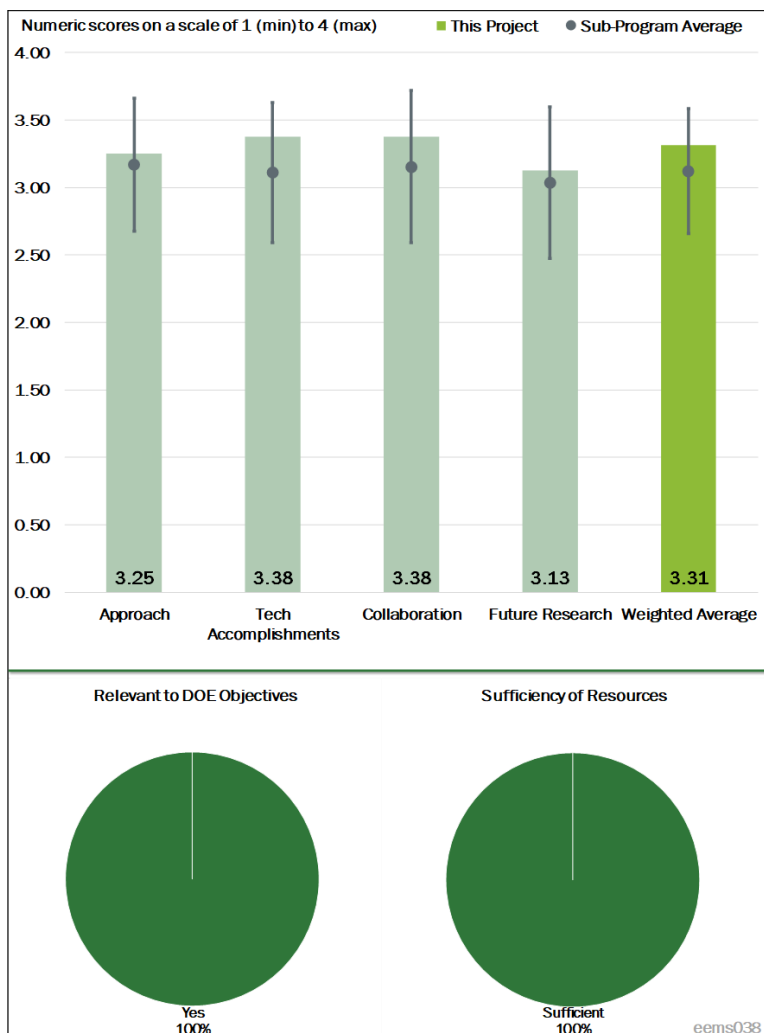the project.

Figure 3-24 - Presentation Number: eems038 Presentation Title: Fuel
Selection of Privately Owned Shared Vehicles Principal Investigator: Shawn
Salisbury (Idaho National Laboratory)

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer said that the project is on track and has already provided some interesting insights into charging infrastructure deployment.

Reviewer 2:

The reviewer commented that so far, the project team is at quarter two of FY 2018 with simulations being complete. The reviewer looks forward to seeing the results from quarter three and quarter four for FY 2018, which starts to look at economics.

Reviewer 3:

The reviewer noted that the team has evaluated a great deal of real-world data, and determined several key results. These results then pointed to several very important infrastructure development considerations, which helped to determine specific infrastructure scenario plans. The reviewer cited as an example how the project verified home charging as a critical infrastructure source. While the team may have anticipated this, the project generated sufficient results to document exactly how critical.

Reviewer 4:

The reviewer said that for shared mobility applications, it would be valuable to determine the impact of satisfactory and unsatisfactory levels of infrastructure on EV usage for privately owned ridesharing vehicles. In addition, the change in behavior of ride operators/owners to availability of charging would be beneficial. The reviewer appreciated the presentation of unexpected results (home charging impact).

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer remarked the level of collaboration and coordination is appropriate.

Reviewer 2:

The reviewer observed appropriate collaboration with other national laboratories and external data sources.

Reviewer 3:

The reviewer said the team includes not only other national laboratories, but also several partners specifically to provide real-world data.

Reviewer 4:

The reviewer said yes, this shows the project lead and partners, but does not quite lay out who does what, exactly. The reviewer inquired were the results from RideAustin and Columbus, Ohio shared with the cities. The reviewer also wondered if there could be some sort of rate structure to improve the dead-heading on RideAustin. The reviewer also pointed out that as part of the project set-up, it did not quite detail out the difference between a taxi and ride hailing. The reviewer though this is more of a paper study as to how the different businesses operate—great for an MBA study project.

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

Reviewer 1:

The reviewer remarked the project has clearly outlined next steps.

Reviewer 2:

The reviewer pointed out that the project has identified several areas for future efforts, focused upon upcoming changes in the underlying application areas. A number of additional questions have developed as the team progressed further into the research. The reviewer noted the project team is also developing relationships with other organizations who might be able to provide additional data to help answer these developing questions.

Reviewer 3:

The reviewer saw what the team has accomplished as good. The reviewer would like to see something more compelling for future research—whether it is engineering driven from a battery standpoint and charging standpoint—or if the author basically stops at Slide 11. The reviewer asked what compelling future research the author has in mind.

Reviewer 4:

The reviewer commented that proposed future research seems open-ended and is not well-defined.

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

Reviewer 1:

The reviewer said that the project is relevant to determining charging infrastructure needs in response to future EV proliferation.

Reviewer 2:

The reviewer pointed out that the project is focused on attempting to determine infrastructure needs for privately shared vehicles, particularly based upon performance/range requirements and use patterns. This is particularly important for non-conventionally-fueled vehicles, in order to determine the potential energy savings/petroleum displacement by incorporating alternative fuel vehicles.

Reviewer 3:

The reviewer described this dead-heading for ride hailing as rather annoying, and asked if that percentage is acceptable.

Reviewer 4:

The reviewer remarked the project loosely supports DOE objectives by determining charging infrastructure requirements—but the reviewer was not clear what the action items will be once the project is complete.

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

Reviewer 1:

The reviewer said that at this time, the resources appear sufficient. As additional questions arise, there may be a need for additional resources.

Reviewer 2:

The reviewer commented that the team has been able to find data resources to accomplish the project task.

Reviewer 3:

The reviewer commented resources appear sufficient.

Reviewer 4:

The reviewer noted that the project team spent $325,000 in FY 2018. The reviewer inquired what is compelling to keep adding to the team's future research.

Presentation Number: eems039
Presentation Title: Fuel Selection for
Fully Automated, Commercially
Owned Taxi Fleet
Principal Investigator: Timothy
Lipman (Lawrence Berkeley National
Laboratory)

Presenter
Timothy Lipman, Lawrence Berkeley
National Laboratory

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

Question 1: Approach to performing
the work—the degree to which
technical barriers are addressed, the
project is well-designed and well-
planned.

Reviewer 1:
The reviewer said the approach is set up
in a good way and is supported by
logical goals and work plan. The
reviewer found that this is a well-
designed project.

Reviewer 2:
The reviewer remarked the project
appears focused on answering the key
questions related to incorporating AVs
into fleets. The project team is using
existing modeling modules where
possible, and then adapting them to
address the project's specific needs. The
reviewer detailed that the key areas are market and infrastructure elements. One small concern is that right now
the only comparison really going on is between plug-in electric vehicles and gasoline vehicles. The reviewer
said it could be useful to include other alternative fuels with lower operating costs (particularly such as natural
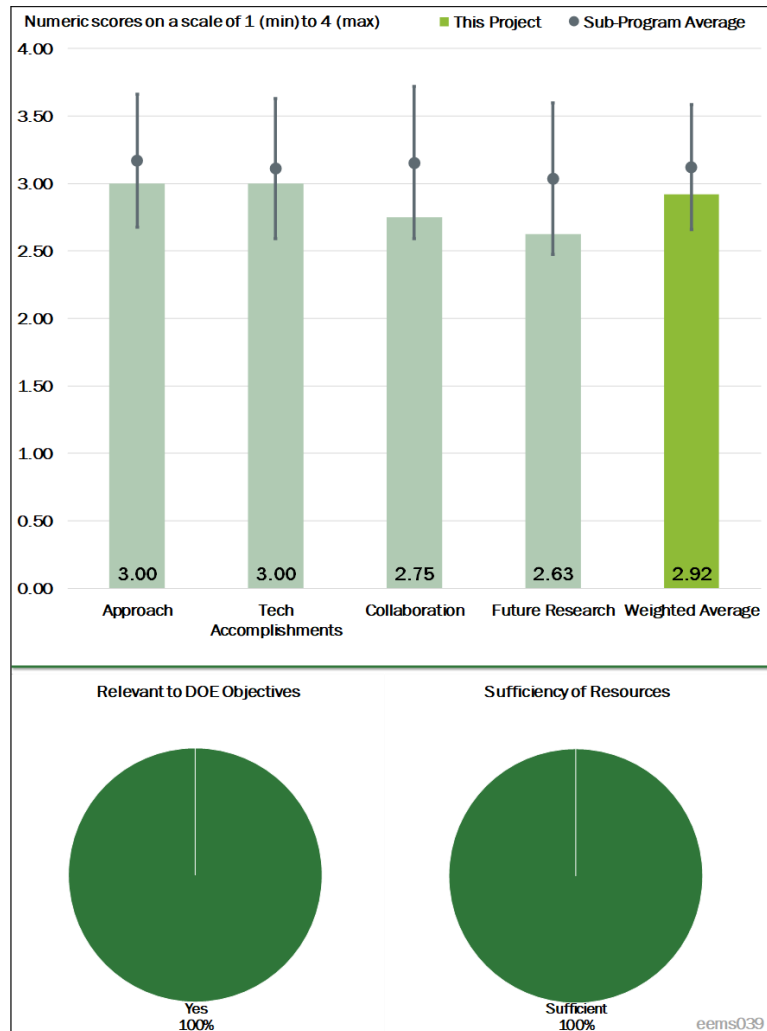gas or propane) at some point.

Figure 3-25 - Presentation Number: eems039 Presentation Title: Fuel
Selection for Fully Automated, Commercially Owned Taxi Fleet Principal
Investigator: Timothy Lipman (Lawrence Berkeley National Laboratory)

Reviewer 3:
The reviewer said that using a BEAM-like agent-based system to test charging behavior appears to be a viable
direction. The reviewer noted that Slide 8 suggested that a large part of the effort will be in modifying BEAM
to ride-hailing/TNC markets and BEAM PEV. The reviewer said that it is hard to evaluate how much effort
this takes; the former could be quite complex (to add ride-hailing origins-destination (O-D) pairs plus trip
assignment algorithm). The later (BEAM PEV) seems already advertised on http://beam.lbl.gov/, so not sure
what modifications the project needed. Slides 16-18 show some options. The reviewer asked if these options
were done by the project, or by earlier BEAM developments. The reviewer also asked if the project chose one
of these three options, and why. Still, according to the reviewer, updating BEAM for an AD and MaaS is an
important effort, and one that deserves support. The reviewer said that the general direction is "very good,"
and seeing that was not an option, the reviewer chose the closest response to this on Question 1.

Reviewer 4:

The reviewer found this project rather confusing in its goals and approach. The goals mention the various options for fueling future taxi fleets made up of CAVs, yet EVs are the only ones analyzed. The authors mention gasoline as a topic for future study, but fuels such as natural gas or propane would offer potential lower costs and lower emissions. The reviewer noted that the authors show work that tries to evaluate different charging and energy storage options, yet it is not clear how their results would feed into anyone's decision-making process. The reviewer said the authors calculate an overall annualized investment that combines costs for the vehicles, charging stations, grid upgrades, and energy, yet each of these may be purchased by a different entity to that no one really cares what the total investment number really is. The reviewer said the authors show results for siting charging stations, yet it is not clear that the authors are taking into account the key deterministic parameters. The reviewer liked the fact that the work is focusing on real fleets (taxis) in real cities (New York City, and San Francisco), but the reviewer is not confident that it is addressing the right barriers or that the tools being developed are the rights ones to contribute to answering the questions that will be confronting decision-makers. The reviewer remarked the results regarding temperature dependence of charging time and energy use for EVs hardly seem to require a complex model. While the reviewer gave the researchers some not-insignificant credit for focusing on real systems, the reviewer thought the project team needs to clarify the questions it wants to answer and ask itself and other interested parties (fleet owners, city managers, etc.) whether these are the right questions.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer described that the team has been focused on refining its modeling tools, and then running different scenarios to identify anticipated infrastructure needs. More of the effort is currently focused on the demand element for integration into the BEAM model, using multiple approach concepts (including one iterative approach). The reviewer said that the team has been using real-world data to build their modeling knowledge base. In particular, one key element analyzed was charging performance at different ambient temperatures.

Reviewer 2:

The reviewer said that initial simulations of infrastructure cost and energy use are complete and results are encouraging. The reviewer was not entirely clear how the team will compare baseline fuel infrastructure to EVs.

Reviewer 3:

The reviewer remarked that, as previously mentioned, this updating of BEAM is important. The results on Slides 12, 13, and 19 are nice, but feel more an effort to debug the BEAM implementation as opposed to definitive answers. The reviewer thought that at this point in the project, that is no problem. The reviewer said that clearer statements on the simulation outputs are expected for next year.

Reviewer 4:

The reviewer referenced prior comments in Question 2. The reviewer is not convinced that the researchers are addressing the right questions in the right way, so it is hard to give a high score to the team's technical accomplishments. Most of the results that the authors showed, whether it is those regarding investment as a function of vehicle and charging station characteristics or those regarding temperature dependence of energy use in EVs, seem capable of being reached with relatively simple calculations and do not require complex models. The reviewer said that the authors seem to be developing the model for its own sake and not for the purpose of addressing real questions that are, or soon will be, vexing decision-makers.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer said that the project includes collaboration among the key national laboratories working in this area. The reviewer commented it might have been nice to incorporate at least a few fleet operators to inform decision-making and planning, as well as perhaps infrastructure providers/utilities.

Reviewer 2:

The reviewer noted that Slide 22 seems to indicate there is some logic behind the collaboration efforts, and the reviewer trusted that is true. As with most of the EEMS projects, the reviewer thought the roles of the participants and the contributions of each to the overall goals could and should be much clearer.

Reviewer 3:

The reviewer observed that Slide 22 summarized collaboration. One has the feeling that collaboration (or perhaps high-level information sharing) "will take place," but the reviewer found that descriptions on Slide 22 are quite vague, e.g., "working with," "comparison with." INL appears to be involved, but the reviewer was not clear how. More specific collaboration details should be included by next year's AMR. The reviewer said the table showing interdependencies on the bottom of Slide 22 is nice, but it is not the same as collaboration.

Reviewer 4:

The reviewer observed very good coordination within the national laboratory community, but according to the reviewer the project needs industry collaboration.

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

Reviewer 1:

The reviewer noted that there is a specific and rational plan for next steps to address the remaining questions, building upon previous results. Like other projects in this area, it appears that as research goes along, new questions arise, so there may be additional needs for future research.

Reviewer 2:

The reviewer reiterated that updating BEAM to these MaaS and AD scenarios is important, and should be continued. However, such tasks rarely have a linear relationship with time, so it may be hard to describe exactly what was done, and what exactly needs to happen. The reviewer understands and appreciates that challenge. Still, these slides do not give this reviewer a good sense of "how close to the end" the project is. It would be ideal to have more project reports provided to this reviewer. The reviewer expressed having no reason to think that good progress has not been made, and some tangible, more-clearly-relatable accomplishments will appear as we go forward.

Reviewer 3:

The reviewer said the presentation did not have enough discussion about future research needs.

Reviewer 4:

The reviewer commented future plans only talk about developing more detailed inputs for the model rather than presenting a plan with milestones and decision points. Without such markers, it is impossible to tell whether the work is progressing as needed to a logical goal or endpoint. The reviewer said that this may be the intent, to avoid critical assessment of the project. The future work hints at addressing more about vehicle characteristics, charging station characteristics, and fuel choices, yet it does not clarify how it will address any of those in a meaningful way.

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

Reviewer 1:
The reviewer remarked the project is focused on simulating energy consumption and costs of new transportation scenarios, including comparing conventional versus alternative fuel options.

Reviewer 2:
The reviewer responded yes, and elaborated that BEAM is a DOE tool that needs to be updated to address modern questions of the interactions of AD and MaaS. This will be important in setting direction for energy estimations and other impacts of these new technologies.

Reviewer 3:
The reviewer said that both are addressed. The reviewer asked does vehicle automation improve the economics of an EV fleet when considering the different charging infrastructure needs, and what types of charging infrastructure planning will support AV operations in the future.

Reviewer 4:
The reviewer said that as with most of the EEMS projects reviewed, this project is aimed at dressing real questions about energy use and infrastructure requirements for future CAVs. However, it does not do so in a very clear way so the reviewer did not think it supports DOE objectives very effectively. The reviewer remarked if the authors took time to pose the critical questions more carefully, the project might do a better job of supporting the DOE objectives.

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

Reviewer 1:
The reviewer responded that the resources currently appear sufficient, though there may be need to extend the project to answer new questions that are arising. The reviewer pointed out that no resources have been identified at this time to address such a scenario.

Reviewer 2:
The reviewer said that the resources seem to be sufficient based on the type of modeling being done, the number of people involved, and in comparison to other projects. However, according to the reviewer the presentation does not really identify any milestones because the work plan is not laid out in a logical, progressive manner that includes milestones and decision points. The reviewer reiterated that modeling real fleets in real cities is a plus, and the resources identified here should be sufficient to do some valuable work. However, per the reviewer, the project needs to have a better set of goals and a better work plan to assure the project spends funds properly.

Reviewer 3:
The reviewer said that it was hard to really judge this, as the slides list six people, but not how much of their time is consumed by this project.

Reviewer 4:
The reviewer said none.

Presentation Number: eems040
Presentation Title: Fuel Selection in Automated Mobility Districts/Dynamic Wireless Power Transfer Feasibility
Principal Investigator: Omer Omar (Oak Ridge National Laboratory)

Presenter
Omer Omar, Oak Ridge National Laboratory

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer found that overall, the project is well-designed. The main barrier of obtaining real-world data does not appear to have a solution, which is a major concern, because the validity of the models relies on the performance of a new technology.

Reviewer 2:
The reviewer described that the outcome of this task is to produce a design guideline applied to an example test case scenario for the optimal deployment of dynamic wireless power transfer (DWPT) systems to support future roadway and electric power infrastructure planning. This is a notable and important outcome if it can be achieved. The reviewer said that the approach needs to include more input from transportation planning stakeholders to make it more realistic.

Reviewer 3:
The reviewer said that overall, the presentation lays out the optimization problem statement quite well, with a somewhat confusing example. The reviewer said please refer to comments in response to Question 4.

