3. Energy Efficient Mobility Systems

The Vehicle Technologies Office (VTO) has a comprehensive portfolio of early-stage research to enable industry to accelerate the development and widespread use of a variety of promising sustainable transportation technologies. The research pathways focus on fuel diversification, vehicle efficiency, energy storage, and mobility energy productivity that can improve the overall energy efficiency and efficacy of the transportation or mobility system. VTO leverages the unique capabilities and world-class expertise of the National Laboratory system to develop innovations in electrification, including advanced battery technologies; advanced combustion engines and fuels, including co-optimized systems; advanced materials for lighter-weight vehicle structures; and energy efficient mobility systems. VTO is uniquely positioned to address early-stage challenges due to strategic public-private research partnerships with industry (e.g., U.S. DRIVE, 21st Century Truck Partnership) that leverage relevant expertise. These partnerships prevent duplication of effort, focus DOE research on critical research and development (R&D) barriers, and accelerate progress. VTO focuses on research that industry does not have the technical capability to undertake on its own, usually due to a high degree of scientific or technical uncertainty, or that is too far from market realization to merit industry resources.

The Energy Efficient Mobility Systems (EEMS) subprogram supports early-stage research to support industry innovation that improves the affordability and energy productivity of the overall transportation system. Initial DOE analysis indicates that the future energy impact of connected and automated vehicles 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 applies complex modeling and simulation expertise, experience with data science and artificial intelligence, and high performance computing (HPC) capabilities unique to DOE National Laboratories to explore the energy and mobility impacts of emerging disruptive technologies such as connected and automated vehicles (CAVs), information-based mobility-as-a-service (MaaS) platforms, and advanced powertrain technologies to identify and develop innovative mobility solutions that improve energy productivity, lower costs for families and business, and support the use of secure, domestic energy sources. The EEMS subprogram consists of four primary activities: the SMART (**S**ystems and **M**odeling for **A**ccelerated **R**esearch in **T**ransportation) Mobility National Laboratory Consortium, HPC-enabled data analytics, advanced mobility technology research, and core evaluation and simulation tools. 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 completing the development of a quantitative metric for mobility energy productivity (MEP), which measures the affordability, efficiency, convenience, and economic opportunity derived from the mobility system, which will be used by the program to evaluate success, and by the transportation community to inform planning decisions. The metric will be applicable to both light-duty and heavy-duty vehicles and systems.

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
eems007	Mobility Data and Models Informing Smart Cities	Joshua Sperling (NREL)	3-7	3.50	3.75	3.50	N/A	**3.64**
eems009	Modeling and Simulation of Automated Mobility Districts	Venu Garikapati (NREL)	3-9	3.33	3.17	3.33	3.75	**3.30**
eems011	Integrated Mesoscale Urban Systems Modeling with Behavior, Energy, Autonomy, and Mobility (BEAM) to Explore Shared and Automated Vehicles and their Impacts on Energy and Mobility	Zac Needell (LBNL)	3-12	3.17	3.17	3.33	2.75	**3.14**
eems013	ANL Core Tools–Simulation	Aymeric Rousseau (ANL)	3-15	3.00	3.33	3.50	3.17	**3.25**
eems016	Energy-Efficient CAVs	Dominik Karbowski (ANL)	3-18	3.17	3.50	3.00	2.50	**3.23**
eems019	Smart Urban Signal Infrastructure and Control	Hong Wang (ORNL)	3-21	3.25	3.25	3.50	3.00	**3.25**
eems020	Multi-Scenario Assessment of Optimization Opportunities due to Connectivity and Automation	Jackeline Rios-Torres (ORNL)	3-23	3.00	3.17	3.50	3.50	**3.21**
eems023	The Whole Traveler Transportation-Behavior Study	Anna Spurlock (LBNL)	3-26	3.33	3.33	3.67	4.00	**3.46**

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems027	Multi-Modal Energy Analysis for Freight	Alicia Birky (NREL)	3-29	3.50	3.67	3.67	3.50	**3.60**
eems028	Developing an Eco-Cooperative Automated Control System (Eco-CAC)	Hesham Rakha (Virginia Tech University)	3-32	3.00	3.00	2.83	3.00	**2.98**
eems030	Experimental Evaluation of Eco-Driving Strategies	Wei-Bin Zhang (LBNL)	3-35	2.67	3.00	2.83	2.50	**2.83**
eems031	Traffic Micro-Simulation of Energy Impacts of CAV Concepts at Various Market Penetrations	Hao Liu (LBNL)	3-38	3.25	3.75	3.25	3.25	**3.50**
eems033	Using Passenger Car Cooperative Adaptive Cruise Control (CACC) to Test Operational Energy Consumption at Intersection with Active Traffic Signal Control	Xiao-Yun Lu (LBNL)	3-41	2.83	3.00	2.83	2.50	**2.88**
eems034	Optimization of Intra-City Freight Movement and New Delivery Methods	Amy Moore (ORNL)	3-44	3.33	3.67	3.33	2.83	**3.44**
eems035	Coupling Land-Use Models and Network-Flow Models	Paul Wadell (University of California at Berkeley)	3-47	3.33	3.33	3.33	N/A	**3.33**
eems037	High-Performance Computing (HPC) and Big Data Solutions for Mobility Design and Planning	Jane MacFarlane (LBNL)	3-50	4.00	3.25	3.50	3.25	**3.47**
eems038	Charging and Repositioning Decision Making for Fully Automated Ride-Hailing Fleet	Zonggen Yi (INL)	3-52	3.33	3.67	2.83	3.00	**3.40**
eems039	Charging Infrastructure Design Tradeoffs for a Fleet of Human-Driven and Fully Automated Electric Vehicles in San Francisco	John Smart (INL/LBNL)	3-55	3.75	3.63	3.63	3.67	**3.66**

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems040	Dynamic Wireless Power Transfer Feasibility	Omer Onar (ORNL)	3-58	3.25	3.00	3.25	3.00	**3.09**
eems041	ANL Core Tools–Hardware	Kevin Stutenberg (ANL)	3-60	3.13	3.50	3.25	3.13	**3.33**
eems044	Quantification of National Energy Impacts of Electrified Shared Mobility with Infrastructure Support	Joann Zhou (ANL)	3-63	3.25	3.00	3.50	3.50	**3.19**
eems045	Focused Validation and Data Collection to SMART Activities	Eric Rask (ANL)	3-65	3.25	3.50	3.25	3.25	**3.38**
eems057	Urban Traveler–Changes and Impacts: Mobility Energy Productivity (MEP) Metric	Venu Garikapati (NREL)	3-67	3.38	3.50	3.38	3.33	**3.43**
eems058	Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility Consortium Tools and Process Development	Aymeric Rousseau (ANL)	3-70	3.75	3.75	3.25	3.50	**3.66**
eems059	Experimental Evaluation of CACC for Passenger Cars	Xiao-Yun Lu (LBNL)	3-72	3.17	2.83	3.50	3.33	**3.06**
eems060	Agent-Based Model and Data Collection for Inter- and Intracity Freight Movement	Monique Stinson (ANL)	3-75	3.50	3.50	3.25	3.25	**3.44**
eems061	Real-Time Data and Simulation for Optimizing Regional Mobility in the United States	Jibonananda Sanyal (ORNL)	3-77	3.00	3.00	3.25	2.75	**3.00**
eems062	Deep-Learning for Connected and Automated Vehicle (CAV) Development	Robert Patton (ORNL)	3-80	3.33	3.33	3.33	3.33	**3.33**
eems063	Ubiquitous Traffic Volume Estimation through Machine-Learning Procedure	Venu Garikapati (NREL)	3-83	3.75	3.50	3.75	3.75	**3.63**

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems066	Livewire Data Platform–A Solution for Energy Efficient Mobility Systems (EEMS) Data Sharing	Lauren Spath-Luhring (NREL)	3-86	3.38	3.38	3.38	3.00	**3.33**
eems067	Virtual and Physical Proving Ground for Development and Validation of Future Mobility Technologies	Dean Deter (ORNL)	3-91	3.17	3.17	3.50	2.83	**3.17**
eems069	Next-Generation Intelligent Traffic Signal for Multimodal, Shared, and Automated Future	Andrew Powch (Xtelligent)	3-94	3.25	3.25	3.50	3.25	**3.28**
eems072	Charging Infrastructure Needs for Electrification of Freight Delivery Vehicles	Victor Walker (INL)	3-97	3.50	3.38	3.50	3.25	**3.41**
eems074	Smart Cities Topology–Curbs and Parking	Stanley Young (NREL)	3-101	3.00	3.25	3.00	3.50	**3.19**
eems078	Simulation Model Results for Energy and Mobility Impact of Behavioral Scenarios in POLARIS	Joshua Auld (ANL)	3-104	3.25	3.38	3.50	3.00	**3.31**
eems079	Travel-Time Use and Value With Mobility Services	Paul Leiby (ORNL)	3-108	3.50	3.50	3.75	3.50	**3.53**
eems081	Nationwide Energy and Mobility Impacts of CAV Technologies	David Gohlke (ANL)	3-111	3.83	3.67	3.00	N/A	**3.62**
eems082	Validation of Connected and Automated Mobility System Modeling and Simulation	Jeffrey Rupp (American Center for Mobility)	3-114	3.33	3.17	3.83	3.17	**3.29**
eems083	CIRCLES: Congestion Impact Reduction via CAV-in-the-loop Lagrangian Energy Smoothing	Alexandre Bayen (University of California at Berkeley)	3-117	3.50	3.33	3.83	3.00	**3.40**

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
eems084	Energy-Efficient Maneuvering of connected and Automated Vehicles (CAVs) with Situational Awareness at Intersections	Sankar Rengarajan (Southwest Research Institute)	3-120	3.25	2.75	3.13	3.25	**2.98**
eems086	Simulation Tool for Energy-Efficient Connected and Automated Vehicle (CAV) Control Development	Dominik Karbowski (ANL)	3-124	3.25	2.50	3.00	3.25	**2.84**
eems087	Computation of Metropolitan-Scale, Quasi-Static Traffic Assignment Models Using High-Performance Computing	Jane MacFarlane (LBNL)	3-126	3.50	3.50	3.50	3.50	**3.50**
eems088	Chicago Transit Authority Transit Network Efficiency and the Changing Mobility Landscape	Joshua Auld (ANL)	3-128	3.17	3.17	2.83	3.17	**3.13**
Overall Average				**3.30**	**3.31**	**3.34**	**3.17**	**3.30**

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 two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

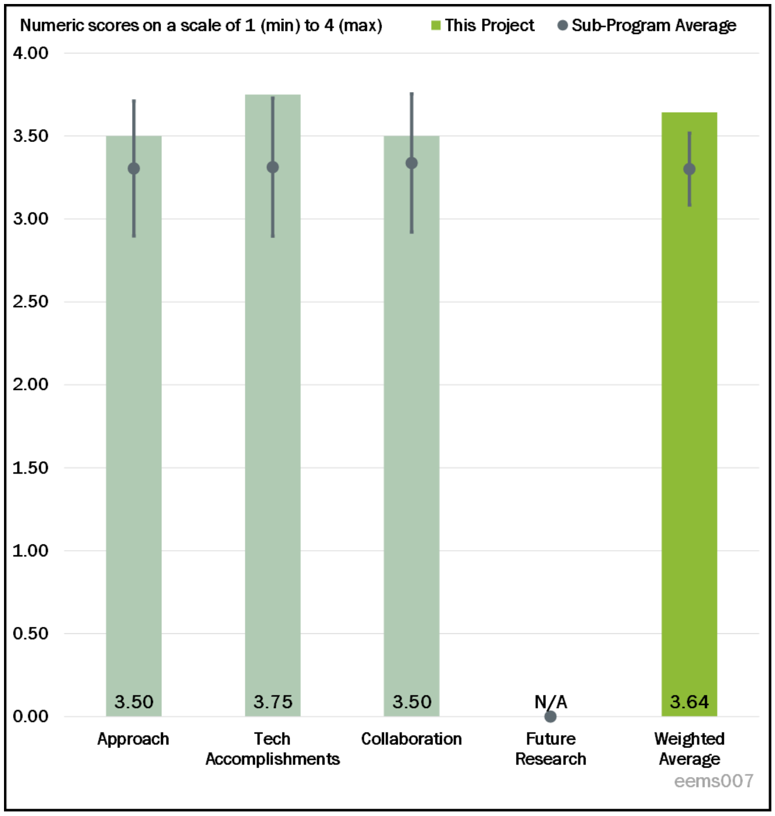

Figure 3-1 - Presentation Number: eems007 Presentation Title: Mobility Data and Models Informing Smart Cities Principal Investigator: Joshua Sperling (National Renewable Energy Laboratory)

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 project, which is now mostly complete, has delivered on its goals of analyzing personal travel data in order to conduct quantitative analysis of energy implications in light of emerging mobility options.

Reviewer 2:

The project team focused on readily available data, which makes sense to start, but the team was also cognizant of the need to obtain data to fill gaps. The reviewer was sure it still took effort to obtain the data utilized. The reviewer stated the team also used innovative analysis techniques.

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:

An impressive publication record was accomplished, including several peer-reviewed journal articles, conference papers, and presentations.

Reviewer 2:

The project team has utilized the data available to expand the understanding of urban mobility related to getting to and from airports (both users and employees), parking, emerging technologies, typology, and more.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration with partners appeared well coordinated and well managed by the Principal Investigator (PI).

Reviewer 2:
A broad team with lots of collaborators contributed.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The project is almost complete.

Reviewer 2:
The project has ended.

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

Reviewer 1:
The reviewer stated energy implications due to emerging personal mobility technologies are one of the important areas in which the Department of Energy (DOE) has interest.

Reviewer 2:
The project provides new insights and data to use for modeling to understand the energy impact of moving people in urban environments.

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

Reviewer 1:
The project seems to have been successfully completed with the allocated resources.

Reviewer 2:
A lot was accomplished, given the resources provided.

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 three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

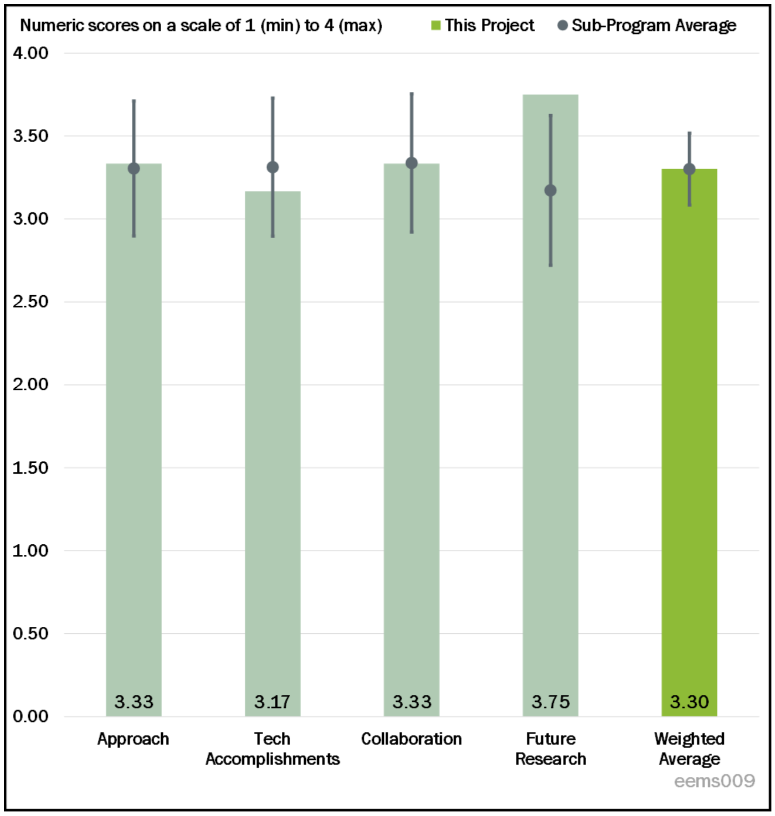

Figure 3-2 - Presentation Number: eems009 Presentation Title: Modeling and Simulation of Automated Mobility Districts Principal Investigator: Venu Garikapati (National Renewable Energy Laboratory)

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 a very good approach to performing the work, which includes building the following models:

- Fleet and Route Optimization Module to determine the optimal configuration (number and capacity) of shuttles and optimal routes to serve a given demand
- Mode-Choice Model to develop a mode-choice model that is responsive to shuttle operations (frequency and capacity) and regional transportation infrastructure
- Automated Mobility District (AMD) Toolkit to exercise in at least one additional deployment location to Greenville, South Carolina, which will help the project team gain insights from early-stage AMD deployments.

Reviewer 2:
This year's project approach built upon previous year's efforts in developing the AMD Toolkit. The Fiscal Year (FY) 2019 approach included determining optimal fleet configurations for meeting specific shuttle demands; developing a mode-choice module for the Toolkit; performing at least one additional case study (beyond Greenville, South Carolina) in an urban location using the Toolkit; and gathering data on early-stage AMD deployments around the country to gain insights.

Reviewer 3:
The objective of developing modeling capabilities that quantify net mobility gains was achieved. Significant effort was placed on coordination with existing mobility districts to obtain data for model development. From the presentation, it appears that the model is based on forcing mode choice (Slide 14) and then quantifying the mobility impacts. This is a bit like calculating the obvious. The reviewer commented that the development tool would be more useful if it predicted the mode choice and then quantified the mobility impact.

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:
This reviewer noted very detailed work with great results. Technical accomplishments include the following: preliminary AMD simulations using Greenville data; development of an AMD operational configuration optimization module; initiation of mode-choice module development; enhancement of the optimization module; development of a graphical user interface (GUI); implementation of the mode-choice module post-Annual Merit Review (AMR); completed AMD simulations in Austin, with shared and automated vehicles (SAVs) serving as first-mile and last-mile (FMLM) connections to transit; and initiation of the automated shuttle rider survey at the National Renewable Energy Laboratory (NREL).

Reviewer 2:
The researcher indicated that the FY 2019 portion of this 3-year project was completed as of the 2020 AMR. Efforts included enhancing the optimization module by adding a GUI; determining optimal fleet configurations for meeting specific demands; fully incorporating a mode-choice module into the Toolkit; completing case studies for Greenville, South Carolina, and Austin, Texas, using the Toolkit; and reviewing early-stage AMD deployments around the country to gather insights.

Reviewer 3:
The project is complete and met its objective of quantifying impacts.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The project team had very good collaborations between academia, National Laboratories, and city governments, which are not always easy.

Reviewer 2:
The collaboration with Greenville and Austin is impressive and provides great support to the DOE objective of identifying levers that improve energy productivity by utilizing real-world data and interfacing with those operating mobility systems.

Reviewer 3:
The researcher presented on good collaborative efforts with various universities, a municipal government, and a nonprofit organization. The researcher also stated collaborative efforts with other National Laboratories but did not offer details on these efforts as related to this year's project 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. Note: if the project has ended, please state project ended.

Reviewer 1:
The reviewer reported that proposed future research includes incorporating additional mobility-on-demand (MOD) modes, such as shared bikes, electric scooters (e-scooters), and SAVs for FMLM connections; integrating the Toolkit into a regional travel-demand model, such as Austin's regional travel model in the

context of FMLM simulations; and focusing on FMLM simulations, including enhancing operational logic with features like dynamic ridesharing and deadhead minimization, in addition to rising demand levels and system size.

Reviewer 2:
Although this 3-year project has been completed, the researcher suggested future work involving incorporation of MOD modes into the Toolkit; full integration of the Toolkit with regional travel-demand models for greater utility; and using FMLM connections in the simulations. It is also recommended that the researcher continues collecting information through data and surveys (including the NREL survey) for further input to, and validation of, the Toolkit.

Reviewer 3:
Not applicable was indicated by this reviewer.

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

Reviewer 1:
This project supports the overall DOE objectives by quantifying the net mobility gains and energy impacts of automated, connected, electric, and/or shared (ACES) vehicles deployed in dense urban districts.

Reviewer 2:
The project-developed methodology will provide a basic quantification of AMD energy impacts. While great uncertainties and estimations exist in the quantification, it is a good first step and is commensurate in detail with the volume of real-world data available for validation.

Reviewer 3:
The project is relevant for DOE's program as it addresses the need for modeling and simulation tools for assessing advanced mobility technologies in various urban and suburban settings. The project's focus on AMDs allows for later application of its results to broader and more complex regional environments.

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 sufficient resources for this project; however, these studies should continue to help build AMDs.

Reviewer 2:
The project team fulfilled objectives on schedule, indicating resources were sufficient.

Reviewer 3:
At about $250,000 per fiscal year, the researcher has made significant progress on a comprehensive work plan, including FY 2019. The researcher intimated that additional funding for more in-depth data collection that supports and validates the AMD toolkit would be useful.

Presentation Number: eems011
Presentation Title: Integrated Mesoscale Urban Systems Modeling with Behavior, Energy, Autonomy, and Mobility (BEAM) to Explore Shared and Automated Vehicles and their Impacts on Energy and Mobility
Principal Investigator: Zac Needell (Lawrence Berkeley National Laboratory)

Presenter

Zach Needell, Lawrence Berkeley National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 67% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 33% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

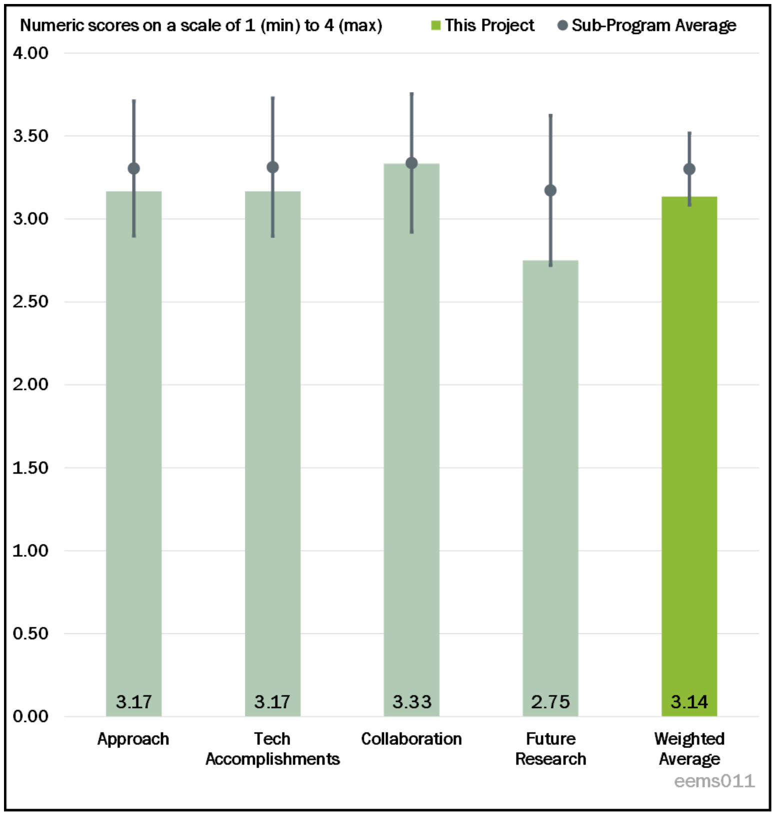

Figure 3-3 - Presentation Number: eems011 Presentation Title: Integrated Mesoscale Urban Systems Modeling with Behavior, Energy, Autonomy, and Mobility (BEAM) to Explore Shared and Automated Vehicles and their Impacts on Energy and Mobility Principal

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 overall approach was excellent. The reviewer's only concern is that the project involves the fairly complicated integration of multiple models in a way that may not always yield expected results.

Reviewer 2:

The modeling could benefit from greater sensitivity analyses and real-world validation, as previous reviewers have noted, particularly in light of recent events. Ridership patterns, transit use, parking, and vehicle miles may be permanently changed. Further, characterization of other emerging factors should also be considered, such as teleworking, electronic commerce (e-commerce), and micro-mobility.

Reviewer 3:

The workflow seems comprehensive, but judging from the analytical results, the project's contribution to the understanding of system impacts of major mobility trends, as stated in the barriers section on Slide 2, remains to be realized. For example, the results only show impacts from light-duty (LD) vehicles, even though one would imagine that micro-transit is a viable option where medium-duty (MD) vehicles are utilized. It was not clear to the reviewer whether this is due to the lack of modeling capabilities or simply a choice of what to show in the results. In any case, focusing solely on LD passenger movement only paints a fraction of the whole picture.

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 technical accomplishments and progress were excellent. In at least one aspect, they would have been improved by documenting and highlighting the assumptions behind transportation network company (TNC) deadheading and its effect on congestion throughout the results and whether the deadheading was an input or an output of the model. An increasing body of literature is finding that TNC effects on congestion, even with shared mobility, may be a net negative due to the deadheading effects on congestion.

Reviewer 2:
The analysis has made significant progress in creating an integrated model of highly complex systems. As a policy tool, however, it may be limited by the availability of data for validation, particularly on emerging and disruptive trends as they relate to various urban transportation systems, so that longer range scenarios can be analyzed for applying policy tools.

Reviewer 3:
The reviewer would have liked to see more insights resulting from a project this size. Judging from the presentation, the results are mostly on ride sharing and automation. The chart on Slide 19 indicates that the impacts of these trends are not much over the base scenario. It is also not clear whether improvements in mobility energy productivity (MEP) are statistically significant or practically meaningful.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
This project involved many high-impact and relevant collaborators at all levels and with geographic diversity. Therefore, the reviewer rated this element as outstanding.

Reviewer 2:
The collaboration is very (northern) California-centric, which is not typical in many respects to other urban areas.

Reviewer 3:
Slide 22 indicates that there is collaboration on charging behavior and infrastructure, but the results did not show anything related to electrification or charging. The extent of collaboration that took place was unclear to this reviewer.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The reviewer indicated that there is always more a researcher can propose, and the project suggestions were useful to review. Perhaps the project could have benefited from an increased focus on real-world impacts, use, and implementation rather than a focus on modeling.

Reviewer 2:
The project has ended. While the future research stated on Slide 25 makes intuitive sense, it is difficult to judge whether or not it is technically achievable without seeing a detailed work plan.

Reviewer 3:
This reviewer reported that the project ended.

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

Reviewer 1:
The project supports DOE's current objectives.

Reviewer 2:
Creating an agent-based transportation model is certainly within DOE objectives. The only concern would be any overlap or duplicative efforts with similar projects.

Reviewer 3:
The project supports DOE objectives in that it shows the impact of sharing and automation on mobility and energy. The question is, now that this project has shown that there is not much impact, should DOE keep pursuing further analyses or the implementation of such technologies?

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

Reviewer 1:
The resources seem sufficient for the work produced.

Reviewer 2:
The resources and funding are appropriate for the development of the analysis tool.

Reviewer 3:
The reviewer would have expected more scenarios analyzed, given the size of the project.

Presentation Number: eems013
Presentation Title: ANL Core Tools—Simulation
Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)

Presenter

Aymeric Rousseau, Argonne National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

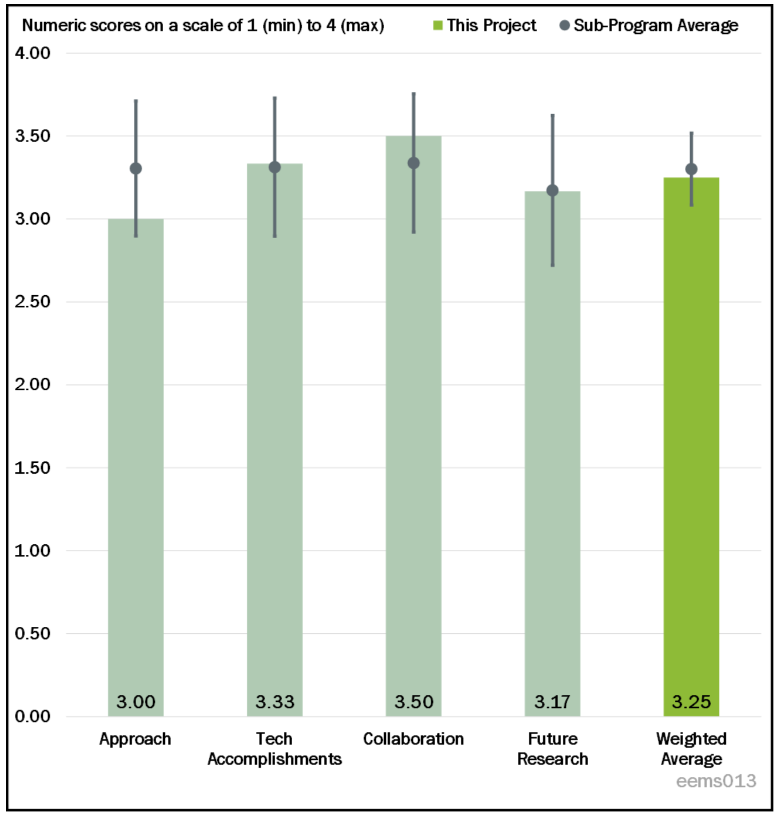

Figure 3-4 - Presentation Number: eems013 Presentation Title: ANL Core Tools—Simulation Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)

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 tools being developed are appropriate for vehicle and mobility system modeling. The automation techniques and user aids (workflows) are enablers for efficiently completing large studies.

Reviewer 2:
The tools updated as part of this project are part of an integrated Advanced Model Based Engineering Resource (AMBER) environment, which has an Autonomie focus, and allows for a new generation of workflow management.

Reviewer 3:
The list of barriers and challenges speaks to the fundamental problem of precision and depth the project team wants to go. There is a lot of feedback between the different models and modules. The project team has a grand vision, but each handoff embeds uncertainty in compounding and escalating levels. Until these fundamental issues are clearly addressed and pass extensive validation and review, it is hard to see how advancing depth of the research will add additional, useful output to inform decision making.

Using the phase “fairly good representation of real world cycles” creates a concern. Are the representations useful or not? Do they provide sufficient representation or not? The team needs to be clear on what the threshold or target is and if the work is meeting it. Vague words like “fairly” suggest work may have fallen short.

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:
Improved user interfaces, enabling millions of simulation runs via AMBER, and reusing vehicle models with changes are all important accomplishments. Heavy-duty (HD) electrification was an appropriate use case evaluation selection.

Reviewer 2:
Progress has been very good in meeting the project milestones for creating and improving the AMBER tool ecosystem functionality. It is slightly unclear which technical accomplishments were completed during the review period.

Reviewer 3:
The ability to reuse part of a vehicle to create a new one is notable. Although there is clear value in what was accomplished, the reviewer questioned the reported times. According to the reviewer, 5 seconds seems unreasonably fast, as it can take more than that just to interact with the GUI. A more complete explanation with more, real examples and context will help the reviewer in evaluating the extent of this accomplishment.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The partners listed represent a broad spectrum of the user audience for the tool suite. The data needed to validate tool results are generally available.

Reviewer 2:
The project has a substantial and diverse set of collaborators that appear to have been engaged and contributed. The reviewer thought more explicit illustration of the coordination and contributions between and from the partners will help. In some ways, the number adds substantial complexity and requires very careful management.

Reviewer 3:
The project team has good collaboration with numerous Systems and Modeling for Accelerated Research in Transportation (SMART) Consortium partners for input updates, outputs to inform Energy Efficient Mobility Systems (EEMS) research, and evaluation of Vehicle Technologies Office (VTO) program benefits. The reviewer indicated it was nice to see leveraging of U.S. Driving Research and Innovation for Vehicle efficiency and Energy sustainability (U.S. DRIVE) and the 21st Century Truck Partnership (21CTP) for updated information. The reviewer suggested the team consider inputs from California deployment projects like California Air Resources Board's (CARB) Zero and Near-Zero Emissions Freight Facilities (ZANZEFF) Class 8 to validate modeling results for HD electrification.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
There is a good plan in place for tool improvements and distribution of models.

Reviewer 2:
The project team proposed relevant future research, including AMBER refinement, benefits evaluation of different use-cases, and license-free, compiled tunable model availability.

Reviewer 3:
The project team should list the priority of the proposed future work. MD and HD vehicle incorporation may be more important than adding more complexity to the model.

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

Reviewer 1:
The project develops foundational tools used in many VTO studies and analyses.

Reviewer 2:
Autonomie's use by a range of DOE projects, industry, and other end-users speaks to its utility in addressing fundamental research and design questions.

Reviewer 3:
This work is directly relevant in many different aspects, including evaluating program benefits; using as a tool for enabling EEMS research; quantifying the effects of changes in vehicle components and vehicle types across different applications; and conducting large-scale simulations to measure fuel economy and petroleum use impacts.