Reviewer 4:
The reviewer commented that the project is well-designed with supporting calculations. The 90% power transfer assumption should be reviewed to ensure that is the correct value and that no additional technical barriers exist with an implementation that delivers 90%.
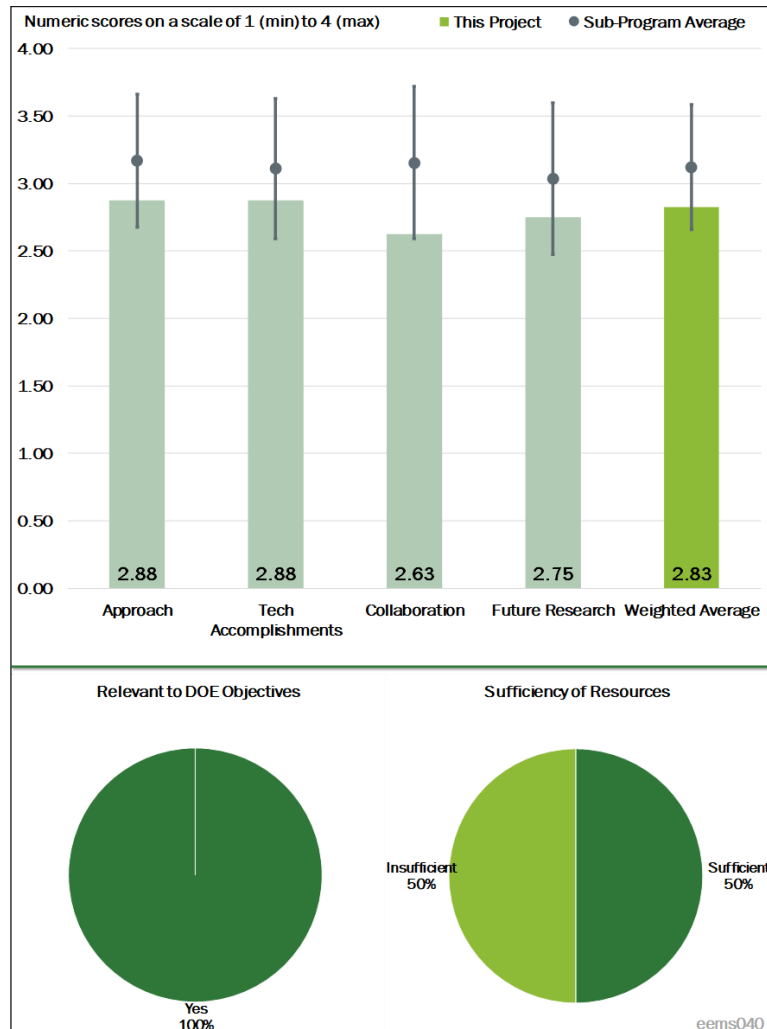

Figure 3-26 - Presentation Number: eems040 Presentation Title: Fuel Selection in Automated Mobility Districts/Dynamic Wireless Power Transfer Feasibility Principal Investigator: Omer Omar (Oak Ridge National Laboratory)

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer said that good progress has been made with respect to the development of power estimation, transfer efficiency, and track planning.

Reviewer 2:
The reviewer said very complete simulations and data provided to support the progress of overall project.

Reviewer 3:
The reviewer observed pretty good progress overall, but this reviewer does have some very specific comments about some of the reported work. Referring to Slides 11 and 12, in general, the reviewer is not a fan of providing so many significant digits in calculations. LIGO precision levels are not being discussed here, and four or five significant digits give a false impression about the accuracy of the calculations. The reviewer said that this stands in stark contrast to the assumptions on driveline efficiency and auxiliary power, which are rounded off to one or two significant digits.

The reviewer was also unsure why the UDDS cycle is being used as an example, especially when the test vehicles include a light-duty vehicle (LDV), a medium-duty vehicle (MDV), and an HDV, two of which are never subjected to a UDDS certification cycle. The reviewer said that if the purpose is to use this purely as an example, then perhaps that should be made clear in the very beginning.

Reviewer 4:
The reviewer described that what was presented were calculations regarding potential DWPT levels. The reviewer said this was not fully relevant, and there were no cost inputs for higher power systems. The reviewer noted that most of the technical results did not include the transfer efficiency. The reviewer found that accomplishments were incomplete and not really meaningful.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer said good collaborative effort with INL and NREL.

Reviewer 2:
The reviewer said that a collaboration with ANL to determine vehicle energy use rates is good. Further collaboration with a partner than can provide data is essential for project success.

Reviewer 3:
The reviewer remarked there were only internal DOE collaborations. This project would require real-world input from transportation planners, from systems people, or from DWPT systems providers.

Reviewer 4:
The reviewer commented that the project needs external industry partners, especially to support the goal of establishing a plan for a wireless roadway. The reviewer remarked a partner from DOT or a civil engineering university program would provide benefit to the project.

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

Reviewer 1:
The reviewer remarked that the proposed research is effectively planned given the barrier of lack of field data.

Reviewer 2:

The reviewer said that, because to this reviewer's knowledge there are no DWPT systems in use, the reviewer is unsure how analysis can be expanded to "real data." Perhaps the approach that will be used to achieve this should be spelled out in more detail. The reviewer thought that expanding the analyses to cover quasi-dynamic (quasi-static?) systems is definitely a worthwhile idea, because this would be the first step towards the implementation of any DWPT system. The reviewer remarked that the last deliverable, designing a more advanced DWPT system with improved efficiency, power transfer, and reduced emissions, is perhaps outside the scope of this project. The reviewer pointed out there have been other DOE-funded projects at ORNL that have looked at a similar goal.

Reviewer 3:

The reviewer remarked the future research needs to have additional input to make it fully meaningful. Expand collaborations and incorporate more understanding of systems and operational constraints.

Reviewer 4:

The reviewer referenced prior comments.

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

Reviewer 1:

The reviewer agreed that this project supports DOE objectives, although the availability of power distribution and infrastructure may shape the priority as a long- or short-term study to pursue.

Reviewer 2:

The reviewer said the project supports all aspects of DOE wireless charging power objectives, except perhaps heavy-duty trucks.

Reviewer 3:

The reviewer expressed holding opinions about the efficacy of DWPT, especially in relation to other DOE supported technologies. As far as addressing the DOE objectives, the reviewer said yes, the project does support overall DOE objectives. The reviewer elaborated that DWPT could allow EVs to downsize their batteries, reducing their cost and improving their efficiency, range, etc., thereby paving (with coils) the way to make them more affordable.

Reviewer 4:

The reviewer said the concept supports DOE objectives, but it is not clear that the outcome will have any significant impact without adding a lot more stakeholder input, both technically and operationally.

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

Reviewer 1:

The reviewer stated that resources appear to be sufficient for the project.

Reviewer 2:

The reviewer said that this is primarily a theoretical exercise and does not require any hardware. The data to validate the models presumably came from separately funded projects. So, according to this reviewer it appears that the funding level is sufficient to execute this project successfully.

Reviewer 3:

The reviewer remarked that the project needs input from stakeholder resources to assure success.

Reviewer 4:
The reviewer commented add partners and conceptual scope for implementation in the future work.

Presentation Number: eems041
Presentation Title: Hardware-Focused Connected and Automated Vehicle (CAV) Research: Experimental Results and Benefit Analysis
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 and well-planned.

Reviewer 1:
The reviewer said excellent work in leveraging the available resources to answer questions about the impact of CAV-related technologies without actually having CAVs. The reviewer commended researchers for their ingenuity. Actual CAVs would be great, but the reviewer understands that the likelihood of obtaining some in this highly competitive R&D area is low.

Reviewer 2:
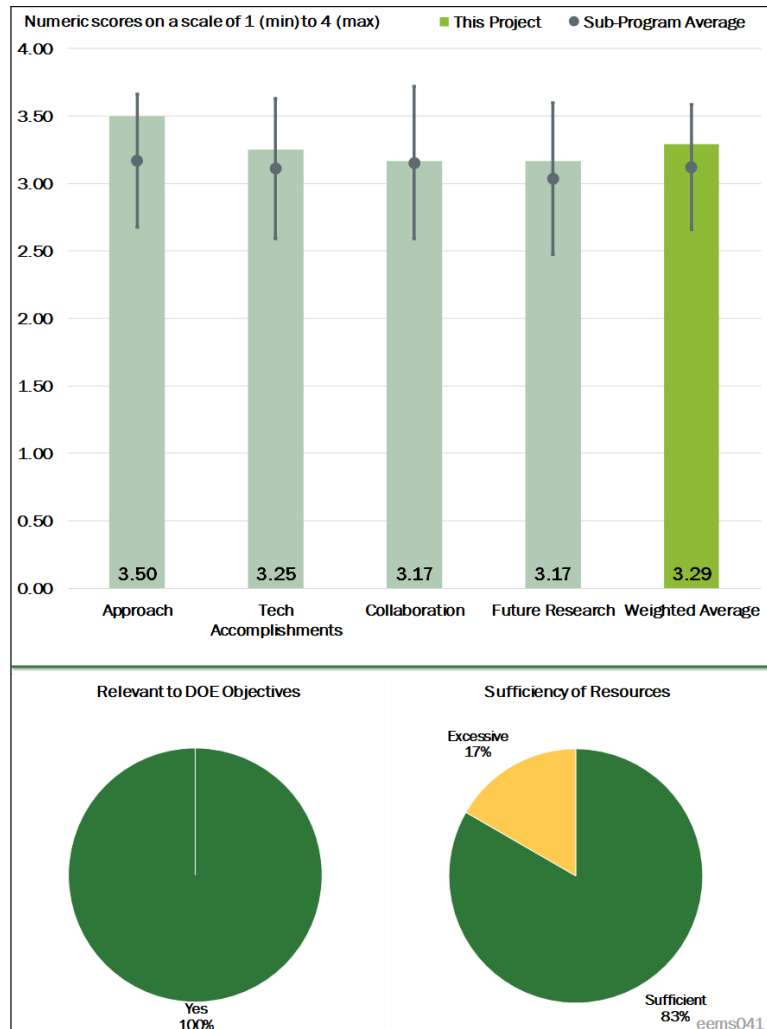The reviewer observed a well laid-out approach with clarity.

Figure 3-27 - Presentation Number: eems041 Presentation Title: Hardware-Focused Connected and Automated Vehicle (CAV) Research: Experimental Results and Benefit Analysis Principal Investigator: Eric Rask (Argonne National Laboratory)

Reviewer 3:
The reviewer remarked well-communicated plan, research thrusts, and project overview.

Reviewer 4:
The reviewer acknowledged that the barrier of obtaining repeatable, accurate, and objective data for emerging CAV systems is a large hurdle for those involved in this research area. The project does a formidable job of combining several parallel tracks of data to reach this goal.

Reviewer 5:
The reviewer liked this approach. This project also had significant funding. The reviewer did not see how the project spent money, whether on hardware, manpower, etc.

Reviewer 6:
The reviewer elaborated that this is an experimental dataset accumulation on currently available vehicles with in-market CAV elements. The reviewer noted how this is something that can form a baseline for evaluation of

current and future CAV technologies. The project collects data in normal ways for a new technology, and the project is developing libraries. The reviewer said the approach seems okay and is fairly straightforward.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer commented accomplishments are clear and on track.

Reviewer 2:
The reviewer said that progress is excellent. The ACC experimental results are complementary to the theoretical work being done in other projects.

Reviewer 3:
The reviewer really liked accomplishments on Slide 11, in relationship to ACC cycles showing fewer shifts. ACC operation shows expanded top gear utilization. However, the reviewer thought the project team needs to note is the components used for ACC, such as year, supplier, the software used (year and lines of code), transmission gears used, and explain a lot more what that means.

Reviewer 4:
The reviewer said that overall progress in delivering meaningful data is promising. There is room for improvement in identifying the baseline human driving assumptions and the corresponding variance to test data. In addition, according to the reviewer further work on the relationship between fuel economy improvement versus tractive energy reduction and powertrain operational changes would be valuable.

Reviewer 5:
The reviewer said that of the four complimentary research thrusts, the only question this reviewer came away with is how the chassis dynamometer control data will be used in future modelling efforts. The reviewer observed a very good presentation of results.

Reviewer 6:
The reviewer remarked that the project is focusing on the CAVs systems' data accumulation. The reviewer detailed that the project ran on a dynamometer, then ran on a track, then ran in the real-world, and compared resultant datasets.

The reviewer said the project is focusing on energy use rather than safety, and can take current vehicles and apply a robotic driver system. The reviewer asked can this add CAV capability in the future. The reviewer pointed out that the robot system is only for lab-based non-steering drive cycles, and this will not fill any need for automated development tools up to Level 5 in real-world test environments. The reviewer remarked ACC removed shifts from the F-150 should not be a surprise. The big engine can maintain speed in a single gear, and that is good programming from a drivability perspective.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer commented existing collaborations with ANL/DOE/SMART Mobility Consortium are good. The reviewer recommended future collaboration with similar research teams and/or original equipment manufacturers (OEMs) for data validation.

Reviewer 2:
The reviewer said good work and coordination among the partners.

Reviewer 3:

The reviewer observed good collaboration across national laboratories and academia.

Reviewer 4:

The reviewer thought that it would be nice to see who is presenting what, perhaps in a RASIC chart, or in a flow chart for data.

Reviewer 5:

The reviewer remarked definitely an in-house program with no industry collaboration.

Reviewer 6:

The reviewer said none.

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:

This was probably one of this reviewer's favorite presentations. Eric Rask showed not only enthusiasm for the project, but also competency. The reviewer thinks the author is just scratching the surface here for how ACC+ (the reviewer put + in there as technologies are moving quickly) can improve energy usage, and even potentially change the design of say, mechanical components in the powertrain. The reviewer does think the author has to be careful to outline what components, cameras, radar, and software are being used.

The reviewer suggested that the PI catch up with Karl Heimer, who puts together the Cyber Auto Challenge, which SAE sponsors; and the PI puts together the Truck Cyber Challenge sponsored by TARDEC and others in the heavy-duty industry. Also, the reviewer pointed out Ryan Gerdes at Virginia Tech is doing some great work on cyber relating to ACC+.

Reviewer 2:

The reviewer observed a comprehensive list of potential future activities that appear essential.

Reviewer 3:

The reviewer commented that the general direction is good, and would be strengthened with more specifics.

Reviewer 4:

The reviewer commented a tighter integration with the DOE modeling and simulation toolchain is a valuable deliverable. The reviewer said that correlating the CAV benefits to physics would enable parameterization for downstream models and greater capability of the toolchain.

Reviewer 5:

The reviewer stated the project is pretty much planning to do higher fidelity versions of what has been done and run new drive cycles.

Reviewer 6:

The reviewer said detail plan for future work.

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

Reviewer 1:

The reviewer loved this and commented that a combination of real world testing, modeling, as well as understanding cyber and how all these systems interact will inform how to optimize for energy improvement.

Reviewer 2:

The reviewer said yes, it is an essential deliverable in CAV development.

Reviewer 3:

The reviewer described that the project is needed for validation and exploration of new technology at the vehicle level. The reviewer said the project is useful for assessment of theoretical results from other tasks, and there is potential to gain insights that can inform other work.

Reviewer 4:

The reviewer said the project has value to mobility and vehicle connectivity.

Reviewer 5:

The reviewer agreed yes, especially for light-duty. The reviewer would have liked to see an integration of HDVs in the data collection.

Reviewer 6:

The reviewer agreed it is relevant to the DOE's stated objectives of understanding how new technologies can affect fuel use and reduce waste.

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 resources are in-line with the project scope.

Reviewer 2:

The reviewer agreed that the project appears to be on track with current resources. Given uncertainties in experimental work, it is hard to say if the resources are sufficient.

Reviewer 3:

The reviewer found that resources are sufficient as long as Level 3-Level 4 sensors are within budget for future work.

Reviewer 4:

The reviewer pointed out that this was a big dollar project. Please carefully outline how the project spent money, and what needs to be done, dollar wise as well for future research. The reviewer also suggested please also reach out to industry as money is being spent there as well. With telematics and sensors, the authors might be able to determine wear on parts as well.

Reviewer 5:

The reviewer questioned the value of performing tests such as these in a national laboratory environment, relative to the resources required for it.

Reviewer 6:

The reviewer said none.

Presentation Number: eems042
Presentation Title: High-Performance Computing (HPC) Enabled Computation of Demand Models at Scale to Predict the Energy Impacts of Emerging Mobility Solutions Principal Investigator: Jane Macfarlane (Lawrence Berkeley National Laboratory)

Presenter
Jane Macfarlane, Lawrence Berkeley National Laboratory

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer agreed that a distributed vehicle energy consumption estimation is a great approach to developing a robust scalable energy consumption monitoring system.

Reviewer 2:
The reviewer remarked good approach.

Reviewer 3:
The approach is a logical framework for creating a large-scale modeling methodology that allows application of multiple different existing traffic assignment models within an HPC processing environment through a uniform data input/output format. The reviewer characterized this as important work.

Reviewer 4:
The reviewer said the project to address the complexity of urban-scale integrated transportation networks clearly describes the technical challenges and potential solutions. Previous solutions have focused on travel time and not on energy use (although the two are related). The reviewer pointed out that information-aware routing is a significant challenge not just in the modeling and simulation but also in realistic implementation in urban real-world scenarios. The project recognizes these challenges and proposes to bring HPC capabilities to solve the traffic assignment problem.

The reviewer described that the project formulation is guided by well-thought out questions such as the need for information sharing and automation of vehicles, the need for navigation apps, the appropriate responses to accidents, emergency situations and so on. Recognizing the computational intensity of the traffic assignment problem, HPC resources are proposed as a computational platform to solve the problem. The reviewer thought
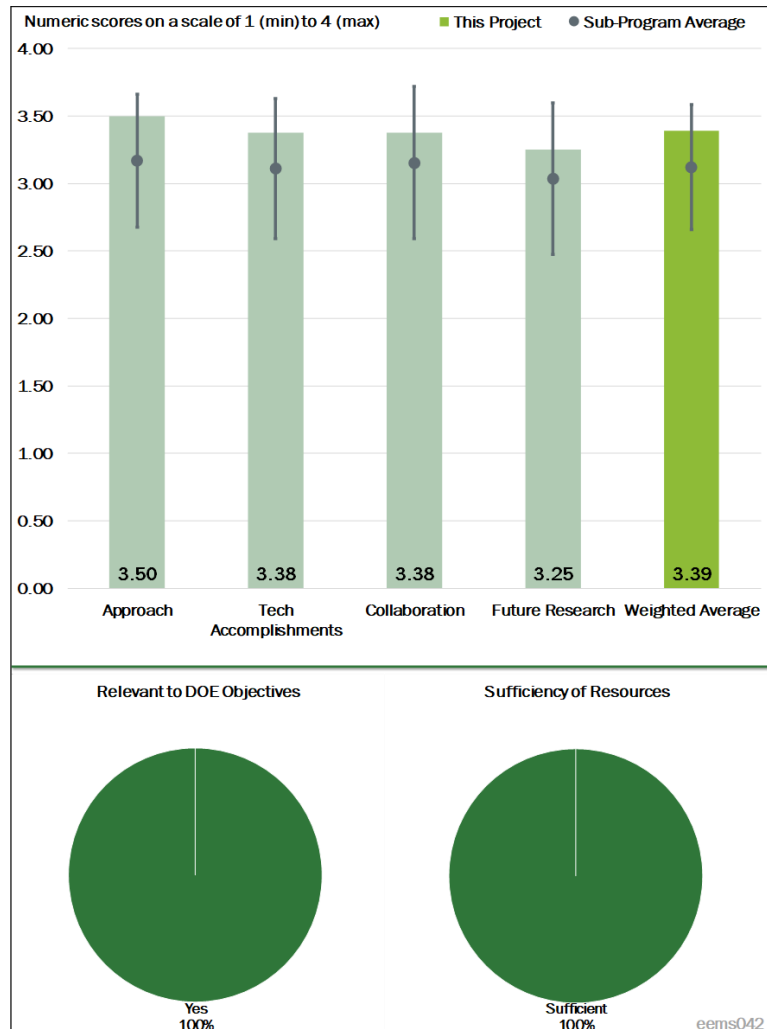

Figure 3-28 - Presentation Number: eems042 Presentation Title: High-Performance Computing (HPC) Enabled Computation of Demand Models at Scale to Predict the Energy Impacts of Emerging Mobility Solutions Principal Investigator: Jane Macfarlane (Lawrence Berkeley National Laboratory)

this seems appropriate, but does bring up the question of long-term implementation in realistic transportation networks that have distributed computing resources and the need for millisecond timescale decisions from real vehicles on the road; it is therefore unclear if the lessons learned from HPC-based solutions may be easily implemented in real-world scenarios. The reviewer pointed out that considering that distributed computing architectures in transportation networks (on vehicles, roadside computing etc.) differ from HPC architectures, questions related to efficient data movement for timely computations and decision making are yet to be addressed. However, given the timeline of the project, and that it is only 5% complete, these issues and concerns may yet be included in the project formulation and planning. The reviewer found that the project is therefore well-designed and feasible from a research perspective but is probably not well-designed from the long-term view of implementing the solution in realistic scenarios.

The reviewer noted that the technical approach suggests the creation of a standard process for ingesting map data at scale on distributed platforms. The proposal also refers to the implementation of a distributed solution algorithm for static user equilibrium formulation and the dynamic traffic assignment solution. The reviewer said that if the proposed distributed algorithms can emulate technical solutions for real-world distributed computing resources on vehicles and in data centers used by vehicle OEMs, then better alignment with real-world needs and scenarios is possible.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer said the project just started.

Reviewer 2:
The reviewer remarked results to date look good.

Reviewer 3:
The reviewer commented work appears to be on schedule.

Reviewer 4:
The reviewer detailed that the project started in April 2018 and is therefore only 5% complete. The project describes the formulation of user equilibrium for energy using a comprehensive modal emission model that is graphically represented as a plot of fuel consumed in grams per mile as a function of average speed in miles per hour. The project obtained these data from previous work. The reviewer remarked a fuel consumption density for UE and the System Optimal case is also depicted graphically to illustrate the challenges that remain to be addressed.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer described that the project team consists of LBNL and the Connected Corridor, the University of California (UC)-Berkeley, CalTrans, Los Angeles (LA) Metro, and HERE for mobility data. The reviewer noted that HERE provides the GPS data for the Connected Corridor region.

The reviewer said that the team appears to have an excellent collaboration and coordination effort. The reviewer elaborated that the combination of infrastructure data and mobility data combined with the HPC and distributed computational resources has the potential to lead to a successful outcome for this one-year project based on previous demonstration of collaboration and coordination on a related project.

Reviewer 2:
The reviewer said good team.

Reviewer 3:

The reviewer noted strong collaboration amongst partners.

Reviewer 4:

The reviewer remarked in addition to the importance of this work among the DOE national laboratories, the participation of the Los Angeles agencies that have provided the data for the study corridor is also key collaboration.

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

Reviewer 1:

The reviewer said that future research is relevant.

Reviewer 2:

The reviewer pointed out that planned deployments are critical.

Reviewer 3:

The reviewer described that the proposed research for the future aims to include models that represent multiple driver classes at large-scale. These are to account for app-routed and non-routed drivers. The reviewer said that the energy impact of these different driver routing profiles is planned. Further, the team has planned parallel algorithms for dynamic traffic assignment and under various scenarios to include instantaneous travel, historical travel time forecast, and so on.

The reviewer noted how app-routed drivers use the cloud for their real-time app information. The reviewer was unclear how the proposed effort plans to integrate cloud-based information that may belong to private vendors such as Google, Apple, Waze and others. Route suggestions provided by these apps in real-time are sourced from the cloud; the computational resources, architectures, computer programs and so on that reside in those clouds and the vehicle or device, are inaccessible to the public, so the reviewer was unclear how app-routed information is planned to be integrated in a future solution based on HPC. The reviewer identified that this risk needs mitigation.

Reviewer 4:

The reviewer pointed out that a schedule risk will occur when extending the processing to a large-scale modeling with dynamic trip assignment.

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

Reviewer 1:

The reviewer said the project can save fuel and prevent congestion.

Reviewer 2:

The reviewer said that project goals are relevant to helping DOE determine traffic dynamics in real time and in a robust fashion.

Reviewer 3:

The reviewer agreed that the work is central to the objectives of developing HPC processing capabilities for large-scale modeling of energy use.

Reviewer 4:

The reviewer noted that the project has significant relevance for DOE and in particular VTO's mission of energy-efficient vehicle mobility. HPC-based solutions to obtain energy use data from vehicles in urban transportation networks are valuable. However, according to the reviewer technical approaches that can address the challenge of energy-efficient mobility through traffic assignment/route planning are even more important in a future where vehicle-to-vehicle connectivity is going to be ubiquitous and cloud-based software solutions will be critical in guiding traffic in congested cities. The reviewer noted that route optimization has a positive dual impact in saving travel times as well as reducing energy use by vehicles in transportation networks.

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 the priority of HPC modeling development justifies the application of full resources.

Reviewer 2:

The reviewer said that resources are sufficient.

Reviewer 3:

The reviewer agreed that resources seem aligned with project activities.

Reviewer 4:

The reviewer remarked resources for this one-year project seem adequate. The proposed objectives may be met considering the resources (in the form of data) that the various team partners provide to develop the foundations of the project. The reviewer pointed out the framework that is built through this project may be scaled for future use with appropriate modifications and changes based on real-world use cases.

Presentation Number: eems043
Presentation Title: Mobility Behavioral Responses to Transportation Network Company Services
Principal Investigator: Alejandro Henao (National Renewable Energy Laboratory)

Presenter

Alejandro Henao, National Renewable Energy Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:

The reviewer remarked this EEMS project does the best job of those reviewed of defining an objective, defining the right research questions to address that objective, and posing those questions in a clear and concise manner so that anyone can understand what is being done and why. The reviewer commented that other EEMS projects could learn from this one about how to formulate a meaningful goal, an approach to fulfilling it, and a presentation to explain it clearly. The reviewer noted that Slides 6 and 7 do a good job of stating the objective and communicating the research questions that will be explored in an attempt to reach the objective. The reviewer described that the only reason this score is not higher is because the reviewer believed there are additional worthwhile questions that this research could address. The reviewer elaborated this is not meant as a criticism but rather as encouragement to do more.
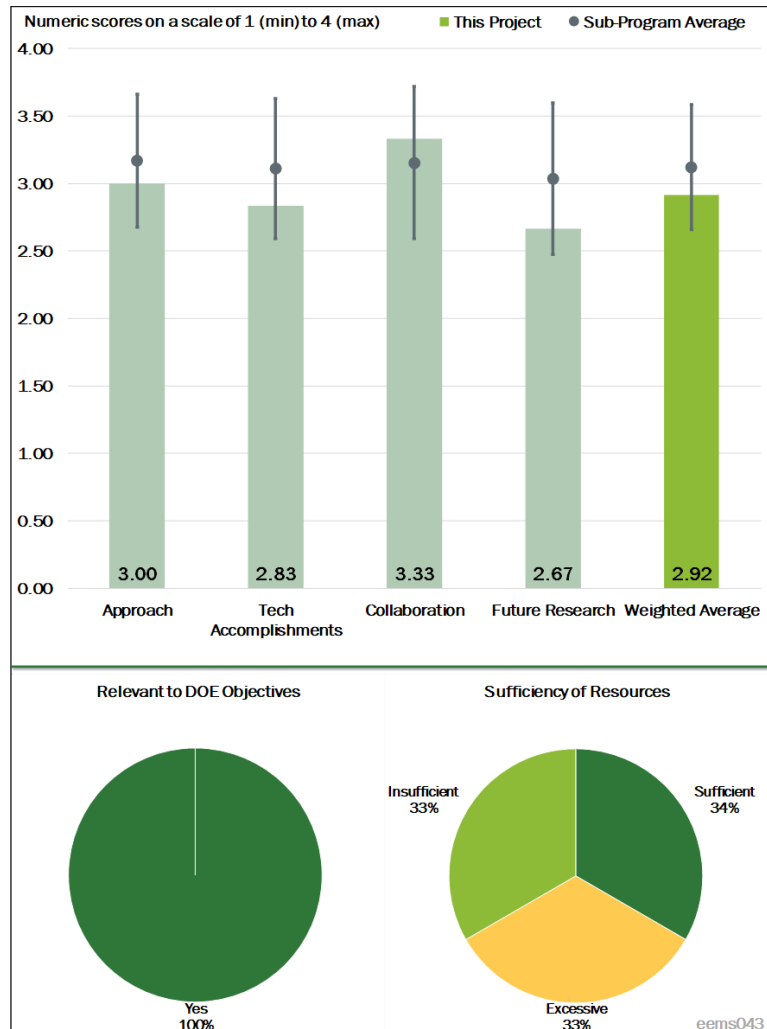

Figure 3-29 - Presentation Number: eems043 Presentation Title: Mobility Behavioral Responses to Transportation Network Company Services Principal Investigator: Alejandro Henao (National Renewable Energy Laboratory)

Reviewer 2:

The reviewer said that some elements of the approach are sound, such as gathering the data around TNC penetration and vehicle ownership. However, the approach is at least somewhat flawed with respect to analyzing correlations and implying they are causations. The reviewer spared the review with the volume of text written on this topic, but suffice it to say, even if vehicle model year increases as TNC availability increases, that is mostly just an interesting coincidence rather than one causing the other. In addition, even if it were a causation scenario, it still would be unclear which direction the causation was. Further, this reviewer inquired as to whether increasing the TNC availability really leads to vehicle model year increases, or whether vehicle model year increases lead to more TNC availability. The reviewer cautioned that this type of error can

ultimately lead to very bad policy that expects a certain outcome by playing with the inputs, when in fact something very different and unanticipated actually happens.

Reviewer 3:

The reviewer was not clear why the project chose two areas (TNC deadheading and vehicle ownership) from Slide 9 to focus on first. There is not a clear connection between these two. Also, according to the reviewer there was not a mention of looking to previous research and how that informed the study. The reviewer cited as an example there are studies out there that have looked at mode shift impacts from TNCs.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer said that based on the presented schedule, the project is on track. However, the schedule only addresses two of the four objectives listed in Slide 6.

Reviewer 2:

The reviewer said that the accomplishments are very preliminary, and do show some promise for some interesting analysis. However, the reviewer said that the correlation versus causation problem is a fundamental flaw that needs reconsidering before any more progress is made. As examples, the reviewer cited a Slide 12 text box, "No significant effect!" and a Slide 13 text box, "Effect on unemployment changes!" The accomplishments themselves need reconsideration. The reviewer pointed out that taken at face value, these conclusions could imply that in order to solve unemployment across America, policies to increase TNC presence should be implemented. The reviewer for one is quite skeptical of that in a vacuum.

Reviewer 3:

The reviewer remarked the research team is producing results that seem valuable and address the research questions appropriately. Slides 12 through 17 communicate some early results and analyses in a relatively clear manner. The reviewer noted how the researchers draw some conclusions that are revealed by the data, which can be revised or challenged later as more data become available. The reviewer elaborated that this score is not higher mainly because it is still early in the project (25% complete) and because the amount of data the team has been able to capture is limited. The reviewer pointed out that more data and more time will likely lead to more conclusive results and a higher score.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer found that the collaboration is the bright spot for this project. With what looks like strong partnerships between two national laboratories, a university, and the private sector (Uber already and others in development), the end results based on those involved could rise to outstanding in time. The reviewer also noted that collaboration could rise to outstanding with bringing in other government agency experts (DOT, etc.).

Reviewer 2:

The reviewer found that the role of collaborators is clear. The reviewer asked if there has been any collaboration with other metro areas to share their experiences and research done on TNC impacts.

Reviewer 3:

The reviewer pointed out that Slide 19 does a pretty good job of defining which team member is doing what. The reviewer thought this could be expanded and enhanced. However, there seems to be evidence that each team member is contributing based on the collection and analysis of the data and the firm conclusions that are drawn from the analyses. Still, this reviewer would like to see the presentation provide more details on what each team member is doing and perhaps provide an example of how data are collected, cleansed (by whom),

transferred, and analyzed. The reviewer thought that this would provide more insight on whether all team members are contributing appropriately or whether one or two are dominating the efforts. But without this level of detail, the results still seem to indicate it is reasonable to conclude there is effective collaboration and coordination going 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 noted how Slide 21 seems to identify some worthwhile tasks. What is lacking is a logical plan with decision points and alternate pathways. This may be difficult to define for this type of project, but this research team seems quite capable in defining goals and research questions and approaches to answering them. The reviewer thought the team should be able to define a prime path and alternatives that show a logical progression toward the overall DOE goal. The reviewer does not want to provide advice where it is not needed or is impossible to follow, but it seems to the reviewer that this research team might benefit from talking with companies or individuals who have been involved in the siting of nuclear power plants (NPPs). Siting an NPP requires extremely thorough data collection and analysis of all the people that live, work, and commute within a 50-mile radius of the plant location. The reviewer described that these firms somehow collect data on every homeowner and business within that radius and every car that passes through that area. Then the data are analyzed within concentric rings of 5- or 10-mile width and within pie-shaped wedges from zero to 50 miles. The reviewer thought that the sources of data and the analysis techniques might offer some suggestions for future research by this team on mobility in a specified area. Just a thought. But, per the reviewer, this team is doing good work and mainly needs to add specificity, structure, and detail to the worthwhile tasks identified on Slide 21.

Reviewer 2:

The reviewer commented that this is really where cause and effect issues need to be sorted out. As is, there is still a line mentioning, "Analyze effect of TNC entry on vehicle ownership by ZIP code," which this reviewer is not confident will be properly pursued. The reviewer acknowledged that the broader goal of investigating TNC effects on energy use is noble and important, and hopefully some of the methodology will yield defendable results in this area to inform other research areas.

Reviewer 3:

The reviewer pointed out that Slide 9 seems to list all of the components to be researched. The reviewer inquired if the intent of the project is to address all of these items, and if so, it is not consistent with what is presented in Slide 21 for proposed future research.

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

Reviewer 1:
The reviewer said yes, it is attempting to directly address energy use impacts from TNCs.

Reviewer 2:
The reviewer said that the high-level, overarching goals of this project do certainly support DOE objectives for understanding how energy use can be reduced, and in this case by TNC presence.

Reviewer 3:
The reviewer pointed out that understanding the impact of TNCs on energy use and mobility is a stated goal of DOE, and this project does a better job than most others of addressing that goal in a meaningful way. The reviewer thought the project is mainly hampered by the lack of relevant data, which argues for even more effort on finding and collecting more data from more sources.

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

Reviewer 1:

The reviewer remarked the research team seems to be producing good results with the resources provided, and the funding seems to be level from year to year, so this reviewer has to assume it is adequate. However, because this team is doing good work and is clear in their approach, the reviewer would recommend applying additional resources to this research through this team IF the team thinks it could apply the additional funds effectively without losing focus.

Reviewer 2:

The reviewer said that the resources are potentially insufficient as there is quite a bit of future work proposed and some hinted at, but the reviewer was not clear it will happen. The reviewer remarked if all of the potential proposed work will be tackled, then more resources may be needed.

Reviewer 3:

The reviewer commented that the budget does seem quite high for the work and direction the work is taking, particularly given the need to regroup on the approach (in this reviewer's judgment).

Presentation Number: eems044
Presentation Title: Estimation of Potential National Benefits of Advanced Fueling Infrastructure Deployment
Principal Investigator: Joann Zhou (Argonne National Laboratory)

Presenter
Joann Zhou, Argonne National Laboratory

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer said that this project leverages regional transportation analysis for Columbus, Ohio to estimate national level impacts of infrastructure support in reducing transportation sector energy consumption.

Reviewer 2:
The reviewer noted that the approach has some challenges in terms of how the results can be interpreted. The net impact of using new mobility services depend on how people respond—specifically, are people less likely to own and use a personal ca. Similarly, the infrastructure piece does not seem to have any economic component. The reviewer said that the availability, locations, price, and nature (direct current fast, Level 2) of charging will have an effect (potentially a major one) on the economics of mobility services. Even for a scenario-based approach, this should be considered. As far as the reviewer could tell from the poster, the Market Acceptance of Advanced Automotive Technologies (MA3T) model can account for vehicle adoption, but not between modes, which could be a much larger effect.

Reviewer 3:
The reviewer remarked there are still a lot of components of this research that are left somewhat unanswered by the presentation. The reviewer cited how will shared EV deployment look in rural versus urban areas. The reviewer asked besides fueling, what are the other factors that will determine what the ramp-up for EVs will be, and is the amount of unoccupied miles in ride-hailing vehicles going to factor into the potential energy savings.
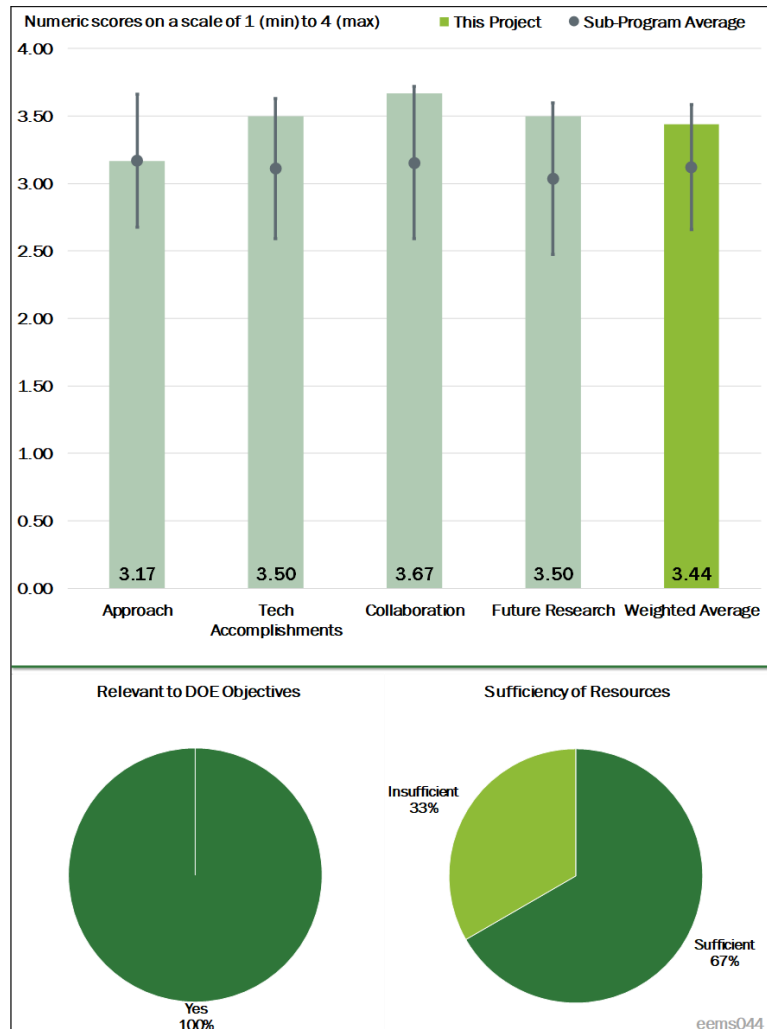

Figure 3-30 - Presentation Number: eems044 Presentation Title: Estimation of Potential National Benefits of Advanced Fueling Infrastructure Deployment Principal Investigator: Joann Zhou (Argonne National Laboratory)

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer commented that results presented had a clear story to tell regarding the marginal benefits of charging infrastructure with regard to reducing energy consumption.

Reviewer 2:
The reviewer noted very nice progress, and appreciated the multiple scenarios. The reviewer said the DC-fast charge results are limited in interpretability because the impact on new mobility is unclear.

Reviewer 3:
The reviewer reiterated there are still some questions that need to be fleshed out and responded to.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer said good collaboration given the project size.

Reviewer 2:
The reviewer noted that there is evidence each of the partners have made significant contributions to delivering strong project results.

Reviewer 3:
The reviewer thought the project could benefit from applying some of their analysis to data from applicable cities to see how real-world impacts may affect findings.

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 the future work is refining the analytic results by investigating regional variations in key independent variables. This work will increase the accuracy of the model estimates.

Reviewer 2:
The reviewer commented yes, multiple avenues to explore, which will nicely address some of the questions posed earlier.

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

Reviewer 1:
The reviewer observed a clear connection to multiple DOE mission areas.

Reviewer 2:
The reviewer said that this work directly supports DOE's objective to measure the energy impacts of advanced mobility concepts and technologies. This work produces clear quantitative measures of shared mobility and supporting charging infrastructure on energy consumption (national level).

Reviewer 3:
The reviewer remarked it will be critical to understand the energy impacts of shared connected and automated vehicles, which have the potential to increase energy use or decrease it significantly if implemented in the right fashion.

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 based on discussions with the ANL staff member that presented the project overview at AMR, it may be appropriate to increase the ORNL funding for this project. ORNL does a lot of work to produce data inputs that feed the analytic models. The reviewer remarked that increasing the ORNL funding by $50,000 per year would provide sufficient funds for this work.