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

Reviewer 1:
Funding appears adequate, and the project appears to be on schedule.

Reviewer 2:
The reviewer stated $3.75 million over 3 years seems appropriate based on the importance and high use of these tools.

Reviewer 3:
The reviewer indicated sufficient resources because additional budget is not needed. However, there is a lack of clarity on how the specific budget is allocated; so, it may be excessive.

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

Presenter

Dominik Karbowski, Argonne National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

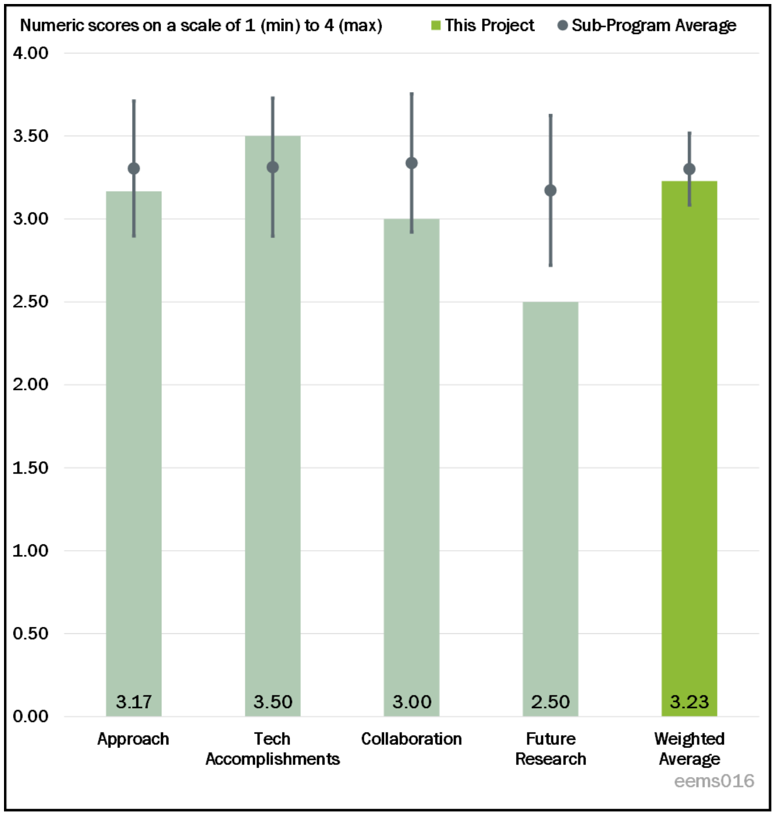

Figure 3-5 - Presentation Number: eems016 Presentation Title: Energy-Efficient CAVs Principal Investigator: Dominik Karbowski (Argonne National Laboratory)

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 subproblems studied in this project are highly relevant to the barriers being addressed for improved connected and autonomous vehicle (CAV) energy efficiency. One caveat is that propagating this work to industry is not explicitly addressed. Because there are no CAVs of this kind studied in the wild, some work could be done to make the implementations adoptable (software toolkits and proposed vehicle interface standards).

Reviewer 2:

Plans and milestones for evaluating energy use and associated validation were generally outlined in the presentation. The research also incorporated a range of scenarios (e.g., Slide 12). Regarding barriers and other challenges, the project team did recognize that the sample is not designed to be statistically representative of the U.S. "driving mix" (urban versus rural, highway versus arterial, etc.).

Reviewer 3:

According to the reviewer, major items noted in the prior review remain. Specifically, the controlled and stylized model did not, and still does not, have a clear path forward to address the major limiting factors for usefulness. Traffic is not considered, overall system efficiency cannot be measured, and true optimality is hard to achieve. Lack of time consideration as a motivator for current driving patterns also makes it hard to relate to improved performance in a real application.

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:
Results and technical accomplishments show high value of the technology and set a suitable carrot for further investigation by industry. Progress appeared excellent to the reviewer.

Reviewer 2:
The project ended in September of 2019 and is 100% complete. The milestones for 2019 Quarter (Q) 3 and Q4 were specifically discussed and are marked as "complete" on Slide 6.

Reviewer 3:
The work progressed and met the requirements. In that regard, the work overcame barriers. It is still difficult to translate these technical accomplishments into fully implementable and actionable outputs for the design of systems. The benefit is primarily still limited to computer simulation and may be difficult to extend to the real world with future work.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The project team made good use of existing data sets via external partners and the simulation tools developed at Argonne National Laboratory (ANL).

Reviewer 2:
Collaborations with external partners outside of the research group are limited and did not indicate close coordination beyond some data-sharing with Lawrence Berkley National Laboratory (LBNL) and Lawrence Livermore National Laboratory (LLNL).

Reviewer 3:
The presentation generally notes that work was done as part of a partnership between ANL (lead) and both LLNL and LBNL (data testing). Relative to other presentations, the reviewer indicated that there were fewer details outlining the specifics regarding coordination between the groups.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The next steps are logical. A gap exists in some sort of standards development since vehicle connectivity is an important part of the work.

Reviewer 2:
The project has ended. However, the presentation does note areas for potential future research such as increased real-world demonstration and validation.

Reviewer 3:
The proposed future work lacks clarity in the description to adequately evaluate. The addition of traffic considerations is important, but what the project team wants to do and how the team wants to do this are not clear. This extends to the other future work proposals, of which all lack decision points. The project has ended, and future work relates to proposed additional funding requests.

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

Reviewer 1:
The project demonstrates the possibilities of future technologies in CAVs that can have an impact on vehicle and transportation system energy consumption reduction, which is a key DOE VTO mission.

Reviewer 2:
This project aims to explore the energy impacts of CAV technology and eco-driving. The project supports DOE's goal of promoting efficient use of energy resources and supporting a more economically competitive, environmentally responsible, secure, and resilient U.S. energy infrastructure.

Reviewer 3:
The reviewer believed the work met the DOE objectives as stated but asserted that the objectives are not well articulated in the presentation. In theory, the work can be implemented in the real world, but it is not clear that it should be or will translate into comparable performance. So, by the letter, yes, the work met the objective.

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

Reviewer 1:
The project is on schedule and resources appear to be adequate for the tasks envisioned.

Reviewer 2:
This project has ended. It appeared that the funding was sufficient to conduct the planned work.

Reviewer 3:
Project funding seems generally sufficient. While additional funding could help support further validation and improved implementation, the project seems to have been able to complete milestones with the budgeted resources.

Presentation Number: eems019 Presentation Title: Smart Urban Signal Infrastructure and Control Principal Investigator: Hong Wang (Oak Ridge National Laboratory)

Presenter

Hong Wang, Oak Ridge National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

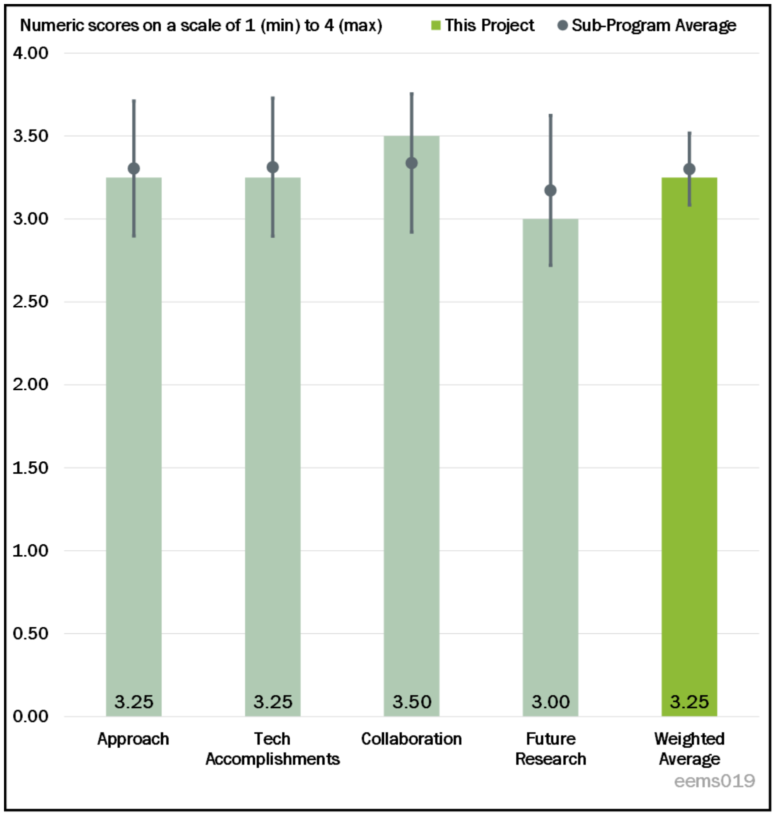

Figure 3-6 - Presentation Number: eems019 Presentation Title: Smart Urban Signal Infrastructure and Control Principal Investigator: Hong Wang (Oak Ridge National Laboratory)

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 approach seems very good and is fairly straightforward, as this is purely a traffic simulation-based study. Three different traffic-control algorithms are being assessed for performance in reducing vehicle delays in a traffic network based in Bellevue, Washington.

Reviewer 2:

The proposed multi-input and multi-output (MIMO) control problem formulation is interesting. The case study of networked signals so far is still over simplified. A more realistic setting would be desired where heuristic methods may be needed to balance the optimality and real-time performance.

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 technical accomplishments appear to be good. Three different traffic-signal control methods were tested on a simulation network of Bellevue, Washington, and the results of these control algorithms are presented. The results are focused on the total traffic delay of all vehicles on the network. It is unclear if estimates of fuel and energy savings will also be calculated and presented, but these were not presented in the poster. It would also be good if there were some measure provided for traffic progression. Since the control algorithms are using an intersection-centric control optimization approach, it would be good to understand if there were any “green progressions” or “green waves” that emerged from the intersection-centric optimization.

Reviewer 2:
The technical accomplishment and progress are reasonable. The reviewer would have expected a more efficient algorithm for realistic scenarios.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
According to the poster, the collaboration among the project team is good and the effort is well coordinated.

Reviewer 2:
Collaboration appears to be very good. However, there are only two entities involved in this study: Oak Ridge National Laboratory (ORNL) and NREL.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
There is very limited information in the poster about future research, but there is a mention of exploring dynamic and stochastic control methods and integrating adaptive routing. There is no mention of studying the energy impacts in the results, so it is unclear if all of the results will remain only in terms of traffic delay.

Reviewer 2:
The future direction mentioned by the PI is generally effective, but a more detailed explanation and/or plan would be desired to gauge this criterion.

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

Reviewer 1:
Networked traffic-signal control is very important and effective for improving system-wide energy efficiency in transportation. From the reviewer’s point of view, the combination of signal control and vehicle control is expected to bring significant benefits to the entire system.

Reviewer 2:
Yes, this project is relevant in that it is developing new traffic-control algorithms that have the potential to reduce traffic delays at intersections in an urban road grid network.

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

Reviewer 1:
The experience and resources of the PI and project team should be sufficient to achieve the stated milestone in a timely fashion.

Reviewer 2:
The reviewer could only assume that resources are sufficient because there was no funding information available in the poster.

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 three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

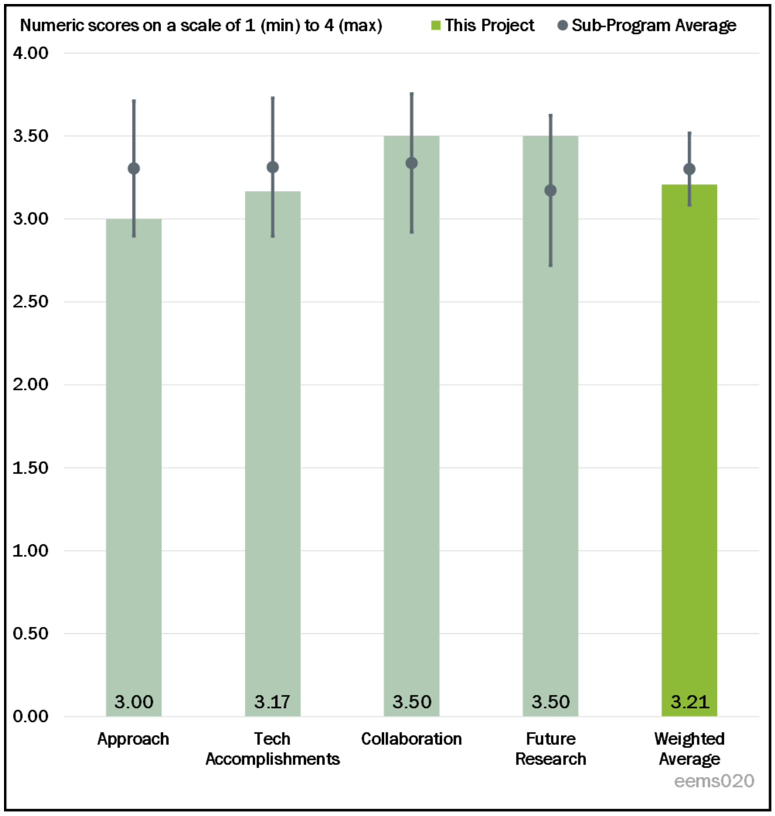

Figure 3-7 - Presentation Number: eems020 Presentation Title: Multi-Scenario Assessment of Optimization Opportunities due to Connectivity and Automation Principal Investigator: Jackeline Rios-Torres (Oak Ridge National Laboratory)

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 project's goal was to explore optimization opportunities to increase energy efficiency in full and partial CAV market penetration under diverse scenarios. A simulation-based assessment, optimization opportunities, and fuel, emissions, energy, and safety implications were the outcome of a literature review, target scenario definitions, and optimal coordination frameworks.

Reviewer 2:

Overall, the approach was good but somewhat narrow in its use of a single-driver model (which is quite inaccurate and likely to heavily influence the energy results) and focus on on-ramps. Both were acknowledged as opportunities for improvement.

Reviewer 3:

The reviewer's primary concerns with the approach were mainly with the calibration and validation of both the autonomous vehicle (AV) and the human driver, car-following, and lane-changing models.

The project team mentioned that the built-in AV driving logics (cautious, all-knowing, etc.) were used. However, did the team validate the AV driving behavior? Based on other research, the reviewer was uncomfortable with the way that the VISSIM driving logics were derived. The reviewer explained that VISSIM models AV driving behavior using the Wiedemann model (which was originally derived using theory on human drivers' perception of objects and reaction to stimuli). Albeit the models are calibrated to AV driving behavior by reducing driving behavior variance (on the relative speed-relative spacing plane) to emulate that the AVs are perfectly following the vehicle in front of them. However, the Wiedemann model was derived based on human behavior, and the reviewer was not convinced that using AV driving data to calibrate the model guarantees that it will properly emulate AV driving behavior. Although interested in hearing about third parties that have validated the driving logics, the reviewer has yet to see this in the literature. Most researchers using the VISSIM platform are continuing to emulate customized AV driving behavior using DriverModel.dll for this reason. The reviewer asked why the ANL vehicle models were not implemented using the VISSIM COM interface to improve the AV modeling behavior conducted as part of the project team's analysis.

Moreover, given that mixed traffic analyses were part of the primary technical outcomes of this project, the reviewer was concerned about how rigorously the human driving behavior component was calibrated. Many traffic-flow modelers are vocal about the need to collect data about human driving behavior in the presence of an AV. It will be important for performance forecasts to understand how human drivers change behavior in the presence of an AV. However, the project team mentioned that loop detector data were used to calibrate the human driving behavior (Wiedemann) model, which is not likely to capture these behavioral discrepancies. Additionally, there is a growing body of literature that highlights that traffic-flow simulators—VISSIM and Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks (AIMSUN)—may produce realistic traffic-flow behaviors while significantly distorting vehicle trajectories (which are required as inputs to safety and emissions models). One of the ways to overcome this is by using vehicle trajectory data, not loop detector data, to calibrate and validate the car-following and lane-changing models.

To have confidence in the team's technical accomplishments (i.e., simulated scenarios in Ann Arbor and Interstate-75 (I-75) in Tennessee), it is important that the team is using well calibrated and validated car-following and lane-changing models in the micro-simulation models, because these model outputs are used as emissions model inputs. However, for the reasons listed previously, the reviewer had concerns about the quality and rigor of the team's calibration of both the AV and human-driver behavior portion of the model.

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 project was completed on time; thus, technical progress was rated as excellent. The reviewer would have liked to see the performance indicators used to measure project success, but this information was not given in the slides.

Reviewer 2:
A comprehensive emissions and efficiency analysis of several scenarios (single merge and corridor) has shown that merging coordination has the potential for significant emissions and fuel consumption reductions (3%-30%).

Reviewer 3:
Technical accomplishments and progress were good. It seems like some opportunities for running more scenarios and/or expanding the model capability may have been missed.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Overall, the collaboration was excellent, including the collaboration for calibrating some scenarios to a portion of I-75 in Tennessee. Collaboration could have been improved if more federal partners had been enlisted (e.g., the Federal Highway Administration [FHWA], National Highway Traffic Safety Administration [NHTSA]), or perhaps some automobile original equipment manufacturers (OEM)s for some reality checks on CAV technology capabilities.

Reviewer 2:
The reviewer reported collaboration among the five DOE SMART Mobility Consortium National Laboratories as well as with the University of Delaware and the University of Tennessee.

Reviewer 3:
Although it was hard for this reviewer to assess project collaboration when only one member of the team is presenting, the project was completed on time. Thus, it seems to be safe to assume that the collaboration worked well on this team.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The proposed future research largely captured many of the shortcomings of the current research, which was excellent.

Reviewer 2:
The project has ended, although several relevant aspects for future research were mentioned.

Reviewer 3:
This reviewer stated that the project has ended.

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

Reviewer 1:
The project's overall intention of modeling energy use within CAVs is clearly aligned with DOE objectives.

Reviewer 2:
As the introduction of CAVs primarily deals with safety, this project investigated the energy and emissions impacts of partial to full penetration of CAV scenarios.

Reviewer 3:
Yes, the project contributes to overall DOE objectives. Having the ability to test multiple scenarios to evaluate energy impacts is important, and this project contributes to that area. This reviewer highlighted the following: Goal 1—Tools, Techniques, and Capabilities to Understand and Improve MEP; and Goal 3—Insight Sharing, Stakeholder Coordination, and Collaboration on Local and Regional Transportation Systems.

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 $1 million in funding for a 3-year project involving multi-partner collaboration seems appropriate for the outlined scope of work.

Reviewer 2:
The resources were not vast, and some of the results indicated modest. However, it is not clear if more funding would have necessarily resulted in enough of a deeper dive, producing useful and meaningful results (i.e., maybe resources would have, or maybe they would not have).

Reviewer 3:
The project has ended, but the budget seems higher than what would be expected for the project accomplishments.

Presentation Number: eems023
Presentation Title: The Whole Traveler Transportation-Behavior Study
Principal Investigator: Anna Spurlock (Lawrence Berkeley National Laboratory)

Presenter

Anna Spurlock, Lawrence Berkeley National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 67% of reviewers indicated that the resources were sufficient, 33% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

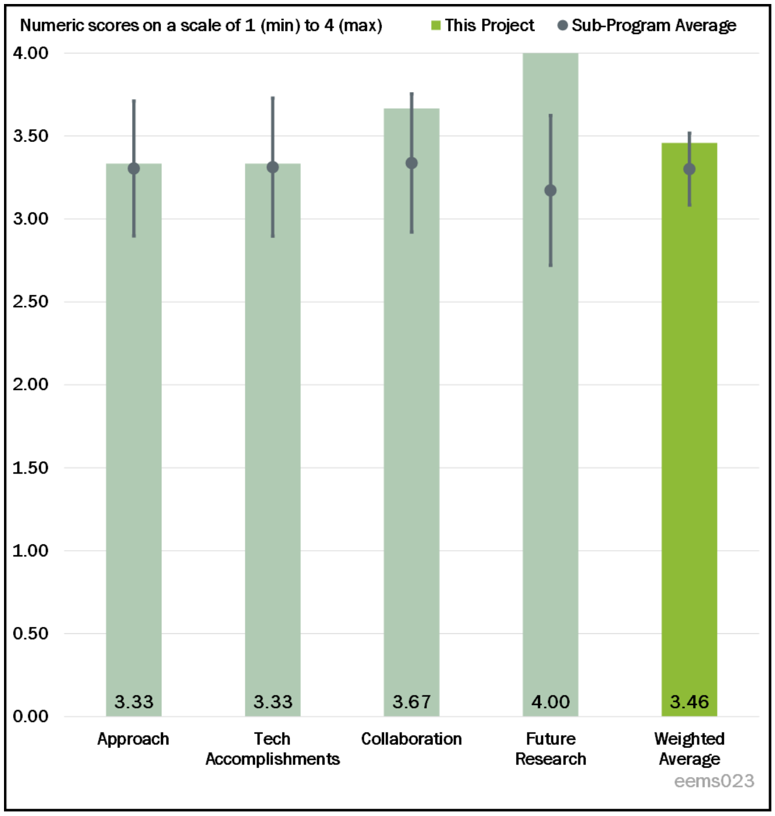

Figure 3-8 - Presentation Number: eems023 Presentation Title: The Whole Traveler Transportation-Behavior Study Principal Investigator: Anna Spurlock (Lawrence Berkeley National Laboratory)

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 approach was well thought out by designing a traveler household survey supported by global positioning system (GPS) trip data collection and innovative analytics to extract the findings of travel choice patterns, preferences, and decision-making processes with the advent of new mobility technologies' multiple time scales. New mobility technologies considered in the study included electric vehicles (EVs), ride sharing, CAVs, ride-hailing and shared mobility, and e-commerce.

Reviewer 2:

The project is well designed and has addressed the barriers. Innovative and broad approaches and topics were explored. If the WholeTraveler data were more representative across the whole socioeconomic spectrum, then this project would be rated as outstanding.

Reviewer 3:

The project has multiple interesting threads and research questions, and it addresses important behavioral questions. However, it was hard for the reviewer to get an overall picture of the project design.

The barrier cited is uncertainty regarding energy impact of new mobility technologies due to a lack of understanding of traveler behavior. While the project has identified interesting relationships between life course and travel behavior and vehicle choice, this year's work does not seem designed to deliver insights on new mobility adoption.

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 GPS location dataset was a big part of this year's effort and making it available to the public should be useful. However, it does not seem that the project itself was able to make use of the data before it ended.

Overall, the project has substantial technical accomplishments leading to numerous papers and presentations. It is also noteworthy that the Phase 1 data have been shared with researchers from six laboratories and academia, and that both Phase 1 and Phase 2 data will be made available on the Livewire Platform.

Reviewer 2:
The project has resulted in a depth of new knowledge with very interesting and broad topics being explored and analyzed in the whole transportation system. This reviewer emphasized that GPS data cleaning is always more complicated than it seems. Having the cleaned (and anonymized) data available to all is very valuable on its own.

Reviewer 3:
The survey data provided insights and resources to improve accuracy and flexibility of transportation system simulation models and reduce uncertainty associated with behavioral and human factors in the transportation-as-a-system modeling and scenario analysis. Anonymized versions of the survey data (including GPS trips) will be available to DOE National Laboratories and external researchers via the DOE Livewire Platform. Gender gaps in vehicle ownerships and spatial mobility when entering parenthood have been identified and studied.

It is unfortunate that the GPS data collected on traveler trips were unavailable until toward the end of the project, and therefore were not available for detailed analysis. Also, while previously acknowledged, a go/no-go decision to collect information in another geographic setting perhaps limited the broader applicability of this data set to other regions with different characteristics.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
There was significant collaboration among three National Laboratories, four universities, and a survey subcontractor. The project was effectively managed to deliver the listed accomplishments.

Reviewer 2:
There is a large project team, and the presenter noted that members "have coordinated in an integrated way." The publications include a large number of authors.

Reviewer 3:
According to the reviewer, collaboration across the team was necessary with such an ambitious, broad, and detailed undertaking.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The project ended in June of 2020. There are three projects proposed for SMART Mobility 2.0 that build off of work done in this project.

Reviewer 2:
The project has ended, although future research is proposed for SMART Mobility 2.0.

Reviewer 3:
The project has ended, but the project team has also proposed future research. The proposed Mobility and Technology Insight Validation Evidence (MOTIVE) work builds from lessons learned from the current project. Including underrepresented groups and a broad geographic area are a plus. Similarly, focusing on key data gaps needed for modeling is also important. The proposed workflow for SMART Mobility 2.0 would also contribute to improving future modeling.

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

Reviewer 1:
Yes, this project conducted early-stage research enabling an understanding of the individual behavioral and economic drivers of, and barriers to, increased MEP for emerging transportation technologies and services. This contributes to EEMS research, whose goal is to achieve an affordable, efficient, safe, and accessible transportation future in which mobility is decoupled from energy consumption.

Reviewer 2:
This data collection and analysis directly contribute to a better understanding of transportation choices across a broad spectrum of topics—emerging technologies, EVs, gender, life cycle, etc.

Reviewer 3:
To date, the results seem somewhat disconnected from saving energy, though eventually better understanding behavioral issues will be important to support the deployment of new mobility options.

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

Reviewer 1:
This project was a significant effort in the EEMS research area as it spanned 3.5 years and was funded with $3.2 million. It also included significant partner collaboration with other laboratories and universities, which is commensurate with the level of funding.

Reviewer 2:
The project was ambitious, but the team was able to accomplish so much with the resources given.

Reviewer 3:
Given the recurring concern that the survey respondents were not a representative sample, it seems possible that additional funding would have been helpful to achieve the stated milestones.

Presentation Number: eems027
Presentation Title: Multi-Modal Energy Analysis for Freight
Principal Investigator: Alicia Birky (National Renewable Energy Laboratory)

Presenter

Alicia Birky, National Renewable Energy Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

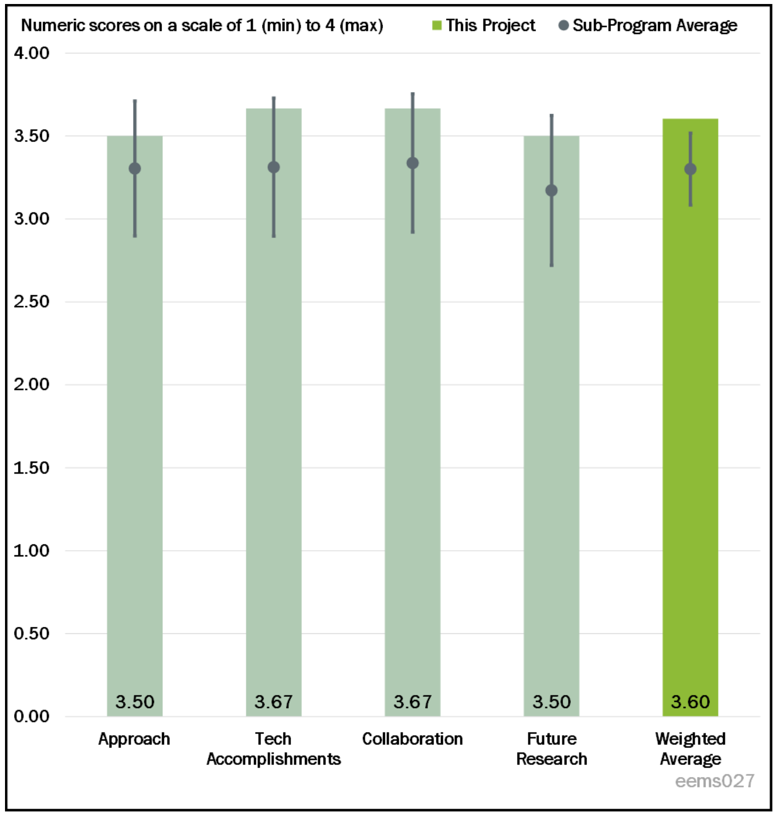

Figure 3-9 - Presentation Number: eems027 Presentation Title: Multi-Modal Energy Analysis for Freight Principal Investigator: Alicia Birky (National Renewable Energy Laboratory)

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 project team has a very good approach by maintaining consistency across other freight modeling and analysis efforts within the SMART Consortium, including the Freight Analysis Framework (FAF) zoning structure and methodologies. The team also applied the national truck flow model to refine estimates of a national potential for energy reduction from truck platooning and developed multi-modal, intercity, freight-energy models to allow analysis of Chicago’s regional and national impact of emerging technologies.

Reviewer 2:

For an initial project in this area, the approach was sound. This short project now offers a good structure for future efforts.

Reviewer 3:

The project comes up with what in theory seems like an effective way to determine the energy-savings opportunities from the application of emerging technologies on intercity freight, given the complex network of freight movement. Additionally, creating the freight mobility energy productivity (F-MEP) will translate the results of the study into an easily understandable measure for relevant stakeholders.

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 project provided a flexible framework that can be applied at various geographic scales and decomposed by commodity or mode. Input was easily obtained from existing data or freight models to compare scenario outcomes. Technical accomplishments reported by this reviewer include the following: development of a national truck flow model; assignments to local and highway links supporting workflow modeling and informing platooning analysis; truck proximity for platoon formation and capacity impacts; proven savings of 9.5% across the platoonable highway segments; and savings depend on vehicle type, platoon size, inter-truck gap, and road type.

Reviewer 2:

The project appears to be on track, and all key technical analyses have been completed. Comments from previous years appear to have been incorporated into model updates.

Reviewer 3:

Although a number of solid technical accomplishments were observed, the reviewer commented that the project team seemed somewhat unstructured—a lot of good work that did not seem to connect enough. Again, this is an example of an initial, short, project in freight analysis, which is very important. The reviewer believed project two will accomplish a great deal.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The project team and collaboration among the team—NREL, ANL, the University of Illinois at Chicago, INRIX, the U.S. Department of Transportation (DOT), the U.S. Census Bureau,, the U.S. Bureau of Labor Statistics, the American Trucking Associations, the American Transportation Research Institute, and the Surface Transportation Board—was very strong.

Reviewer 2:

The project team sufficiently used expertise at other laboratories for this effort. The reviewer expected more collaboration as these efforts become more tactical in nature. Collaborations with companies, and maybe even nonprofit non-governmental organizations (NGOs), will be very helpful.

Reviewer 3:

Partners represent a good variety of interested stakeholders and research organizations. The work seems to have been split up into equal chunks for each provider.

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. Note: if the project has ended, please state project ended.

Reviewer 1:

Future research ideas are practical and good. Prior to and during future work, the reviewer suggested engaging key government agencies, NGOs, and even private companies on which areas of research in this area will be most helpful.

Reviewer 2:

Yes, proposed research for future analysis grows on research already done and strives to refine modeling while answering any outstanding questions.

Reviewer 3:
This reviewer reported the following future research:

- Expand and refine truck movement/platooning model to analyze the energy impact of other connectivity and automation technologies.
- Validate network assignment and improvement of temporal distributions using INRIX data analysis.
- Integrate with multi-modal intercity freight energy (MMIFE) models to evaluate feedbacks.
- Develop plausible inputs for MMIFE scenarios with academic and industry partners.
- Refine parameterization.
- Extrapolate trucking collaborative logistics—cost impacts, load factors, empty movements.
- Refine intercity F-MEP.
- Engage academic, industry, and planners for stakeholder feedback or integration with multi-modal energy models to refine F-MEP as a tool for scenario evaluation.
- Work with industry and university partners to improve freight data and methodologies to reduce uncertainty.

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

Reviewer 1:
This project supports DOE objectives by qualifying the intercity freight-energy reduction opportunity space to define the regional and national energy impacts of SMART Mobility freight transportation technology and inform public and private sector decision makers.

Reviewer 2:
The reviewer stated that EEMS is a really important area for goods movement energy reductions.

Reviewer 3:
Part of EEMS's purview is to attempt to understand how passenger and freight mobility is changing, given the rise of emerging technology options and new information and communications technology. This project fits well into that space and makes a distinct attempt to assign energy reduction impacts to those applications, which will be useful to cities and states striving to create sustainable transportation systems.

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

Reviewer 1:
The project had sufficient resources and should continue this important work.

Reviewer 2:
Project resources seemed sufficient to the reviewer.

Reviewer 3:
The project appears to be well funded, which is appropriate given the scope of the analysis.