Reviewer 2:
The reviewer said that project resources seem appropriate for scale.

Reviewer 3:
The reviewer said that the funding level appears to be appropriate for remaining work.

**Presentation Number: eems045
Presentation Title: Focused Validation
of Select SMART Simulation Activities
Principal Investigator: Erik Rask
(Argonne National Laboratory)**

Presenter
Erik Rask, 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 and well-
planned.**

Reviewer 1:
The reviewer applauded the approach
taken for ingenuity in making do with
what is available from existing
resources, inasmuch as CAVs are not
exactly readily available.

Reviewer 2:
The reviewer observed a very useful
approach to validating theoretical work.
The reviewer thought the project could
benefit from an approach that will be
built on as more comparisons are
done—eventually researchers would
want a library of theoretical versus
measured that will help retrain models
and identify what works best in real-
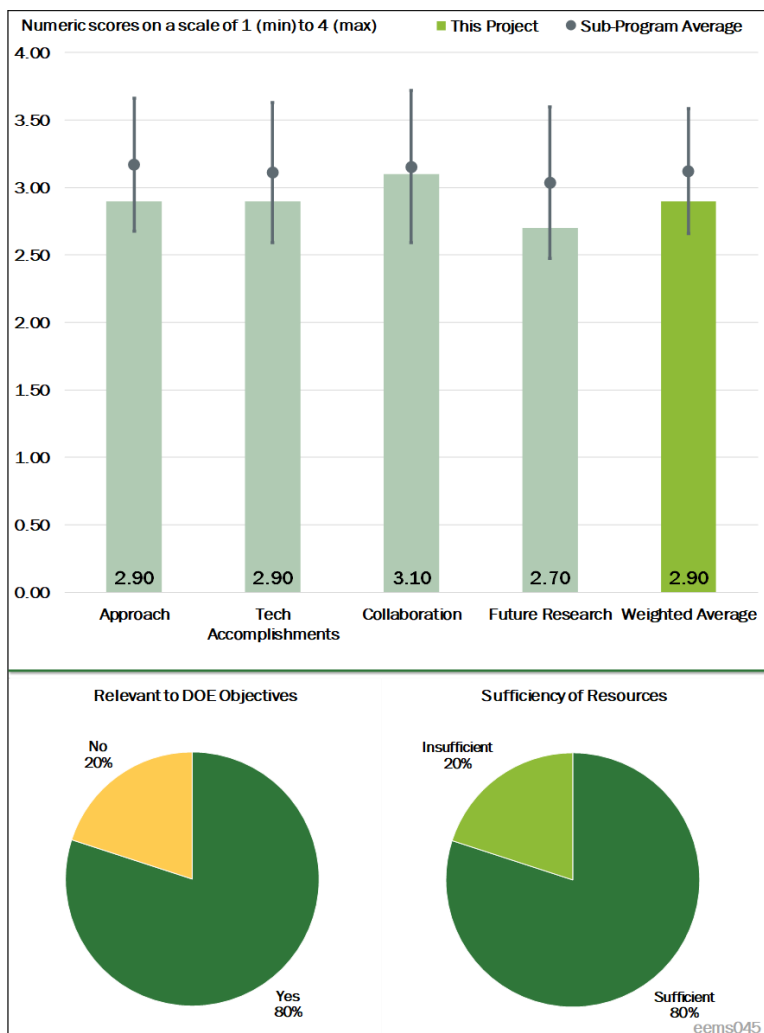world approaches.

Figure 3-31 - Presentation Number: eems045 Presentation Title: Focused
Validation of Select SMART Simulation Activities Principal Investigator: Erik
Rask (Argonne National Laboratory)

Reviewer 3:
The reviewer believed that this project was simply a way to fund a dynamometer lab. The premise of
replicating the analysis data using the dynamometer is okay, but it did not seem extremely valuable. The
reviewer pointed out that this was a low-cost project however.

Reviewer 4:
The reviewer observed no issues.

Reviewer 5:
The reviewer's biggest concern is that this was poorly presented at the poster session.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer said that technical accomplishments are clear. The illustration of what has been done is quantified.

Reviewer 2:
The reviewer observed good progress and results, especially at the given project scale.

Reviewer 3:
The reviewer said that given the resource limitations, the progress is good. The reviewer understood that vehicles developed to the operational level required to demonstrate certain CAV features may be beyond the resources and budget available, but would be more effective tools.

Reviewer 4:
The reviewer stated that the project seems to be on schedule, but for what was unclear to this reviewer.

Reviewer 5:
The reviewer is unsure if the project was initially poorly set up, but it seems that way. The reviewer cited a lot of partners/stakeholder, a minimal budget, and too many barriers noted.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer observed good collaboration among the different national laboratories, with the team sharing data and performing testing and simulation.

Reviewer 2:
The reviewer noted good leveraging of other EEMS data.

Reviewer 3:
The reviewer said that partners are national laboratories, which is good and leverages available support. The reviewer prescribed that snagging an industrial CAV partner would be an outstanding development.

Reviewer 4:
The reviewer was unable to tell the level of collaboration.

Reviewer 5:
The reviewer observed lots of names on Slide 2, for Partners/Stakeholders, but, still not much data per the author's "Barriers."

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 saw a good overview of the remaining work.

Reviewer 2:
The reviewer asked if the project team could include some future work to allow this method to be reproduced and scaled to other EEMS topics.

Reviewer 3:

The reviewer found that future work is somewhat limited by what can be done with what is at hand. As with Question 6, an industrial CAV partner could be a very helpful addition to the work that can be done in this project.

Reviewer 4:

The reviewer thought that Slide 6 notes: "Research underway into sample rate requirements and filtering strategy." The reviewer recommended talking to Geotab, which has a tremendous amount of telematics data. Understand what you can and cannot sample, and combine pieces of data based on sensors. After that conversation, perhaps there will be more opportunities here for future research.

Reviewer 5:

The reviewer said that answers about the project left this reviewer wondering how it was proceeding today versus how it much it may proceed in the future. The reviewer commented not impressed.

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

Reviewer 1:

The reviewer said the project has value to developing profiles based on data.

Reviewer 2:

The reviewer remarked clear relevance to EEMS objectives.

Reviewer 3:

The reviewer found that this project is very useful because it can help answer key questions about the real-world limitations of CAV operating strategies.

Reviewer 4:

The reviewer agreed yes, this supports DOE, but the reviewer recommended the team please go back and evaluate project objectives here and rethink it.

Reviewer 5:

The reviewer did not see the relevance or value of this project to the program.

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

Reviewer 1:

This reviewer's impression was that more can be done if additional resources are made available.

Reviewer 2:

The reviewer said that resources seem appropriate for this effort.

Reviewer 3:

The reviewer observed no issues.

Reviewer 4:

The reviewer said it was hard to say, but the team should wrap up the project and move on to more relevant research that could result in real-world outcomes.

Reviewer 5:

The reviewer thought the team failed to demonstrate any results considering the resources allocated.

**Presentation Number: eems046
Presentation Title: Understanding
Connected and Automated Vehicles
in Automated Mobility Districts
Principal Investigator: Matt Shirk
(Idaho National Laboratory)**

Presenter
Matt Shirk, Idaho National Laboratory

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer remarked that the project has a well-thought approach towards understanding CAVs in AMDs.

Reviewer 2:
The reviewer detailed that the proposed approach is to identify AMD/CAV pilots and instrument them to get real data. The reviewer found that this is a sound approach.

Reviewer 3:
The reviewer commented a good outline of the approach and objectives.

Reviewer 4:
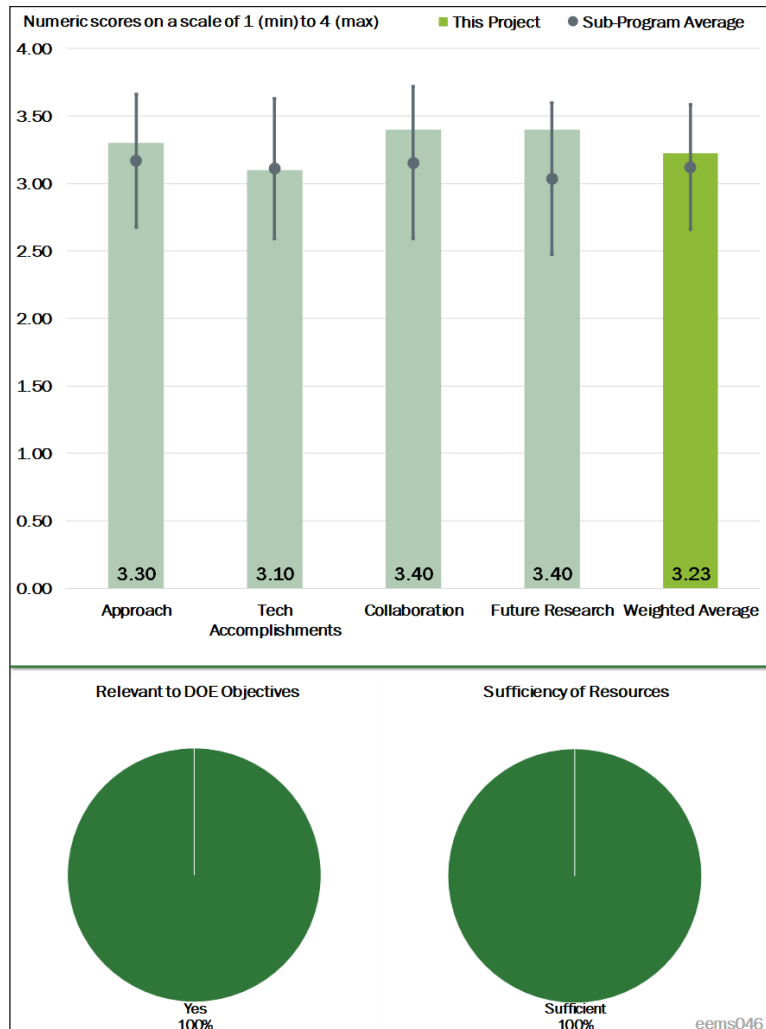The reviewer said the approach is very appropriate for this stage of the project.

Figure 3-32 - Presentation Number: eems046 Presentation Title: Understanding Connected and Automated Vehicles in Automated Mobility Districts Principal Investigator: Matt Shirk (Idaho National Laboratory)

Reviewer 5:
The reviewer observed that it is a great idea to collect energy data from pilots, and the project could be improved by incorporating some data on the most important factor for the success and energy impacts of these projects—occupancy. The reviewer pointed out that the direct energy use is a good component but will not mean much on its own.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer said the team has made significant progress in all aspects of the project to date.

Reviewer 2:
The reviewer remarked accomplishments were clear and on track.

Reviewer 3:

The reviewer said this is appropriate for this stage of the project.

Reviewer 4:

The reviewer detailed that CAV pilots have been identified and instrumentation packages have been prepared for field deployment. These include charging hardware energy meters and 10 Hertz (Hz) GPS interfaced to controller area network data loggers.

Reviewer 5:

The reviewer said progress (identifying pilots and planning) seems a bit short for being halfway through the project. Data collection and management will be huge challenges, so the reviewer hoped the work can accelerate going forward.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer observed good collaboration across teams and data sources.

Reviewer 2:

The reviewer said close coordination and use of data among the partners.

Reviewer 3:

The reviewer said it is apparent that the different organizations have distinct, complementary roles that can help the project succeed.

Reviewer 4:

The team has shown good coordination with INL, NREL, the University of Michigan, and the State University of New York-Buffalo/New York State Energy Research and Development Authority.

Reviewer 5:

The reviewer observed increased collaboration, and utilization of synergies among the various national laboratories has improved from the past, but the project has more potential to leverage their research and resources within the EEMS program

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 is on time and approaching the final phase.

Reviewer 2:

The reviewer said that there is a solid plan for FY 2018 to achieve the remaining challenges and barriers.

Reviewer 3:

The reviewer said that this is appropriate for this stage of the project.

Reviewer 4:

The reviewer detailed that the plan is to continue data collection, merge vehicle and charging data, and refine analyses as appropriate.

Reviewer 5:

The reviewer said that there is clearly a lot more to do and results will be useful if they can be pulled off.

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

The reviewer noted that the project present opportunities to understand vehicle usage and energy consumption by CAVs operating in an AMD, so it is relevant to DOE's mission and objectives.

Reviewer 2:
The reviewer remarked getting real-world data on CAVs will be useful for validating models and understanding trends.

Reviewer 3:
The reviewer said there is value towards understanding the ways to improve energy efficiency.

Reviewer 4:
The reviewer said the relevance is clear.

Reviewer 5:
The reviewer said the potential for this project, and the overall EEMS program, are crucial to meeting objectives of energy efficiency solutions and decisions made by government and private industry to make informed decisions.

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 resources seem appropriate.

Reviewer 2:
The reviewer said that the project has sufficient resources to accomplish the milestones.

Reviewer 3:
The reviewer commented this is appropriate for this stage of the project.

Reviewer 4:
The reviewer said that resources are adequate for the stated plans.

Reviewer 5:
The reviewer observed no issues with resources.

Presentation Number: eems047
Presentation Title: An Estimation of Energy Impacts of Various Policies on Personal Travel Model in the San Francisco Bay Area
Principal Investigator: Tom Wenzel (Lawrence Berkeley National Laboratory)

Presenter
Colin Sheppard, Lawrence Berkeley National Laboratory

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer said that the approach is sound, utilizing and enhancing the BEAM model to tease out energy implications to modal shifts involving transit and TNCs as alternatives.

Reviewer 2:
The reviewer noted that pricing trade-off decisions are important dynamics that EEMS should include in its analysis of mobility energy productivity. The reviewer liked that this project is using real-world questionnaire data to inform its modeling of modal selection decision making. The project is estimating total energy consumption and several modal selection scenarios.
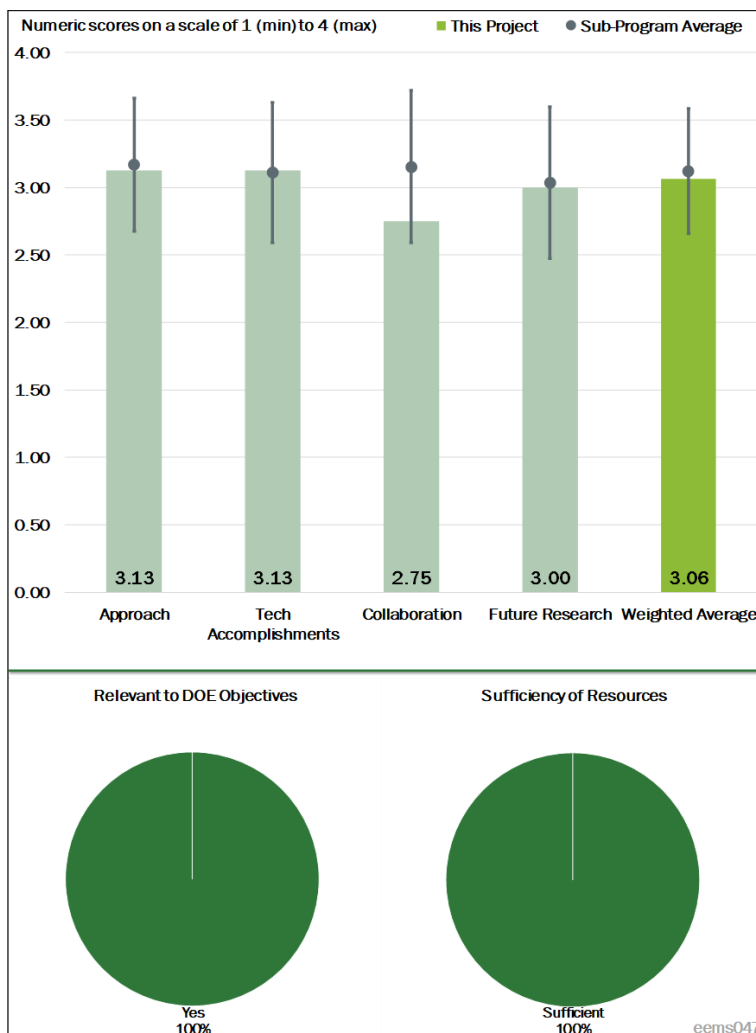

Figure 3-33 - Presentation Number: eems047 Presentation Title: An Estimation of Energy Impacts of Various Policies on Personal Travel Model in the San Francisco Bay Area Principal Investigator: Tom Wenzel (Lawrence Berkeley National Laboratory)

Reviewer 3:
The reviewer detailed that this project answers the critical question of how upcoming mode shifts in passenger transport particularly with regards to TNCs will change energy consumption at the city level. Given the lack of available TNC data, the reviewer thought the approach adopted here is sound and replicable for other cities. The reviewer said the project could be improved by potentially providing modeled analyses for a few more cities and some guidance on next steps to obtaining valuable TNC data that will better help understand their impacts.

Reviewer 4:
The reviewer did not see how the stated barriers were addressed in this work.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer noted that among the notable accomplishments, there is a preliminary validation of the BEAM model with actual observations, which is very valuable. Also, the results around price sensitivities (and price in general) are very important to ultimately understanding the impact on energy use. In particular, the reviewer cited understanding the implications of losing transit service and/or understanding what effect TNC surge pricing has is extremely important.

Reviewer 2:

This reviewer appreciates that the project team has carried the preliminary analysis through to evaluate their key quantitative metrics.

Reviewer 3:

The reviewer said it appears that, to date, the model has provided some interesting preliminary results for San Francisco on the trade-off between transit and TNCs, as well as some of the impacts of key determinants of transit and TNC use.

Reviewer 4:

The reviewer said that it seemed like some good work was done in this study. But still left this reviewer wanting to see more tangible results. The work is academic and not practical in this reviewer's opinion.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer remarked the presentation provided information on specific collaborative contributions that are being made by project partners Stanford and Conveyal.

Reviewer 2:

The reviewer did not have a real sense of the quality of collaboration but it seems like this project's coordination with Conveyal and Stanford University will help to improve the model being developed to estimate energy impacts

Reviewer 3:

The reviewer said it does seem like broader collaboration with consultation with other cities or researchers within the national laboratories or other government agencies would further enhance the value of this research.

Reviewer 4:

The reviewer observed no information on collaboration.

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

Reviewer 1:

The reviewer said that basically, the future research takes the validation of the model that has mostly been achieved, and pivots to examining the impact of long-term system changes on energy use associated with transit system changes. The reviewer found this is logical and of significant value, a reasonable next step.

Reviewer 2:

The reviewer gave this a Satisfactory as it is hard to get all of this information in 15-20 minutes.

Reviewer 3:

It is difficult for this reviewer to get excited about the future work focus on transit systems. This project would get a higher score if the project's focus was on the CAVs.

Reviewer 4:

The reviewer said that this project has identified key milestones for 2018 and 2019 but does not really identify any alternative pathways in the event that specific research questions cannot be answered.

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

Reviewer 1:

The reviewer commented this work is highly relevant to DOE's goals as it goes to the heart of understanding TNC interaction with traditional transit, and how these interactions affect energy consumption.

Reviewer 2:

The reviewer remarked this work addresses energy consumption as a function of modal choices. This analysis is directly relevant to developing information on energy consumption impacts of new mobility modes.

Reviewer 3:

The reviewer commented this project seems to line up well with EEMS goals as a program to support research on automated, connected, electric, and/or shared vehicles.

Reviewer 4:

The reviewer thought it was on target to the objectives, but the investigator seemed not to have a practical understanding of the substitution of TNCs for mass transit and other modes. The reviewer reiterated the project is academic and not practical.

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 the project is making adequate progress to meet its milestones using a limited budget.

Reviewer 2:

The reviewer said that resources seem sufficient for developing a model and following up on 2018 and 2019 milestones.

Reviewer 3:

The reviewer remarked the team has accomplished a significant amount for the resources provided. The reviewer was unclear how much more the team could produce for more funding, but the reviewer also would not recommend reducing funding either.

Reviewer 4:

The reviewer said that resources should be sufficient but cannot be sure.

Presentation Number: eems048
Presentation Title: An Analysis of the
Spatial Distribution and Impacts of
One-Way Car-Sharing Programs on
Transit Ridership and Energy Use
Principal Investigator: Susan Shaheen
(Lawrence Berkeley National
Laboratory)

Presenter
Tom Wenzel, Lawrence Berkeley
National Laboratory

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

**Question 1: Approach to performing
the work—the degree to which
technical barriers are addressed, the
project is well-designed and well-
planned.**

Reviewer 1:
The reviewer detailed that the focus of
this project is to conduct early-stage
R&D at the traveler level to better
understand behavioral patterns of
drivers, and barriers to increased
mobility energy productivity of future
integrated mobility systems.
Specifically, it is to understand the
energy implications of shifts in personal
travel, including public transit, from
emerging transportation modes such as
one-way carsharing. This project will
assess the relationships between transit
accessibility, urban form, and the

Figure 3-34 - Presentation Number: eems048 Presentation Title: An
Analysis of the Spatial Distribution and Impacts of One-Way Car-Sharing
Programs on Transit Ridership and Energy Use Principal Investigator: Susan
Shaheen (Lawrence Berkeley National Laboratory)

impacts from one-way car sharing. These relationships will be applied to other cities and agent-based model
simulations. The reviewer noted how the project recognizes there is a limited understanding of the impacts of
carsharing and transportation network companies (TNCs such as Uber and Lyft) on energy consumption and
their relationship with transit.

The reviewer noted a strong element of this project is that the approach leverages and builds upon an existing
survey of users on VMT and mode shift impact to understand spatial factors of survey responses at a very low
cost to DOE. This unique existing data set (from car2go and previously funded by the Federal Highway
Administration [FHWA], city of Seattle, and the San Diego Association of Governments) contains user survey
responses linked to their trip O-Ds. This existing survey covered five cities (Calgary, San Diego, Seattle,
Vancouver, and Washington DC), with the car2go program in San Diego having a unique all-EV fleet, which
is the future model for automated TNC services. The reviewer noted that Slide 7 presents a number of key
research questions which are very salient and informative, and provide a philosophical foundation for the
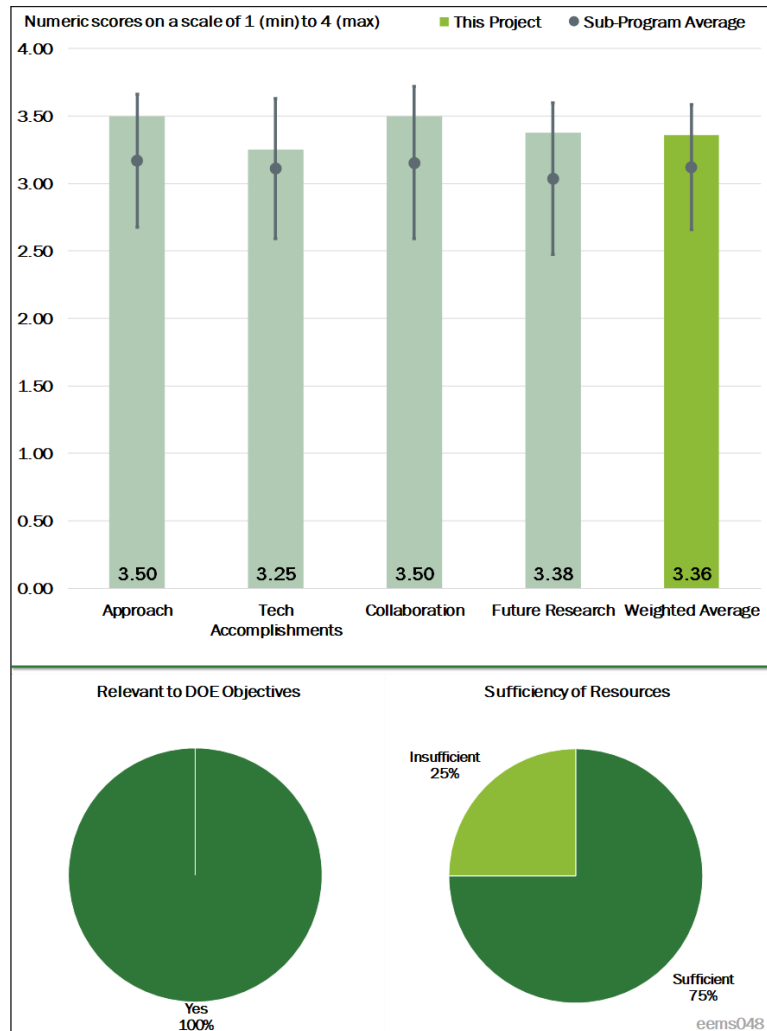project moving forward.

The reviewer found that this project is very sharply focused upon the spatial distribution and impacts of one-way carsharing and findings will be used to inform the regional modelling efforts under BEAM for San Francisco. A solid set of four logical and progressive milestones are provided and explained, although go/no-go milestones are missing, which probably is not an issue given the limited project scope and funding. The reviewer found that the project is well-designed, surely feasible, and, in short, obtains a lot of mileage and usefulness out of limited funding.

Reviewer 2:
The reviewer said good data sources from rideshare services, and the project is looking at unintended impacts on public transit is high-impact and feasible.

Reviewer 3:
The reviewer observed a very good approach to build on an existing UC-Berkley survey of users (9,500 car2go survey respondents across 5 North American cities) on VMT and mode shift impacts.

Reviewer 4:
The reviewer remarked the survey data from car2go users allows the project to analyze real-world data to gain insights into customer transportation choices that have been affected by having access to the service. One strength of the approach is that it leverages data previously collected for a DOT project. One weakness of the approach is that the data may not accurately interpret cause and effect relationships. The reviewer cited as an example, a contributor to Washington, DC car2go user decrease in public transit may be attributable to the unsafe operations and significant service interruptions of DC metro trains. The reviewer inquired if the switch to car2go service is a sustainable/long-term shift in modal behavior in Washington, DC (or just a temporary preference that will change with improved public transit operations).

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer observed good data analysis so far, and that a geo-analysis of positive and negative public transit impacts is impressive.

Reviewer 2:
The reviewer noted that INL developed a database of socio-economic characteristics and public transit information in five cities, and LBNL began visualization analysis of survey respondents in the Washington, DC metro area.

Reviewer 3:
The reviewer remarked the project's geo-coded map products are useful in communicating the spatial distribution data collected on select metro areas. The project results included some relevant data on the energy impacts of the car2go service.

Reviewer 4:
The reviewer remarked the technical accomplishments and progress toward overall project objectives are reasonable and on schedule. As mentioned, the project builds heavily off the previous survey results from car2go.

The reviewer summarized that INL has completed development of a database of socio-economic characteristics and public transit information from the five cities. This database contains a number of elements including population, households, employment by type; land area densities; vehicle ownership and worker by income; trip production and attractions; and road network density, proximity to public transit, frequency of transit, and job accessibility. The reviewer noted that the project identified transit station and bus stop locations, and transit routes, schedules, and frequencies with detailed data for the Washington, DC metro area.

The project conducted spatial mapping analyses for some of these parameters. The reviewer noted that the team provided this information to LBNL, which has geocoded survey respondents to ZIP codes and begun visualization analysis of survey respondents.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer noted that the primary team members are LBNL and INL. For a small task with a limited scope, there are good collaborations with car2go, FHWA, the San Diego Association of Governments, and the City of Seattle to leverage existing survey information and practical experience.

Reviewer 2:
The reviewer commented looks like good coordination between LBNL, INL, and rideshare partners providing data.

Reviewer 3:
The reviewer noted collaboration between LBNL and INL within the SMART Mobility Lab consortium, as well as leveraging information from FHWA car2go project participants.

Reviewer 4:
The reviewer remarked there is evidence that LBNL is making use of INL's and car2go's data.

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

Reviewer 1:
The reviewer said that plans for the remainder of the project look like they will produce good results, particularly applying results to San Francisco.

Reviewer 2:
The reviewer pointed out that developing statistical models to estimate relationships and using the models to estimate energy and other impacts of one-way carsharing will likely make significant contributions to EEMS research areas.

Reviewer 3:
The reviewer observed the future work is clearly and logically laid out with each element having a specific deliverable date. The future work includes finishing the visualization analysis of the relationship between the spatial distribution of car2go impacts and characteristics in each city; developing statistical models to estimate relationships; using the models to estimate energy and other impacts of one-way carsharing in a new city (DOT Smart City Finalist); summarizing results in a report or journal article; and ultimately using the findings as inputs to the LBNL BEAM model to simulate one-way carsharing in the San Francisco Bay Area.

The reviewer remarked as indicated, the findings from the project can be applied to other types of shared mobility modes in other environments, as well as provide a better understanding of how systems perform in specific environments to support more efficient decisions on designing public transit. The project identified two salient questions to be answered, which this reviewer quoted from the Summary. The first question quoted by this reviewer is, "Under what circumstances do one-way carsharing and other shared mobility systems support or undermine public transit?" The second question quoted is, "What metrics define when mobility systems are most efficient in specific environments?" The reviewer concluded that future work follows a logical progression to obtain the most out of its findings.

Reviewer 4:

The reviewer remarked that the planned work is a logical pursuit of the project objectives. The reviewer pointed out it may be useful for the statistical modeling to include correlation analysis of the variables.

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

Reviewer 1:

The reviewer said that this work is clearly relevant to increasing the relationships between new mobility choices and energy use.

Reviewer 2:

The reviewer pointed out that understanding rideshare services are essential to understanding future transit. Rideshare is already impacting transit in unforeseen and currently un-comprehended ways.

Reviewer 3:

The reviewer said yes, this project supports overall DOE objectives. Specifically, it will help better understand the drivers of human behavior, which influence the viability of increased mobility energy productivity and the energy implications from shifts in personal travel, including public transit, to emerging transportation modes such as one-way carsharing.

Reviewer 4:

The reviewer noted that this project focuses on early-stage R&D at the traveler level for a better understanding of behavioral drivers and barriers to increased mobility energy productivity of future integrated mobility systems. The reviewer found that early results seem mixed but there is potential for reduced use of petroleum.

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

Reviewer 1:

The reviewer remarked, based on the limited results presented, the car2go database has only been partially exploited. This project has a modest budget, and additional funds may be useful for increasing the results from this project.

Reviewer 2:

The reviewer found that the resources are tight but sufficient to achieve the stated project objectives and milestones in the allotted timeframe.

Reviewer 3:

The reviewer remarked great use of DOE funds (only $375,000) to leverage more than a $1 million previous investment by FHWA and extract EEMS-relevant learnings from a significant existing survey dataset.

Reviewer 4:

The reviewer said the resources seem in line with the work performed.

Presentation Number: eems049
Presentation Title: Vehicle Modeling and Data Analysis: Transportation Secure Data Center (TSDC), FleetDNA and FASTSim
Principal Investigator: Jeff Gonder (National Renewable Energy Laboratory)

Presenter
Jeff Gonder, National Renewable Energy Laboratory

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

Question 1: Approach to performing the work—the degree to which technical barriers are addressed, the project is well-designed and well-planned.

Reviewer 1:
The reviewer said good outline of the objectives and key metrics on how to achieve them.

Reviewer 2:
The reviewer said the project seemed to address the availability of data for other studies.

Reviewer 3:
The reviewer found that the approach is very good and relevant.

Reviewer 4:
The reviewer said that the approach is appropriate for this stage of the project.

Figure 3-35 - Presentation Number: eems049 Presentation Title: Vehicle Modeling and Data Analysis: Transportation Secure Data Center (TSDC), FleetDNA and FASTSim Principal Investigator: Jeff Gonder (National Renewable Energy Laboratory)

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer said that accomplishments are appropriate for this stage of the project.

Reviewer 2:
The reviewer pointed out that data sampling and analysis are critical, along with having a wide sample size that reflects different drive environments and regions.

Reviewer 3:
The reviewer remarked great data and information so far, and need to take this to the next level.
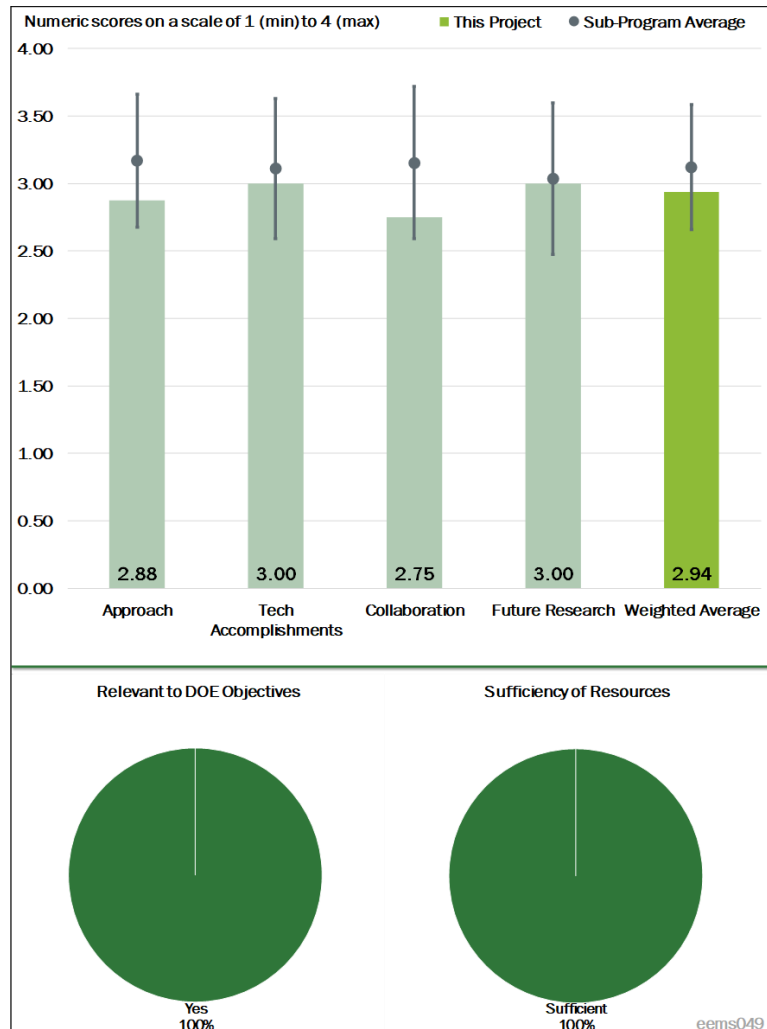
Reviewer 4:

The reviewer said it is very hard to tell in the time given how well this and other projects are truly progressing.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer said that the work plan among the collaborators is effective.

Reviewer 2:

The reviewer said good collaboration and team members, and the project should get more commercial input.

Reviewer 3:

The reviewer remarked not a lot of information on collaboration during the discussion.

Reviewer 4:

The reviewer pointed out there are areas in this project that could provide additional value to other EEMS projects. This collaboration has improved from the past, but has more potential for improvement in the future.

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 research is appropriate for this stage of the project.

Reviewer 2:

The reviewer remarked future research can produce great tools.

Reviewer 3:

The reviewer noted that it is critical to have a large sample size of data, for different regions and drive scenarios.

Reviewer 4:

The reviewer remarked the project ends soon, so not much else to report on.

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

Reviewer 1:

The project helps to get a lot of data available to others, according to this reviewer.

Reviewer 2:

The reviewer said that the outcome is a factor in understanding the drive behavior and will help with choosing the right technology for future mobility.

Reviewer 3:

The reviewer remarked will save fuel and reduce congestion.

Reviewer 4:

The reviewer said this is appropriate for this stage of the project.

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

Reviewer 1:
The reviewer said should have more funding to produce powerful tools

Reviewer 2:
The reviewer said that resources are appropriate for this stage of the project.

Reviewer 3:
The reviewer observed no issues with resources.

Reviewer 4:
The reviewer said not much left to do, so should be able to complete in the time given.

**Presentation Number: eems051
Presentation Title: SMART Mobility
Modeling for Typical Mid-Size City
Principal Investigator: Andrew Duvall
(National Renewable Energy
Laboratory)**

Presenter
Andrew Duvall, 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 and well-
planned.**

Reviewer 1:
The reviewer remarked the approach
appears sound, and it is a good way to
collect specific data for these predictive
models by working with specific cities
and to ensure replicability.

Reviewer 2:
The reviewer observed a good approach
to accomplishing the important task of
incorporating tech-enabled mobility
strategies into existing transport
planning and analysis processes. The
presentation indicates that approach is
adaptable to existing modeling
platforms, and that many metropolitan
planning organizations or cities should have the capacity to use the resulting methods/tools.

Figure 3-36 - Presentation Number: eems051 Presentation Title: SMART
Mobility Modeling for Typical Mid-Size City Principal Investigator: Andrew
Duvall (National Renewable Energy Laboratory)

Reviewer 3:
The reviewer described the key objective of this project is to extend existing transportation data and models to
include emerging smart transportation options to better assess affordability, efficiency, safety, and mobility
accessibility. This includes mobility as a service, ubiquitous communications, and automation. An additional
focus is to develop recommendations for extension of current models to include emerging travel technologies
and practices.

The reviewer identified as barriers transportation models do not integrate smart technologies, and that
foundational modeling data sources are not contemporary and insufficiently flexible to maintain accuracy. The
reviewer said that the project's approach is to work directly with city research entities (Texas A&M
Transportation Institute [TTI] and Metropia) which are knowledgeable of the Austin, Texas, and Columbus,
Ohio travel demand models and associated data. This will establish a good understanding of the modeling
capabilities of these two cites. Subsequently, according to the reviewer the approach looks to extend the
existing models incrementally to include smart mobility technologies and estimate mobility and energy
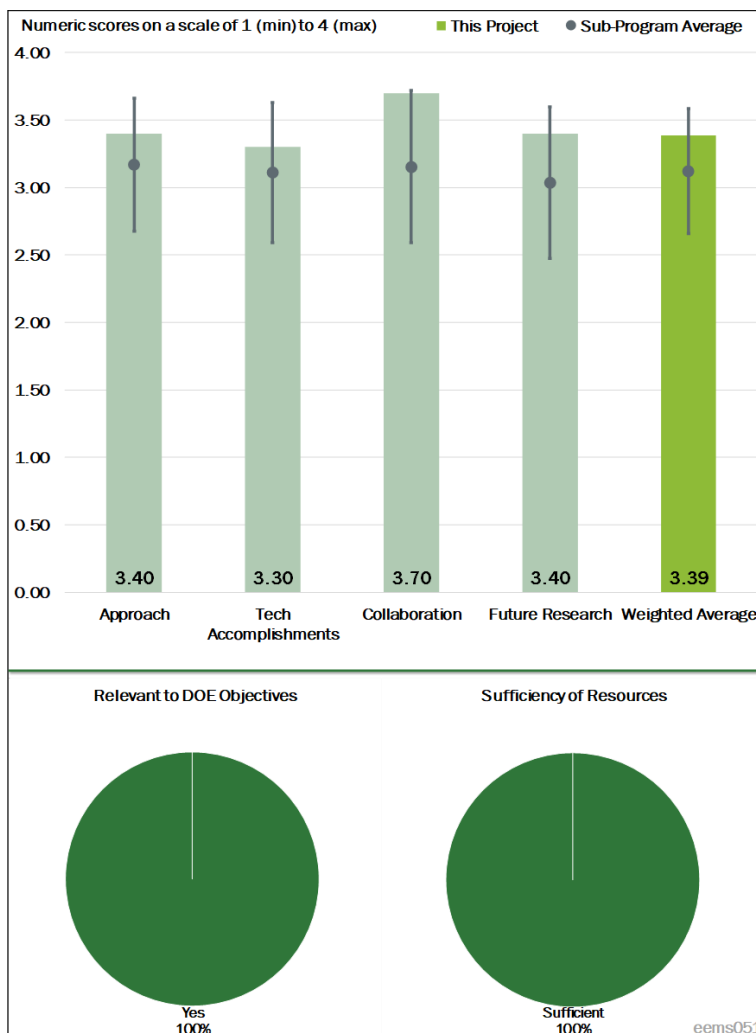
impacts of smart technologies within the existing/established modeling framework as a case study for other cities. Finally, integrate findings from the ARPA-E Traveler Response Architecture using Novel Signaling for Network Efficiency in Transportation (TRANSNET) project to augment modeling capabilities.