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 three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

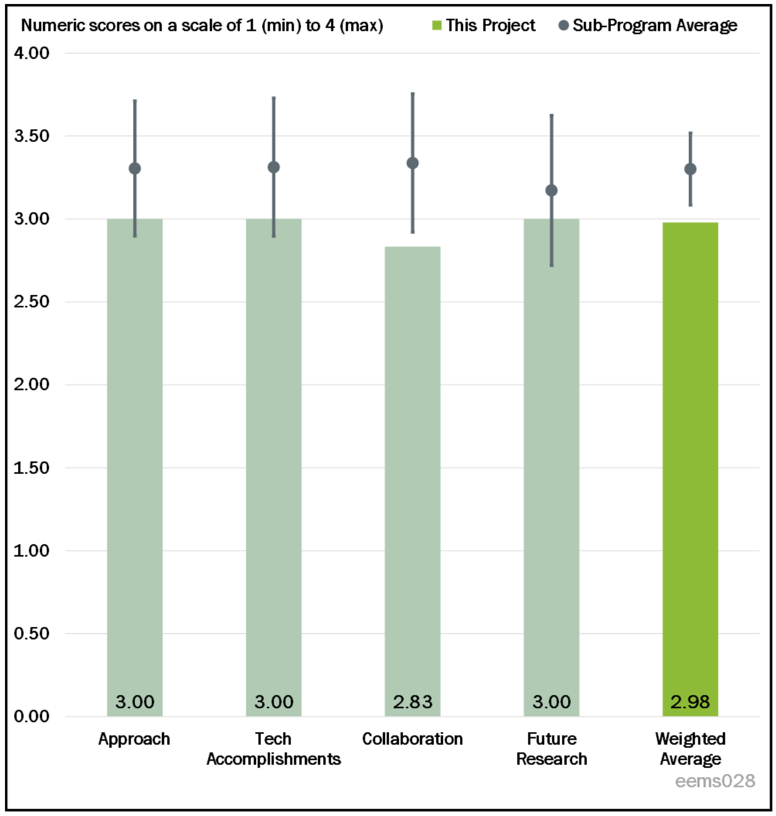

Figure 3-10 - Presentation Number: eems028 Presentation Title: Developing an Eco-Cooperative Automated Control System (Eco-CAC) Principal Investigator: Hesham Rakha (Virginia Tech University)

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 the project team took a relevant approach to performing the work.

Reviewer 2:
The design of the work seems sound, and the focus on accounting for different powertrain types is useful. Work thus far has assumed 100% CAVs; it is not clear that scenarios of partial CAV penetration will be included, but that would be very useful.

Reviewer 3:
Overall, the project approach made sense to the reviewer. One issue that is not very clear is how well the INTEGRATION tool can simulate the microscopic-level behavior (vehicle dynamics) of the real-world vehicle. It is always reported that large-scale simulation calibration at the microscopic level (for energy estimation purposes) is very challenging. Also, the computational time to include multi-level optimization is another concern.

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 original date of completion is listed as June 30, 2020, but the percentage of work that has been done is about 75% (maybe due to the breakout of COVID-19). According to the PI’s presentation, a no-cost extension

(NCE) has been approved, which should address some concerns of the reviewers on the technical accomplishment and progress. It is very good to see the publication record from this project.

Reviewer 2:
Some project findings were highlighted, but the reviewer was not sure about the ability to compare them with those of other researchers.

Reviewer 3:
Milestone completion dates are not consistent with an end date of June 2020, but researchers have requested a no-cost extension. It does not appear that the project team has yet finished integrating multiple CAV applications, which is the first goal listed.

One finding was that, with an increasing percentage of EVs, the optimal speed of platooned vehicles declines to an unacceptably low level (38 kilometers per hour at 45% EVs). The presenter noted that a multi-objective function, including energy and time, would be required to achieve a more reasonable outcome. The reviewer said that range should be considered as an objective as well. Also, a conclusion that platooning light-duty vehicles (LDVs) is not useful as EVs become widespread would be helpful information.

Differences in percentage reduction of greenhouse gas (GHG) and fuel use on Slide 9 were not adequately explained.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The reviewer indicated that collaboration and coordination across the project team was only vaguely described.

Reviewer 2:
No partners are funded by DOE, but collaboration with others (e.g., OEMs, state DOTs) will help ensure relevance of the work in the real world.

Reviewer 3:
In this presentation, the PI highlighted more of the algorithm development and simulation work. The reviewer stated that it would be better to see more involvement from the industrial partners—Toyota and Ford—besides the provision of test vehicles.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The reviewer reported that the project is ending this year.

Reviewer 2:
Proposed future research is limited to completion of ongoing work.

Reviewer 3:
Some unaddressed technical barriers identified by the reviewer include the application of actuated or adaptive signal control; and consideration of lateral control to potentially improve the efficiency and energy consumption of eco-vehicle(s) as well as the entire traffic flow.

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

Reviewer 1:
The primary objective of the project is to reduce vehicle energy use by using vehicle control strategies and CAV applications. The subject eco-cooperated automated control (eco-CAC) system is projected to achieve 20% energy savings, which is a large improvement. Hence, this supports the overall DOE objectives.

Reviewer 2:
The work is going in the right direction, but the reviewer was not sure how findings could be applied more broadly.

Reviewer 3:
This project should support the overall DOE objective. Based on the reviewer's knowledge, the DOE Advanced Research Projects Agency-Energy (ARPA-E) NEXT-Generation Energy Technologies for Connected and Automated On-Road Vehicles (NEXTCAR) Program has sponsored a few teams performing work similar to what is shown here. It would be interesting to compare all of these 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 thought the project resources should be sufficient, and that the delayed project delivery date was possibly due to the COVID-19 breakout.

Reviewer 2:
The project is behind relative to initial milestone dates, but there is no indication of insufficient funding.

Reviewer 3:
This reviewer reported that the project is ending.

Presentation Number: eems030 Presentation Title: Experimental Evaluation of Eco-Driving Strategies Principal Investigator: Wei Zhang-Bin (Lawrence Berkeley National Laboratory)

Presenter

Wei-Bin Zhang, Lawrence Berkeley National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

67% of reviewers indicated that the project was relevant to current DOE objectives, 33% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

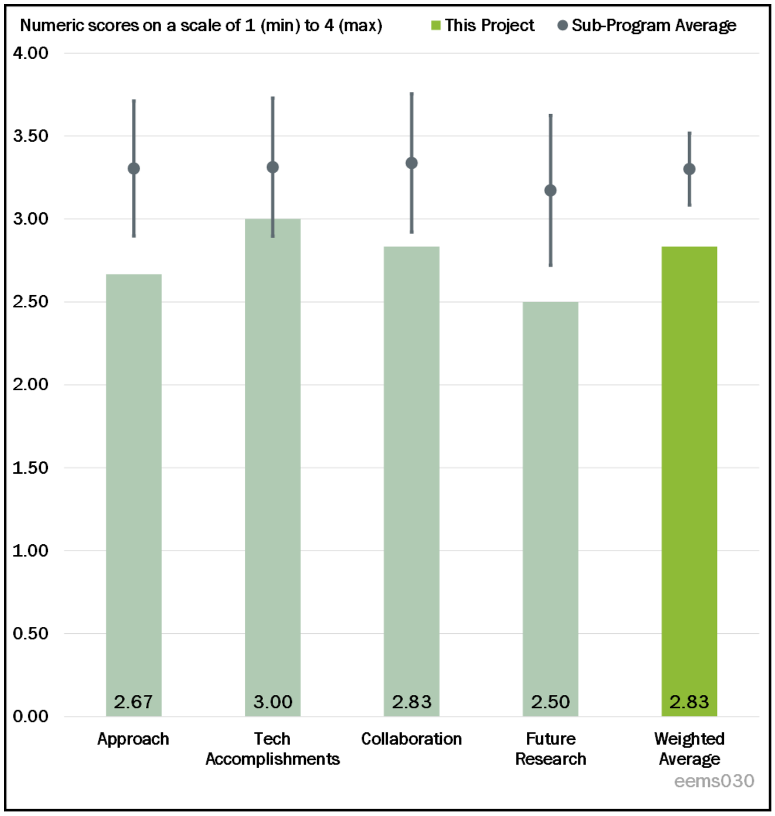

Figure 3-11 - Presentation Number: eems030 Presentation Title: Experimental Evaluation of Eco-Driving Strategies Principal Investigator: Wei Zhang-Bin (Lawrence Berkeley National Laboratory)

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 project identified potential opportunities for eco-driving strategies and quantified the energy benefits and environmental impacts. Real-world data were collected for arterial corridors and local intersections to support the analyses of unproductive energy consumption.

Reviewer 2:

The reviewer described a fairly known approach.

Reviewer 3:

After careful consideration and review, the reviewer concluded that the project approach has some fundamental flaws and limitations. After the presentation and discussion, it remains unclear how this can really extrapolate real-world motivations—fuel saved versus time, induced congestion, etc. This is difficult to reconcile with the stated objective of real-world application and realistically answering how much eco-driving can save.

A fundamental question on how much of the gains were from a change in method was unanswered and does not give confidence in utility of the results.

The work focuses on potential savings of individual vehicles but does not consider systemic effects, including loss of potential efficiency in other vehicles due to changes in velocity; cars that cross intersections before the light changes; and other congestion-related effects that are tradeoffs.

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 accomplishments and progress are technically sound.

Reviewer 2:
The project team collected 2 days of vehicle trajectory level traffic data at 14 intersections in the San Francisco Bay area. Field evaluation of eco-approach and departure (EAD) was conducted using five experimental vehicles at the testing corridor in San Jose. Extensive traffic analyses were conducted for one signalized intersection and one unsignalized intersection. Moderate fuel savings of 10%-20% per event were realized, but fuel savings at a trip level are less than 1% on average. Therefore, the fuel-savings benefit of EAD at the intersection level is insignificant.

Reviewer 3:
The study failed to extract truly unproductive (avoidable via eco-driving) fuel consumption, from fuel consumption due to safety regulations and performance tradeoffs. The project team acknowledged that much of what is considered fuel waste is not an eco-driving issue. Because the data used are very specific and not generalizable, it is difficult to extract value.

The data and output were too limited to provide meaningful evidence against the relevant desired outcomes. The results cannot inform realistic energy savings from eco-driving; at best, results can provide an upper bound. The field experiments were too limited in scope to be extensible to almost all real-world conditions.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration with San Jose State University and data sharing with DOE’s SMART Mobility Consortium were reported by this reviewer.

Reviewer 2:
The reviewer noted that not much collaboration across the project team was highlighted.

Reviewer 3:
Collaborations across the project team were adequate, but did not really add critical skills or input.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The project has ended. Future collaborations between LBNL, Texas A&M University, and ANL were suggested to develop national-level data needed to support the analysis of wasted and unproductive fuel consumption. Additional field-data collection and analyses were suggested that seem appropriate.

Reviewer 2:
This reviewer reported that the project ended.

Reviewer 3:
Although the concept outlined by the project team has merit, the narrative lacks any information on how future work will be conducted; address barriers and challenges to completing; and enumerate decision points to track value and progress.

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

Reviewer 1:
The reviewer stated that an understanding of unproductive fuel consumption at a regional and national level is necessary to understand how technologies and measures could be implemented to reduce vehicular fuel consumption.

Reviewer 2:
The reviewer saw this as an average project.

Reviewer 3:
The reviewer was unclear as to what objective the project supports and is less sure that the results and output support general objectives of informing overall energy savings at the national level.

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

Reviewer 1:
At $460,000 of funding over 2 years, this was a relatively small project that showed that EAD at the intersection level would not yield significant fuel savings. However, the project team also showed the importance of understanding where unproductive fuel use occurs.

Reviewer 2:
Resources are sufficient to support the full-time staff (or equivalent) working on this project, and the amount of staff should be sufficient to execute the work.

Reviewer 3:
This reviewer commented that the project ended.

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

Presenter

Hao Liu, Lawrence Berkeley National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

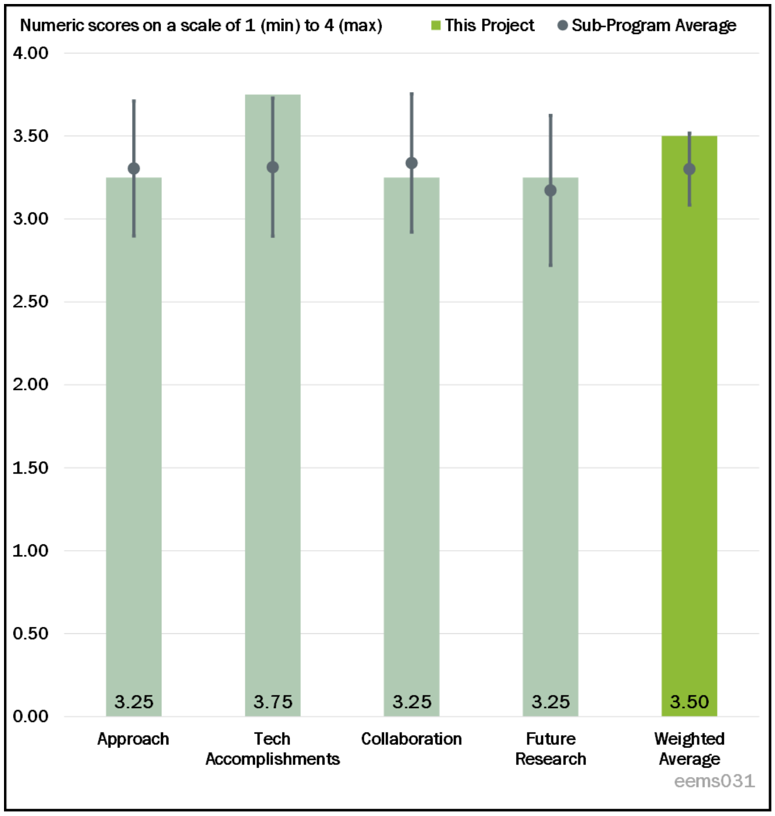

Figure 3-12 - Presentation Number: eems031 Presentation Title: Traffic Micro-Simulation of Energy Impacts of CAV Concepts at Various Market Penetrations Principal Investigator: Hao Liu (Lawrence Berkeley National Laboratory)

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:

This project is focused on intersection control (new signal control algorithms and centralized vehicle trajectory control) and active traffic management (ATM) strategies for improving freeway traffic flow. A special emphasis is placed on addressing the uncertainty of system performance under partial CAV penetration scenarios. As real-world field testing of the impact of CAVs on energy savings is highly expensive, this project takes an early modeling approach to identify possible opportunities and associated benefits for intersections and on the freeway under various CAV penetration scenarios. It has developed an operational-level micro-simulation model in Aimsun.

The approach incorporates two principal elements. First, it includes development of a cooperative signaling algorithm, both with and without trajectory planning. This includes identifying the optimal signal-phase sequence, signal timing, and number of stages, as well as incorporating trajectory planning. This approach utilizes a simple algorithm relying on prediction of two vehicle states: passing without slowing down and passing after joining the queue. The second element—modeling freeway mobility and energy performance—looks at two cases. This includes an isolated freeway merge bottleneck (incorporating ramp metering [RM]) and a real-world freeway corridor (California State Route 99) scenarios under various ATM strategies. ATM strategies include local responsive ramp metering (LRRM), coordinated ramp metering (CRM), and variable speed advisory (VSA). In short, the freeway modeling looks at three ways to improve flow at ramp bottlenecks, including local, whole corridor, and regulating the speed of freeway sections upstream.

The Motor Vehicle Emission Simulator (MOVES) model is used to estimate vehicle energy consumption. Overall, the approach seems reasonable and well designed.

Reviewer 2:
The interaction between vehicles and roadway infrastructure to optimize traffic flow is a key enabler to make CAVs effective. The exploration of practical, implementable approaches is very welcome.

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:
A good synopsis is provided of the technical barriers, including the rapid evolution of vehicle technologies and services enabled by connectivity and automation and determining the value and productivity derived from new mobility technologies. In general, the project is responsive to these technical barriers.

A new signal control optimization algorithm, V2, has been demonstrated through simulation to save energy (up to 30%-40%) in saturated conditions. This is achieved via fewer decelerations and vehicles in queue that can pass through intersections without waiting for multiple cycles. The results diminish at higher cooperative adaptive cruise control (CACC) vehicle market penetrations. It was also found that the benefit of including trajectory planning is small.

For the performance of freeways at isolated bottlenecks, it was found that the use of LRRM eliminates capacity drop and improves traffic mobility and performance. For a freeway corridor, LRRM improves performance in mobility and fuel consumption. CRM and VSA both achieved improvements of more than 20% in mobility, fuel consumption, and emissions.

In short, the modeling results indicate the potential of the new control algorithms and ATM strategies to improve the overall performance at both the local intersection level and on the freeway at ramp bottlenecks. Specifically, the results show average energy efficiency improvements of 1%-30%, especially in saturated conditions with CACC market penetrations of 15%-30%.

The project has demonstrated a solid list of modeling results with some promising mobility and energy performance benefits. The project is now successfully complete and has achieved all of the milestones.

Reviewer 2:
Significant progress has been made in proving the outlined concepts. In addition, how to implement the accomplishments has been addressed.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The partners are closely aligned in terms of tools and data sharing.

Reviewer 2:
Overall, for an early modeling activity, project collaboration and coordination are good. Collaboration with ANL is mentioned about better understanding and potentially using Autonomie to better quantify the vehicle-side response and benefits of the proposed traffic-control algorithms. The extent of collaboration with ORNL is less clear, though.

The PI did mention that outputs of this study are used by EEMS075—General Microsimulation to Meso-Simulation Workflow—but some additional detail regarding this would have been useful to the reviewer.

This project fits well into the EEMS end-to-end modeling workflow at the microscopic traffic-flow level.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The next steps are logical and build on current project progress.

Reviewer 2:
As presented, it appears that many of the remaining challenges and barriers surround the need for greater accuracy and resolution of models, whether estimating vehicle travel distances, human driver behavior, or vehicle acceleration and deceleration. Also, there is a need to better understand queue length to enable better signal control and trajectory planning. In short, the project proposes further examination and refinement of algorithms and fidelity of modeling results. Subsequently, the project should expand efforts to arterial corridors.

There are a number of reasonable proposals for future work, but the project is still strictly an upfront, theoretical modeling activity. As technology quickly progresses and implementation becomes more and more of a reality, questions arise with regard to this project moving forward. Where do proposed future efforts converge? How would the project team prioritize the proposed future activities, especially if only limited funding could be provided? Also, has any research been done to determine if the proposed signaling algorithms and freeway strategies are compatible with existing signaling infrastructure? Has any initial outreach/coordination been done to reach Metropolitan Planning Organizations (MPOs) and/or commercial signaling companies (e.g., Econolite) to discuss compatibility and commercialization realities regarding implementing new signaling technologies? If follow-on efforts are in the works for this project, it may be beneficial to expand communication and coordination with these entities upfront to better understand real-world constraints and adjust future modeling strategies and approaches accordingly to enable compatibility and future technology transfer.

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

Reviewer 1:
Traffic congestion is a significant barrier to transportation energy consumption. The project results show the benefits of coordinated control of on road vehicle movement.

Reviewer 2:
The project is relevant as it strives to identify methodologies to maximize mobility and vehicle energy efficiency at intersections via new CAV communication capabilities. It also is looking to develop ATM strategies for improved freeway mobility and energy performance. Successful development and implementation of either of these elements would improve overall vehicle-system mobility, energy efficiency, and emissions.

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

Reviewer 1:
The resources provided for this task were essentially appropriate and have allowed for timely, on-schedule completion of project milestones and deliverables.

Reviewer 2:
The project appears to be adequately funded.

Presentation Number: eems033
Presentation Title: Using Passenger Car Cooperative Adaptive Cruise Control (CACC) to Test Operational Energy Consumption at Intersection with Active Traffic Signal Control
Principal Investigator: Xiao Lu-Yun (Lawrence Berkeley National Laboratory)

Presenter

Xiao-Yun Lu, Lawrence Berkeley National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 33% of reviewers indicated that the resources were sufficient, 67% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

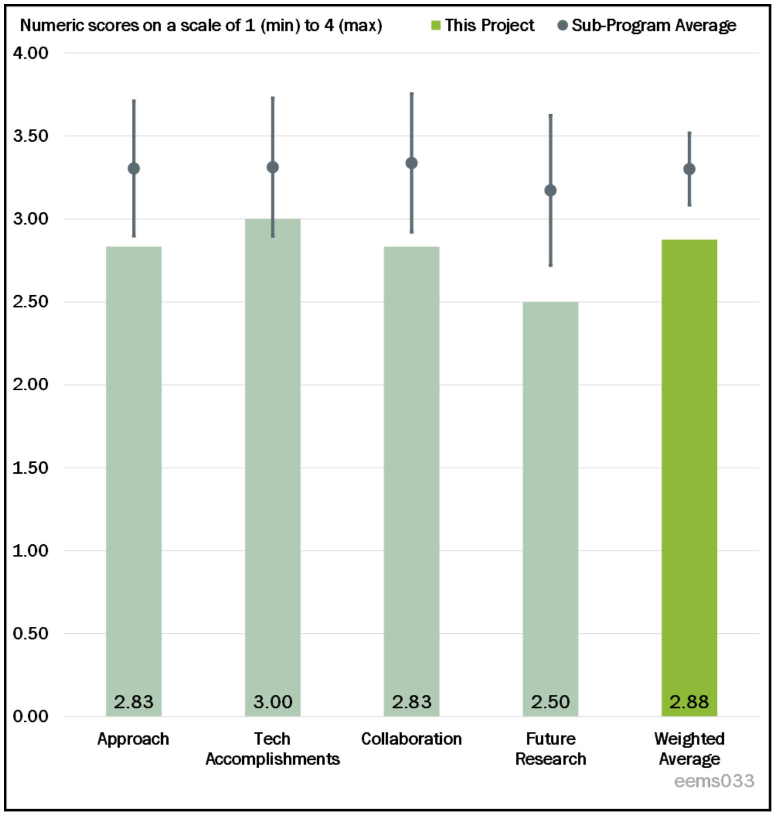

Figure 3-13 - Presentation Number: eems033 Presentation Title: Using Passenger Car Cooperative Adaptive Cruise Control (CACC) to Test Operational Energy Consumption at Intersection with Active Traffic Signal Control Principal Investigator: Xiao Lu-Yun

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 presentation was good and was presented in an easily digestible form.

Reviewer 2:

The reviewer noted that the switch from trucks to cars is significant for the project scope. These vehicles operate completely differently and by different operators. The project will have little to no value in the trucking industry for these reasons.

Reviewer 3:

The reviewer had trouble understanding the full approach and the problem being solved. The change from HD trucks to cars should have been more fully discussed to better understand how this impacted the project goals. The reviewer offered kudos for making the adjustment, but since the project will be completed in the next few months, it would have been good for the team to finalize the approach and suggest next steps for future research more directly.

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 project team adopted new algorithms developed under CAV Task 1.2, which were different from what had been developed and simulated under this project in FY 2019. Good simulation data were collected.

Reviewer 2:
The project seems to capture the necessary background.

Reviewer 3:
Data were presented that supported the completed testing and various real tests supported by simulation. However, key findings are not well understood. What did this work tell us? What should be done next? These were too unclear for this reviewer.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Good work was done among participating team members and on redirection of the truck versus car plan. The reviewer stated this was well done. The reviewer is supportive of more industry involvement, even if serving as an advisor on these projects.

Reviewer 2:
Some project collaborations were highlighted.

Reviewer 3:
Project delays have caused Volvo not to respond to low-speed issues. The reviewer thought there should have been more OEM support for 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. Note: if the project has ended, please state project ended.

Reviewer 1:
The project team should use these data to support a project with several truck OEMs.

Reviewer 2:
The proposed future research is well stated, but the reviewer thought that it should be tied to a few overarching project objectives. It seems this work is making good contributions, but the end result is unclear. Because a potential follow-on effort is being decided, answering this question is important.

Reviewer 3:
The reviewer commented that the project is ending soon.

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

Reviewer 1:
The project is relevant.

Reviewer 2:
The project is tackling relevant issues.

Reviewer 3:
The project supports the overall DOE objectives, but it does not offer much more value than the studies that are already complete.

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

Reviewer 1:
The project team needs more truck OEMs and industry input from trucking companies.

Reviewer 2:
There are multiple remaining challenges (listed on Slide 18) and little time and budget left.

Reviewer 3:
This reviewer reported that the project is ending soon.

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 three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 67% of reviewers indicated that the resources were sufficient, 33% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

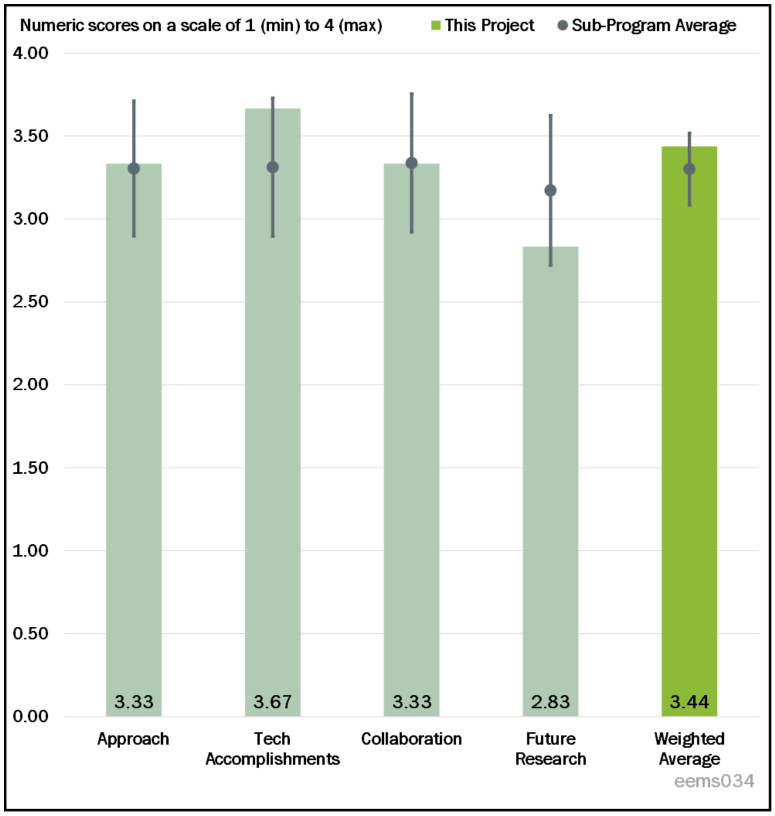

Figure 3-14 - Presentation Number: eems034 Presentation Title: Optimization of Intra-City Freight Movement and New Delivery Methods Principal Investigator: Amy Moore (Oak Ridge National Laboratory)

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:

This project looked at many options and groups of options concerning energy use of packages in e-commerce. Over the course of a few years, some have been added and others have been changed. This project kept up with these challenges well.

Reviewer 2:

The reviewer observed an excellent, long-term project approach that successively built upon each previous year's accomplishments. This year's research had a nice blend of emerging technology testing and delivery scenario development and modeling. The team made great use of United Parcel Service (UPS) delivery data for providing real-world input to the modeling effort.

Reviewer 3:

The reviewer believed the project team did an excellent job presenting the possibilities, with a few exceptions. The reviewer would have given the team an outstanding mark had it taken into account the differences in gas, diesel, electric, and propane as the fuels to compare because they are real-world fuels used in the transportation sector. The team could have also taken lockers into consideration, in addition to other carriers that come into the same neighborhood, street, or house several times a day, increasing emissions and traffic.

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:
This year's research provided valuable insights into new freight delivery methods, both individually and in combination relative to an established urban baseline. The research provided a greater understanding of drone delivery capabilities and energy use in the context of urban delivery and supported the expansion of Planning and Operations Language for Agent-based Integrated Simulation (POLARIS) for assessing freight delivery impacts. Based on the presentation, it appears significant progress was made in FY 2019 in completing the remaining milestones, as well as presenting project results in a number of relevant forums in FY 2020.

Reviewer 2:
Based on the report, the reviewer believed that the project team adequately covered the goals it set out to cover. The team even saw a little into the future with drone deployments, but also realized drones currently are not a very efficient delivery method other than for short distances with a light payload.

Reviewer 3:
The presentation showed the energy use of various scenarios well and tried to keep the conditions the same to enable comparisons, which is really hard (e.g., when a consumer uses a car for the final move of packages home and combines this with other trips). The reviewer commented that this could have been even better, but care was taken by the researchers. The reviewer also thought drone efforts were a little too much. It seems as if this project spent too many resources on testing drones.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Considering the team was spread out, the reviewer thought that assigning the different groups to a specific part of the project was a good use of time and resources.

Reviewer 2:
The reviewer observed very nice collaboration among multiple research, industry, and government organizations. Team members brought specific and relevant expertise to the project. There was great collaboration for meeting this year's project objectives among ORNL and other National Laboratories. The reviewer highlighted INL (freight modeling and drone testing); NREL (delivery mode energy use); LBNL (e-commerce and consumer data); and ANL (POLARIS model). The project team also made good use of relevant data sources, such as UPS, Federal Express (FedEx), and the City of Chicago government.

Reviewer 3:
The reviewer tended to believe that many VTO projects should have more industry collaboration. How about conducting surveys, or other information-gathering using partners? The reviewer thought that some organizations may actually be willing to do this at no cost. Not picking on the project too much on this, it is a good example of how desired information on benefits or consequences of one scenario versus another could be gathered through surveys or interviews.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The presenter indicated that the proposed future work would involve additional collaboration with ANL to further expand POLARIS's freight modeling capabilities for evaluation of e-commerce and its effects on urban transportation. The presenter also hinted at expanded drone testing, which is assumed to be conducted by INL. Both of these elements would extend the valuable research platform of this project as related to freight delivery

methods and energy impacts. The presenter also alluded to extending a similar research approach to other cities (Atlanta, Knoxville, Chattanooga, Austin, Detroit) in addressing last year's research comments. This multi-metropolitan research could also be an important element of future research in terms of evaluating similar freight delivery methods in different urban settings. Further, it is assumed that the researchers will address some of the data challenges identified as part of any future research plans.

Reviewer 2:
The reviewer did not know if there is much left in dissecting drone use or the effect that e-commerce has on freight mobility. During this pandemic, it is pretty clear that people are restricting outside movement and more things are being ordered for home delivery. Also, unless drone legislation or drone size changes, there will not be much to discuss in that arena.

Reviewer 3:
The reviewer was not sure additional drone testing is needed and asked if future research could better compare alternatives on other benefits and consequences. The reviewer thought that this is needed more than more work specifically on the energy use.

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

Reviewer 1:
The research is very relevant to DOE's programs, given the need for understanding the energy impacts of increasing congestion and vehicle populations, growth in e-commerce, and emerging freight movement technologies in urban environments. The results provide a valuable research platform for evaluating additional freight delivery scenarios and technologies under a variety of metropolitan conditions.

Reviewer 2:
Vehicle technology will play a huge role in emissions, and because freight is a major contributor, the reviewer thought it is important to make it a major part of the conversation.

Reviewer 3:

With some reservations, fuel use is a smaller part of some of the issues with e-commerce, but the reviewer thought that VTO has a responsibility to help understand them.

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

Reviewer 1:
The funding level appears to be sufficient for the efforts prescribed and multiple organizations involved.

Reviewer 2:
The reviewer did not know if it is possible, but suggested that there needs to be more data collection from other organizations, not just UPS. FedEx and Amazon may show different trends if they are added to the mix.

Reviewer 3:
Project resources are okay.

Presentation Number: eems035
Presentation Title: Coupling Land-Use Models and Network-Flow Models
Principal Investigator: Paul Wadell (University of California at Berkeley)

Presenter

University of California at Berkeley

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 67% of reviewers indicated that the resources were sufficient, 33% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

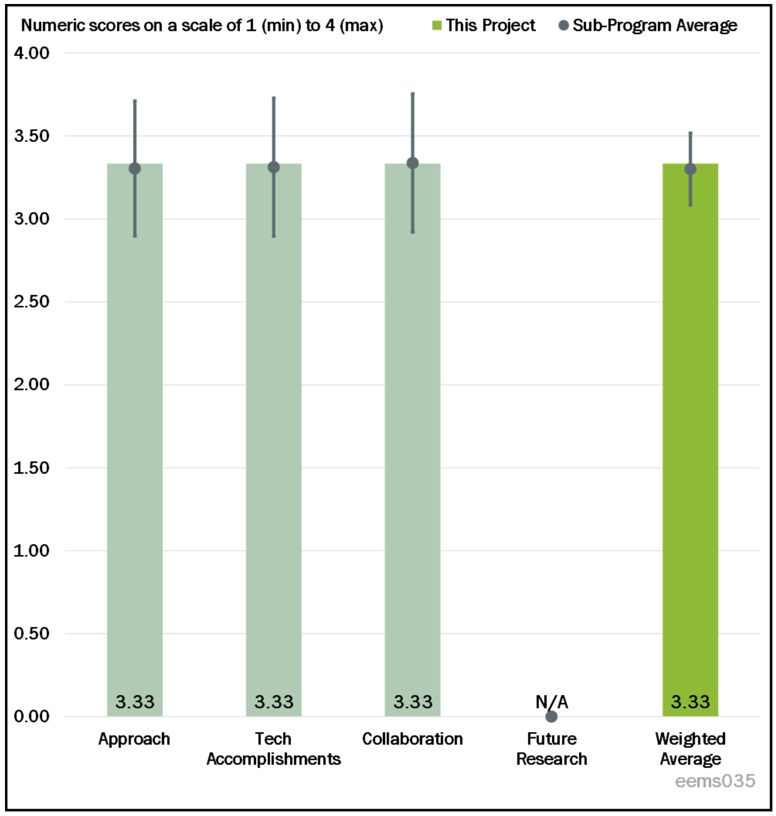

Figure 3-15 - Presentation Number: eems035 Presentation Title: Coupling Land-Use Models and Network-Flow Models Principal Investigator: Paul Wadell (University of California at Berkeley)

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:

Urban Simulation (UrbanSim) is the only land-use model in the SMART Mobility workflow and is thus path-critical for most core models. It involves land-use change, vehicle ownership, and advanced accessibility analysis.