The reviewer found this approach is sound and feasible especially because it emphasizes close working relationships with local entities with extensive knowledge of the modeling capabilities of these cities and focuses upon augmenting existing models as opposed to creating new models which can be very expensive. Identifying and developing tools (potentially open source) are emphasized to minimize cost and maximize potential applicability to other cities' modelling platforms. Additionally, according to the reviewer the project builds upon results of the ARPE-E TRANSNET project including use of the Metropia mobility app which leverages incentives, convenience to shift behavior, and learns user preferences.

Reviewer 4:

The reviewer commented that the research focuses on reviewing existing transportation models and their shortcomings for incorporating smart mobility technologies for assessing energy and mobility impacts. Researchers are looking at incremental ways of improving existing models rather than a clean sheet of paper approach that would be ultimately more cost-effective and faster to implement. The reviewer noted that the researchers are working with two of the more progressive Smart Cities in the country, Columbus and Austin, in using their existing transportation model platforms as a means to evaluate existing models and identify ways to improve for new technologies. The research is also leveraging off ARPA-E TRANSNET project results using relevant tool and models from these efforts.

Reviewer 5:

The reviewer said that although the objectives of the project are interesting and relevant, the proposed approach does not provide a well-thought and detailed-oriented plan towards achieving these objectives. To the reviewer, it seemed that there is a significant overlap with previous work funded by ARPA-E.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer said that accomplishments appear to be ahead of schedule.

Reviewer 2:

The reviewer remarked although the project started relatively recently, the team has made significant progress.

Reviewer 3:

The reviewer commented the project to date has achieved a significant amount of work, including scoping conditions in Austin and Columbus as well as delivering recommendations for the creation of smart transportation systems.

Reviewer 4:

The reviewer reported that as of the AMR conference, the researcher indicated the project is 25% complete. For a 2-year project initiated in October 2017, the project pace seems reasonable. FY 2018 accomplishments include assessments of existing transportation models for Austin and Columbus and their respective capacities for incorporating smart technologies. The reviewer noted that a the project developed a recommendations report for Austin and Columbus with the key finding that its existing model should be augmented and expanded for incorporating new technologies, not replaced. The reviewer said that model development in these cities will support smart technology application in other cities using different models, so model flexibility in incorporating new technologies will be important and open source tools may be advantageous.

Reviewer 5:

The reviewer noted several technical accomplishments. The reviewer detailed that NREL has developed methods to estimate the energy impact of travel options presented through the Metropia app. The project tailors energy units presented to users to individual preferences, and estimated system-scale energy impacts from aggregated user data.

The reviewer noted the assessment and modeling report for Austin, Texas is being developed and has identified innovations in the Austin Smart Mobility Roadmap, including a two-way open data portal, framework for interactive data flow, and connected traveler initiative. The Austin Smart Mobility Roadmap details plans to foster shared electric and autonomous vehicle technologies and identifies the need for advancement and augmentation of existing models. The reviewer noted that a key message identified is that replacement of current models or frameworks is not recommended due to the high level of effort and cost for a completely new model. Augmenting existing models is viable and cost effective.

The assessment and modeling report for Columbus, Ohio is being developed and has identified that the MORPC and Ohio Department of Transportation (ODOT) have developed an activity-based model (ABM) for forecasting and analysis and in 2017 integrated the DynusT model for dynamic traffic assignment. The reviewer noted that MORPC and ODOT are working towards transitioning to an agent-based modeling and simulation (ABMS) framework, capable of incorporating smart mobility technologies. The integrated framework provides the initial step in transitioning to an ABMS framework and could serve as an intermediate assessment platform prototype for other cities exploring new technologies and mobility options. The reviewer noted that the key message is that it is essential for Columbus to develop robust, updatable, next-generation modeling capabilities to reflect emerging transportation technologies.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer noted strong collaboration with a varied team.

Reviewer 2:

The reviewer commented that the project has established nice collaborations among the partners with complementary roles.

Reviewer 3:

The reviewer remarked that the partner list is comprehensive and thorough. Each organization is a relevant stakeholder and has identifiable roles and specific contributions to the project.

Reviewer 4:

The reviewer reported that NREL is working closely with TTI and Metropia, relationships which were originally developed through the ARPA-E TRANSNET project. Collaboration and coordination is conducted with other institutions, including the Columbus Partnership, MORPC, Ohio State University, University of Texas Center for Transportation Research, City of Austin, Austin Energy, Pecan Street Development (Austin), and Texas DOT. Overall, a broad series of collaborations at many levels for a modestly sized task.

Reviewer 5:

The remarked that collaboration on this project is extensive, and noted that the research team is working with TTI (Austin-related Smart City model support) and Metropia (DynusT modeling support for Columbus). NREL, TTI, and Metropia have worked together previously through the ARPA-E TRANSNET program. The reviewer pointed out that the researcher also claims collaborative efforts with organizations involved in Columbus (The Columbus Partnership, Mid-Ohio Regional Planning Commission, Ohio State University) and Austin (University of Texas, City of Austin, Austin Energy, Pecan Street Development, Texas DOT) Smart City development efforts.

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 future research plan makes sense. The team identified possible data sources for emerging transportation options, though availability is uncertain.

Reviewer 2:

The reviewer said that the team has in place a solid plan to address the remaining challenges and barriers in FY 2018.

Reviewer 3:

The reviewer remarked that the project recognizes the impact of data availability on planning for smart systems and has wisely focused future work on this as well as understanding how to bulk up future models with additional information, scenarios, and data.

Reviewer 4:

The reviewer said that the future work is in-line with what has already been accomplished and the objectives of the research. Researchers propose to refine the recommendations for Columbus and Austin and extrapolate results for application to other mid-size cities, identify new data sources, and modeling methods for mobility-as-a-service, AVs, and for extension to additional transportation models, and estimate energy and mobility impacts using an existing modeling framework as a case study for other cities.

Reviewer 5:

The reviewer remarked that the project has identified current transportation models and characteristics of sample cities, and developed recommendations. The next step is to develop strategies to achieve recommendations for extension of models. The reviewer reported that challenges therein include identifying sources for emerging transportation and enabling production and integration of tools and frameworks to extend existing models to other cities and regions.

For the remainder of FY 2018, the reviewer detailed that the project will refine report recommendations and develop and implement an approach for employer-provided mobility, AMD special generator, and/or TNC use. For FY 2019, the project will bring in new data and modelling methods for MaaS, AVs, and other emerging mobility choices. The reviewer said that existing travel demand models will be extended and be transferrable to additional cities and regions. Additionally, the project will estimate automated, connected, electric, and/or shared (ACES) mobility and energy impacts within an existing/established modeling framework as a case study for other cities.

The reviewer said that the proposed future work is logical and heavily leverages existing resources and collaborations with other organizations. If successful, the resulting findings and model augmentation strategies would be very useful to other cities contemplating aggressive moves towards smart mobility. The reviewer said that it would have been helpful if some additional technical insight was provided as to how existing models can augmented and transferred to other cities. Additionally, there is no discussion of alternate development pathways should envisioned model augmentation schemes prove inflexible and largely-non transferrable.

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

Reviewer 1:

The reviewer commented yes, this project supports the DOE EEMS program through support for development of new tools and models for assessing energy and mobility impacts of smart technologies.

Reviewer 2:

The reviewer said the project supports DOE objective of reducing petroleum consumption and the EEMS objective of decoupling mobility from energy use.

Reviewer 3:

The reviewer said yes, and explained that the project addresses energy, infrastructure, and investment impacts of incorporating smart mobility into transportation systems.

Reviewer 4:

The reviewer said the project will extend existing transportation data and models to access efficiency, safety, and accessibility of mobility. So, it is relevant and addresses DOE's objectives in this domain.

Reviewer 5:

The reviewer commented the development of replicable methods to augment and transfer transportation modelling capabilities (including new smart mobility technologies) to other cities would be instrumental to overcoming barriers. These models would be very useful for transportation planning and would help identify cogent arguments for key government entities and private sector companies to pursue smart mobility.

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 the resources identified ($350,000) are reasonable and appropriate to achieve the project objectives and milestones.

Reviewer 2:

The reviewer remarked that the partners have enough resources to meet the milestones.

Reviewer 3:

The reviewer commented the budget is appropriate for the activities of the project.

Reviewer 4:

The reviewer remarked it is difficult to assess adequacy of resources without knowing more about ARPA-E TRANSNET project methods.

Reviewer 5:

The reviewer said funding seems somewhat uncertain for this project. If all the money comes through then yes, it will be sufficient.

**Presentation Number: eems052
Presentation Title: Resiliency Analysis
for Automated Mobility Systems
Principal Investigator: Joanne
Wendelberger (Los Alamos National
Laboratory)**

Presenter
Joanne Wendelberger, Los Alamos
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 and well-
planned.**

Reviewer 1:
The reviewer rated this as good, and
remarked this is a new project with a
grand total budget of $140,000, which
means that the authors are just starting
to think about this. Although, if the
authors could put this in equivalent
man-hours or engineering heads, this
would be more straight-forward.

Reviewer 2:
The reviewer detailed that the overall
objective of this task is to develop a
statistical approach to understanding
system resilience strategies for smart
city transportation technologies (EVs,
CAVs, and AMDs) to assist with planning and mitigation actions during extreme conditions (special events,
natural disasters, emergency situations, etc.). The focus is to provide quantitative approaches for addressing
resilience including building a quantitative framework and anticipating how systems will respond under stress
and planning accordingly. The reviewer said that the approach is intended to be broadly applicable, including
potential applications in transit systems, on-demand ride services, and charging station infrastructure.

The reviewer noted the team presented some high-level barriers, including understanding how systems will
respond to abnormal conditions; quantifying resilience; and developing systems that will be robust and able to
recover from extreme conditions. The reviewer commented that the team provided a solid level of background
material, including information on: the Statistical Planning for Resilience in Next Generation Systems
(SPRINGS) conceptual model for resiliency including a block diagram, an example using a trolley simulation,
quantifying resilience, and resilience planning. The reviewer found especially appealing the slide which
provides a framework and process for quantifying resilience.

The reviewer said that the proposed approach is through SPRINGS. This approach uses statistical methods to
characterize distributional behavior of systems under normal, stressed, and extreme conditions. The approach
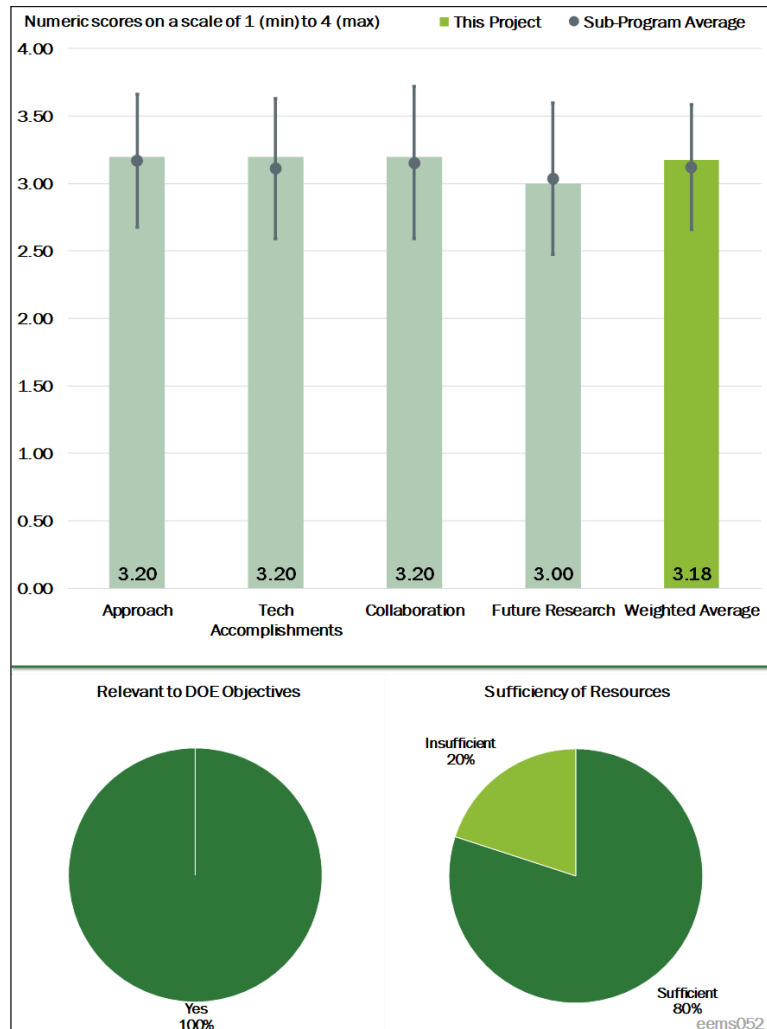

Figure 3-37 - Presentation Number: eems052 Presentation Title: Resiliency
Analysis for Automated Mobility Systems Principal Investigator: Joanne
Wendelberger (Los Alamos National Laboratory)

models the impact of disruptions to normal operating conditions and resilience of system response as abnormal conditions subside. The reviewer detailed that next, interventions are introduced and studied to characterize the impact of abnormal conditions on system behavior and key drivers. Subsequently, the use of resiliency modelling is demonstrated to proactively anticipate and address overcapacity and/or loss of infrastructure for EV/AMD systems.

The reviewer found that this approach will characterize and develop an understanding of how systems will respond to stressed and extreme conditions in the presence of new technologies and other distributions; quantify resilience including proposing metrics of different aspects of system resilience and incorporating data from multiple sources for evaluation; and strive to develop strategies to enable identification and implementation of robust systems.

The reviewer assessed that this is an interesting, early stage, exploratory project for which there are no clear exemplars. It seeks to explore areas (resiliency) largely untouched within the transportation space. The reviewer found that it appears to be well-designed and potentially feasible. The team has provided a significant amount of detail indicating it has been well-conceptualized with a clear focus and direction.

Reviewer 3:
The reviewer remarked the research project focuses on developing a better understanding and quantification of how automated mobility systems respond to extreme conditions as well as the development of statistical tools to assist in designing and planning these systems that can be used by municipalities and other stakeholders. For FY 2018, the reviewer said the approach seems reasonable in developing an initial resilience framework and potential data sources, implementing and testing statistical methodologies using simulated data, developing case studies to evaluate the framework, and then expanding the framework by adding more complex scenarios. The reviewer remarked that using the SPRINGS approach seems appropriate as applied to AMS.

Reviewer 4:
The reviewer found that the technical barriers are clearly stated. However, the outreach to obtain data to support the modeling and validation activity appears somewhat tentative. The PI has reached out to various data sources, but does not appear to have access to any significant amount of data yet. Secondly, according to the reviewer if this project is to support the DOE EEMS goal, then it should specifically investigate how the methods developed in this project allow us to evaluate the resilience strategies for smart city technologies as opposed to the status quo. The baseline would have to be the strategies that exist now according to this reviewer, who questioned "dumb city strategies." The reviewer said that there does not appear to be any focus on the baseline.

Reviewer 5:
The reviewer remarked that this looks like an analytically sound project, and injecting rigor into resilience evaluation is valuable. However, there is no discussion about the relationship between the project approach and cities' ongoing efforts to increase resilience, so the reviewer was unclear how useful the project will be.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer noted the researcher stated that the project is about 50% complete as of the AMR conference. Given the October 2017 start-up and 1-year (as currently funded) timeframe, this pace of progress seems appropriate. The reviewer noted that technical accomplishments cited included development of simplified conceptual model for assessing disruption and resiliency, a simplified closed loop trolley simulation for initial application, evaluation of system variables on operation, development of resilience metrics, identification of the SPRINGS approach for modeling extreme behavior, and employment of socio-technological analysis to identify resiliency planning strategies and their strengths/weaknesses. The reviewer assessed that through FY 2018 Quarter 2, the researcher has developed a technical report, a conference poster, and two presentations.

The reviewer remarked that the objectives for the October 2017-April 2018 timeframe included developing a conceptual model, identifying statistical concepts and methods, and beginning to explore methods using simulated data. Four milestones (one for each quarter in FY 2018) are laid out and sufficiently detailed.

The reviewer assessed that the project is on track and has achieved an impressive level of technical accomplishments in a short period of time. This includes development of a conceptual model to examine the processes of disruption and recovery; a simple closed loop trolley simulation was developed as a precursor to more complex systems; simulation results were used to provide information on the impact of changes to system variables; resilience metrics were proposed; the SPRINGs approach was proposed for modelling extreme behavior; and socio-technological analysis identified key concepts and resiliency planning strategies along with strengths and weaknesses. The team documented all results via a technical report, a conference poster, and two presentations to meet FY 2018 Quarter1 and FY 2018 Quarter 2 deliverables.

Reviewer 3:

The reviewer remarked significant progress appears to have been made in the project. The reviewer expressed some reservations about some aspects of the project. The reviewer is not quite sure whether special events qualify as extreme. The purpose of this project, it seems, is to plan for extreme events that occur very infrequently. Special events are typically planned events, and are not infrequent. The reviewer remarked that the focus should perhaps be to develop models and strategies to address events that are beyond what is normally observed. Sporting events, conferences, and trade shows are normal, and one would hope that the city planners have already accounted for these type of events. The reviewer acknowledged that of course, information from such events may provide valuable validation data for the model.

Reviewer 4:

The reviewer said that the project appears to be on schedule, though it is not entirely clear from the presentation.

Reviewer 5:

The reviewer said that there really have not been technical accomplishments. This is more of "setting up" a project to begin. Although, the reviewer wondered why the authors pick the Kansas City Trolley, and why not look at this as to what happened to infrastructure, let alone Tesla EVs during Hurricane Irma.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The reviewer said that there is active collaboration and coordination across the team.

Reviewer 2:

The reviewer noted the project is led by Los Alamos National Laboratory (LANL) and incorporates input and subject matter expertise from INL. Collaboration and coordination exist with other entities including members of the Urban Science Pillar of SMART Mobility, and possibly NREL with regards to data from TNCs and design and analysis of computer experiments for investigating resilience. The reviewer noted the project has also been in contact with Smart City finalist Kansas City planners to explore data sources associated with the Kansas City Streetcar and charging infrastructure, and has had discussions with the University of Michigan regarding modeling of campus bus data, and the National Science Foundation (NSF) regarding their resilience effort. The reviewer remarked overall, a solid list of collaborations and engagements for the early stages of a small, exploratory task.

Reviewer 3:

The reviewer said that collaborative efforts for the project have been good. The researcher is working with SMART Mobility Consortium member, INL, utilizing its technical and technological subject matter expertise in AMS and technologies. The researcher has also collaborated with NREL regarding TNC data sources and

computer analytical designs for investigating resiliency. The reviewer pointed out efforts in data source identification have also included discussions with Smarty City Kansas City organizations and the University of Michigan. According to the reviewer, the researcher also cited discussions with NSF regarding its resilience efforts, but did not provide specific details about those discussions and how they relate to the project.

Reviewer 4:
The reviewer noted that there appears to be collaboration with the INL team, but much of the other collaboration appears to be planned, and has not yet borne fruit.

Reviewer 5:
The reviewer remarked that with LANL and INL, this is a great start. But, the reviewer asked the authors to explain why NREL and why Kansas City. The reviewer asked why Kansas City's trolley was picked, and why not pick areas where there are significant weather systems, or significant Federal Emergency Management Agency issues. The reviewer asked what the authors are concerned about in Kansas City—such as tornados.

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 given the somewhat limited funding, the proposed research is well-planned out. Perhaps applying the model on an actual example, using a mesoscale simulation tool such as BEAM or POLARIS), where a major disruption in the supporting infrastructure can easily be introduced, may be a good way to showcase the overall approach. The reviewer pointed out this would also involve more collaboration with other national laboratories, which is a good thing.

Reviewer 2:
The reviewer said the project has identified remaining challenges and barriers including: the technical challenge of modelling extreme behavior that has only infrequently or never been modelled before; the fact that validation of the resilience approach will necessitate access to data which may require significant effort; and data collected for other purposes may not be adequate for modelling resilience. The reviewer commented the project presents a logical, progressive, and detailed approach for proposed future research. This includes: building on the preliminary framework to implement the SPRINGS resiliency approach; continuing efforts to obtain access to mobility system data; examining work by other researchers (transportation and emergency) to gain further insights; actively probing systems and examining flows as different interventions are introduced to experiment with different strategies; developing resiliency strategies; and exploring dynamic visualization methods to enhance the resiliency modeling process and communication of models and results. The reviewer did not notify any notable omissions. The reviewer remarked that the project, however, does not really discuss nor identify other potential solution pathways should the SPRINGS approach provide infeasible whether technically or through lack of sufficiently appropriate data for validation.

Reviewer 3:
The reviewer commented that the remaining FY 2018 activities planned under the project are reasonable and build upon earlier work. These activities include the development of case studies using the initial framework followed by the expansion of the framework to include more complex scenarios through review of research on transit systems, autonomous vehicles, and emergency and natural disaster situations. The reviewer pointed out the researcher recognizes that data may be a limiting factor for this work in terms of identifying sources and its viability for modeling system resilience. The reviewer noted that FY 2019 funding is pending funding approval but would involve further development of the framework and its demonstration on specific mobility systems.

Reviewer 4:

The reviewer pointed out that uncertainty about availability of data is a major challenge to further work. The reviewer also pointed out interaction with cities interested in resilience planning would help to ensure the utility of the project.

Reviewer 5:

The reviewer remarked this is a start and thought there are a lot of places to make significant strides here. This reviewer referenced Irma, where one could see gas stations closing, highways clogged, airports shutting down, and Tesla doing over-the-air (OTA) updates to get longer range.

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

Reviewer 1:

The reviewer commented DOE is investing heavily in EEMS, and while the potential for petroleum displacement and increased access to mobility is very high, it would be of great interest to understand how these new systems and transportation infrastructure respond to extreme events, compared to the systems that are currently in place.

Reviewer 2:

The reviewer said there is a relationship between resilience and DOE's objective of petroleum displacement, but the researcher should spell out this connection in work products and outreach. The reviewer remarked reduced dependence on transport fuels could be identified as a resilience strategy.

Reviewer 3:

The reviewer said in a different way, this project is relevant to DOE objectives. Resilient, smart transportation systems can be integral elements of Smart Cities by providing increased safety and life-savings capabilities in extreme disaster situations, augmenting city functions (e.g., medical services, buildings) during brown-outs or other limited power scenarios, and potentially reducing emissions and increasing the quality of life in urban areas.

Reviewer 4:

The reviewer said that the project is relevant to DOE EEMS programs and objectives in supporting the development of tools and models for assessing AMS. The project supports the development of AMS by providing a statistical tool for assessing system resiliency under extreme conditions.

Reviewer 5:

The reviewer exclaimed absolutely, but said to make this more tangible. The reviewer wondered if this is worry about a truck running into the Kansas City trolley, or about power interruption. The reviewer asked about where the trolley goes, and the number of people that ride the trolley. The reviewer said the authors could have done something similar, such as the train on the east coast running into the wall, and said to make this real.

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

Reviewer 1:

The reviewer remarked for an early-stage exploratory project in an area with relatively little to build upon, the resources are thin but sufficient. The reviewer remarked if the SPRINGS concept pans out, more significant resources will be needed to bring the concept to fruition.

Reviewer 2:

The reviewer said that the budget is small but appropriate at this point given the limited scope of work. However, there is a mention of a possible data shortage, which could relate to budget issues.

Reviewer 3:

The reviewer remarked this project's funding appears appropriate for FY 2018, and FY 2019 funding is pending approval.

Reviewer 4:

The reviewer noted that the funding for this project appears somewhat limited. The reviewer would think that a more extensive simulation of various scenarios, supported by appropriate data, and the acquisition of those data would require more funding than what has been allocated for the completion of this project.

Reviewer 5:

The reviewer commented it is a start.

**Presentation Number: eems053
Presentation Title: Infrastructure
Spatial Sensing at Intersections
Principal Investigator: Stan Young
(National Renewable Energy
Laboratory)**

Presenter
Stan Young, National Renewable
Energy Laboratory

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

**Question 1: Approach to performing
the work—the degree to which
technical barriers are addressed, the
project is well-designed and well-
planned.**

Reviewer 1:
The reviewer said that this is a good
approach as this is a quick look project
to review infrastructure sensing
technologies such as LIDAR in
stationary application like an
intersection. This is a very low-cost
approach leading up to a go/no-go
decision for potential demonstration in
FY 2019. The reviewer was unclear if
Continental technology is a commercial
system or still under development. If
commercial, the reviewer asked what
the intended use is (likely safety), and
what analytics are already part of the
system.

Figure 3-38 - Presentation Number: eems053 Presentation Title:
Infrastructure Spatial Sensing at Intersections Principal Investigator: Stan
Young (National Renewable Energy Laboratory)

Reviewer 2:
The reviewer said that the research focused on better understanding of potential spatial sensing technologies
for intersection applications in supporting AMS and reducing energy consumption, especially in light of
potential benefits to a broader range of stakeholders (e.g., traffic control, pedestrians, etc.). The scope involves
reviewing current spatial sensing technologies and applications to identify research gaps for mobility systems,
followed by identifying commercial sensing technology partners for creating and demonstration HPC methods
to analyze and communicate spatial information for mobility system applications.

Reviewer 3:
The reviewer detailed that the objective of this project is to explore the mobility/energy impact potential of
spatial sensing (such as LIDAR) at critical intersections in the real world. Successful implementation of this
project would enable the potential capability to track all objects (conventional vehicles, connected vehicles
(CV), AVs, pedestrians, and bikes) for enhancing mobility and energy efficiency.
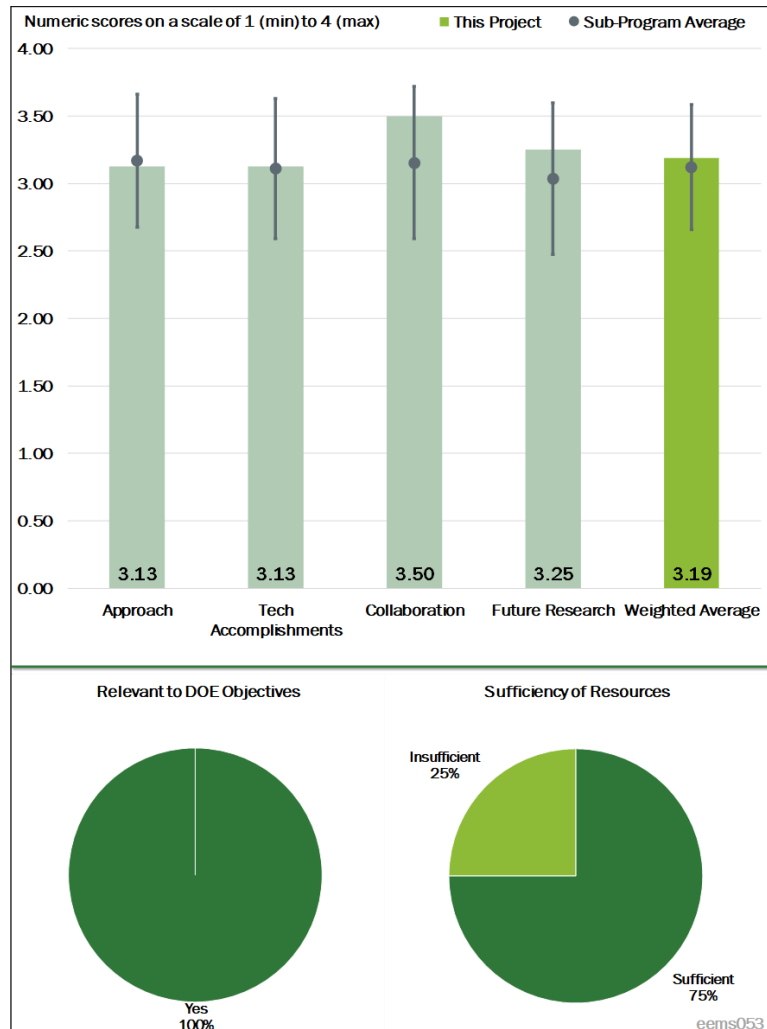
The reviewer detailed the high-level barriers that the authors have identified, including: understanding the existing space and literature regarding mobility/energy potential of spatial sensing (such as LIDAR) at critical intersections; exploring energy equivalence of improved safety at signalized intersections; and industry is primarily focused on on-vehicle sensing, but on-infrastructure implementation might afford more benefit to a wider set of stakeholders (pedestrian, traffic managers).

The reviewer said that the project approach includes: reviewing state-of-the-art infrastructure sensing technologies and applications, and highlighting gaps and focus areas to enable enhanced mobility energy productivity (MEP), developing memorandums of understanding and non-disclosure agreements with industry partner(s); developing a draft assessment of the energy equivalence of safety at intersections; and establishing high-speed, real-time data links with partners (Continental, University of Nevada, Reno [UNR]) for field data. The team established a go/no-go milestone for FY 2019 to move onto an FY 2019 demonstration. The reviewer found that it would have been beneficial to explain the criteria for successfully achieving the go/no-go milestone and provide a specific target date. The reviewer assessed that overall, the project appears well-designed and feasible and the approach will address the aforementioned technical barriers.

Reviewer 4:
The reviewer said that this is an interesting pilot. The reviewer was still not clear what the application of technology like this would be in the real world and what the goal of a system like this would be.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:
The reviewer noted that a 2-year duration was listed for the very small project (only $50,000) and is 50% complete (likely delays due to budget uncertainty). The reviewer detailed how ANL has developed a proof of concept exploratory portable awareness system, UNR has installed LIDAR sensors at a campus intersection, and the team is engaging Continental for data sharing from Columbus, Ohio demonstration. In addition, energy equivalence of safety improvements/crash avoidance has been quantified.

Reviewer 2:
The researcher stated that the project is about 50% complete as of the AMR conference. This progress appears to be somewhat ahead of schedule for a 2-year project with an October 2017 start-up. Technical accomplishments in FY 2018 have included reviewing technologies and identifying technology partners (ANL, UNR, and Continental), and assessing energy equivalence metrics for safety improvements and crash avoidance for intersections.

Reviewer 3:
The reviewer noted that the project is on schedule, and for a small effort a strong list of technical accomplishments has been achieved in a short time. To date, identified milestones have been achieved. Specific technical accomplishments include: ANL's proof of concept exploratory portable awareness and data collection system; UNR has installed and networked LIDAR sensors at intersections near campus with full data streams to traffic research center starting in March 2018 (also exploring data transmission to NREL in real-time);a controlled demonstration of Continental's infrastructure spatial sensing system was conducted in Brimley, Michigan in 2017 with a demo planned for Columbus, Ohio in 2019; and the energy equivalence of safety improvements/crash avoidance has been identified and highlighted.

Reviewer 4:
The reviewer said that the project seems to be on track for a 2019 completion.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer noted that collaboration partners include UNR, University of Maryland (UMD), and Continental. The relationship with Continental to get access to their field deployment data is critical for potential follow on work.

Reviewer 2:
The reviewer commented that the project has thus far exhibited outstanding collaboration and coordination. The prime participants are ANL and NREL with close coordination with UNR, Continental AG, and UMD. Each partner brings different capabilities and expertise. UNR has expertise in intersection spatial sensing techniques including LIDAR technologies. Continental AG is a leading German OEM with expertise in intersection sensing data sharing and abstraction, and UMD is skilled at assessing the energy equivalence of accident research. The reviewer assessed that this appears to be an excellent balance of team members for the project at hand.

Reviewer 3:
The reviewer remarked the project appears to have effective collaboration with other organizations. The team is working with SMART Mobility Consortium member, ANL, as a technology partner (proof of concept portable awareness system and data collection). The project is also working with partners UNR (LIDAR sensor demonstration), Continental (intersection spatial sensing data sharing), and UMD (energy equivalence research).

Reviewer 4:
The reviewer commented that the stakeholder group and collaboration could be built out further to identify other applications of this technology and how it can answer existing data gaps.

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 good follow up and continuation of the project.

Reviewer 2:
The reviewer remarked that the proposed future research plan focuses on addressing perceived near-term barriers, including high-bandwidth data transmission from roadside source to data center, and large-scale data processing and machine learning mobility system analysis and communication. The reviewer noted that for the remainder of FY 2018, the research will establish high-speed, real-time spatial data links between NREL and partner demonstration sites, and conduct additional research on energy equivalence metrics for intersection safety improvements. In FY 2019, the team will focus on machine learning methods using HPC to analyze and communicate spatial information and map spatial sensing technologies to specific mobility applications.

Reviewer 3:
The reviewer noted that FY 2018 work will be completed soon and the project budget overall is very small ($50,000). The reviewer noted that the authors mentioned a potential FY 2019 demonstration involving HPC, but the reviewer was unclear if it would be a different project as a follow-on.

Reviewer 4:
The project has clearly identified the remaining challenges and barriers including: data transmission bandwidth from roadside to data center; large-scale cloud sensing data processing and machine learning technologies for moving objects recognition, analysis, and communication; research on energy equivalence of

safety improvements / crash avoidance. Ultimately, the goal is to achieve instrumented intersections, data fusion for visibility, develop a communication strategy for vehicles, pedestrians, others; and advance the knowledge and research base.

The reviewer detailed that proposed research for FY 2018 includes: establishing a high-speed, real-time spatial data link with partners; and performing energy equivalence of safety research. For FY 2019, proposed future research includes: creating machine-learning approaches with HPC to recognize, analyze, and communicate spatial information; and mapping spatial infrastructure sensing to applications that enhance mobility/energy efficiency and safety, including traffic signal control strategy, near-miss detection and prevention, and cybersecurity applications for CV/vehicle to infrastructure/infrastructure to vehicle.

The reviewer assessed that the proposed future research seems logical and directly addresses the identified barriers. As mentioned before, the reviewer believed that more detail on the criteria for the go/no-go milestone in FY19 would be beneficial. The reviewer noted that the team provided no discussion of risk mitigation through development of alternate development pathways.

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

Reviewer 1:
The reviewer remarked assessing the mobility/energy performance potential of placing spatial sensors (i.e., LIDAR) at critical intersections is relevant to increasing efficiency of the transportation system and therefore reducing petroleum consumption. The reviewer said that a review of the current project findings will determine if a follow-on demonstration is warranted based on energy efficiency (petroleum) savings.

Reviewer 2:
The reviewer found that this project is relevant to VTO's EEMS program in that connected and automated technologies can integrate smart infrastructures to enable drive smoothing and reduce traffic accidents and thereby decrease energy consumption. The reviewer said the project has highlighted the energy equivalence of safety improvements/crash avoidance. Specifically, the National Highway Safety Administration estimated in 2015 excess fuel per fatal crash for urban arterials to be 504 gallons, 102 gallons per injury crash, and 68 gallons of fuel per "property damage-only" crash.

Reviewer 3:
The reviewer remarked this project is relevant to DOE objectives in reviewing mobility system applications of spatial sensing technologies and assessing machine learning methods using HPC to analyze and utilize spatial information for supporting future mobility systems and other applications.

Reviewer 4:
The reviewer remarked, at the very least, this pilot will help generate some interesting data about traffic intersections that could be plugged into other traffic models.

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

Reviewer 1:
The reviewer remarked this is a small exploratory task that currently only has an allocation of $50,000. The reviewer said resources seem insufficient to fully explore the capability and feasibility of infrastructure spatial sensing at intersections.

Reviewer 2:
The reviewer found that the budget seems appropriate for length and depth of project.

Reviewer 3:

The reviewer observed an appropriate use of funds (only $50,000) for a quick-look project to investigate the feasibility of using spatial sensing in a stationary application and quantify the energy saving opportunity before additional and more significant DOE funding is invested.

Reviewer 4:

The reviewer said that project funding appeared appropriate for FY 2018 activities as described.

**Presentation Number: eems054
Presentation Title: Infrastructure
Impacts of SMART Technology: Data
Analyses on Energy Use
Principal Investigator: John Beck
(Idaho National Laboratory)**

Presenter
John Beck, Idaho National Laboratory

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

**Question 1: Approach to performing
the work—the degree to which
technical barriers are addressed, the
project is well-designed and well-
planned.**

Reviewer 1:
The reviewer said that the approach
appears to be evolving at this point in
the project, and the approach is
somewhat vague so there is not much of
one to critique.

Reviewer 2:
The reviewer remarked the approach
needs more definition. The reviewer
inquired what data analytics will be
performed, and how will the team
obtain the data.

**Question 2: Technical
Accomplishments and Progress
toward overall project goals—the
degree to which progress has been
made and plan is on schedule.**

Figure 3-39 - Presentation Number: eems054 Presentation Title: Infrastructure Impacts of SMART Technology: Data Analyses on Energy Use Principal Investigator: John Beck (Idaho National Laboratory)

Reviewer 1:
The reviewer remarked the project is behind on some key aspects—particularly data accumulation, which will be challenging in many aspects.

Reviewer 2:
The reviewer said at this early stage of the project there is much to evidence to assess the technical accomplishments and progress.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer observed a good array of partners but looks like partnerships are largely for data collection purposes. The reviewer asked if there are any analytical partnerships.
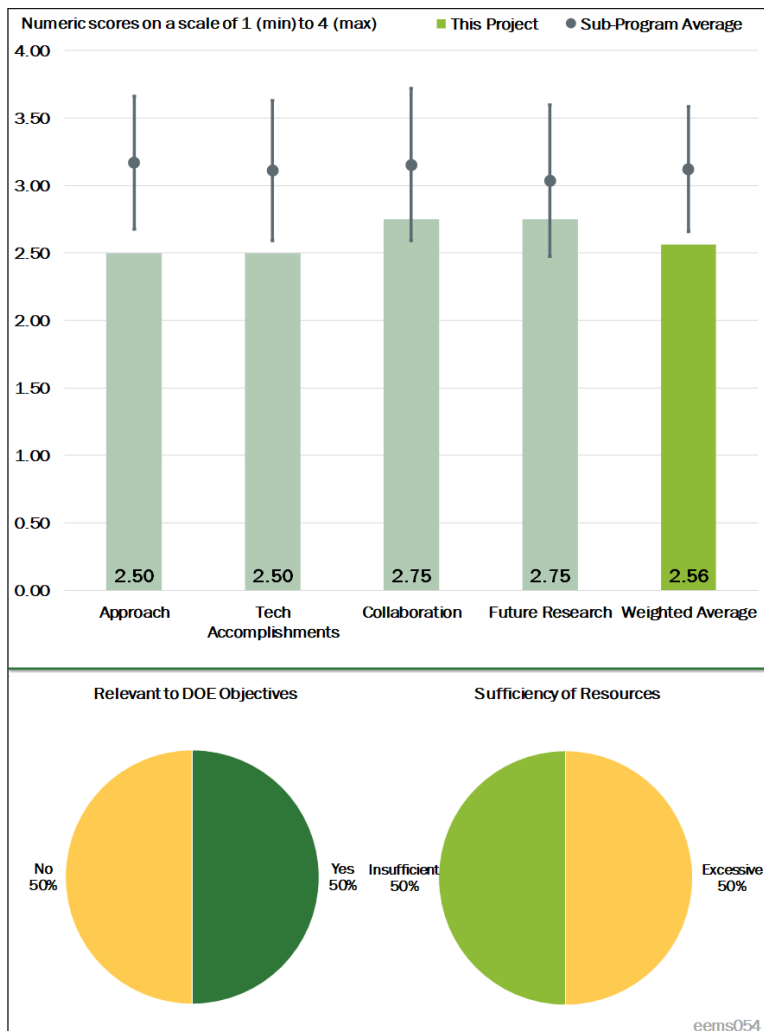
The reviewer stated the collaborative relationships for this project are evolving and need to be further solidified.