Reviewer 2:

Interactions between land use and mobility will be critical to understanding the energy impacts of future transportation systems. The project is a good example of interaction of models for analysis.

Reviewer 3:

This project fits well within the EEMS end-to-end modeling workflow. The project basically combines vehicle-side modeling (new forms of mobility, travel behavior, advanced charging infrastructure, traffic-flow analysis, vehicle ownership, etc.) with land-use change modeling. The project utilizes POLARIS and Behavior, Energy, Autonomy, and Mobility (BEAM) for the vehicle side, combined with UrbanSim as the land-use model, and coupled with ActivitySynth in the SMART Mobility workflow.

The project outlined three principal objectives: develop an integrated modeling pipeline that encompasses land use, travel demand, traffic assignment, and energy consumption; model combined and cumulative impacts of transportation infrastructure and land use; and improve computational performance to simulate regions over 30 years for scenario analysis. The project appears to have been well designed and targeted to overcoming specific barriers initially identified in the overview.

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 project has successfully completed all of the identified quarterly milestones. A number of technical accomplishments with regard to modeling have been achieved. Utilizing UrbanSim and POLARIS, this includes identification and validation of workplace choices and activity demand generation; and identification of average commute times by scenario and how this translates to changes in the built environment. Results indicate a relationship between decentralized jobs accessibility and rent job density gradients.

Technical accomplishments also include validation of activities through ActivitySim. This includes validation of departure time with the Metropolitan Transportation Commission (MTC) travel model results for work and school. Also, validation has been achieved of mode shares for mandatory and non-mandatory commute trips, commute trip distance, school choice, and auto-ownership models. Additionally, the project has demonstrated on a graphics processing unit (GPU) the ability to significantly scale performance. Simulation statistics have been developed for departure times, average speeds, and edge volumes. Finally, the project is conducting ongoing model enhancements to further improve validity with regards to real activity demand, dynamic shortest path, intersection modeling, and control inference. Significant improvements in model run times have also been achieved. In short, this reviewer observed a strong list of technical accomplishments.

Reviewer 2:

UrbanSim, coupled with BEAM and POLARIS models, showed results that closely match MTC travel model results. Workflow enhancements have significantly reduced model run times and were validated with Uber movement speed.

Reviewer 3:

The project makes good progress toward its goal of understanding the combined impacts of land use and mobility on energy use, as well as outlining continued model refinements.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The project lead is LBNL and project partners include NREL, ORNL, INL, and ANL. Further collaborators include Google, Purdue University, and the MTC. Overall, the project consists of a solid and diverse set of participants for a relatively modestly funded project. The role of each partner was sufficiently identified or could be inferred from the presentation.

Reviewer 2:

The project consisted of a strong team including the five DOE SMART Consortium National Laboratory partners and collaborators, such as Google, Purdue University, and the MTC.

Reviewer 3:

No additional details on the roles taken by each of the partners were provided in 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. Note: if the project has ended, please state project ended.

Reviewer 1:

Future research focused appropriately on refining accuracy of the model.

Reviewer 2:
The project has ended, so proposed research is not applicable. However, if future activities were considered, it would be good to aggressively pursue methodologies to increase the confidence in future modeling predictions, given the extremely long-term time frames (up to 30 years) required of urban planning. During the AMR presentation, the PI discussed new technologies and approaches that are emerging that would help address the challenges of very long-term modeling predictions within the environment of a quickly evolving transportation technology landscape in the near- to mid-term. This was interesting and encouraging to hear.

Reviewer 3:
The project has ended, and no future research was discussed.

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

Reviewer 1:
This project is relevant to VTO objectives as linking long-term modality styles with short- and medium-term mode choice in a multi-modal transportation system (with the ability to simulate emerging mobility services) helps quantify the impact of urban development on mobility patterns and energy use.

Reviewer 2:
Yes, the project is very relevant to the EEMS goal of better understanding the impacts of emerging mobility services.

Reviewer 3:
Yes, the project is relevant because it serves to help quantify the impact of urban development on mobility patterns and energy use and the impact of SMART Mobility technologies on long term urban development. It supports the EEMS goal of linking long-term modality styles with short and medium mode choice in a multi-modal transportation system, with the ability to simulate emerging mobility 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 commented that $690,000 of funding for a 2-year project that involved DOE SMART Consortium National Laboratories and additional partners seems a bit low for the significance of the project scope. Because UrbanSim is the only land-use model in the SMART Mobility workflow, it is critical for most core models.

Reviewer 2:
Funding seems appropriate for such a computationally rigorous analysis.

Reviewer 3:
The resources allocated have proven sufficient to achieve the stated objectives.

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 two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

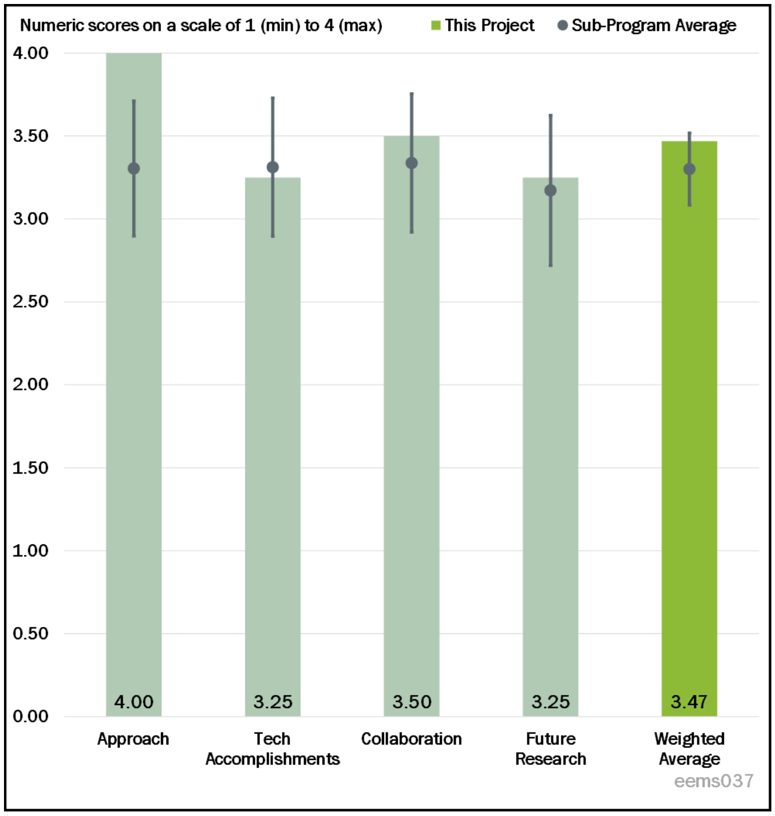

Figure 3-16 - Presentation Number: eems037 Presentation Title: High-Performance Computing (HPC) and Big Data Solutions for Mobility Design and Planning Principal Investigator: Jane Macfarlane (Lawrence Berkeley National Laboratory)

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 approach is outstanding as the team has already demonstrated significant success in travel-demand modeling. Many of the traditional challenges are addressed through high performance computing (HPC), artificial intelligence (AI) and machine learning (ML) approaches that have not necessarily been perfected before. The results look promising.

Reviewer 2:

The reviewer believed the analysis was the best that could have been achieved within the sensor input source parameters and data received from live sources such as Uber. The barriers mentioned to overcome encompassed real issues and not hypothetical ones. Even the end product will be hard to fully and accurately be used in all metropolitan locations because of different limitations.

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 project goal was stated as seeking an urban-scale digital twin to the real-world traffic patterns for the northern California region. It appears that the team has made significant strides toward this goal with notable progress. Therefore, the reviewer would characterize the project team's progress as excellent.

Reviewer 2:
Real-life performance indicators may have varied during the pandemic where probably fewer passenger vehicles entered the equation with the same or more heavy transport vehicles that were not part of the scenario. This would mean less traffic on city streets where cars move, and fewer cars on the interstates. The project team was still able to model those changes into the program. It should be interesting to see how everything plays out as the project wraps up in September.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
As indicated on one of the final slides, the collaboration seems to be broad and comprehensive, and results speak for themselves as evidence of strong coordination within the team.

Reviewer 2:
Judging by the list of participates, the project team had a good cross section of inputs from academia, individuals, transport companies, data suppliers, and transportation departments.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
All of the proposed future research seems reasonable. As mentioned in the question and answer (Q&A) section, data are always the issue with any project. Nonetheless, the reviewer wondered if there still might be other data out there to provide more training data and/or validation data. For example, the reviewer did not hear Waze data mentioned, despite knowing that DOT currently logs all Waze data nationwide. Perhaps there could be an additional team member and collaboration incorporating this company or other data.

Reviewer 2:
The reviewer believed that, before the change in driving habits, the project team was right on track. The team will have to change the manner in which the rest of the experiment is being conducted to figure out if the new normal that affects traffic will remain in some part, completely go back to how it was, or totally change with the vehicle makeup, which would dictate traffic flows, times, and emissions.

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

Reviewer 1:
Clearly, this project addresses the question of transportation energy use, connectivity, and novel approaches to modeling.

Reviewer 2:
Since this project deals with mimicking traffic patterns and aims to adjust those patterns for better flow and reduced congestion—ultimately yielding to less energy use—it is relevant.

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

Reviewer 1:
From the reviewer’s point of view, the resources seem well aligned with the accomplishments, team size, and future direction.

Reviewer 2:
The project team is a few months away from completing the study and is in good shape to complete it on time without requiring any more outside assistance.

Presentation Number: eems038
Presentation Title: Charging and Repositioning Decision Making for Fully Automated Ride-Hailing Fleet
Principal Investigator: Zonggen Yi (Idaho National Laboratory)

Presenter

Zonggen Yi, Idaho National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

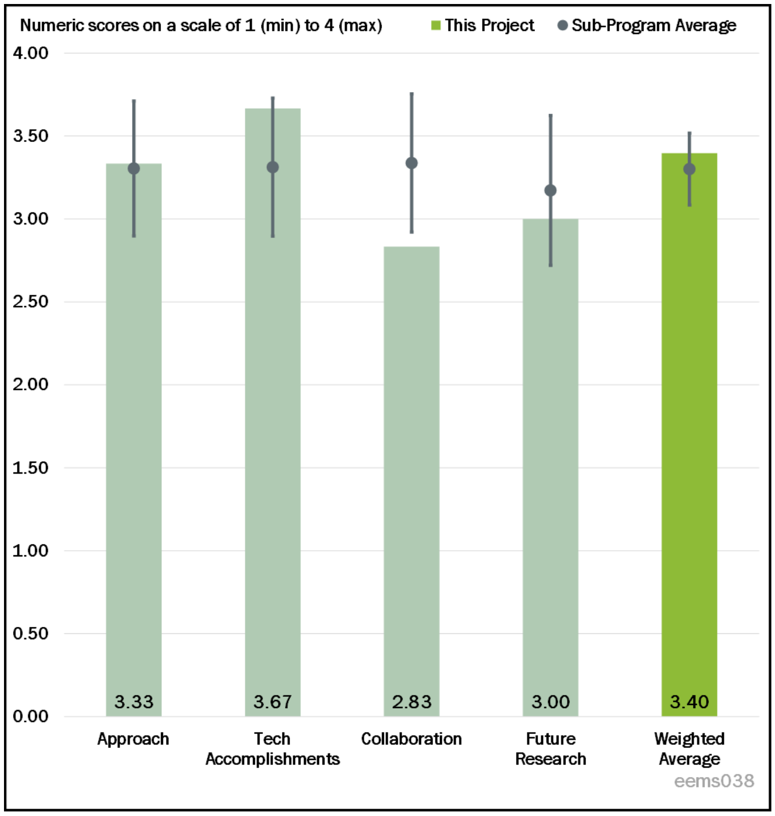

Figure 3-17 - Presentation Number: eems038 Presentation Title: Charging and Repositioning Decision Making for Fully Automated Ride-Hailing Fleet Principal Investigator: Zonggen Yi (Idaho National Laboratory)

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:

This project is very impressive in the amount of work that was done for only $100,000. The objective was specific, and the chosen real-world program provided the data required to complete the program. For many, this is a barrier that is never overcome. An optimized dispatch system was also developed for the New York data set. Similar scopes of work have taken longer and been substantially more costly.

Reviewer 2:

This project investigated two different models for autonomous electric vehicle (AEV) fleet operation (charging and ride-hailing). The systematic optimization approach considered all vehicles, ride requests, and chargers in the New York City area. Multiple criteria were applied to choose which vehicles to reposition in which areas and whether and where to charge. The heuristic approach assumed each vehicle independently decides whether and where to reposition and charge. Using today's New York City charging network of level 2 (L2) and direct-current fast charging (DCFC) seems unrealistic as significant AEV deployment would most certainly require a significant number of additional chargers in specific locations to serve an AEV fleet ranging from 500 to 4,000 vehicles.

Reviewer 3:

The project provides a nice approach for evaluating future AEV fleet management with regard to ride-hailing service performance and necessary charging for providing that service using two disparate AEV control methodologies. The approach developed a framework for evaluating system-level versus basic heuristic AEV fleet management methods, as well as some insights about their effectiveness when applied in major urban settings like New York City.

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:
For a fleet of 1,750 ride-hailing AEVs, optimization-based, centralized fleet management would result in 14% more ride requests satisfied and 43% fewer zero-occupancy miles traveled than if AEVs make independent decisions based on a heuristic strategy. To satisfy 90% of ride requests, an AEV taxi fleet using a heuristic strategy needs 15% more vehicles than a centrally and optimally controlled fleet. The smaller, centrally controlled fleet also drives 19% fewer empty miles. DCFC is essential for either scenario.

Reviewer 2:
The project succeeded in meeting its objectives of developing two methods for managing the ride-hailing service and charging requirements for AEV fleets; employing those methods in a New York City-based simulation; and quantifying their benefits from a ride-hailing service and effective charging basis. All project milestones were achieved within the proposed 1-year timeframe. The New York City simulation results indicated that the optimized system-level method generally offered significant advantages over the heuristic method for the AEV ride-hailing fleet sizes that were considered.

Reviewer 3:
The program was completed on schedule in 1 year and the objectives were met.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
This project was part of the Advanced Fueling Infrastructure (AFI) pillar. No specific collaborators were mentioned, but the project length was only 1 year with $100,000 of funding. Assumptions and methodologies were coordinated with EEMS039.

Reviewer 2:
The reviewer commented that this was a difficult category, as there was little collaboration in the program by design. However, none was necessary to complete the program, so it is unfair to lower the rating for that. The singular focus at INL was probably also a major contributor to the amount of work that was completed in just 1 year and the low cost to accomplish it. While the reviewer cannot rate collaboration as excellent, as it has no collaboration, the project was designed to move without significant collaboration and was successful.

Reviewer 3:
No direct collaboration with other organizations was presented by the researcher. The researcher did collaborate with another INL investigator—EEMS039—with a similar research scope to share assumptions and methodologies, but no significant details on this coordination were presented with regard to the project. For future work, the research may solicit input from TNCs for possible insights on current and future AEV fleet management.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The project has ended. Several future research recommendations have been made, including a study on how to manage high-mileage EV driving and charging to maximize vehicle and battery life.

Reviewer 2:
Although this 1-year project has been completed, the researcher offered several future-related research topics, including expansion of dynamic control algorithms for adapting to changing grid and traffic conditions, system-level predictive capabilities, and management of AEVs for optimizing vehicle and battery lifetimes.

Reviewer 3:
Not applicable was indicated by this reviewer.

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

Reviewer 1:
Fleet management and charging strategies for an autonomous EV fleet are directly relevant to future transportation systems and their impact on energy use (including petroleum reduction) and emissions.

Reviewer 2:
The project has quantified the effect of more rapidly charging AEVs and the benefits of an active optimization of ride-hailing management. These both provide a runway for early application of AEVs in ride-hailing services, which is a DOE objective.

Reviewer 3:
This project is relevant to DOE's EEMS program in that it researches the nexus of automated ride-hailing vehicle fleet management and productivity and electric infrastructure charging and availability.

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

Reviewer 1:
Significant work was accomplished in a short period and for little cost. The reviewer exclaimed more of this kind of success is needed!

Reviewer 2:
The project was a "quick look"-type of a project with only $100,000 of funding over a 1-year period, which is a good, brief investment to understand the significance of the opportunity that AEVs present.

Reviewer 3:
The funding for this project seems sufficient for a 1-year project and for the technical accomplishments presented.

Presentation Number: eems039
Presentation Title: Charging Infrastructure Design Tradeoffs for a Fleet of Human-Driven and Fully Automated Electric Vehicles in San Francisco
Principal Investigator: John Smart (Idaho National Laboratory)

Presenter

John Smart, Idaho National Laboratory

Reviewer Sample Size

A total of four reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

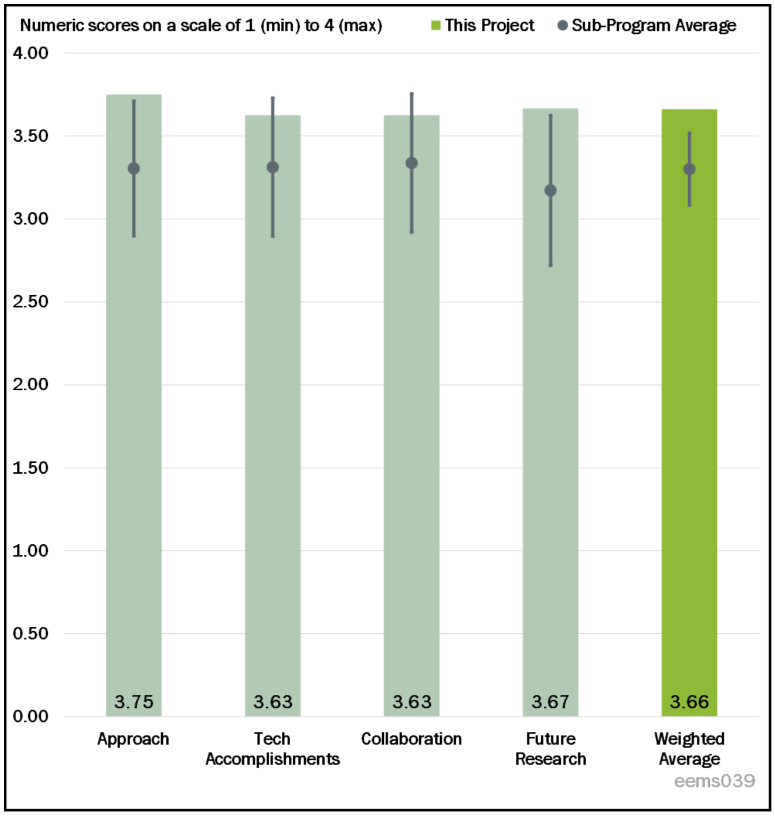

Figure 3-18 - Presentation Number: eems039 Presentation Title: Charging Infrastructure Design Tradeoffs for a Fleet of Human-Driven and Fully Automated Electric Vehicles in San Francisco Principal Investigator: John Smart (Idaho National Laboratory)

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:
Nicely done project.

Reviewer 2:
At its onset, the project was faced with a wide range of potential areas of investigation. The scope of the project was sufficiently focused to enable analyses to result in useful conclusions.

Reviewer 3:
The PI and project team have presented a well-designed project and conducted the work to completion.

Reviewer 4:
This is a really good problem and the reviewer looked forward to future work. The reviewer noted the classic chicken-or-the-egg of cars or infrastructure, and more specifically, asked how much of each and where. The team had a solid approach to kicking off these efforts, which the reviewer expected will continue with more funds.

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 team delivered a very good presentation, and the reviewer mentioned it is sad to see this project ending.

Reviewer 2:
The project is complete and has generated very useful results, including insight into the impacts of sparse charging infrastructure and the cost impacts of richer infrastructures.

Reviewer 3:
The project has been completed, and all project deliverables have been met.

Reviewer 4:
Good use of graphics. It is obvious that showing the analysis results for stakeholder understanding was important to the team. All were helpful in sharing the key conclusions, particularly the building ones starting on Slide 16. The challenge in the green box on Slide 22 seemed a bit challenging and could be off-putting. While probably not intended, the reviewer suggested being careful as all stakeholders need to be engaged rather than disengaged, which can occur too easily. The reviewer emphatically praised the good work here.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Excellent project coordination between INL, LBNL, ANL, and NREL. DOE should ensure that more projects feature this kind of integrated, multi-laboratory coordination.

Reviewer 2:
The project utilized resources from LBNL, INL, ANL, and NREL, which were coordinated in the Smart Mobility Consortium, to complete work tasks.

Reviewer 3:
Seemingly good leverage was noted by this reviewer.

Reviewer 4:
The reviewer described collaboration and coordination across the project team as excellent for the defined partners, and believed that projects like this could very much benefit from an industry advisory committee. Why does that not seem to be an option on these projects? The reviewer believed there would be interested parties to do this at no cost and a line on confidentiality could be drawn. Perhaps this could be suggested for a future 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. Note: if the project has ended, please state project ended.

Reviewer 1:
The project is tackling relevant questions and offering quantitative, easily transferable results.

Reviewer 2:
In the “future research” section, the PI and team accurately captured what the reviewer was thinking throughout the presentation, which was how to expand this more generally so that other urban population centers can conduct this analysis in a cost effective way. Future work should also consider the costs associated with any detrimental effects to TNC vehicles due to rapid charge and discharge of the battery (e.g., battery degradation).

Reviewer 3:
The reviewer understood that, at this point, the project team is suggesting industry validation. As stated previously, the reviewer thought this would be easier if a bit of industry involvement occurred earlier. The reviewer appreciated the consideration and liked bringing in level-of-service targets, which came up in a few earlier evaluator questions.

Reviewer 4:
Not applicable was indicated by this reviewer.

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

Reviewer 1:
Charging infrastructure availability is integral to transportation electrification. Understanding the placement and the quantity of charging infrastructure, particularly in the early stages of transportation electrification, is key to supporting transportation electrification. This project provides initial insights into the quantity and cost of the required infrastructure.

Reviewer 2:
Understanding the cost-benefit analysis tradeoffs associated with building more charging infrastructure compared to larger battery sizes is valuable for TNC expansion.

Reviewer 3:
The project is very relevant to the current shared economy.

Reviewer 4:
The project is very relevant.

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

Reviewer 1:
The project was completed on schedule and produced excellent results. This is indicative that the resources were sufficient.

Reviewer 2:
The resources appear sufficient across the project team.

Reviewer 3:
The project resources were good.

Reviewer 4:
This reviewer reported that the project ended.

Presentation Number: eems040
Presentation Title: Dynamic Wireless Power Transfer Feasibility
Principal Investigator: Omer Onar (Oak Ridge National Laboratory)

Presenter

Omer Onar, Oak Ridge National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

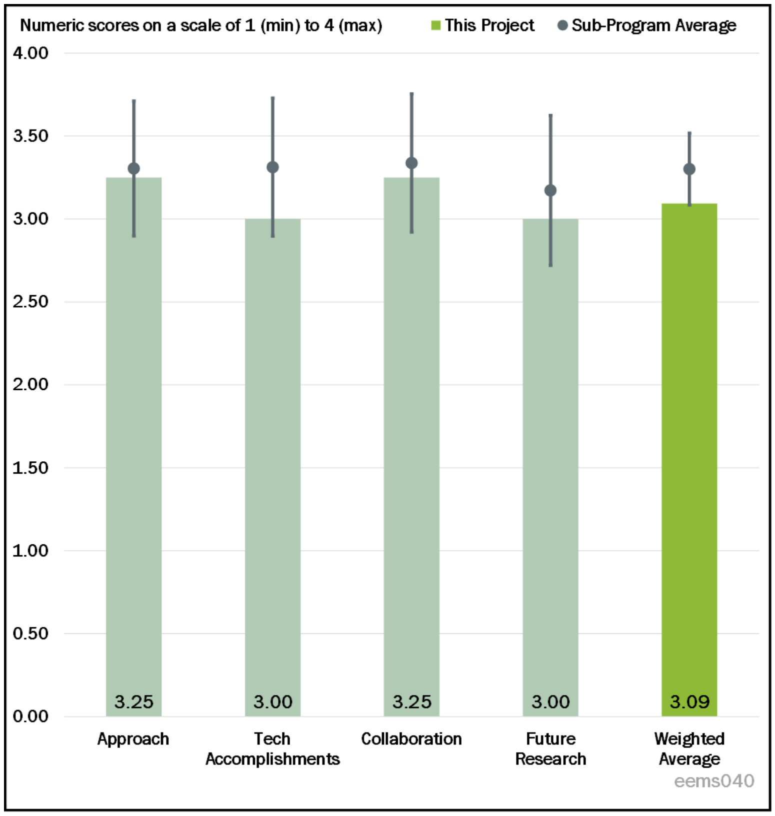

Figure 3-19 - Presentation Number: eems040 Presentation Title: Dynamic Wireless Power Transfer Feasibility Principal Investigator: Omer Onar (Oak Ridge National Laboratory)

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 project both developed an optimization technique and applied it to a specific purpose. With the vast number of factors that can impact the feasibility of dynamic wireless power transfer (DWPT), let alone its optimization, the analysis of specific applications appears to provide the greatest value for determining the value of DWPT. Otherwise, this appears to be a solution in search of a problem.

Reviewer 2:

The sound modeling approach includes characterizing vehicle energy consumption for CAVs; creating an optimal framework for sizing and placement of DWPT segments; estimating grid requirements; and validating with real-world data from M-City.

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 stated technical accomplishments of evaluating vehicle energy consumption levels and DWPT system requirements, in addition to grid infrastructure requirements, is well received. A scheme for implementing in-route DWPT has been worked out and suggests that a fully automated system can be realized with charge-sustaining operation and unlimited range. The reviewer exclaimed this is very impressive and would allow a dramatic reduction in battery sizing.

An additional key finding is that with 8%-12% of route coverage using 200-250 kilowatt (kW) DWPT, charge-sustaining operation can be maintained at 70 miles per hour (mph).

Reviewer 2:
The analysis of the Arma shuttle to demonstrate the optimization techniques was a significant accomplishment. However, the results were rather qualitative and should have been reduced to a common cost denominator.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The inter-laboratory coordination was evident, but interface with the M-City Arma shuttle was excellent and key to achieving the technical results.

Reviewer 2:
Collaborations with INL have gone well.

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

Reviewer 1:
Although the project is complete, a subsequent effort could be focused on real-world verification of the proposed schemes from the present effort.

Reviewer 2:
Not applicable was indicated by this reviewer.

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

Reviewer 1:
This project fully supports DOE EEMS's stated objectives of minimizing energy use via CAVs with reduced mass, cost, and onboard energy storage.

Reviewer 2:
Unfortunately, the response choice here is bi-stable. The reviewer indicated yes because this project has demonstrated the DWPT concept; currently, it does not have quantifiable benefits outside of a specific application. The reviewer would consider future work as not supporting DOE objectives unless tied to solving an issue with a specific application.

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

Reviewer 1:
The project completed its milestones on schedule and is currently complete.

Reviewer 2:
The FY 2019 funding of $235,000 was adequate.

Presentation Number: eems041
Presentation Title: ANL Core Tools—Hardware
Principal Investigator: Kevin Stutenberg (Argonne National Laboratory)

Presenter

Kevin Stutenberg, Argonne National Laboratory

Reviewer Sample Size

A total of four reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

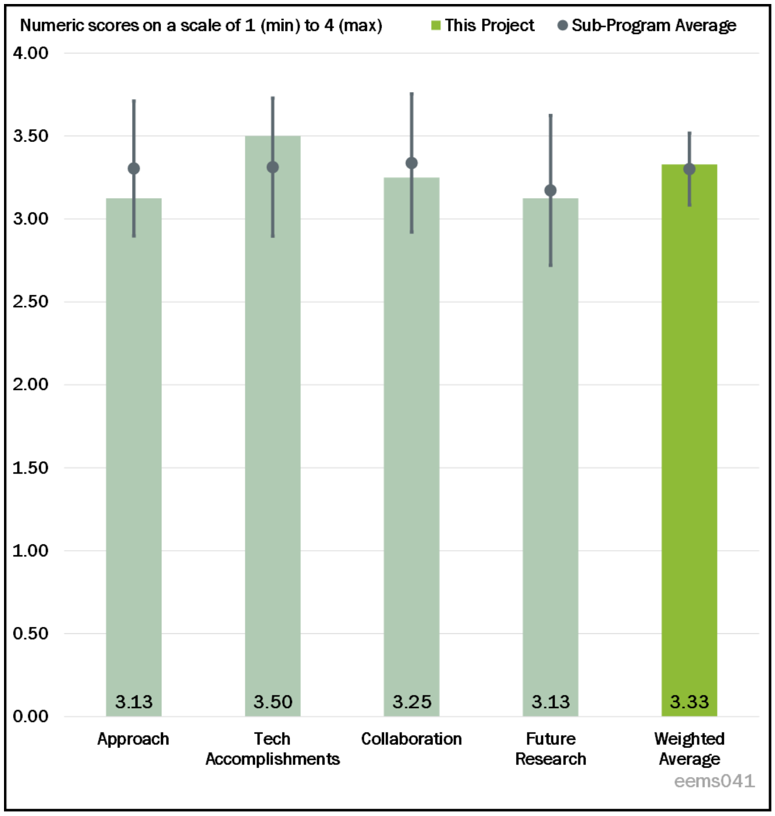

Figure 3-20 - Presentation Number: eems041 Presentation Title: ANL Core Tools—Hardware Principal Investigator: Kevin Stutenberg (Argonne National Laboratory)

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 investigators do a great job of making do with what is available and have come up with ingenious workarounds to answer the posed questions.

Reviewer 2:
Overall, the project is doing a solid job of advancing the work.

Reviewer 3:
The approach to quantifying the benefits of CAVs by creating unique, versatile hardware and software tools as part of this project is very sound.

Reviewer 4:
The vehicle-in-the-loop (VIL) approach adds credibility to the modeling results of impacts of CAV technologies.

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:
Progress has been generally excellent. The VIL work is outstanding, and the on-the-road aerodynamic work is interesting and valuable.

Reviewer 2:
Technical accomplishments—creating and calibrating the VIL system as well as quantifying the effects of platooning, aerodynamics, driver models, accessory loads, etc.—provide an excellent foundation for MEP calculations.

Reviewer 3:
The team seems to have made solid progress over the last year.

Reviewer 4:
Additional clarity on the true project objective will help. There are way too many combinations of vehicle types, orders, chains, and condition, to simulate them all; this is complicated by continuously changing vehicles on the road. Given this, the reviewer wondered if the real objective is to understand generalized conditions. If not, better articulation of the objectives and what can realistically be developed and show output will help align the output with the objectives.

The other primary question the reviewer had is that if there is no standard method for CAVs, then how does the work extend? The reviewer would like the team to explain further and in greater detail in future documentation.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Partnerships provide the appropriate data required for the research, and an excellent effort was achieved in making the collected data publicly available.

Reviewer 2:
Collaboration and coordination with EcoCAR, NHTSA, Wayne State University, Clemson University, Michigan Technological University, etc., are well executed.

Reviewer 3:
This type of collaboration is not always easy, but the project seems to be doing a solid job in engaging and ensuring communication and input across the range of partners. This should remain an important focus of the project management, and the value is very dependent on the coordination and transfer of information.

Reviewer 4:
Collaboration exists, but it is still unclear who would be the transition partners.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The proposed future research appropriately extends the work that has been done to date.

Reviewer 2:
Planned future work on expansion of the VIL capabilities with connectivity, driver-in-the-loop, additional powertrains, as well as additional aerodynamics cases will widen the span of the project research findings.

Reviewer 3:
The plan seems logical, but the value of the proposed future research could be better articulated.

Reviewer 4:
This reviewer had nothing to add.

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

Reviewer 1:
This project provides data for other DOE VTO projects, which improve the quality of the results of those projects.

Reviewer 2:
This project strongly supports DOE EEMS's stated objective of investigating a possible reduction of transportation energy use via CAVs.

Reviewer 3:
This project contributes to the understanding of energy savings from CAV technologies in vehicle operations.

Reviewer 4:
The current work appears to meet DOE objectives. For this to remain the case in the future as the project nears completion, the researchers will need to distill and generalize the findings in a useful and actionable way. Otherwise, it will primarily end up as an academic exercise.

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

Reviewer 1:
The FY 2020 budget of $750,000 is adequate to complete the target deliverables.

Reviewer 2:
The project is sufficiently funded.

Reviewer 3:
Resources are adequate. However, some state-of-the-art vehicles are not covered by this work. It seems additional resources might be required to cover the rapidly evolving vehicle space.

Reviewer 4:
While the researchers note the potential need for additional resources, the reviewer believed the resources are sufficient to continue progress along the proposed schedule and meet the objectives if work remains properly focused.

Presentation Number: eems044
Presentation Title: Quantification of National Energy Impacts of Electrified Shared Mobility with Infrastructure Support
Principal Investigator: Joann Zhou (Argonne National Laboratory)

Presenter

Joann Zhou, Argonne National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

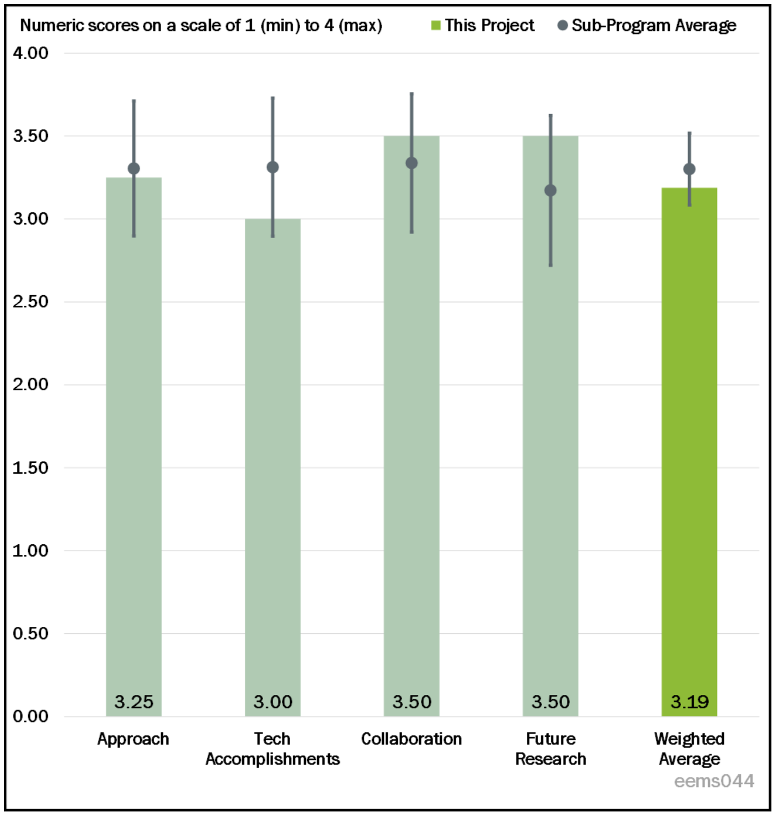

Figure 3-21 - Presentation Number: eems044 Presentation Title: Quantification of National Energy Impacts of Electrified Shared Mobility with Infrastructure Support Principal Investigator: Joann Zhou (Argonne National Laboratory)

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:

Comments from previous reviews point out that the project has substantial uncertainties due to lack of data, models that were used, and impacts of factors that were not considered in the analysis. While this should have been anticipated during the project's inception, the team did a good job of trying varied analytical approaches (top down versus bottom up) to try to bring clarity to the results. The development of this analytical framework provides a foundation for future work defining the usefulness of electrifying ride hailing.

Reviewer 2:

The approach to performing the work and addressing barriers is well designed. In future work, the PI should consider including a diversity of DCFC types, including those above 50 kW (up to 350 kW).

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 PI has completed all deliverables as planned.

Reviewer 2:

The project is complete and has provided some quantification of the impacts of electrifying ride hailing and the effects of battery electric vehicle (BEV) penetration and charging availability. However, the results have sufficient uncertainty that they are only useful to confirm what one would intuitively anticipate: more chargers and more EVs will save more fuel. The exploration of multiple methods of quantifying national energy impacts has significant value for guiding future work.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Coordination between ANL, NREL, and ORNL has been significant while conducting the project work.

Reviewer 2:
The project has solid partnerships across ANL, ORNL, and NREL. Now that the project is complete, the PI should work with DOE to communicate the project results to the shared mobility industry and request feedback for future research in this arena.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The reviewer indicated that the project has ended and suggested that the PI consider social equity in future research in shared mobility, especially when considering the value of electric utility support in growing charging infrastructure for shared mobility programs for limited income populations.

Reviewer 2:
Not applicable was indicated by this reviewer.

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

Reviewer 1:
Understanding how transportation electrification can impact national energy use is clearly supportive of DOE objectives. While the objective of providing quantification of this impact was not fully met, the development of an analytical framework for future projects supports DOE efforts to fully understand and quantify the impacts of transportation electrification on national energy use.

Reviewer 2:
Accurately measuring system-wide transportation impacts of AFI supporting shared mobility is timely and relevant to DOE objectives.

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

Reviewer 1:
Milestones were met, evidencing that sufficient resources were available.

Reviewer 2:
Time and financial resources were efficient to complete the project.

Presentation Number: eems045
Presentation Title: Focused Validation and Data Collection to SMART Activities
Principal Investigator: Eric Rask (Argonne National Laboratory)

Presenter

Eric Rask, Argonne National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

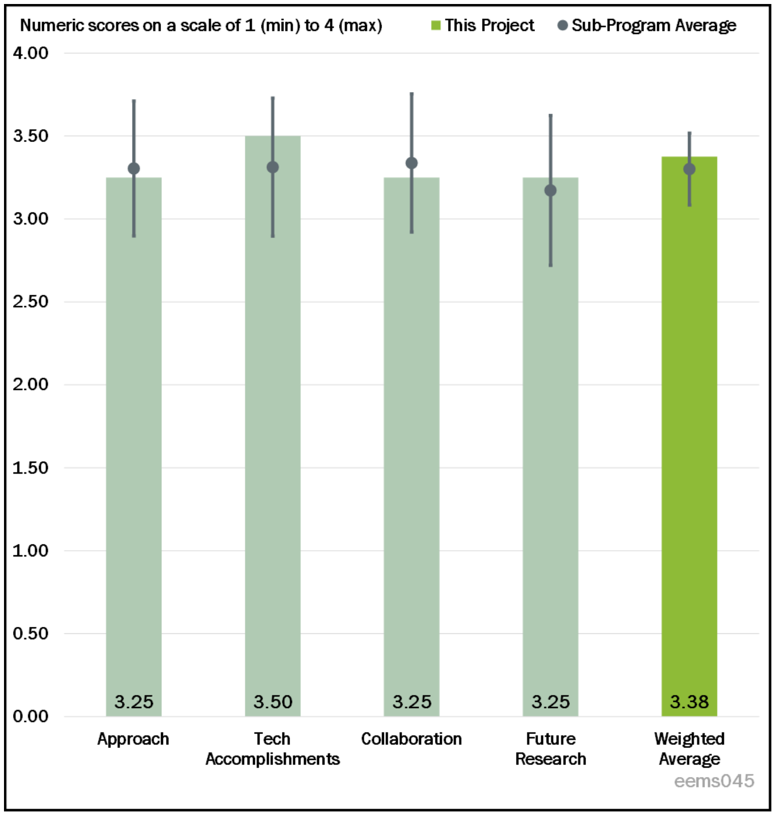

Figure 3-22 - Presentation Number: eems045 Presentation Title: Focused Validation and Data Collection to SMART Activities Principal Investigator: Eric Rask (Argonne National Laboratory)

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 team did very good work in designing the project to achieve maximum results with limited resources and a somewhat open-ended subject since CAVs are emerging technology.

Reviewer 2:

As the PI mentioned, this was a first “nibble” in this area and an important one according to the reviewer. It is challenging to have two projects within one. Color coding the presentation was a good idea for this reviewer’s understanding.

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:

Important results have been obtained that help to clarify inputs for other projects (e.g., power consumption of a vehicle sensor suite). The team did good work on the automated shuttle, another emerging technology option.

Reviewer 2:

Activities completed matched the goals of the project’s broad description. The team has brought to the forefront the sensing and computing loads that are significant and likely underappreciated before this work. Future work should more explicitly estimate the options going forward to mitigate these loads (e.g., the situation today is x, but improvements can reduce the power demand to y in the future).

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The listed partners are helpful in providing either data and/or hardware needed for achieving the project goals.

Reviewer 2:
Evidence presented showed good collaboration across the labs, but the reviewer believed more involvement by industry would have helped. Could there have been some sort of industry advisory committee for this project? Is that done with DOE projects? Should it be? Maybe such a committee could meet only once or twice per year.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Future work continues and extends the existing project work. A bit more detail would be helpful.

Reviewer 2:
The reviewer believed proposed future work was missing in the review. As this first nibble, this team should have proposed a much longer and deeper list of suggestions for future work.

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

Reviewer 1:
Knowledge and data gained from this project are used to inform other DOE VTO project work.

Reviewer 2:
The reviewer responded that, absolutely, there are oftentimes adverse consequences and power demand for the new technology is clearly one.

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

Reviewer 1:
The project is working well with the existing resources. However, more funding would be beneficial in expanding the vehicles available for study, particularly as more OEMs produce L2 and L3 capable vehicles.

Reviewer 2:
The project resources are sufficient.

Presentation Number: eems057
Presentation Title: Urban Traveler–Changes and Impacts: Mobility Energy Productivity (MEP) Metric
Principal Investigator: Venu Garikapati (National Renewable Energy Laboratory)

Presenter

Venu Garikapati, National Renewable Energy Laboratory

Reviewer Sample Size

A total of four reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

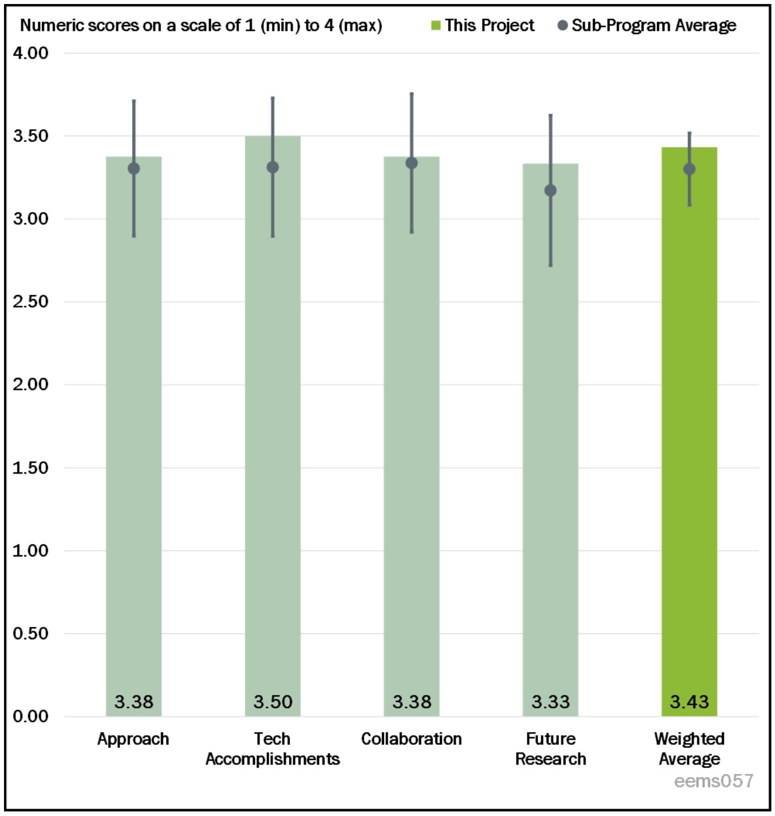

Figure 3-23 - Presentation Number: eems057 Presentation Title: Urban Traveler–Changes and Impacts: Mobility Energy Productivity (MEP) Metric Principal Investigator: Venu Garikapati (National Renewable Energy Laboratory)

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 approach seemed sound for this MEP-focused project.

Reviewer 2:
The design of the project has been greatly enhanced by addressing the concerns of the previous review. It is feasible, and technical barriers have been addressed.

Reviewer 3:
The project clearly addresses the need to establish a practical metric to quantify MEP and design integration of the value into other models evaluating travel behavior, autonomous vehicles, and regional planning carried out by National Laboratories and regional planning agencies. The capability to illustrate results in a geo-spatial display makes the metric more useful and understandable in comparative analyses.

Reviewer 4:
The model has potential as a useful framework for performing scenario analyses for policy development. However, urban policy generally focuses on improving quality-of-life factors, such as air quality, safety, and noise, none of which is addressed in the model (but likely correlate with it). Also, the relative value of renewables should be weighted with a premium in parts of the country where the grid is comprised of greater renewable electricity.

The model also does not propose a metric for robustness of each mode. The number of the assumptions varies considerably within each transport mode; the benefits of some modes, perhaps such as walking, have a narrow range of assumptions. Transport by private cars, ride sharing, and CAVs has a broad range of assumptions. Particularly when a disruptive event like COVID-19 comes into play, it suggests the importance of a robust metric for sustainability and/or resilience. This tool could likely address such questions, but presently does not.

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 project exhibited success in generating energy productivity scores for 50 top metropolitan areas in the United States, although it appears this met half of the 100-city goal. This success still provides a baseline to compare the impact of future actions initiated by cities and regional planning organizations. The deep-dive analysis provided greater insights than expected. It is good to see MPOs picking up the tool to use in regional planning.

Reviewer 2:
According to the reviewer, good progress and findings have been made to date. The fact that several municipalities are considering utilizing MEP tool shows success and validity.

Reviewer 3:
The application of the tool to many cities in the United States demonstrates good progress. Further work is needed to develop MEP models for emerging trends in micro-mobility and teleworking.

Reviewer 4:
Overall, the technical accomplishments and progress were excellent (and actually wrapping up). The main concern or at least question about MEP as a metric is around what difference in MEP for a given scenario is statistically significant, producing a real and noticeable change to the transportation system? While MEP is clearly useful qualitatively and directionally, it is not clear if it is worth pursuing a different scenario from the baseline for an MPO for a MEP difference of x, for example.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The project displayed an outstanding effort to integrate energy productivity with the BEAM and POLARIS models and the SMART Mobility Team with input and collaboration with industry partners.

Reviewer 2:
The outreach to various MPOs, Transportation Planning Organizations (TPOs), and state DOTs is especially impressive and worth promoting further.

Reviewer 3:
Overall, the collaboration seemed fine, but it also seemed like the collaboration should have included DOT in the research team.

Reviewer 4:
Collaboration across the project team was hard to discern in the presentation. It was not totally clear who was doing what. The partners are excellent and diverse, but there needed to be a slide and discussion on division of tasks.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
While this project is finished for now, the future research suggestions is nonetheless useful and on point.

Reviewer 2:
Proposed future research was very well defined but may need to change due to COVID-19 and other disruptors. It does seem that the algorithm will allow this to be included.

Reviewer 3:
The project ended.

Reviewer 4:
The proposed follow-up research is reasonable. Given the impact of COVID-19 on travel demand and the related economic downturn, it might be worth adding an income and wealth dimension to the model that provides insights about impacts on disadvantaged communities. Also, it might be worth modeling the impact of telecommuting and work-at-home trends spurred by COVID-19 and comparing energy productivity by adopting a more integrated intercity rail, subway, surface tram, and bicycling “what if” scenario as seen in several European cities.

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

Reviewer 1:
Multi-modality is vital. With this addition, the project is quite valid.

Reviewer 2:
The project is definitely relevant to DOE objectives, though the only concern is ensuring there is not duplicative efforts with other projects.

Reviewer 3:
The MEP project supports DOE’s current objectives.

Reviewer 4:
The project advances and is consistent with DOE goals to improve the energy productivity evaluation of a future integrated mobility system.

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

Reviewer 1:
A significant amount of work seems to have happened, given the (now complete) funding for this project.

Reviewer 2:
The funding and resources have been sufficient to successfully achieve the project goals.

Reviewer 3:
Resources appear to be fine, but the role of each needs clarification.

Reviewer 4:
The project was completed on schedule even though additional cities could have been added in a comparative analysis.

Presentation Number: eems058
Presentation Title: Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility Consortium Tools and Process Development
Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)

Presenter

Aymeric Rousseau, Argonne National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

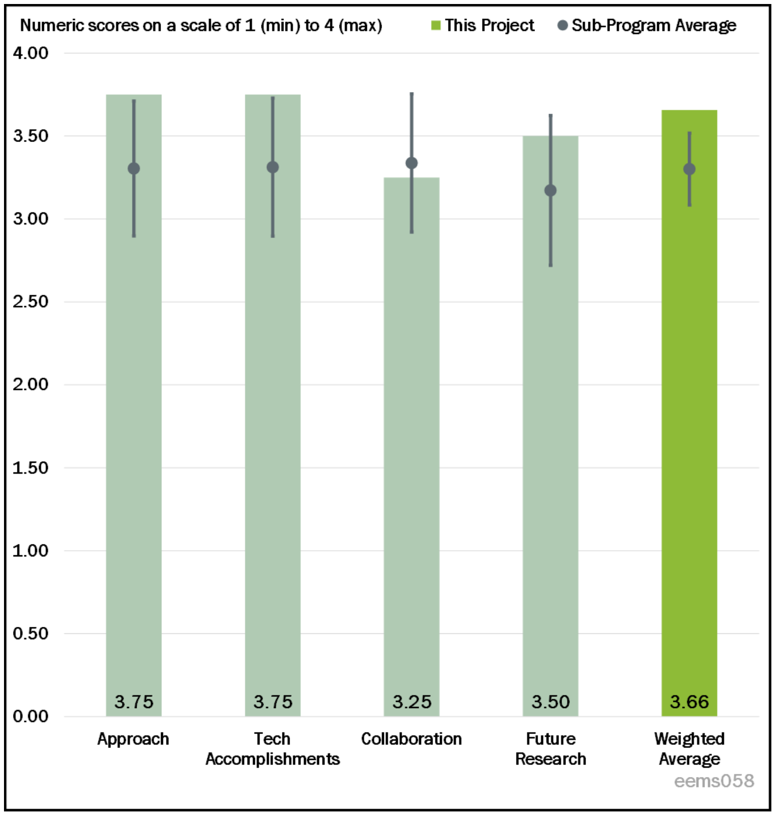

Figure 3-24 - Figure 3 24 - Presentation Number: eems058 Presentation Title: Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility Consortium Tools and Process Development Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)

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 overall approach is outstanding, including the incorporation of HPC on top of a POLARIS model (that can run efficiently on a desktop) to produce much more powerful, numerous, and comprehensive results.

Reviewer 2:
The approach is comprehensive in addressing the barriers.

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 overall technical accomplishments and progress (now wrapping up) were outstanding. One noted as positive was the POLARIS codebase being in C++ rather than built upon a bloated, modular coding system. This clearly is perhaps an unsung hero in this model, allowing for 4-6 hours of runtime for 10 million agents as a basis upon which HPC can take over and create a far deeper and a broader dive into the modeling space. It also should be noted that the validation of POLARIS is no small feat and truly positions that model for a strong future.

Reviewer 2:
The team has made solid progress.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The collaboration on this project appears to be strong and excellent, with multiple diverse partners having useful perspectives.

Reviewer 2:
There is plenty of collaboration, but the complex team structure may also pose logistical challenges in coordination.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
While the funding is ending for this particular project, the future research proposals were solid and useful to use for scoping next steps. The one area not discussed (at least the reviewer did not think it was discussed) was utilizing this system for real-time, operational support in addition to scenario simulations. The reviewer had the sense that there may be some opportunities here.

Reviewer 2:
The project has ended.

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

Reviewer 1:
Clearly this project builds on strong past work and is highly relevant to the DOE objectives.

Reviewer 2:
The project supports DOE objectives in understanding future scenarios, especially from the travel-demand perspective.

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

Reviewer 1:
The resources seemed sufficient and produced significant deliverables for that level of funding.

Reviewer 2:
Funding was sufficient.

Presentation Number: eems059
Presentation Title: Experimental Evaluation of CACC for Passenger Cars
Principal Investigator: Xiao Lu-Yun (Lawrence Berkeley National Laboratory)

Presenter

Xiao-Yun Lu, Lawrence Berkeley National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 67% of reviewers indicated that the resources were sufficient, 33% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

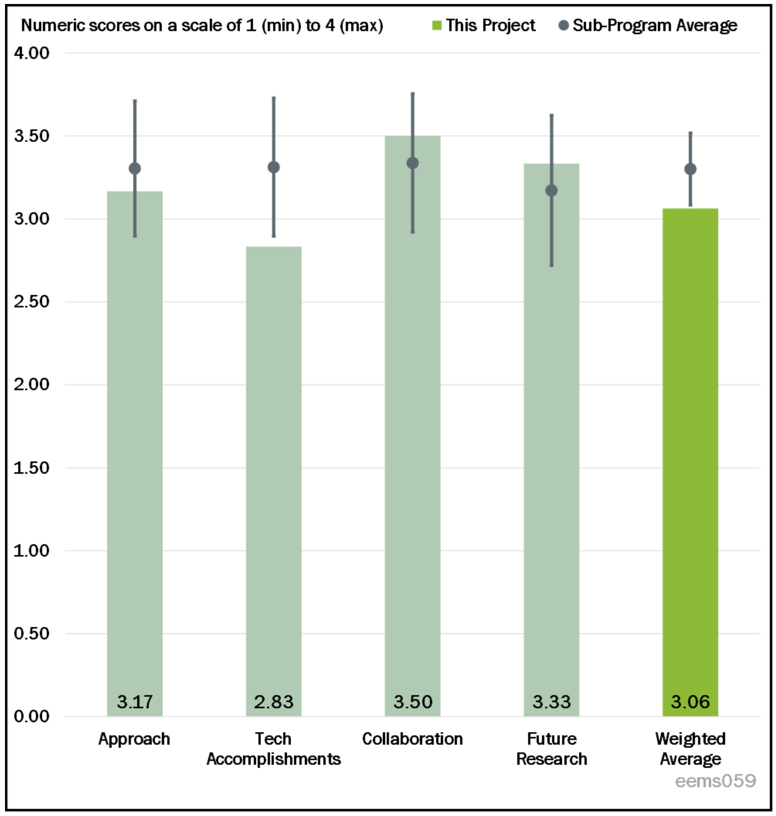

Figure 3-25 - Presentation Number: eems059 Presentation Title: Experimental Evaluation of CACC for Passenger Cars Principal Investigator: Xiao Lu-Yun (Lawrence Berkeley National Laboratory)

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:

For the given goals and the constraints involved (e.g., no automotive OEM support), the approach was sound for creating adaptive cruise control (ACC) and CACC systems of vehicles.

Reviewer 2:

The project approach was outlined in the presentation, including reference to vehicle instrumentation; developing torque mapping for control actuation; installing driver for dedicated short-range communications (DSRC) packet passing; developing vehicle dynamics modeling and CACC; control design; implementation and systems integration; developing a driver vehicle interface (DVI); preliminary test track testing; control tuning; and high-speed field testing. The presentation also specifically discussed responses to last year’s review, as well as remaining project challenges. The project seems to thoughtfully take various factors and feedback into consideration.

Reviewer 3:

More detail is needed on other barriers that CACC can address in terms of energy use in vehicles and efficiency of transportation systems.

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:
This project started on September 1, 2018, and is scheduled to end on July 31, 2020. The presentation noted that all milestones had experienced some initial delay. However, as of the end of April 2020, one milestone was fully accomplished and two were largely accomplished (95% and 80% progress, respectively).

Reviewer 2:
The technical accomplishments and progress were good, but perhaps could have been enhanced with a bit more application (and results) from exercising the ACC and CACC system that was developed. As part of the audience, the reviewer indicated like there was a big wind-up to creating this fascinating system to then be able to run all of these various scenarios, gather data, and present on the data. However, there was only a little bit on the application and scenario front presented.

Reviewer 3:
The reviewer expressed interest in the reasons for project delays. What are the implications for this research in the long run and how can this to full automation?

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The presentation makes it clear that collaborating partners (ANL, INL, LBNL) have successfully accomplished a range of outlined achievements described in the slides. Tasks were clearly divided, and subsequent progress was successfully made. While the reviewer cannot speak specifically to the dynamics of the team's coordination mid-project, it appears that there was significant team contribution in pulling together the final output.

Reviewer 2:
The responsibilities seem fairly divided between partners.

Reviewer 3:
It was noted that previous reviewers suggested that safety be studied as part of this research, and the response to that mostly was that NHTSA was already doing this. However, the reviewer thought this missed the point. The safety and energy use of CACC are inextricably linked and cannot very effectively be segmented out to one organization performing the safety part and one organization performing the energy-impact part. In the end, CACC and platooning will either save energy and be safe, or the following distance will be too great to capture the significant savings from reduced aerodynamic losses.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
A range of future research proposals is outlined, including developing higher-level automation, vehicle-control capabilities and developing other maneuver capabilities, among other proposals (funding dependent). Specific examples are provided along with each suggestion, detailing how work could be further advanced.

Reviewer 2:
The proposed research focusing on L2 and L3 vehicle automation makes sense, as this project was an effort to document energy impacts from L3 vehicles. Doing a comparison of LD to HD energy savings from CACC applications would be worthwhile.

Reviewer 3:
The reviewer thought this type of work could have a very significant impact if continued, but to date it indicated like it was more of a setup to, than an execution of, capturing needed data and scenarios.

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

Reviewer 1:
The objective of this project is to develop cruise control (CC), ACC, and CACC capabilities for three passenger cars with different powertrains and leveraging L1 automation on public roads. By exploring associated impacts on energy consumption and traffic flow, this project contributes to DOE's goal to support a more economically competitive, environmentally responsible, secure, and resilient U.S. energy infrastructure.

Reviewer 2:
This project is no doubt highly relevant to DOE's objectives: studying energy of a vehicle CACC system.

Reviewer 3:
This project is in line with EEMS automation research.

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

Reviewer 1:
The resources were sufficient for the soon-to-end project, as the primary end points were met. Future funding would of course be needed to explore further, including the possibility of upgrading to more late-model vehicles, some of which may have some built-in functionality.

Reviewer 2:
Funding appears to have generally been sufficient. The presentation broke down funding by year—FY 2018 versus FY 2019. The presentation did note, however, that data support would be necessary for microscopic mixed traffic modeling with CAVs with different powertrains and its mobility and energy consumption evaluation.

Reviewer 3:
Given the delay in the project timeline, more funds may be needed to complete the research.

Presentation Number: eems060
Presentation Title: Agent-Based Model and Data Collection for Inter- and Intracity Freight Movement
Principal Investigator: Monique Stinson (Argonne National Laboratory)

Presenter

Monique Stinson, Argonne National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

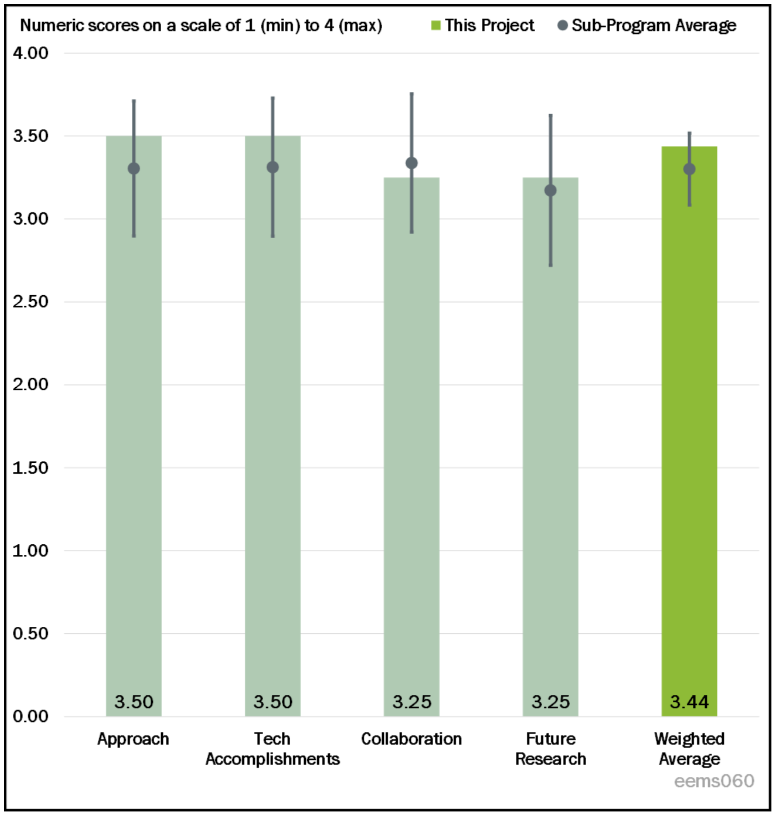

Figure 3-26 - Presentation Number: eems060 Presentation Title: Agent-Based Model and Data Collection for Inter- and Intracity Freight Movement Principal Investigator: Monique Stinson (Argonne National Laboratory)

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:

There is a strong start and logical approach for creating a baseline for future research with this short project.

Reviewer 2:

The team attempts to answer the key question of how commercial and household activity has the potential to impact freight energy use and mobility.

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:

POLARIS is now set up for freight in a way that will scale for freight analyses, both intracity and regional.

Reviewer 2:

The project seems to be on track, but it would be interesting to understand how some of these models change, given current COVID-19 impacts. It would also be good to understand how last-mile delivery options and autonomy may change the modeling results.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:

The project team has good stakeholder and data representation.

Reviewer 2:
The collaboration was okay at the start of this work. However, the reviewer ended to believe projects like this could benefit from some informal work with industry and maybe even academia. Are there ways to utilize surveys or workshops to gain knowledge and needs with other companies and NGOs?

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. Note: if the project has ended, please state project ended.

Reviewer 1:
There is a good pretty lengthy list of future research, given the base framework created. The reviewer suggests maybe working with others, along with VTO, to prioritize these future efforts.

Reviewer 2:
Follow-up research questions seem logical, but the team is still missing an evaluation of a situation, such as the current one, where all consumption shifts to e-commerce due to lack of access to stores. It would be useful to have a comparison point, even for short-term spikes.

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

Reviewer 1:
The project very much supports the overall DOE objectives. The reviewer was glad that VTO is investing in the freight system along with the vehicle technologies themselves.

Reviewer 2:
E-commerce will have a significant impact on the frequency and method of goods delivery. Given that the impacts are still relatively unknown, this seems like an appropriate research question for DOE objectives.

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

Reviewer 1:
Project resources seem appropriate for a project of this scope.

Reviewer 2:
Project resources seem sufficient, although it is difficult to really ascertain.