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 seems like appropriate next steps.

Reviewer 2:

This reviewer has no argument that the steps outlined are logical to advancing the maturity of this project.

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

Reviewer 1:

The reviewer said that it is important to understand how ACES will impact infrastructure requirements and spending.

Reviewer 2:

The reviewer commented the focus on this project appears to be on urban planning instead of mobility energy productivity. An example of the irrelevance of this project to DOE objectives is that it lists one of the primary barriers addressed by this work as, "Expansive community of relevant stakeholders." This reviewer has never seen stakeholder characteristics listed in the statement of DOE objectives.

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

Reviewer 1:

The reviewer speculated that perhaps this project's budget could better be used pursuing other EEMS projects. The project presentation gives the impression that the project may be floundering.

Reviewer 2:

The reviewer remarked that given the slow progress, it seems possible that the budget for this project could surpass what has been requested.

Presentation Number: eems055
Presentation Title: Simulation Model Results for Energy and Mobility Impact of Behavioral Scenarios in POLARIS
Principal Investigator: Josh Auld (Argonne National Laboratory)

Presenter
Josh Auld, 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 and well-planned.

Reviewer 1:
The reviewer said that the project approach is fairly comprehensive and well-suited to the scope of the proposed work. The level of detail that goes into addressing each question raised is impressive.

Reviewer 2:
The reviewer was not clear whether the model includes the influence of weather on mode choices. The reviewer thought the team should make very clear that these models are not meant to predict the future, but are more useful to study the expected changes that could be the outcome when the input scenarios are changed. In other words, any prediction of this model would be quite hard to confirm/verify.

Reviewer 3:
The reviewer remarked using existing models and data to do the research is a good approach.

Reviewer 4:
The reviewer remarked the outline of the approach to use simulation modeling is properly outlined, and it is critical to have the right assumptions for the driver behavior.

Reviewer 5:
The focus of this project is to demonstrate how consumer behavior interacts with new mobility technologies to potentially save energy. The project objectives identified are to: consider the behaviors of individual travelers at multiple timeframes; and assess the influence of traveler decisions on MEP for future mobility. The key goal is reducing uncertainty of MEP changes due to decision-making from VTO analysis. The reviewer indicated
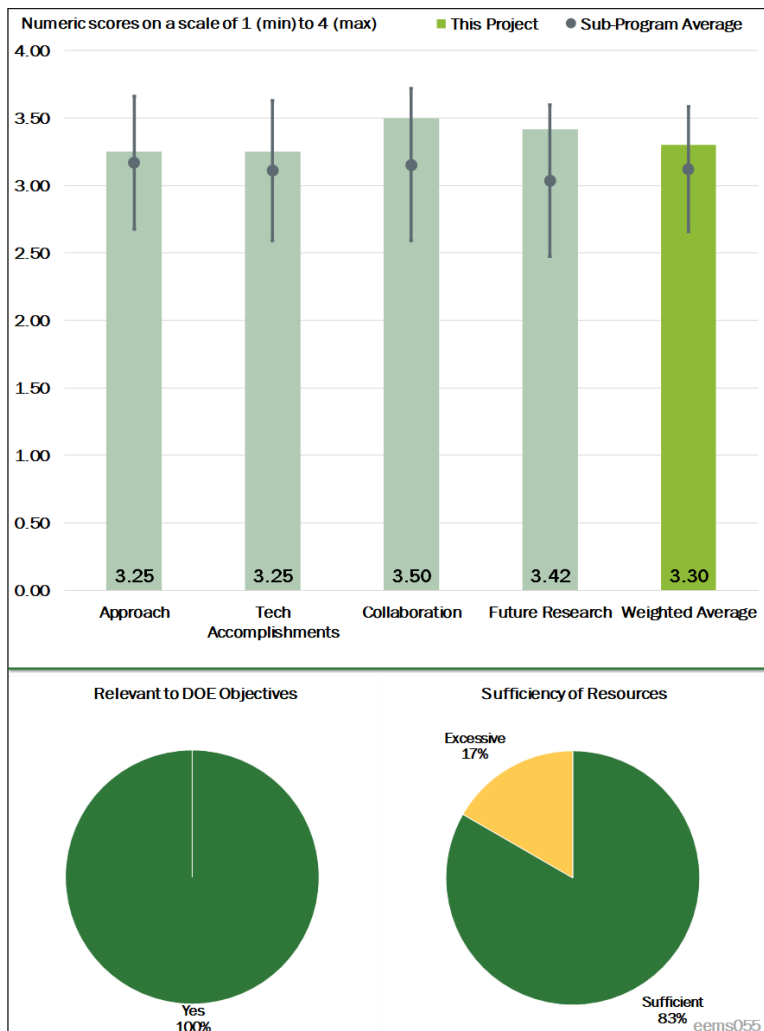

Figure 3-40 - Presentation Number: eems055 Presentation Title: Simulation Model Results for Energy and Mobility Impact of Behavioral Scenarios in POLARIS Principal Investigator: Josh Auld (Argonne National Laboratory)

there is a high degree of interconnection between decision-making, transportation system performance, and development of smart mobility technologies.

According to the reviewer, the project identified high-level barriers, including: high uncertainty in technology deployment, functionality, usage, and impact at the system level; computational models, design, and simulation methodologies; lack of data on individual behaviors resulting from CAV adoption and usage; and integration of disparate model frameworks.

The reviewer detailed that the project approach incorporates three primary components: updating behavioral models in core tools (POLARIS and Autonomie) used for transportation and energy simulation; leveraging a variety of data sources within and outside of SMART; and developing and providing input to case studies and analyzing energy outcomes. The reviewer noted that significant detail is provided as to the activities under each of these components. Overall, the reviewer assessed that the project is well-designed, feasible, and appears to address many of the technical barriers. It would have been beneficial to more sharply define the project objectives and provide specific FY 2019 milestones.

Reviewer 6:

The reviewer really liked the approach to this problem and thought this project gets to the heart of whether CAV adoption and usage makes sense or not. What the reviewer would like to see clearly defined from this project is facts that can be used in the media. For example, there is a fuel savings of 1% if telecommuting moves from 2.6% to 5.6%. The reviewer pointed out the paper did not clearly outline this, but this was on the poster board.

The reviewer also observed the paper noted that there will be a significant time when CAVs are empty. The reviewer inquired what that means for energy costs, and how should that be improved. The reviewer asked whether, as such, there is a limit for CAVs.

Question 2: Technical Accomplishments and Progress toward overall project goals—the degree to which progress has been made and plan is on schedule.

Reviewer 1:

The reviewer commented relative to project objectives, progress has been excellent. The additional building blocks in POLARIS for multi-modal travel and AV usage are key components to adapt it for use in answering the questions posed by the SMART Mobility activity.

Reviewer 2:

The reviewer said that the project appears to be on schedule achieving the milestones established to date. The project has achieved a significant number of technical accomplishments and the team has provided a substantial amount of detail. Specifically: First, modelling of telecommuting adoption and frequency behavior from survey data has found that flexible schedules, work trip distance, and travel time all increase telecommuting frequency, while low income decreased the likelihood of telecommuting. Second, the reviewer noted that ANL has developed and implemented a new multi-modal point-to-point router that is used to simulate non-auto trips and explore competition between modes. This routing algorithm is multimodal, intermodal, agent-based, and computationally efficient. The reviewer noted how ANL has generated the set of potential feasible mode choice options for each agent with enhanced heuristic filters to generate appropriated walk-to-transit and drive-to-transit routes. Third, the reviewer noted that ANL has developed a preliminary model with TNC estimated using a Federal Transit Administration (FTA) stated preference survey. Fourth, the reviewer noted that ANL developed a model for intra-household Level 5 AV and ride sharing. This model identifies the optimal number of privately owned autonomous vehicles for each household considering vehicle sharing, as well as ride sharing. Fifth, the reviewer noted that ANL analyzed time use and time valuation data as the disutility of travel time significantly influences travel. The value of time varies depending upon the data source and it is critical to understand the limitations of data, methods, and survey design. Sixth, the reviewer noted that ANL has implemented a time of day and activity duration choice model and developed key insights.

Additionally, the team used the POLARIS Chicago model to conduct case studies on the impact of telecommuting, including the effects of flex-work scheduling on telecommuting and energy use. The team found that flex work scheduling was somewhat effective in alleviating peak period congestion. The reviewer observed, overall, an extensive list of accomplishments.

Reviewer 3:
The reviewer remarked having the right assumptions, and leveraging available data helps in the maturity of the modeling.

Reviewer 4:
The reviewer said that results so far seem to have provided good insights into telecommuting behavior and impacts.

Reviewer 5:
The reviewer said that some of the key findings (telecommute model) appear to be intuitive and the reviewer supposed indirectly validate the model. The more interesting aspect of the findings is the actual relative magnitudes of the telecommute frequencies. As the reviewer mentioned in the response to Question 2, it is not clear whether the routing algorithm accounts for a change in the mode preference as a function of the weather condition. The reviewer pointed out this is the Windy City, and winter weather can be less than appealing. The reviewer found it is good that the model allows "random parameters" to represent heterogeneity, but that also means that the authors have another knob to control. The reviewer recommended it would be very helpful if the team listed all the acronyms used on a separate slide.

Reviewer 6:
The reviewer remarked this is a good start. The reviewer would like to see more exploration on items that were found, and how to improve the data to come to results. Also, the reviewer would like to see results defined, in a business sense, in an energy improvement (or not) sense, and dollarize where possible.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer very much so appreciated the collaboration, especially with the City of Chicago, which is at ANL's back door.

Reviewer 2:
The reviewer remarked good outline of how the partners are working; the key is to share data that is reflective of real world.

Reviewer 3:
The reviewer observed that the project exhibits strong partnerships and collaborations with others including: ORNL, LBNL, FTA, Chicago Department of Transportation, University of Illinois at Chicago, and the University of New South Wales. Each entity provides a different expertise and/or access to specific modelling capabilities and real-world/surveyed data. The reviewer assessed that overall, the team is diverse and well-balanced.

Reviewer 4:
The reviewer said the project relies on a wide array of collaborators and information/study sources to get the required data for the features to be implemented.

Reviewer 5:
The reviewer said the national laboratories, Chicago Department of Transportation, and FTA have collaborated well.

The reviewer said that this project takes in inputs from several other EEMS projects, and involves several national laboratory partnerships as well as partnerships with other organizations. This reviewer emphasized that any cross-talk between the LBNL team (BEAM) and the ANL team is notably absent, and that, of course, there is collaboration with the land use modeling team at LBNL.

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 challenges are with having enough data and the assumptions behind it; to have a wide array of different drive scenarios

Reviewer 2:
The reviewer pointed out the important questions to be answered in the proposed future work are the project's reason for being. The challenges remaining to get to those answers appear clearly understood.

Reviewer 3:
The reviewer said that the authors are just scratching the surface here. Dig deeper, dollarize. The reviewer is looking forward to seeing what the authors find (with data) compelling or not in this very exciting space.

Reviewer 4:
The reviewer said that the project provides a strong synopsis of the remaining challenges and barriers, including: activity generation and how it will shift in response to CAVs is a key unknown in models; data limitations of many of the models and how they relate to future mobility technologies; the great variety of parameters controlling the behavior of responses of travelers that interact to create system results; and model integration challenges between systems operating at vastly different time scales. The reviewer said these barriers make sense and are informative.

The reviewer detailed as next steps for the project are to: connect to vehicle choice models for realistic fleet distribution; incorporate research into time use behavior and travel time valuations; improve traffic flow model; expand analysis to additional CAV technologies and shared use cases; and evaluate transferability for national level energy evaluations. The reviewer said that proposed future research includes: exploring activity generation models and changes under CAV scenarios while linking to time use analysis; extending telecommuting analysis looking at the impact of CAVs and connections between increased teleworking and freight delivery; integrating data and models from surveys about travelers' attitudes towards CAVs; extending mode choice and other behavioral analysis to include non-privately owned CAVs, including ridesharing, autonomous fleets, etc.; exploring connections between individual travel choices and land use; and conducting sensitivity analysis of key SMART Mobility metrics to various behaviors. The reviewer assessed that the proposed future work considers many of the behavioral barriers to the realization of SMART Mobility technologies and proposes a number of logical future activities to target. The reviewer said that the project does not specifically discuss alternate development pathways.

Reviewer 5:
The reviewer said the PI is going about systematically addressing all the weak links in the current project—that is not to say that the current project as it stands is not well-executed. The reviewer pointed out very nature of the project involves a large number of uncertainties, and the PI is working to reduce those.

Reviewer 6:
The reviewer pointed out the proposed sensitivity analysis is particularly critical.

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

Reviewer 1:
The reviewer really enjoyed this presentation and work. The reviewer encouraged keep pushing for estimating/determining/modeling how people will behave in this new model of mobility.

Reviewer 2:
The reviewer said that with MEP as a key metric of the EEMS program, this project links together a diverse set of projects to evaluate the metric based on individual behavior.

Reviewer 3:
The reviewer found that the project supports DOE objectives by providing a powerful tool to study possible energy consumption outcomes at the transportation system level. This will help DOE to set appropriate future policy objectives.

Reviewer 4:
The reviewer said the combined analysis of energy use and mobility impacts of traveler behavior through mobility decision modeling and transportation system simulation is critical to DOE objectives.

Reviewer 5:
The reviewer found that this project is relevant as behavior is a high source of uncertainty with regards to the impact of advanced mobility, and there is limited data on behavioral responses to CAVs and other future mobility technologies. The reviewer detailed that this project seeks to reduce uncertainty around energy use forecasts for SMART Mobility technologies and other traveler options. Through mobility decision modeling and transportation system simulation, this project improves the understanding and prediction of the impact of traveler behavior. The reviewer said by doing so, more informed smart mobility decisions can be made, as well as better estimates of ensuing energy and mobility impacts.

Reviewer 6:
The reviewer said the work is important to have a modeling tool that predicts drive behavior.

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

Reviewer 1:
Resources appear to be sufficient for FY 2018, and FY 2019 work funding is not indicated but the project is worthy of continuation.

Reviewer 2:
The reviewer commented the resources ($1.35 million total for FY 2017-FY 2019) are sufficient to achieve the project's objectives and stated milestones.

Reviewer 3:
The reviewer pointed out the funding level for FY 2019 appears to be somewhat higher than that for FY 2017 and FY 2018, and should be sufficient to accomplish the remaining list of tasks.

Reviewer 4:
The reviewer said that data are critical to support the effort.

Reviewer 5:
What happened is in the author's budgeting process, the reviewer saw only a total. The reviewer did not see anything relating to manpower days, $/hour, etc. which is what one typically sees in engineering management. The reviewer asked if there is something MORE that the authors need from constituents to be successful, say

from the City of Chicago and the FTA. The reviewer asked what more do the authors need to be successful in their endeavor. The reviewer saw in the Barriers to the Project that the authors are lacking data on individual behaviors relating to CAV adoption and usage. The reviewer asked, well, what do the authors need to get to the data, and what data do the authors need. Define it. Figure it out. Go after it.

The reviewer said there seems to be a lot of funding for the level of work actually being done.

Acronyms and Abbreviations

ABM	Activity-based model
ABMS	Agent-based modeling and simulation
ACC	Adaptive cruise control, automated cruise control
ADAS	Advanced Driver Assistance System
ACES	Automated, connected, efficient, and shared; automated, connected, electric, and shared
AES	Automated electric shuttle
AMBER	Advanced Model Based Engineering Resource
AMD	Automated mobility districts
AMR	Annual Merit Review
ANL	Argonne National Laboratory
APRF	Advanced Powertrain Research Facility
ARPA-E	Advanced Research Projects Agency-Energy
ATM	Active traffic management
AV	Automated vehicle
BEAM	Behavior energy autonomy mobility
BEV	Battery electric vehicle
CAC	Cooperative automated control
CACC	Cooperative adaptive cruise control
CAFÉ	Corporate Average Fuel Economy
CAN	Controller area network
CAV	Connected autonomous vehicle, connected and automated vehicle
CO_2	Carbon dioxide
CV	Connected vehicle
DoE	Design of experiment
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation

DSRC	Dedicated short-range communications
DWPT	Dynamic wireless power transfer
Eco-CACC-I	Eco-Cooperative Adaptive Cruise Control-I
EEMS	Energy-Efficient Mobility Systems
EPA	U.S. Environmental Protection Agency
EV	Electric vehicle
FAA	Federal Aviation Administration
FASTSim	Future Automotive Systems Technology Simulator
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FTA	Federal Transit Administration
FY	Fiscal Year
GPS	Global positioning system
HD	Heavy-duty
HDV	Heavy-duty vehicle
HEV	Hybrid electric vehicle
HPC	High-performance computing
HWFET	Highway Fuel Economy Test
Hz	Hertz
ICE	Internal combustion engine
INL	Idaho National Laboratory
iTiC	International Transportation Innovation Center
ITS-JPO	Intelligent Transportation System Joint Program Office
L4	Level 4 high automation
L5	Level 5 full automation
LA	Los Angeles
LANL	Los Alamos National Laboratory
LBNL	Lawrence Berkeley National Laboratory

LD	Light-duty
LDV	Light-duty vehicle
LIDAR	Light imaging, detection, and ranging
LIGO	Laser Interferometer Gravitational-wave Observatory
LLNL	Lawrence Livermore National Laboratory
LSTM	Long short-term memory
MA3T	Market Acceptance of Advanced Automotive Technologies
MaaS	Mobility-as-a-system, mobility-as-a-service
MD	Medium-duty
MDV	Medium-duty vehicle
MEP	Mobility energy productivity
ML	Machine learning
MOC	Model predictive control
MORPC	Mid-Ohio Regional Planning Commission
MOU	Memorandum of Understanding
MOVES	Motor Vehicle Emission Simulator
MPC	Model-predictive control
MPO	Metropolitan Planning Organization
NDA	Non-disclosure agreement
NHTSA	National Highway Traffic Safety Administration
NPP	Nuclear power plant
NRC	National Research Council of Canada
NREL	National Renewable Energy Laboratory
NSF	National Science Foundation
O-D	Origins-destination
ODOT	Ohio Department of Transportation
OEM	Original equipment manufacturer
ORNL	Oak Ridge National Laboratory

OTA	Over-the-air
PEV	Plug-in electric vehicle
PHEV	Plug-in hybrid electric vehicle
PI	Principal Investigator
PNNL	Pacific Northwest National Laboratory
POLARIS	Planning and Operations Language for Agent-based Regional Integrated Simulation
Q&A	Question and answer
R&D	Research and development
RL	Reinforcement learning
RMS	Root mean square
ROI	Return on investment
SAE	Society of Automotive Engineers
SMART	Systems and Modeling for Accelerated Research in Transportation
SPRINGS	Statistical Planning for Resilience in Next Generation Systems
SUV	Sport utility vehicle
SVTrip	Stochastic vehicle trip
TARDEC	U.S. Army Tank Automotive Research, Development and Engineering Center
TAZ	Travel analysis zone
TNC	Transportation network company
TRANSNET	Traveler Response Architecture using Novel Signaling for Network Efficiency in Transportation
TRL	Technology Readiness Level
TSDC	Transportation Secure Data Center
TTI	Texas Transportation Institute
UC	University of California
UDDS	Urban Dynamometer Driving Schedule
UE	User equipment
UIC	University of Illinois at Chicago

UMD	University of Maryland
UNR	University of Nevada, Reno
UPS	United Parcel Service
V2I	Vehicle-to-infrastructure
V2V	Vehicle-to-vehicle
VATT	Vehicle average travel time
VIL	Vehicle-in-the-loop
VMT	Vehicle miles traveled
VTO	Vehicle Technologies Office

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