Presentation Number: eems061
Presentation Title: Real-Time Data and Simulation for Optimizing Regional Mobility in the United States
Principal Investigator: Jibonananda Sanyal (Oak Ridge National Laboratory)

Presenter

Jibonananda Sanyal, Oak Ridge National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

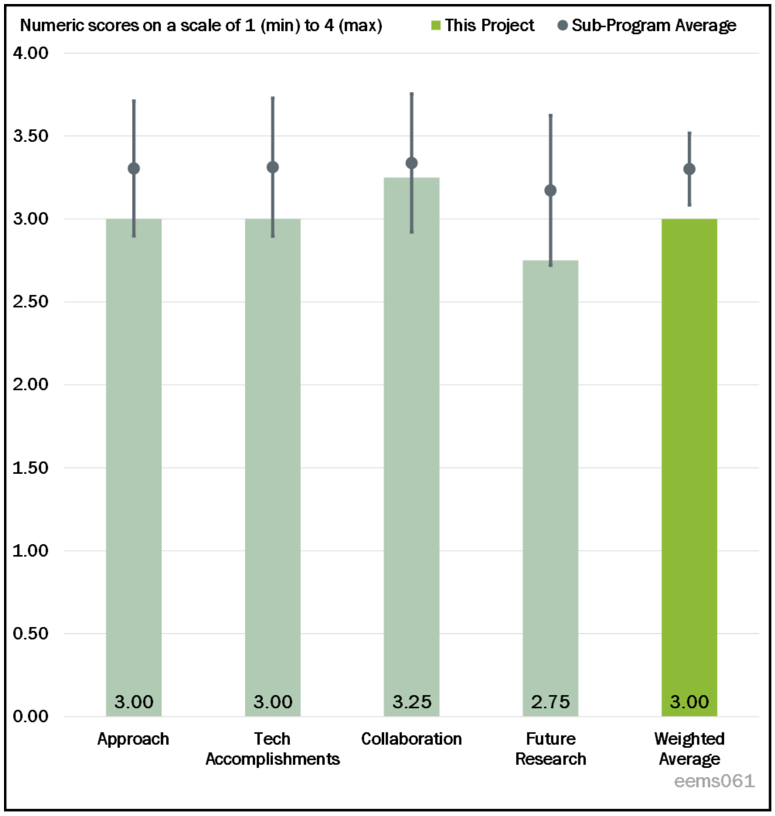

Figure 3-27 - Presentation Number: eems061 Presentation Title: Real-Time Data and Simulation for Optimizing Regional Mobility in the United States Principal Investigator: Jibonananda Sanyal (Oak Ridge National Laboratory)

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:

This is an interesting and ambitious project from a technical perspective. The project used HPC to address the problem of computational complexity. This feature could be an obstacle to cities' adoption of the tool. Also, a working digital twin of a metro area used for transportation planning and operations should include all modes, not just cars and trucks.

Researchers indicated that the model does not account for induced demand or other behavioral aspects (though it does have a dynamic traffic assignment component). The extent of any induced demand could be an important determinant of the energy impacts of the control system. A simple sensitivity analysis of possible effects would be informative.

Reviewer 2:

The proposed project leaves a lack of accurate data to fill in the gaps. If the premise is reliant on good data and it is admitted the data are a little erroneous, it is tough to draw an accurate conclusion. Without freight data that are good in that corridor and that also have a high flow of tractor-trailers that are restricted to the interstate, it would be hard to do a good simulation.

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:
This is a technically challenging project that has had substantial accomplishments. The project has shown energy savings approaching the 20% target in certain circumstances. However, that is the target for regional savings, not single-road savings.

It would be useful to report what the control system's effect was on travel time.

Reviewer 2:
It seems that the plans and anticipated deadlines are being met. Given the pandemic, the reviewer asked whether those figures can be reflected accurately in the model where there will be a constant or rise in freight but a reduction in passenger cars?

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration between ORNL and the NREL appears to have been sufficient. Non-funded partners provided data and sensors but do not seem to have participated in the research.

Reviewer 2:
There was good collaboration with the universities, DOT, and TomTom, but the reviewer wanted to know if there is another real-time entity to gather information from. One's cell phone makes real-time traffic decisions better than the one programmed in the vehicle simply because of so many constant variables.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Proposed FY 2020 research includes "energy estimates model refinement." It would be useful to include vehicle powertrain type in anticipation of a growing EV population, since these vehicles may show lower percentage savings and require different control strategies. Demonstration of CTwin portability in FY 2021 will be important.

Reviewer 2:
The reviewer thought that the future research should include information as far as Knoxville, Tennessee, to get a better idea of the different conditions. If you use this model to predict an Atlanta, Georgia, scenario, the differences are too wide a gap to do it accurately.

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

Reviewer 1:
The reviewer believed the project team attempted to determine better traffic flow, which helps reduce idling time, energy, and, in essence, emissions for Class 8 vehicles.

Reviewer 2:
The project is focused on energy savings, supporting overall DOE objectives. However, the boundaries of the analysis may keep it from delivering a complete picture of the energy impacts of this approach.

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

Reviewer 1:
The project appears to be largely successful and on time, with no indication of insufficient resources.

Reviewer 2:
The reviewer thought the resources are sufficient but will not yield as large a swath as necessary to carry it over a large area.

Presentation Number: eems062
Presentation Title: Deep-Learning for Connected and Automated Vehicle (CAV) Development
Principal Investigator: Robert Patton (Oak Ridge National Laboratory)

Presenter

Robert Patton, Oak Ridge National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

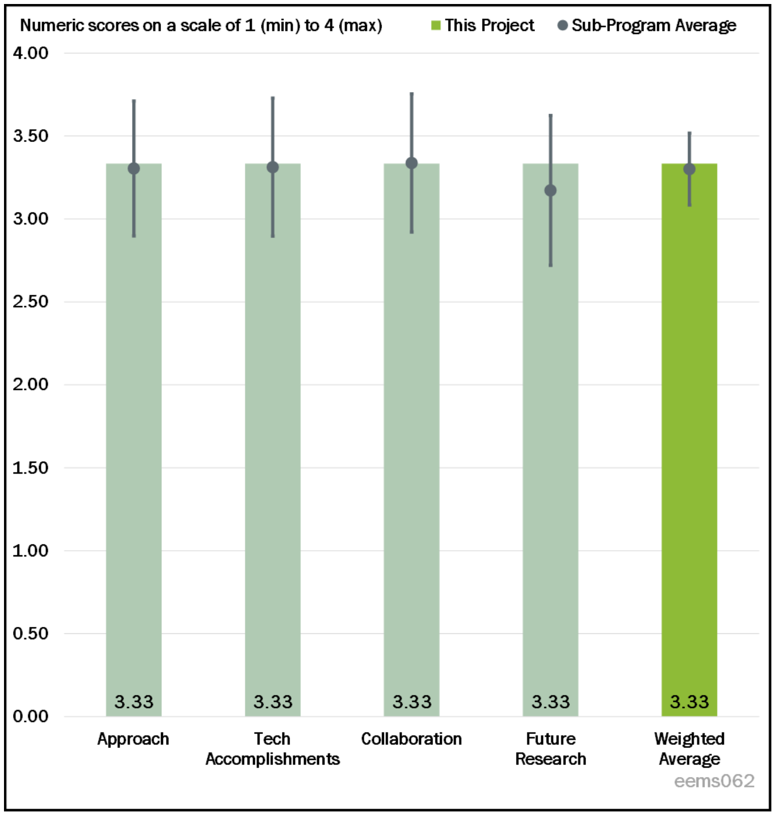

Figure 3-28 - Presentation Number: eems062 Presentation Title: Deep-Learning for Connected and Automated Vehicle (CAV) Development Principal Investigator: Robert Patton (Oak Ridge National Laboratory)

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 team's approach to developing computational capability using HPC in order to rapidly develop perception, control, and communication algorithms for CAVs is sound.

Reviewer 2:

A clear action plan and timeline have been provided. Barriers are addressed, but there are still many unknowns in this phase.

Reviewer 3:

This project seems to focus on an end-to-end solution for camera-based autonomous driving. "CAV" in the title may be a bit confusing. So far, it is not very clear how to quantify a driver to be an expert for imitation learning. Also, it is not very clear if there would be any other side effects for the entire traffic flow (under different CAV penetration rates, including the extreme case of 100% CAVs) if autonomous driving is trained in this way.

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 technical accomplishments in this project include the use of Multi-node Evolutionary Neural Networks for Deep Learning (MENNDL) for object perception; imitation learning; gathering training data for imitation learning; adversarial testing; Kroad; KFlow; and two-dimensional and three-dimensional learning transfer. Very impressive!

Reviewer 2:
According to the timeline and percentage of completed efforts, the reviewer did not have too much concern about the progress. The technical accomplishments sound reasonable.

Reviewer 3:
The team has made a good start in the analysis and scenarios, according to plan.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Since last year, the presenter has coordinated well with several key companies in this space.

Reviewer 2:
Collaboration and coordination with the NREL and General Motors (GM) are well executed.

Reviewer 3:
The involvement of GM weighs much for the project team. The reviewer expected the project team could leverage much experience and knowledge on AV (using the similar platform) from the industry, like GM (or its Cruise) in this project, although there might be some confidentiality issues.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Future research included a clear action plan, partner roles, and next steps. Roadblocks and a means to address them were well thought out.

Reviewer 2:
The integration of a game engine-based driving simulator (CARLA) and traffic simulator (e.g., Simulation for Urban Mobility [SUMO]) makes sense to the reviewer. The reviewer thought the development of such an advanced simulation and modeling platform would be an interesting research topic for further exploration.

Reviewer 3:
The list of proposed future work includes the creation of enhanced perception and control algorithms using MENNDL, improved reinforcement learning for driving simulators, and increased scenario generation.

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

Reviewer 1:
This project supports DOE EEMS's stated objective of exploring reduced transportation energy use via autonomous vehicles.

Reviewer 2:
Yes, this project should support the overall DOE objectives by leveraging the CAV modeling and control capability within DOE National Laboratories.

Reviewer 3:
The reviewer thought this will take time to figure out because the replication of the human driver in simulation is needed to then assess the energy savings.

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

Reviewer 1:
Enough people and research partners were provided, and the focus remains, despite the economic issues in the industry at this time.

Reviewer 2:
The FY 2020 resources of $2.2 million are adequate to achieve the target deliverables.

Reviewer 3:
Again, the reviewer thought the inclusion of GM in this project should provide sufficient resources to achieve the stated milestones in a timely fashion. The only concern is how much of industry's resources can flow into this project.

Presentation Number: eems063
Presentation Title: Ubiquitous Traffic Volume Estimation through Machine-Learning
Procedure Principal Investigator: Venu Garikapati (National Renewable Energy Laboratory)

Presenter

Yi Hou, National Renewable Energy Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

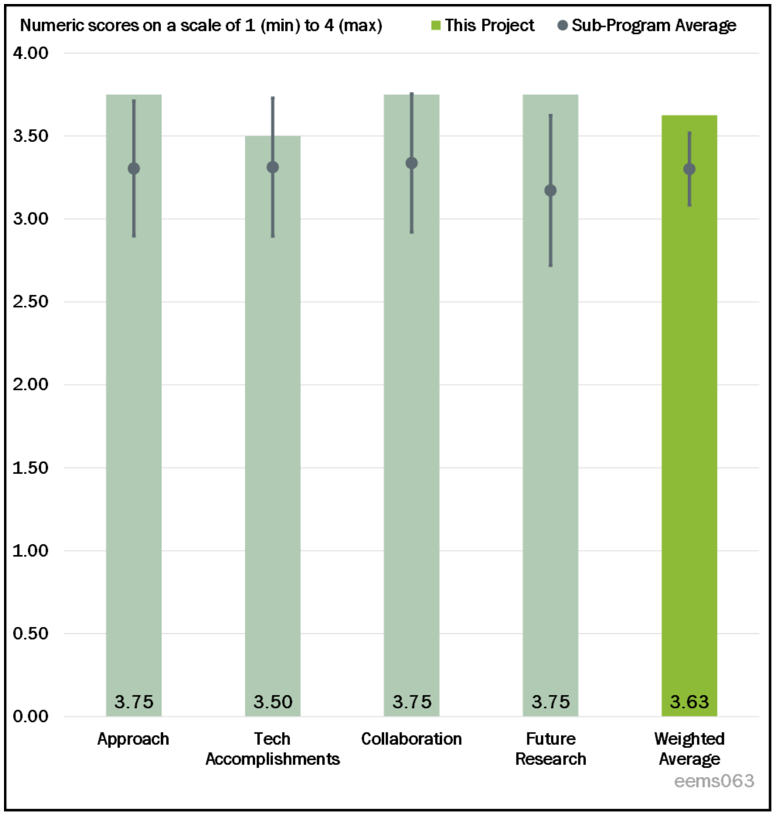

Figure 3-29 - Presentation Number: eems063 Presentation Title: Ubiquitous Traffic Volume Estimation through Machine-Learning Procedure Principal Investigator: Venu Garikapati (National Renewable Energy Laboratory)

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 project has a very clear and narrowly defined objective: commercialize a machine learning based traffic volume estimation tool with TomTom using vehicle probe data. The focus is to utilize and fuse existing high-quality yet sparse data with probe data to predict traffic volumes on each and every link of a road network.

This is essentially a product development project from concept through first product version. The project approach includes milestones tool validation; demonstration of tool prototype; detailed commercialization plan; integration of a demonstration product into the TomTom web framework; publication of validation results from real-time deployment; and delivery of a first version of the product. The project milestones seem logical and well sequenced.

The project approach includes four types of input (probe traffic data, road characteristics, weather information, and temporal information) uploaded to a ML model (XGBoost), which generates traffic volume information anytime. Four parameters have been identified to define model accuracy, including the coefficient of determination (R2); mean absolute error (MAE); weighted absolute percentage error (WAPE); and error to maximum flow ratio (EMFR). These parameters and their maximum threshold percentages were identified and developed in concert with program partners. Subsequently, the approach splits fused data into training data and test data to exercise and validate the XGBoost model. Overall, this is a very strong project concept and technical approach.

Reviewer 2:
The PI has sufficiently demonstrated that the approach has the potential to bring a first of its kind tool, in terms of level of accuracy for traffic-flow predictions, into the market.

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 project has demonstrated a solid list of technical accomplishments. This includes demonstrating data training of the model through testing and validation of predicted versus actual volume estimation results in freeway and off-freeway scenarios. Three geographical locations were examined: Harrisburg, Pennsylvania; North Carolina; and Chattanooga, Tennessee. Overall, model traffic volume estimation results from the first two locations were considered excellent and good, respectively. The results for Chattanooga were only considered fair, largely as a result of less robust data inputs and more significant resulting deviations from the established boundaries of a few of the model accuracy parameters. The finding here is that probe data and sensor data quality have a significant impact on volume estimation accuracy.

The traffic volume estimation tool, XGBoost, has been validated and verified by data from the aforementioned sites, and it has been demonstrated that machine learning is a powerful tool for volume estimation. XGBoost is not only able to predict recurring traffic patterns, but is also able to detect anomalies in regular patterns (e.g., an extreme weather event). The results from this project can be applied to both historical and real-time traffic volume estimations.

This 2-year project started late because of contract negotiations with TomTom, but now appears back on schedule.

Reviewer 2:
The progress and results generated thus far seem to be well on target with respect to the project plan.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
This project includes an extensive group of diverse project participants—multiple state DOTs, the University of Maryland, the Texas Transportation Institute, the I-95 Corridor Coalition, and an industrial manufacturer, TomTom—with strong intra-project collaborations.

Reviewer 2:
Collaboration with partners appears to be well coordinated.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Future research appears well thought out. Development of a data-streaming pipeline and automated anomaly detection are spot-on, logical steps toward a reliable commercial tool.

Reviewer 2:
The project does an excellent job of identifying the remaining challenges and barriers, including the need for a real-time data feed, addressing different data formats, and the quality of data, which necessitates the development of a data-quality check mechanism. The proposed future research directly addresses these challenges.

Another reviewer asked how long model predictions would be valid into the future. One question that comes to mind is how much will the estimated cost be to update and periodically calibrate XGBoost to keep it sufficiently accurate and relevant moving into the future? The reviewer also asked if it were possible that this could end up being an onerous expense and potentially diminish the tool's value.

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

Reviewer 1:
This project is very relevant, as it supports two of EEMS's strategic goals and has three direct applications, including enabling energy assessments, enhancing energy efficiency, and enabling accurate transportation modeling and simulation through real-world mobility data.

Reviewer 2:
Accurate traffic-flow estimation is an important piece in a bigger puzzle of designing more efficient transportation systems.

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

Reviewer 1:
The project is moderately funded by DOE ($500,000) and includes 50% cost share from TomTom, which is excellent.

Reviewer 2:
Project tasks and allocated resources seem to be aligned appropriately.

Presentation Number: eems066
Presentation Title: Livewire Data Platform–A Solution for Energy Efficient Mobility Systems (EEMS) Data Sharing
Principal Investigator: Lauren Spath Luhring (National Renewable Energy Laboratory)

Presenter

Lauren Spath Luhring, National Renewable Energy Laboratory

Reviewer Sample Size

A total of four reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

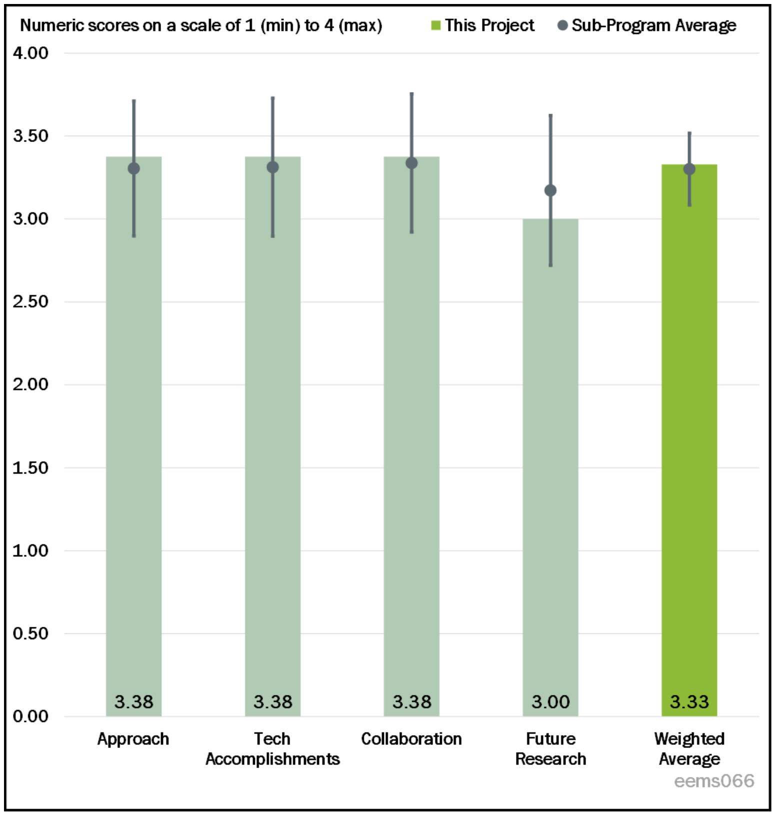

Figure 3-30 - Presentation Number: eems066 Presentation Title: Livewire Data Platform–A Solution for Energy Efficient Mobility Systems (EEMS) Data Sharing Principal Investigator: Lauren Spath Luhring (National Renewable Energy Laboratory)

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 was really impressed with the LiveWire Data Platform (LDP), said it is very user friendly, and was thrilled to hear that the 2020 DOE VTO funding opportunity announcement (FOA) is requiring that data generated by the funded projects must be shared via the LDP. The reviewer thought this is a huge step toward overcoming the cultural barriers associated with not wanting to share data.

The reviewer thought there is a real opportunity here to cross reference data.transportation.gov (DTG) datasets on the LDP, and vice versa. DTG is likely to have different users (e.g., state DOTs, MPOs, traditional transportation consultants) from LDP (e.g., folks that traditionally work with DOE). By pointing to the datasets available on both sites, this might increase the likelihood that the user (e.g., student, researcher) finds the needed dataset(s). If the project team decides to move forward past the go/no-go point, the reviewer encouraged the team to consider a task to coordinate this.

Recently, the reviewer looked at the LiveWire website and started to make an account to see the available datasets. The reviewer was a bit intimidated by the question, "Justification – What EEMS project are you working on?". The reviewer assumed that part of the motivation behind this question is to give dataset owners more information about the intended use of the data; however, the reviewer was afraid it might send the message that someone cannot create an account or access the data if not affiliated with an EEMS project (unless that is truly the intent, in which case it is highly effective).

Reviewer 2:
This reviewer observed a sound approach to creating the LDP platform by leveraging two existing, successful platforms and allowing data access via application programming interface (API), downloads, etc.

Reviewer 3:
The team developed automated tools to create metadata and standardization in order to make sharing data more efficient and straightforward to use.

Reviewer 4:
Overall, the project approach appears logical, well designed, and feasible. Philosophically, it approaches the challenges from two directions: the technology and the cultural (people) aspects. Specifically, the project consists of three phases: developing the new LDP and inventorying the desired datasets, including outreach to, and for, data and users; launching of the LDP and shifting emphasis to growth of datasets and users; and transitioning to LDP operation and continuing to grow data/users and track impacts/benefits pending successful go/no-go in year 2.

Good approach to leverage existing successful data platforms (a2e.energy.gov, api.data.gov, and the API Umbrella) and extensively incorporate information from the Transportation Secure Data Center (TSDC) and FleetDNA as foundational data building blocks.

The approach mentioned on Slide 7 mentions addressing historical challenges by providing "A community -builds partnership and collaboration rather than competition." It does mention that new features enable data owners to request information on how data will be used before granting access and manage visibility and access to data. It would be beneficial to provide further insights and details on how cultural (people) barriers to sharing data can be overcome.

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:
Accomplishments include site redesign for better user experience, file upload, metadata creation tools, increased data, and user registrations. Very impressive!

Reviewer 2:
According to self-reported data on Slides 4 and 5, the project is on or somewhat ahead of schedule. The reviewer also thought that the selected performance measures for the go/no-go decision are effective.

Reviewer 3:
Site usability seems good from both sides. The reviewer could tell that a lot of work went into developing the back end. Having registered users from 18 different organizations seems broad. However, having only 9 projects hosted and 12 in the pipeline so far seems like too few. The reviewer was glad that VTO will require project data to be stored here because there is a lot of potential. There are major barriers when it comes to sharing data, not just making the data usable to others but also legal issues. The team has done a good job on a very difficult, multi-faceted problem. The team has been receptive to feedback and has improved the user experience in response.

Reviewer 4:
The project does a good job of identifying the historical data challenges right up front, including technical (platform) and cultural (people) challenges, including details therein.

The project appears on schedule as a 3-year project starting in October 2018 with a current estimated completion of 60%.

A steady stream of technical progress has been demonstrated on achieving quarterly milestones over the last year, with clearly identified task leads. Overall, most seem to refer to information technology (IT) advancements to further upgrade the functionality of the LDP, including improved usability of existing datasets; data download advancements; platform success measurement and reporting; growth in users and available data; metadata creation tools; file upload features; and site redesign for a better user experience. Another important technical accomplishment mentioned under the reviewer-only slides is that access is standardized and managed through authentication processes that ensure privacy at the level desired by researchers for their data.

Of particular interest to the reviewer is the measurement and reporting of platform success. Have metrics use, engagement, and impact been defined at this point for, say, December 2020 and project completion in September 2021? Metrics extending out to September 2020 have been provided, appear relevant, and are on track.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration and coordination with ORNL, Carnegie Mellon University, PNNL, and INL are well executed.

Reviewer 2:
It seems like the team from NREL, PNNL, and INL was able to work well together on several levels.

Reviewer 3:
The project team of the NREL, PPNL, and INL is strong and diverse, and there appears to be relatively extensive further interactions and collaborations with other entities, such as ORNL, universities, and FOA and Lab Call awardees. As mentioned in the presentation, it is important to continually work to build collaboration and coordination with others, particularly potential data sources, including those outside the immediate orbit of DOE and VTO. Ultimately, this is likely to heavily influence the overall long-term success of the project.

Reviewer 4:
It is hard to assess this question when only one team member from one National Laboratory and university is responsible for providing Laboratory updates. However, as far as the reviewer can tell (based on Slides 4 and 5), the project seems to be well coordinated across Pacific Northwest National Laboratory (PNNL), NREL, INL, and EEMS partners. The reviewer would like to see other government agencies added as partners, as suggested above.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The decision point in June 2020 is logical and has appropriate performance assessment indicators in place. As far as the reviewer knew, that is the last decision point for the project, which is not scheduled to end until September 2021. The upcoming milestones (until September 2020) are well described and seem to be logical next steps. However, the proposed research for the last year of the project- (highlighted on Slide 21) is described at too high a level of detail to be evaluated here. In the future, the reviewer suggested a more granulated list of tasks (like those listed on Slide 5) in the “Reviewer-Only” slides to aid reviewers with assessing the question.

Reviewer 2:
Proposed future work including user management, elimination of impediments to sharing data, evolution of the metadata structure, and protection of the controlled data will improve LDP.

Reviewer 3:
Overall, the proposed future research is good, but more emphasis (and detail) should be placed on addressing the human factors impeding data sharing with the LDP. Are there any high-end tools within the LDP now or planned for the future that would allow data providers to manipulate and analyze data in unique and value-added ways? This gets to the core challenge of further incentivizing entities to contribute data to the LDP. Furthermore, how do you "handle" entities that frequently access data via the LDP and have data of their own but refuse to share it? Do some protocols need to be in place so that, eventually, extensive data "users" need to also be data "providers" or access to the LDP?

Under the remaining barriers and challenges section, three items are mentioned including legal challenges around non-disclosure agreements (NDAs) and licenses; manual processes that impede sharing by rapidly evolving, complex modeling projects and datasets; and human factors. It is good to see that the project has clearly identified these specific challenges moving forward.

Reviewer 4:
The team is attempting to address both technical and human factors to facilitate broader use of the LDP, but this reviewer commented that legal issues were not mentioned.

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

Reviewer 1:
The project absolutely supports overall DOE objectives. Goal 7 of the EERE Strategic Plan is to "Enable a High-Performing, Results-Driven Culture through Effective Management Approaches and Processes." Accessible data are paramount toward that strategic goal. This project also improves DOE's compliance with the Open Government Data Act. By making the data available for other researchers to use, it significantly increases the return on investment of the government taxpayer funds used to fund the collection of the dataset.

Reviewer 2:
This project supports DOE EEMS' stated objective of developing tools to address transportation energy-use reduction via optimized mobility systems.

Reviewer 3:
Yes, the LDP is very relevant to overall DOE and EEMS's objectives, given the critical need for (but lack of tendency to share) cutting-edge data in this evolving field.

Reviewer 4:
EEMS aims to "support research and development at the vehicle, traveler, and system levels, creating new knowledge, insights, tools, and technology solutions that increase mobility energy productivity for individuals and businesses," and this project created a data portal to ensure high-quality data are available for anyone to access and use.

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

Reviewer 1:
The FY 2020 budget of $1.5 million is adequate to accomplish the target deliverables.

Reviewer 2:
At $3 million over 3 years, the funding identified for this project is sufficient.

Reviewer 3:
It is expensive to set up the backend of the necessary data portal, and the team has managed to accomplish a lot, given the resources. Long-term funding of the project is still needed.

Reviewer 4:

Because the reviewer did not have experience building a data repository and interface like LiveWire, the reviewer deferred to the PI (who did not mention any budgetary shortfalls) and concluded that the resources are sufficient.

Presentation Number: eems067
Presentation Title: Virtual and Physical Proving Ground for Development and Validation of Future Mobility Technologies
Principal Investigator: Dean Deter (Oak Ridge National Laboratory)

Presenter

Dean Deter, Oak Ridge National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 67% of reviewers indicated that the resources were sufficient, 33% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

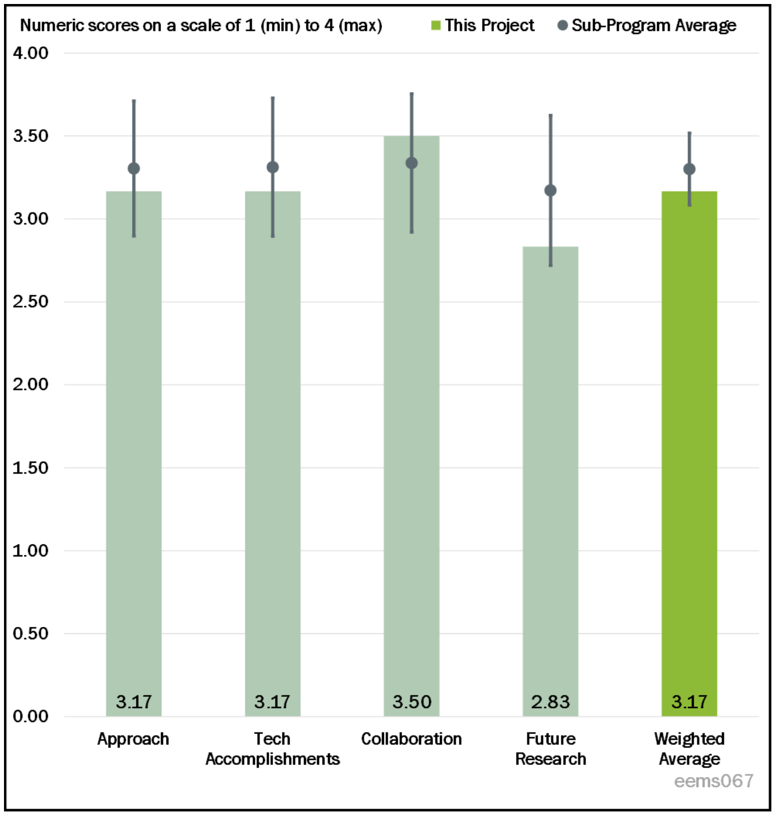

Figure 3-31 - Presentation Number: eems067 Presentation Title: Virtual and Physical Proving Ground for Development and Validation of Future Mobility Technologies Principal Investigator: Dean Deter (Oak Ridge National Laboratory)

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:

Hardware-in-the-loop (HIL) (vehicle connected to dynamometers in the laboratory and driven in accordance with traffic simulations) is typically an approach that seeks to provide real-world driving realism, with the need for actual on-road driving. Yet, in later planned tasks of the project, there will be track testing. With track testing planned, it is unclear why was there a need for HIL.

Reviewer 2:

The project objective is quite broad, so breaking it down into two tasks helps bring focus to specific areas of the effort. The reviewer assumed it would be hard to tell if the final objective of integration has been reached since there are so many aspects to address. Completing the goals of the tasks helps to chip away at the overall objectives. It seems like any one aspect of this effort could be considered its own stand-alone project.

Reviewer 3:

The approach to performing the work is good but still not comprehensive enough. It seems that two approaches—HIL (dynameter plus vehicle plus dSPACE plus CARLA) and software-in-the-loop (SIL) (IPG plus VISSIM)—are examined separately. It would be more interesting to see a unified approach or platform that integrates all of these components together, or provides further discussion on the potential challenges to develop a unified approach.

It is not clear how the vehicle-to-anything (V2X) communication is modeled in the SIL environment. Is it based on the function provided by VISSIM or IPG, or using some kind of HIL strategy? Either way, the reviewer had potential concerns. Firstly, it is unclear if VISSIM or the IPG module is good enough for the network simulator compared to others such as NS3 or omnet++. Secondly, there may be some inconsistency issues for HIL testing on communication performance as compared to pure simulation or pure real-world testing.

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 was impressed with the Connected and Automated Vehicle Environment lab set up.

Reviewer 2:
It is understandable that there must be quite a lot of details or barriers the research team has to overcome throughout the project.

Reviewer 3:
The project appears to be a bit behind schedule, primarily due to COVID-19.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration across the project team appears well coordinated.

Reviewer 2:
The research team is strong and the collaboration makes sense.

Reviewer 3:
Signs of collaboration were demonstrated through joint development with project EEMS082—"As part of joint development with project EEMS082 led by the American Center for Mobility (ACM), the ACM test facilities HD map has been shared and integrated into both IPG Carmaker and VISSIM to create a digital twin."

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The benefit of on-track testing is unclear when (thus far) the project has been developing a HIL environment. This same point was raised earlier about the approach.

Reviewer 2:
The reviewer thought the future work stated seems reasonable. It is not clear how the team expects to tackle the remaining challenges and barriers related to computing power and integration challenges.

Reviewer 3:
Since this work requires system integration with real-world testing (e.g., HIL), it would be more interesting to see any adaptation plan or risk-mitigation strategy due to the breakout of COVID-19.

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

Reviewer 1:
This project is very timely and important in terms of creating an advanced, cost-effective, immersive CAV modeling and testing platform to support future DOE research.

Reviewer 2:
Developing technologies for CAVs and developing tools to test such technologies are important for future transportation systems.

Reviewer 3:
Understanding CAVs is key to the growth of transportation capability and developing this area with this project supports DOE objectives.

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

Reviewer 1:
Allocated resources seem appropriate for ongoing and planned tasks.

Reviewer 2:
The reviewer believed the resources from all kinds are sufficient for the project to achieve the stated milestones. One potential issue is the interruption and disturbance caused by COVID-19.

Reviewer 3:
Physical testing labs and huge computing requirements consume a lot of funding. The funding seems barely enough to accomplish the stated tasks. If these are the tasks, then how DOE should prioritize the budget is another question in itself.

Presentation Number: eems069
Presentation Title: Next-Generation Intelligent Traffic Signal for Multimodal, Shared, and Automated Future
Principal Investigator: Andrew Powch (Xtelligent)

Presenter

Andrew Powch, Xtelligent

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

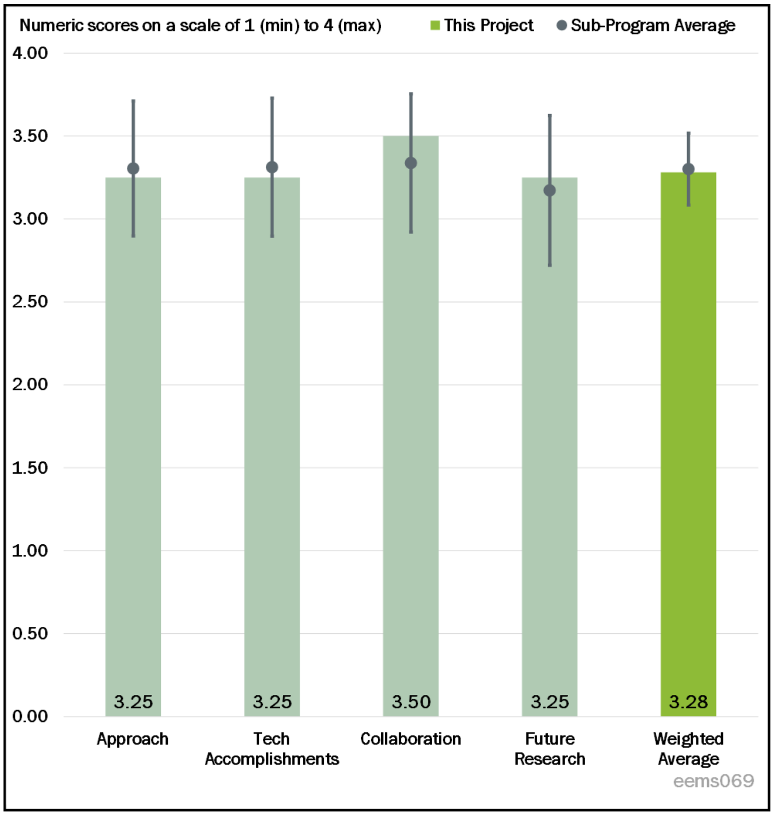

Figure 3-32 - Presentation Number: eems069 Presentation Title: Next-Generation Intelligent Traffic Signal for Multimodal, Shared, and Automated Future Principal Investigator: Andrew Powch (Xtelligent)

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 approach is well thought out and a practical way to demonstrate the technology.

Reviewer 2:

The overall approach is good. One significant item that is not included in the current approach is the use of a robust traffic simulation model. A traffic simulation model that accurately represents the Proportionally Fair (PF) Adaptive Traffic Control System (ATCS) algorithm and the data types and latencies of data provided from the potential data partners could be used to investigate the impact of various market penetration levels and data sources (either single data sources or data sources in combination). This could also be used to identify targeted performance levels for the system. This type of evaluation capability would provide for a much more robust project and could eventually be used by those local agencies who may consider implementing such a system.

Some clarifications in a few of the project details would be helpful, such as a clearer and more complete definition of green-time utilization and slack time. It is clear that these are inverse terms, but a detailed definition of green-time utilization and its calculation would be helpful. A clearer and more complete description of the proposed corridor that is being instrumented for testing would also be helpful.

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:
Results indicate the concept works and produces the anticipated benefit to traffic throughput.

Reviewer 2:
There has been good progress on the project so far, but as described, the reviewer said that there could be some significant delays due to the COVID-19 induced traffic reductions. The implementation of a central computing approach (as opposed to local intersection computing) is a positive accomplishment and should make this project easier to implement.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Partnerships span a number of private and public entities, which is not easy to achieve.

Reviewer 2:
Coordination among existing team members seems good. As stated in the risk section, it may be a little difficult to maintain the focus of the local transportation agencies if they have to deal with COVID-19 induced traffic issues that would have a higher priority than this project. To the extent that the "data partners" are part of the project team, the sooner these partners can be identified, the better continuing progress into Phases I and II will be.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Next steps were appropriate to the reviewer and could improve the adoption prospects of the technology.

Reviewer 2:
The overall planning for future work is good. However, there are some risks that are beyond the control of the project team, specifically restoration of traffic volumes to "normal" levels and commitments of data partners. Of these risks, the lack of commitment of data partners is probably the higher. If sufficient data partners are not participating, the project will not have sufficient market penetration so that the traffic volumes will not be representative of traffic on the network. This would make the traffic-signal timing non-responsive to the traffic in the scenario where no infrastructure-based data collection is used (i.e., objectives 4 and 5 of traffic control with connected vehicle data only).

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

Reviewer 1:
Smart traffic-control technology is an enabler for the DOE VTO objective of transportation system energy consumption reduction.

Reviewer 2:
Yes, the project supports the overall DOE objectives by implementing a traffic-signal control system that is designed to reduce delays, and hence, unnecessary use of fuel along traffic-signalized corridors. However, it is not apparent from the provided documentation how the fuel benefits will be calculated.

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

Reviewer 1:
The project is progressing well with the given funding.

Reviewer 2:
Yes, the resources seem sufficient.

Presentation Number: eems072
Presentation Title: Charging Infrastructure Needs for Electrification of Freight Delivery Vehicles
Principal Investigator: Victor Walker (Idaho National Laboratory)

Presenter

Victor Walker, Idaho National Laboratory

Reviewer Sample Size

A total of four reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

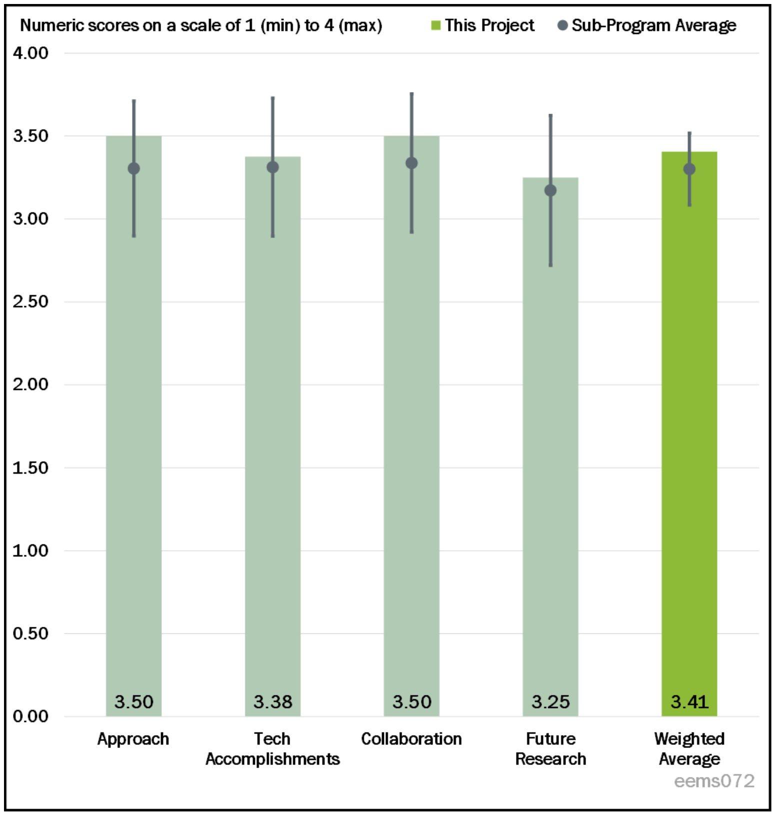

Figure 3-33 - Presentation Number: eems072 Presentation Title: Charging Infrastructure Needs for Electrification of Freight Delivery Vehicles Principal Investigator: Victor Walker (Idaho National Laboratory)

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 approach was well thought out and executed. The project team defined freight use cases and performed market and stakeholder analyses for at least three cases. The team created infrastructure scenario descriptions for at least two use cases based on real-world data and created a model to simulate change points. The team produced a report on charging infrastructure strategies to support Class 7 and 8 trucks and FMLM delivery vehicle electrification.

Reviewer 2:

This project approach allowed for an evaluation of electrification requirements for various freight truck fleet applications. The approach followed a progressive research pathway of segmenting and analyzing the truck freight sector, selecting high-value segments for analysis, collecting real-world fleet data to understand duty cycles and operations, and then assessing opportunities for electrification during daily operations. The reviewer indicated that the approach resulted in meaningful insights in answering questions about effective electrification for the trucking industry.

Reviewer 3:

The main approach the team took was to find three different representative freight case studies to focus their efforts on. These were informed by real-world data from freight trucks (loggers). The reviewer appreciated that a variety of charging options were examined because of their impact on meeting the fleet needs as well as the costs.

Reviewer 4:
This reviewer noted a collaborative approach among three National Laboratories leveraging their core competencies—INL for EV charging, NREL for fleet duty-cycle understanding, and ORNL for freight vehicle characterization. The reviewer also observed a systematic approach starting with truck industry segmentation, select application data-logging of trucks, and charging scenario investigations.

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 project team characterized the on-road freight movement industry, collected real-world driving-cycle data on three fleets, and developed charging scenarios for three different freight vehicle applications. According to the reviewer, these are good accomplishments for a three-Laboratory collaboration in a year's time frame.

Reviewer 2:
The researchers completed the three prescribed milestones within the 1-year timeframe including market segmentation analysis and identification of case study fleets; characterization and simulation of charging infrastructure scenarios based on real-world duty-cycle analysis; and assessment of practical charging scenarios for supporting regional and long-haul truck operations. The research resulted in some valuable insights on electrification applications for various types of freight truck fleets, such as ubiquitous charging installations across fleet operations is not necessarily the best solution; fleets can take advantage of natural opportunities for charging in daily operational cycles; low- and-medium-power (and thus lower cost) charging at delivery and depot locations can satisfy many fleet requirements; and high-speed charging at truck stops can meet typical long-haul fleet requirements.

Reviewer 3:
Based on fleet-collected data in two cities, the project team developed route data to produce typical charging needs. On-route opportunity charging was also researched.

Reviewer 4:
The objectives of the study were met, but the reviewer did not see where the results were published or shared with interested folks and fleets. The slides do not show any publications or links to mentioned reports mentioned (and a quick internet search came up empty handed). A future tool based on these results would be powerful. Fleets could use this tool to examine what makes sense for them based on their specific fleet characteristics and needs.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration among three National Laboratories leveraged their core competencies. Involvement of on-road freight industry stakeholders (fleets and consortia) contributed to the project's success. Inclusion of current electric fleet experiences would be helpful to confirm hypothetical charging scenarios and particular challenges or concerns associated with each one.

Reviewer 2:
The project employed good collaboration with both the NREL and ORNL. The researcher identified the roles of each team member. In response to comments from last year, the researcher added significant collaboration with industry, including trucking and parcel delivery fleets, and direct discussions with the American Trucking Institute and national trucking consortia.

Reviewer 3:
The team consisted of three national Laboratories. Collaborators also participated.

Reviewer 4:
All parties performed tasks to standard, as planned.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The reviewer stated that building tools for small fleets would be very beneficial, as small fleets normally do not have the engineering assets to do so themselves. Working with industry should include several large fleets and would be a suggested course of action. Large fleets normally have engineering assets and more reliable data than smaller fleets.

Reviewer 2:
This 1-year project has been completed, but the researcher offered several suggestions for future research, including development of new tools, additional analysis of slow charging solutions for fleets, and optimizing smart grid approaches and costs. The reviewer agreed that tool development for allowing different types of trucking fleets to evaluate electrification opportunities and costs would be a valuable asset for future decision making.

Reviewer 3:
The project has been completed, and several general future recommendations have been listed.

Reviewer 4:
The project ended.

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

Reviewer 1:
An accurate assessment of charging infrastructure needs is imperative for electrifying fleets in a cost-effective, responsible manner.

Reviewer 2:
The electrification of the on-road freight industry has the potential of significantly reducing petroleum use.

Reviewer 3:
This project is relevant for DOE's program in that it focuses on how to improve the energy efficiency of goods movement through electrification of freight truck fleets. Freight trucks are a critical element of U.S. freight movement, thus future opportunities for increasing their fuel efficiency through electrification is important to understand.

Reviewer 4:
Yes, understanding the barriers and opportunities of electrifying freight supports DOE's objectives for increased mobility with less energy.

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

Reviewer 1:
The project team had sufficient recourses and proper tools to complete this project.

Reviewer 2:
The reviewer stated that $350,000 for a 1-year project among three National Laboratories seems appropriate for the scope of work. completed.

Reviewer 3:
The funding for this project seems sufficient for a 1-year project involving three national Laboratories and the technical progress achieved.

Reviewer 4:
The scope and budget seem to be a good match.

Presentation Number: eems074
Presentation Title: Smart Cities Topology–Curbs and Parking
Principal Investigator: Stanley Young (National Renewable Energy Laboratory)

Presenter

Stanley Young, National Renewable Energy Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

50% of reviewers indicated that the project was relevant to current DOE objectives, 50% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 50% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 50% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

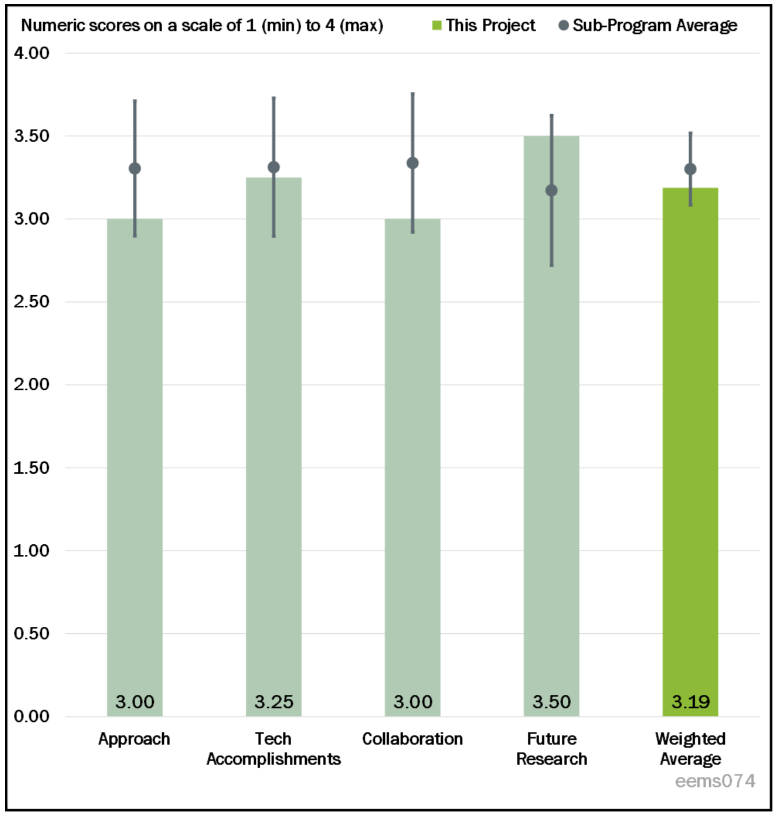

Figure 3-34 - Presentation Number: eems074 Presentation Title: Smart Cities Topology–Curbs and Parking Principal Investigator: Stanley Young (National Renewable Energy Laboratory)

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:

According to the reviewer, this project presents a good start to a new area of modeling. However, for the funding allocated, it is a very small start and more results should be visible from the investment.

Reviewer 2:

Overall, the project approach seems reasonable for achieving project objectives. The initial literature review and interviews of key stakeholder and operators of curbside activities are good first steps to capturing the latest research efforts and obtaining necessary data and information. However, the reviewer found that the presenter provided only limited details on these activities and the data and information objectives, especially as related to informing the later modeling efforts of the project. The early optimization framework effort formed the basis for the later micro-simulation work. Given the data challenges intimated by the presenter, the approach might have considered an additional focus on data capture and survey efforts, although these activities are hinted at in future research plans.

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 presenter appears to have made steady progress in the project, having completed the literature review, stakeholder and expert interviews, and initial optimization framework development. The remaining micro-simulation development work looks achievable, given the current schedule.

Reviewer 2:
Progress against the project design's goals has been made; however, how the model is actually used for decision making is unclear.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
It is clear that the PIs spent sufficient time and effort engaging with real-world stakeholders on the shared curb space topic. The reviewer remarked that more collaboration with other components of the SMART Mobility Consortium and other National Laboratories operating within the Consortium is needed.

Reviewer 2:
The project team includes cross-disciplinary members including NREL, academia, industry, and government organizations. Engagement with industry and government stakeholders appears to be excellent for gathering current curbside research and valuable data and information on curbside operations, configurations, and dynamics. However, discussion of the NREL collaboration with academic team members was limited in the presentation, and their research and/or computational contributions to current project efforts were not extensively explained.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The proposed research is reasonable, given the identified barriers.

Reviewer 2:
The current project approach provided a good foundation for curbside modeling expansion and evaluation of real-world influences. Future research plans included proposals for expanding model attributes, such as additional curbside uses (e.g., e-commerce, micro-mobility); additional, other high-valued outcomes (e.g., safety); additional stakeholder partnerships for data collection and management; and curbside pricing strategies and policy sensitivities.

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

Reviewer 1:
The reviewer asserted that curbside activities are often overlooked in terms of traffic simulation and the associated micro- and macro-evaluation of energy and environmental impacts. Curbside activities are becoming even more relevant to this research, given the advent of TNC, e-commerce deliveries, and other novel curbside uses beyond parking and traditional bus ingress and egress. The project addresses the need for more effective modeling and incorporation of a growing mix of curbside activities into regionally broader and increasingly complex traffic simulation efforts.

Reviewer 2:
The energy component of this project is essentially non-existent. Clear identification of a pathway for why this project is necessary to inform energy technology investment or energy decision making is needed.

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

Reviewer 1:
The FY 2019 and FY 2020 funding appear to be sufficient for the prescribed efforts.

Reviewer 2:

While some of the project budget should be devoted to publications and presentations, it appears that this project's time and financial resource budget was excessively spent on such promotion as compared to investing time in model development.

Presentation Number: eems078
Presentation Title: Simulation Model Results for Energy and Mobility Impact of Behavioral Scenarios in POLARIS
Principal Investigator: Joshua Auld (Argonne National Laboratory)

Presenter

Joshua Auld, Argonne National Laboratory

Reviewer Sample Size

A total of four reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 75% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 25% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

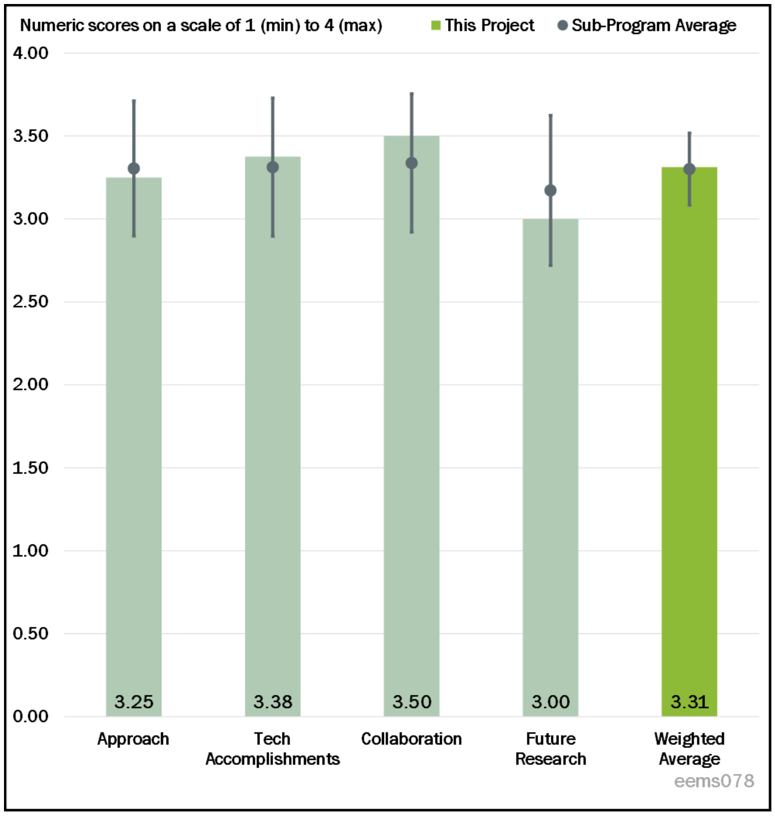

Figure 3-35 - Presentation Number: eems078 Presentation Title: Simulation Model Results for Energy and Mobility Impact of Behavioral Scenarios in POLARIS Principal Investigator: Joshua Auld (Argonne National Laboratory)

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:

This year's approach has successively built upon previous years' accomplishments. Using the now-enhanced version of the POLARIS framework, the research evaluated 13 future vehicle technology scenarios and their impacts on energy use and MEP. This year's work included an assessment of TNC and ride-sharing behavior, and time use and value changes due to CAV implementation.

Reviewer 2:

The approach is good, but the reviewer was not convinced that MEP is the best metric to quantify the effects.

Reviewer 3:

The approach to performing the work (i.e., enhancing POLARIS capability) makes sense to the reviewer. One major concern is about the computational efficiency of using the commercial optimization solvers (e.g., CPLEX, GUROBI). Based on the reviewer's experience, these commercial optimization solvers may not be so reliable to provide the optimal solution of a large-scale problem in a timely manner. For specific application on a large scale, there are usually tradeoffs between optimality and real-time performance. The research team may need to develop some heuristic algorithm(s) to improve the computational efficiency at the expense of certain optimality gaps.

Reviewer 4:

The reviewer thought that the workflow ANL developed is outstanding, though the reviewer would have liked to see more transparency about the modeling subcomponents in the AMR presentations. The reviewer struggled to understand the contribution of this presentation that should be evaluated herein versus the contributions from other presentations (e.g., Monique's, Aymeric's). Acknowledging that this work is very interconnected, the reviewer suggested explicitly stating the contributions of this presentation. The title of the presentation explicitly mentions model results, so that is where the reviewer focused comments.

It is hard to critically evaluate the model results without fully understanding the assumptions that were made with the models; there were not enough details about the approach to properly evaluate this. The reviewer understood that it is challenging with the ANL workflow because of the breadth of the model components used to obtain the results. In the future, this could be contained within the "Reviewer-Only" slides. Along those same lines, the reviewer knew and echoed comments that were made last year about the importance of validation and sensitivity analysis. Both of those activities are so important in order to build confidence in the modeling results. The reviewer was also very excited to see the results in the cities that both BEAM and POLARIS are modeling. If both frameworks are able to produce consistent results, it will significantly increase confidence in the results.

Regarding Slides 13 and 14, is the base case defined?

Regarding Slides 12 and 13, Slide 12 says that 4% of vehicle-miles traveled (VMT) are unloaded under the SAV case (which the reviewer assumed means deadheading/empty vehicles), while15% of VMT are unloaded in the Private AV case. However, on Slide 14, the SAV case has 14% deadhead VMT while the Private AV has 12% deadhead VMT. Those results seem to conflict with one another, unless the reviewer misunderstood something. The reviewer assumed the Private AV scenario would have a significantly higher deadhead VMT (current forecasts are anticipating a future in which Private AV users would send cars home once users are dropped off at work, rather than paying for expensive downtown parking, without appropriate policies discouraging this behavior). This does not seem to be represented in the modeling results.

The reviewer thought the observation of the possibly complementary effects of transit and TNCs is extremely interesting and encouraging. However, it may take some policy changes to see this come to fruition. Speaking from experience, the reviewer found that TNC drivers tend to center themselves in more urban areas and airports (more people, more likely to be assigned to someone), instead of waiting to be connected with a rider in suburbia. It tends to take longer and be less likely that a passenger will be connected with a driver in the suburbs unless a trip has been prearranged.

Regarding Slide 4: the description suggests that the microscopic traffic-flow simulator is outside of the POLARIS model. However, on Slide 8, the traffic-flow model seems to be included within POLARIS. The reviewer tried to find the Liu et al. (2018) in the bibliography, but it was not listed. The reviewer assumed it is more of a mesoscopic traffic-flow model, perhaps like Dynamic Traffic Assignment (DTA), but the documentation provided is unclear.

If POLARIS and the traffic micro-simulations are not linked, the reviewer suggested looking into how to ensure convergence between the two traffic-flow models (i.e., multi-resolution models). It needs to be a bidirectional exchange of data and results, not just taking the results from one model as inputs in the second and concluding that the results are consistent.

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 researcher indicated that the 3-year project was completed in FY 2019. Several key milestones were achieved in FY 2019, including the incorporation of new activity models addressing changes in time use and value; analysis of the interaction of SAVs and traditional transit modes; quantification of system energy and MEP impacts due to time use and value changes; and new modes and technology options. The researcher shared some nice insights of varying levels of vehicle sharing and technology, vehicle automation, and ownership on the interrelationships of transportation system energy use, VMT, congestion, and MEP. Overall, this 3-year project has supported the POLARIS model as an effective transportation system evaluation tool and provided significant understanding of the energy impacts of traveler behavior and future mobility technologies.

Reviewer 2:
The technical accomplishments and progress seemed reasonable to the reviewer.

Reviewer 3:
The progress is satisfactory, but the reviewer expected more journal publications, given the scale and duration of the project.

Reviewer 4:
The project was completed on time and on budget. However, the presenter did not mention the performance indicators for the workflow development and results. It would be interesting to know how the team internally assessed performance, though the reviewer assumed the team has met all of its goals, given that the project is complete. Overall, the enhanced POLARIS capabilities are well described, but the team did not clearly articulate the 13 future scenarios that were modeled.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The project exhibits diverse collaboration and coordination across National Laboratories, universities, and federal and local government organizations. The roles of team members are well described and defined. The research makes great use of universities and collaboration across multiple EEMS research projects.

Reviewer 2:
The collaboration and coordination across the project team were clear to the reviewer.

Reviewer 3:
There appears to be ample collaboration, but the collaboration efforts on EV charging does not quite show.

Reviewer 4:
It is hard to evaluate team collaboration when only one person is presenting for the entire team. However, the project was completed on time without major issues, so the reviewer presumed that collaboration worked well. The reviewer also loved Slide 8, where the presenter showed how different papers (and AMR sessions and posters) contributed to getting the results presented in this presentation. It is a very effective visual.

However, the reviewer would like to have seen end-users of the workflow (e.g., MPOs from Chicago, Austin, Detroit) as part of the project team. End-users would be able to better articulate the challenges of deploying some of the modeling contributions of the ANL workflow into the real world.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Although this 3-year project has been completed, the researcher suggested future work involving expanding and validating additional system scenarios. It is assumed that future efforts will focus on addressing the many remaining barriers and challenges identified in the presentation.

Reviewer 2:
The proposed future research made sense to the reviewer. It is great to see that not only charging facility, but also electricity grid simulation, models are part of the integration plan; that would be more of a system of systems approach. The reviewer indicated that the project has also ended.

Reviewer 3:
The project ended in 2019.

Reviewer 4:
The project ended, and the proposed future research appears extremely complex. It is going to be difficult to execute well.

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

Reviewer 1:
Yes, this project contributes to DOE's objectives. In order to assess complex future scenarios, the workflow is absolutely necessary and is in alignment with Goal 1: Tools, Techniques, & Capabilities to Understand & Improve Mobility Energy Productivity.

Reviewer 2:
The research is very relevant to DOE's EEMS program in the areas of SMART Mobility, HPC, and simulation by supporting and expanding the POLARIS modeling platform for assessing the impacts of traveler decision behavior and future mobility options on transportation system energy and performance. This work is providing key insights on traveler decisions and technology integration within the developing framework of POLARIS.

Reviewer 3:
This project will definitely support the overall DOE objectives by further improving the existing modeling tool, POLARIS, and capability. The project is considered to be a continuing effort in energy efficient mobility system simulation (agent-based modeling).

Reviewer 4:
The project supports DOE objectives in understanding what types of technologies are most promising for energy efficiency.

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

Reviewer 1:
The resources are considered to be sufficient in terms of the time (3 years), funding (approximately $1.4 million), and team members (various stakeholders) to achieve the stated milestones.

Reviewer 2:
The funding level appears to be sufficient for the efforts prescribed and multiple organizations involved.

Reviewer 3:
Project resources are sufficient.

Reviewer 4:
The project ended in 2019.

Presentation Number: eems079
Presentation Title: Travel-Time Use and Value With Mobility Services
Principal Investigator: Paul Leiby (Oak Ridge National Laboratory)

Presenter

Paul Leiby, Oak Ridge National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

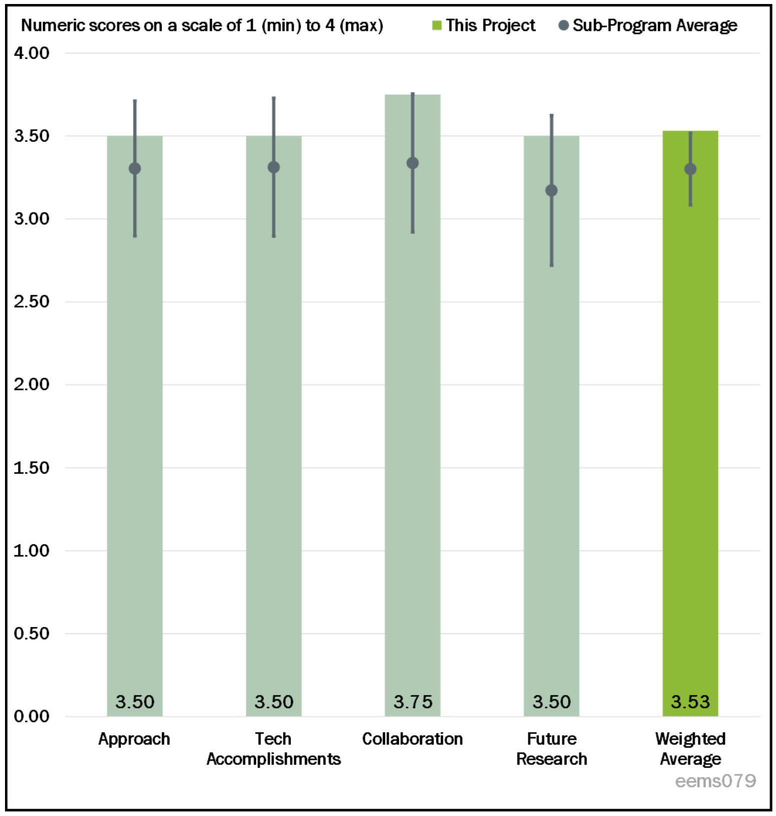

Figure 3-36 - Presentation Number: eems079 Presentation Title: Travel-Time Use and Value With Mobility Services Principal Investigator: Paul Leiby (Oak Ridge National Laboratory)

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 focus of this study is to develop quantitative estimates of how the value of travel time (VOTT) may change when time spent driving is replaced by time spent riding in a car. Specifically, the project sought to determine insights from VOTT for car sharing and ride hailing modes (basically a proxy), and subsequently to make inferences with regard to AVs. Other studies have been conducted, but they had notable weaknesses, including “stated preference/choice” methods based on survey responses, and the use of inappropriate proxies (such as trains or transit), which are dissimilar to AVs. The approach uses real-world data from app users on trip alternatives and their choices. The approach employs two discrete assessment methodologies, including Multinomial Logit and Mixed Logit discrete modeling pathways.

The presentation does a good job of identifying and addressing barriers including the following: determining the value and productivity from new mobility technologies; difficulty in sourcing empirical real-world data applicable to new mobility technologies; and the complex role of the human decision-making process in mobility systems.

Reviewer 2:

This research uses unique datasets to provide insight into a very difficult question.

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 project has achieved a number of accomplishments, including the development of suitable discrete choice models (Multinomial Logit and Mixed Logit with Error Components). Results from both estimation models are similar, indicating a significant reduction in cost ($16-$23 per hour) by using ridesharing—a proxy for AVs—versus driving a car. This shows the greater utility and lower cost of travel time of ridesharing, and thus AVs. These VOTT results are higher than previous studies, which used different parameters. For example, this study utilizes unique data, which in general applies to frequent urban users having higher than normal incomes.

The high-level technical accomplishment is that it has been shown that using real-world trip choice data suggest that a large time cost savings can be achieved from riding as opposed to driving.

The reviewer indicated that there are notable caveats to this study, which were mentioned in the presentation. These include the limited size of the dataset, a lack of clarity if car share driving is more or less convenient than a conventional private car, and that VOTT is known to vary significantly with trip purpose, urgency, and driver income.

Reviewer 2:
The research provided defensible answers.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
For a small task, the project has excellent collaboration and coordination. This includes collaboration with the University of Washington (empirical analysis), Migo (the mobility-as-a-service aggregator, which is providing the data, pre-processing, and interpretation), and ANL.

Reviewer 2:
It appeared to the reviewer that the prime and subcontractor worked seamlessly.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
In short, for future research this project proposes to strengthen and extend the existing estimates to a wider range of travelers and trip types. It would allow another dimension of variations and further refine estimates of VOTT for alternative car-based modes. This proposed future work would further refine and improve the accuracy of the study by expanding the dataset, seeking to improve controls and proxies for rider characteristics (like income) and obtain and utilize better data differentiating travel time for trip alternatives.

This proposed future research makes good sense, especially given the importance of understanding VOTT and the successful outcomes demonstrated by this project. As a prelude to any future efforts though, a cursory cost-benefit analysis may be beneficial to further validate the need for additional study. Eventually, a point of diminishing returns will be reached.

Reviewer 2:
The project has ended.

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

Reviewer 1:
Yes, this task is very relevant. Understanding VOTT is critical for assessing behavior and the benefits of new mobility technologies. Understanding the monetary VOTT is a major determinant of travel behavior and is the principal component of cost-benefit analyses of transportation infrastructure investments. While there has been a long history of similar analyses, the reviewer commented that the impact of automation has not been extensively researched and is highly uncertain. This is exacerbated by the lack of real-world data on VOTT in automated vehicles.

Reviewer 2:
The project helps decision makers understand VOTT as they look to promote ridesharing strategies.

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

Reviewer 1:
The project has successfully been completed and met its objectives with a very modest budget of $75,000, which is commendable.

Reviewer 2:
The resources are sufficient.

Presentation Number: eems081
Presentation Title: Nationwide Energy and Mobility Impacts of CAV Technologies
Principal Investigator: David Gohlke (Argonne National Laboratory)

Presenter

David Gohlke, Argonne National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

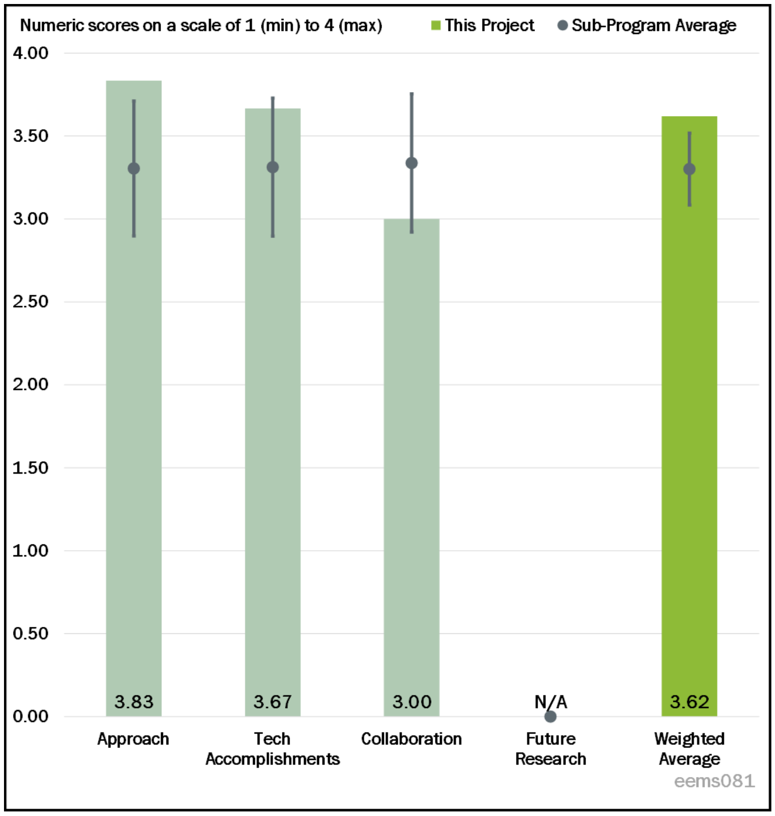

Figure 3-37 - Presentation Number: eems081 Presentation Title: Nationwide Energy and Mobility Impacts of CAV Technologies Principal Investigator: David Gohlke (Argonne National Laboratory)

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 Monte Carlo approach is by far the most plausible way to estimate the range of impacts in future scenarios. According to the reviewer, it is less prone to constraints of assumptions compared to a mechanistic simulation approach.

Reviewer 2:
This project had a very comprehensive approach to literature review for identifying the existing studies relevant to energy use and mobility impacts of CAVs. It was well designed to calculate distributions of impacts due to CAV technologies on VMT and total energy consumption for LD vehicles.

Reviewer 3:
The reviewer found the approach to be very clearly laid out across multiple slides. The project team examined the impacts of CAVs on VMT, fuel economy, and net energy consumption for LD vehicles, and repeated the analysis under various use-case scenarios. The work incorporated a wide range of existing literature (reviewing, for example, over 500 related documents), and variables and factors that accounted for road type (city versus highway), congestion level, etc. The presentation was also delivered in a very accessible, audience-friendly way (with clear graphics and explanations).

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 project has ended and was 100% completed. Accomplishments and key finding, (such as top factors leading to an increase in energy and fuel consumption, VMT, etc.) are clearly outlined in the presentation, including associated graphics. The work appears to have been successfully finished on schedule.

Reviewer 2:
The project was completed in December 2019 and met all of the milestones, concluding with a comprehensive final report. The team identified 24 different factors that contribute to VMT and energy consumption of CAVs in a review of 500 different reports.

Reviewer 3:
The project was successfully completed.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration efforts were generally clearly laid out in the presentation, with ANL providing lead analysis, writing, and the literature review; NREL providing a literature review and analysis methodology; and ORNL providing analysis methodology and literature review.

Reviewer 2:
ANL collaborated with ORNL and NREL in this project.

Reviewer 3:
Project collaboration appears to have been adequate.

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

Reviewer 1:
The project has ended and no specific future research has been proposed. The reviewer suggested that it would likely be beneficial to repeat this project in a couple of years to update the findings and help identify future CAV research needs.

Reviewer 2:
The project has been completed, ending December 31, 2019.

Reviewer 3:
The project ended.

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

Reviewer 1:
As is stated in the presentation, this analysis explores CAV efficiency and demand, identifying potential levers for future R&D to reduce nationwide fuel consumption and improve energy security. As cited in the presentation, "the EEMS subprogram supports early-stage research to support industry innovation that improves the affordability and energy productivity of the overall transportation system." This research is supporting DOE objectives to improve energy efficiency.

Reviewer 2:
This project supports the overall DOE objectives by providing supporting justification for future VTO research in CAVs, which would lead to reductions in petroleum consumption.

Reviewer 3:
The reviewer commented that the results shown on Slide 11 provide a clear reference point for decision makers on which technologies to focus on first.

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

Reviewer 1:
This was a 15-month project funded by a total of $280,000 among three National Laboratories. As a follow-on to the initial literature review a few years ago, the reviewer stated that the funding was appropriate for the scope of work.

Reviewer 2:
Project resources are sufficient.

Reviewer 3:
Funding for this project appears to have been sufficient.

Presentation Number: eems082
Presentation Title: Validation of Connected and Automated Mobility System Modeling and Simulation
Principal Investigator: Jeffrey Rupp (American Center for Mobility)

Presenter

Jeffrey Rupp, American Center for Mobility

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

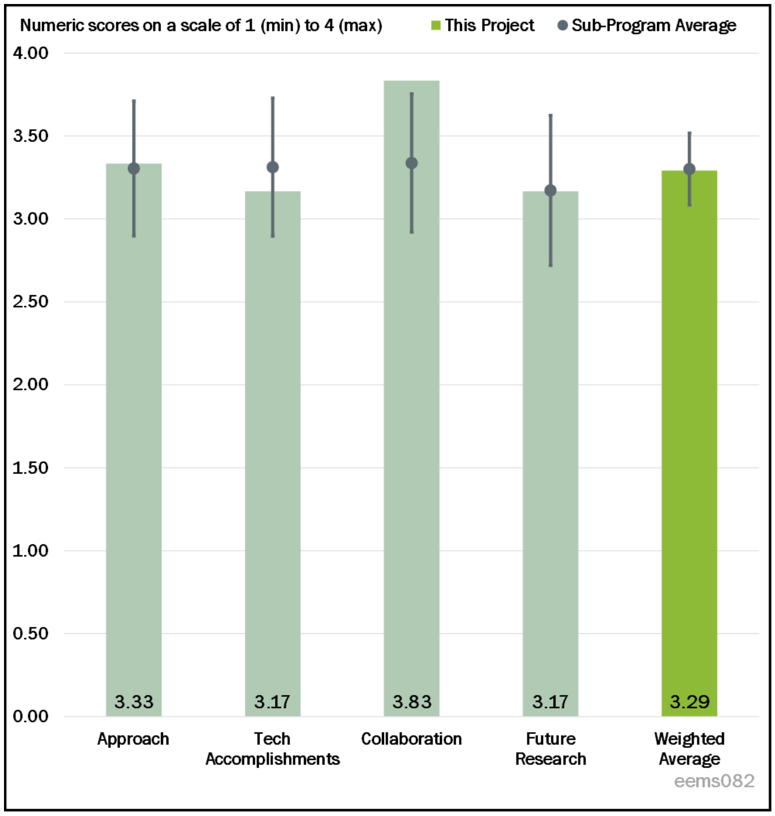

Figure 3-38 - Presentation Number: eems082 Presentation Title: Validation of Connected and Automated Mobility System Modeling and Simulation Principal Investigator: Jeffrey Rupp (American Center for Mobility)

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:

Very pragmatic plan and activity that is progressing well.

Reviewer 2:

The project aims to develop a realistic but controlled environment for on-road testing of CAVs.

Reviewer 3:

The reviewer had no concerns about planned future work. The tasks proposed on Slide 24 all seem reasonable, logical, and contribute toward the overall goal of being able to test realistic CAV scenarios.

The reviewer was concerned the project team underestimates the task of making sure human drivers are appropriately represented in the simulations, especially if mixed traffic simulations are planned. The team is planning to use the VISSIM micro-simulation software that has built-in, car-following, and lane-changing models. However, the reviewer encouraged the team not to rely on the default parameters to accurately model driving behavior. Many studies have shown that, although these models are able to capture driving behavior at a high level (e.g., appropriate capacity, corridor speed, corridor travel time estimates), the models produce trajectories that are not consistent with what is observed in real traffic data. Before running any sort of evaluation to validate transportation system performance, the reviewer encouraged the team to calibrate the human driver models in the analysis using trajectory-level data. The Strategic Highway Research Program 2 Naturalistic Driving Study datasets, the FHWA reconstructed Next Generation Simulation dataset, or the FHWA drone data collection project are all potential data sources to avoid additional data collection efforts.

Additionally, one of the things this reviewer recently thought about is how model projects are validated. Simulations estimate that there could be 4,000 or more vehicles per hour per lane if all vehicles are in CACC mode, but how realistic is that? Model accuracy is improving by making the model components more accurate (e.g., vehicle dynamics models, car-following models), but will that translate to more accurate estimates of performance? The reviewer was unsure if anyone knows that for certain. The reviewer thought VIL and augmented reality (AR) systems like this may be a way to get “ground truth” performance data before reaching high market penetration rates on the roadway. The reviewer encouraged the team to think about how to incorporate this into future research.

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:
There are several barriers, which are unknown at this moment. They are defined well, but there are likely to be more.

Reviewer 2:
The project is still in its very early stages. It appears slightly behind the planned progress, but it is fairly understandable considering COVID-19.

Reviewer 3:
This project is 8 months into its first year of activity. Thus far, progress seems reasonable (especially considering issues related to COVID-19). However, there are no performance indicators listed in the presentation on which to base the evaluation; the reviewer suggested adding them for next year’s AMR.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
There is a clear chart of responsibilities and regular meeting cadence.

Reviewer 2:
Collaboration appears to be well coordinated.

Reviewer 3:
It is hard to assess this question when only one team member is reporting the progress of the team. However, the fact that NDAs have been negotiated and put in place suggests that collaboration is alive and well within the team. The Zoom background was also a really nice touch on Slide 21 and made for a very effective visual!

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Further ideas were listed, including cybersecurity.

Reviewer 2:
The planned tasks for 2021 could be made more concise. Testing weather effects via simulation is understandable, but “artificial” weather effects?

Reviewer 3:
This team described future work in extensive detail. It is both thorough and logical, and the reviewer had no major criticism. If the goal is to evaluate scenarios with mixed traffic (e.g., simulated human vehicles), then the project team should not underestimate the importance of properly calibrating the VISSIM (Wiedemann) model for human driver behavior. The default parameters were calibrated based on driving behavior on the

German Autobahn and are not representative of real-world driving in American cities and freeways. The reviewer will not elaborate on that here because it was in the approach section.

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

Reviewer 1:
The reviewer thought that this project is so important toward validating the work that had been completed under SMART 1.0, but also thought it is important to start validating transportation system-level benefits (e.g., can 4,000 vehicles per hour per lane capacities using CACC really be achieved?). Right now, no one is close to having that type of ground truth data. However, HIL, VIL, and AR systems (like the one the project team is starting to build) are a huge step toward acquiring that type of data. The reviewer was so excited to see the progress that will be made between now and AMR 2021.

Strategic goal #1 for EEMS is 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. Not only is this project developing a new capability, but it is also going to provide a way to ensure that the new tools and capabilities developed by other EEMS projects are accurate.

Reviewer 2:
Automated vehicles (and developing the means to test and improve them) are important for future transportation systems.

Reviewer 3:
This reviewer emphasized that, eventually, the information will be correlated to energy use.

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

Reviewer 1:
The project encompasses excellent academic and laboratory partners, but should have an industry partner.

Reviewer 2:
The allocated resources seem reasonable for the planned tasks.

Reviewer 3:
The reviewer lacked sufficient experience in this area to make a meaningful comment. However, the PI did not mention any concerns with funding; so, the reviewer assumed that means the funding is reasonable.

Presentation Number: eems083
Presentation Title: CIRCLES: Congestion Impact Reduction via CAV-in-the-loop Lagrangian Energy Smoothing
Principal Investigator: Alexandre Bayen (University of California at Berkeley)

Presenter

Alexandre Bayen, University of California at Berkeley

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

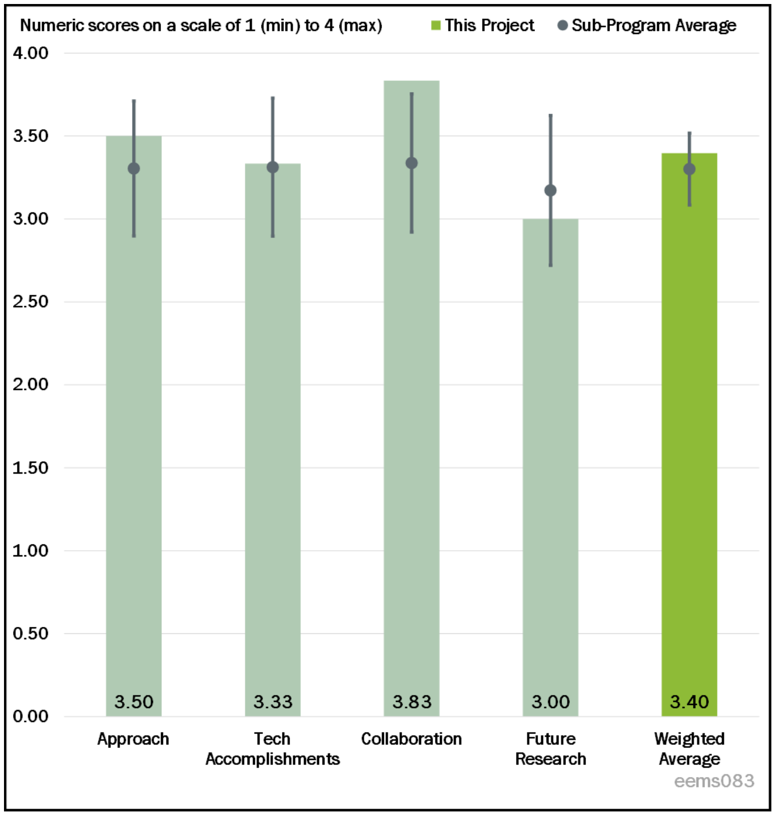

Figure 3-39 - Presentation Number: eems083 Presentation Title: CIRCLES: Congestion Impact Reduction via CAV-in-the-loop Lagrangian Energy Smoothing Principal Investigator: Alexandre Bayen (University of California at Berkeley)

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 project is well designed, but there are many undefined parameters and notable variability that need to be managed.

Reviewer 2:

The project design and approach are clearly laid out by technical category: traffic network modeling; Ordinary Differential Equation (ODE)/partial differential equation (PDE) and mean-field models; energy modeling; reinforcement-learning control algorithms; traffic data collection; test-bed development; and computer vision tracking algorithms. The presentation also addressed challenges and discussed future research plans and associated milestones.

Reviewer 3:

The overall approach appears to be very good. However, the reviewer still had some uncertainty with how the various components of the project fit together. A clearer description of the role of the infrastructure-collected data, the vehicle-collected data, and how they are used in the control strategy would be beneficial. The reviewer understood that the control strategies are being executed at the individual vehicle level, but it is still unclear if only their own sensors are being used for local data collection or if there are some high-level data that are also used in the vehicle control algorithms (e.g., current traffic volumes, speeds, etc.). The assumption can be made that the vehicle control is only controlling the longitudinal vehicle speed, but is it also controlling lane selection or lane changing? In summary, a clearer explanation of what is being developed is needed.

One of the challenges described is the difficulty in developing and calibrating a traffic simulation model that can realistically replicate the traffic waves (e.g., shockwaves). However, there does not seem to be a clear description of how this challenge will be overcome, or whether this project has the resources to overcome this challenge.

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:
This project started on January 1, 2020. According to the presenter and despite being a relatively new project, the project team has already completed more than 1,000 miles (by the time of audio recording for the presentation). The team appears to be on track for its five 2020 goals and laid out progress (e.g., designing relevant traffic macro-models) as well as next steps to help meet each of the outlined project goals.

Reviewer 2:
There appears to be excellent progress being made in this project. Development related to energy consumption models, vehicle-based data collection, and infrastructure-based data collection appears to be progressing well. The one challenge area that does not appear to have a clear solution path is the improvement of the traffic-flow models so that models can accurately replicate the traffic waves. This is a critical component to assess whether the vehicle-based control algorithm can actually “smooth” traffic.

Reviewer 3:
Overall, progress is being made, but some delays occurred due to COVID-19. There are still many unknown and details to finalize.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Each partner was identified with clear roles.

Reviewer 2:
The presentation clearly outlines ongoing collaboration and coordination with partner bodies, breaking up details by partner in a concise chart on one slide. The project team is also regularly coordinating. For instance, the team is working weekly with Toyota to expand the energy model inventory.

Reviewer 3:
The team appears to have excellent collaboration and coordination across its academic, industry, and government partners. All entities are contributing to the continued progress to date.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Milestones for proposed future research are clearly laid out for both FY 2020 and FY 2021. The milestones are somewhat generally described but clear. The team has also budgeted time to, for example, improve simulation boundary conditions.

Reviewer 2:
The project team needs to focus on how to solve for the unknowns to end up with understandable and usable results. Assumptions need to be confirmed to keep all data valid.

Reviewer 3:
The team appears to have a logical plan for moving forward with the research that incorporates go/no-go decision points related to critical milestones. If the development of a realistic traffic-flow model for" shockwaves" is a critical component to the assessment of this project, it would be good if the team were to develop some alternatives in the event that this is not attainable. Some of the other challenge areas, including "automatic detection and process of stop-and-go traffic" and "speed and accuracy of computer vision algorithms," appear to have alternative approaches that would involve more manual intervention or slower processing time, but could be used if necessary. This is based on the assumption that these processes are not used in "real time" vehicle-based control but are used in developing the control algorithms and assessing impacts on traffic flow "smoothing".

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

Reviewer 1:
Yes, this project is clearly focused on the use of CAV technologies to improve the energy consumption of vehicles. A lot of energy is wasted in stop-and-go traffic conditions, and this project aims to both reduce energy consumption for equipped CAVs and for these vehicles to act as a "smoothing" agent to other vehicles within the traffic stream. An additional benefit of the reduction of stop-and-go traffic conditions through traffic smoothing is the potential for reduced rear-end collisions, which have both safety, congestion, and energy impacts.

Reviewer 2:
Definitely, and If analyzed properly, the fuel savings effect for CAVs will be impactful and meet DOE objectives well.

Reviewer 3:
With the aim of helping to improve traffic flow and save energy, this project supports DOE's goal of supporting prudent development, deployment, and efficient use of energy resources.

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

Reviewer 1:
Project resources seem to be well designed and sufficient. Each party has a clear role and communicates well.

Reviewer 2:
Funding seems generally sufficient. Calibration of demand, algorithm fine-tuning, and validation under varied conditions, etc., could always be further developed or expanded in future projects with additional funding later, if/once funding runs out.

Reviewer 3:
The resources appear to be sufficient; however, costs for a medium-scale test always have a risk of "cost creep."

Presentation Number: eems084
Presentation Title: Energy-Efficient Maneuvering of connected and Automated Vehicles (CAVs) with Situational Awareness at Intersections
Principal Investigator: Sankar Rengarajan (Southwest Research Institute)

Presenter

Sankar Rengarajan, Southwest Research Institute

Reviewer Sample Size

A total of four reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 75% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 25% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

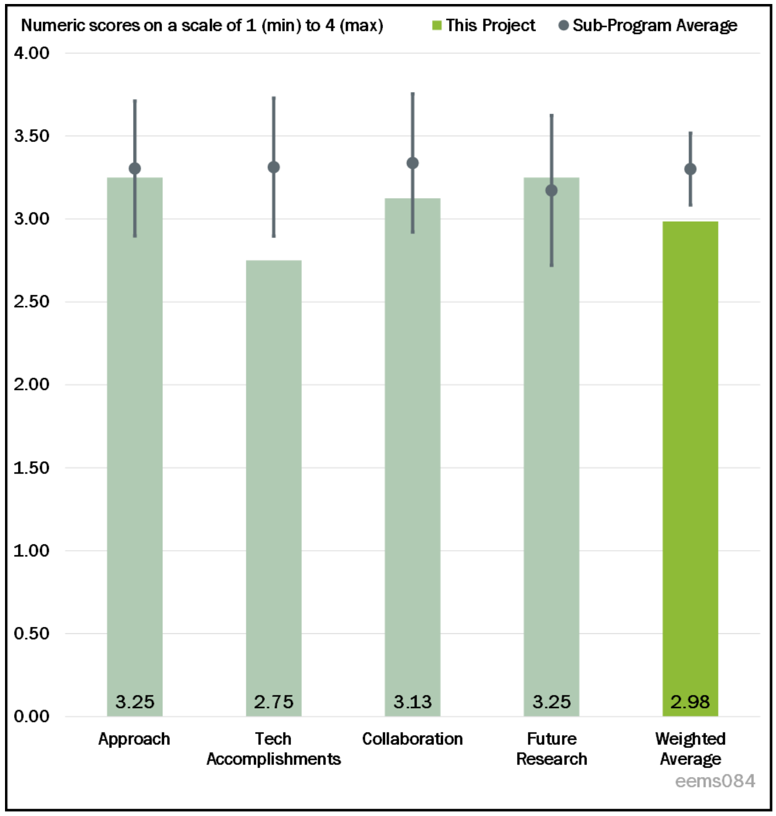

Figure 3-40 - Presentation Number: eems084 Presentation Title: Energy-Efficient Maneuvering of connected and Automated Vehicles (CAVs) with Situational Awareness at Intersections Principal Investigator: Sankar Rengarajan (Southwest Research Institute)

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 project has good experimental parameters, a nice selection of vehicles, simulation routes, and planned roadways for validation.

Reviewer 2:
The approach at the high level is appropriate and valid. The work recognizes the need to address realistic scenarios and validate to a wider range of conditions, including greater than 300 meters from the intersection. The work is feasible.

Reviewer 3:
The project outlines clear program objectives, milestones, and target outcomes. Challenges associated with simulation and related assumptions were addressed and responses to associated questions seemed generally reasonable. For example, the model does not assume a wide variation of vehicles; this means there are no tanker trucks. Rather, the vehicles are essentially assumed to be standard replications of existing vehicles, just with some driving “smart.” The presentation and project seem well laid out, with a good concept.

Reviewer 4:
The approach appears to be good overall, starting with simulation first, then following with a dynamometer integrated with simulation, and then finally a field test. This is a logical progression for the approach.

However, there was no real presentation of how some of the barriers and challenges will be addressed. For example, the system is relying on infrastructure-based detection of all vehicles, the majority of which will be "unconnected vehicles." The challenge was identified by the project team as "intersection stack validation with real data and long-range conditions (~300 meters from the intersection)." The accuracy of intersection-based detection equipment is significantly reduced at longer distances due to occlusion from other vehicles. This, in turn, will severely impact the ability of the eco-driving "speed optimization" to calculate appropriate speeds for the equipped vehicles. Approaches to overcome this challenge were not presented.

One item that could impact the performance of the system but was not mentioned in the presentation is the impact on how human drivers in "unconnected vehicles" will react to the "connected" vehicles that are driving based on optimized eco-driving speeds. These eco-driving "connected" vehicles have the potential to disrupt traffic and cause the drivers of the "unconnected" vehicles to behave differently and aggressively (e.g., changing lanes, speeding up, etc.). Be aware that current traffic simulation models will not take this behavior into account, so the results may not necessarily be realistic, especially at lower levels of market penetration of eco-driving vehicles.

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:
This project started on October 1, 2019, and is scheduled to run through the end of 2022. While the presenter mentioned that the team is still working on subcontracts and intellectual property (IP) agreements with partners, a 15% completion of progress to report is decent, particularly considering the events in the United States over the past several months and that the contract between DOE and the Southwest Research Institute was finalized fewer than 3 months ago on March 25, 2020. The team is on track with four of its FY 2020 milestones and has already started working on one of its FY 2021 milestones.

Reviewer 2:
The project was just approved 3 months ago, so not much significant work has been done. The team has a lot to finish in 2020 and 2021.

Reviewer 3:
This is a new project that is just underway, so not a lot of progress has been made yet. That said, the project appears to be on schedule. However, as mentioned above, it is not clear if progress has been made on coming up with possible solutions to some of the barriers and challenges that the project team has identified. Some of these potential solutions will likely need to be explored prior to the first go/no-go decision.

Reviewer 4:
The work, which is 15% complete, has not progressed sufficiently or met the key benchmarks and output to evaluate beyond this point. If work remains on track, the reviewer expected the rating to go up in subsequent reviews.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Collaboration appears to be excellent so far. The project team is hosting weekly calls to continue progress during COVID-19 times.

Reviewer 2:
The project has a good selection of partners with great synergies and capabilities.

Reviewer 3:
Subcontracts and IP agreements with partners were still being finalized. During this reporting period, the team has stayed connected through WebEx, as an example. The presentation lays out the distinct role and

partnership type for each collaborating partner organization. It is a bit early to fairly assess project-specific coordination with partners.

Reviewer 4:
Project collaboration is satisfactory. The effectiveness will be easier to evaluate after more time. The partners appear to be relevant and bring necessary contributions to the project. There appears to be some contradiction in the role of Continental; it is listed as facilitating meetings with Easy Mile, but also listed as providing the Level 4 vehicle. Please rectify the discrepancy and provide clear, consistent contributions from all partners and collaborators.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The project is well organized, considering its infancy stage. The reviewer would expect more detail as more is learned.

Reviewer 2:
The presentation clearly laid out plans for FY 2021 and FY 2022, with a transition from simulation to CAV dynamometer in FY 2021 and transition from dynamometer to track testing in FY 2022 (whereas FY 2020 is focused on simulation). The presentation and associated PowerPoint slides also discussed potential associated challenges. The reviewer noted that corridor selection for the traffic simulation is in progress. It is a challenge to accurately represent the real world, and the project team is working on this.

Reviewer 3:
Future research appears to be on track for the major milestones in FY 2020. Again, the project is fairly new so not a lot of progress has been made yet. The future milestone in FY 2021 of “intersection stack validated with real traffic data” has a barrier and challenge with respect to intersection-based sensing capabilities at longer distances (greater than 300 meters) that will need to be addressed. Understanding the accuracy of the sensor data at various distances, visibility conditions, traffic composition, etc., will be a key determinant in the system design and robustness.

Reviewer 4:
This question is not relevant because future work is this project’s formal work plan.

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

Reviewer 1:
This project aims to explore the potential benefit for eco-driving technology in a mixed fleet, potentially reducing energy consumption without negatively impacting trip times. This project supports DOE’s goal of promoting efficient use of energy resources and supporting a more economically competitive, environmentally responsible, secure, and resilient U.S. energy infrastructure.

Reviewer 2:
Yes, this project is very relevant, as it focuses on eco-driving for “connected” vehicles. Various vehicle powertrains and automation driving levels are being studied. Also, understanding the impact that a small percentage of “connected,” eco-driving vehicles will have on the majority of “unconnected” vehicles in the traffic stream will yield good insights.

Reviewer 3:
The project properly enumerated how the results align with DOE objectives.

Reviewer 4:
The project is using a mix of vehicles to confirm energy efficiency, which separates it from other projects. Also, the experiment to prove that even non-connected vehicles will have energy efficiency improvements is interesting and unique.

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

Reviewer 1:
The reviewer believed project resources are the minimum needed to complete this project, but very good expertise exists in those selected.

Reviewer 2:
Funding seems generally sufficient to generate findings. For increased scope, scalability, etc., more resources later on could potentially help to further develop the project and findings (e.g., validating energy consumption benefits, etc.), if desired.

Reviewer 3:
Yes, resources appear to be sufficient.

Reviewer 4:
If the vehicles are provided by the partners, the $4 million or greater cost for a 2-year project appears high, given the tasks. While some of the cost will cover the chassis dynamometer testing, the indication is that much of the budget is for individual time. The reviewer expected more deliverables for the budget.

Presentation Number: eems086
Presentation Title: Simulation Tool for Energy-Efficient Connected and Automated Vehicle (CAV) Control Development
Principal Investigator: Dominik Karbowski (Argonne National Laboratory)

Presenter

Dominik Karbowski, Argonne National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

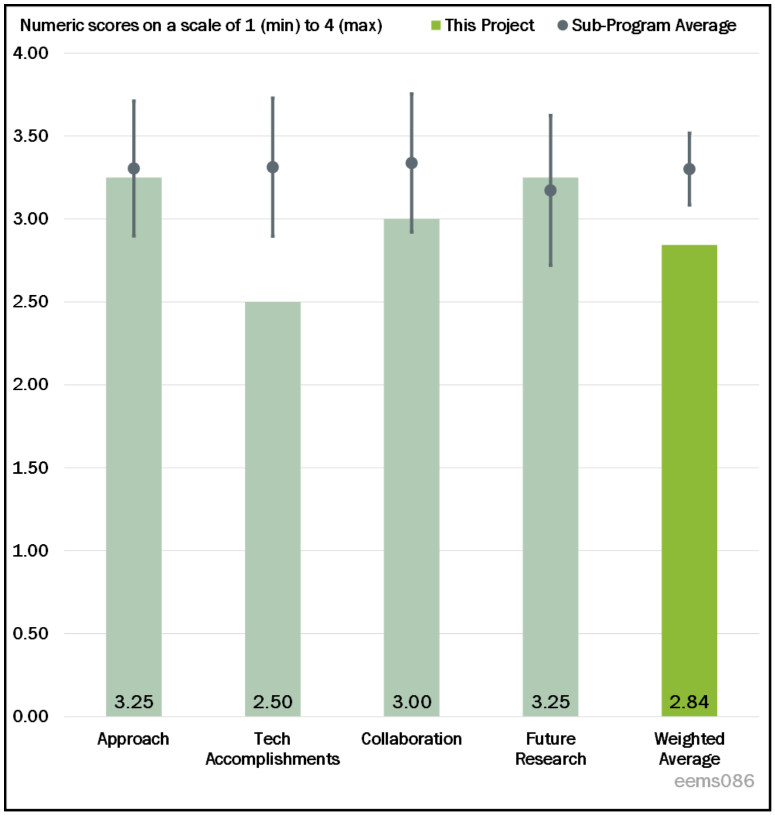

Figure 3-41 - Presentation Number: eems086 Presentation Title: Simulation Tool for Energy-Efficient Connected and Automated Vehicle (CAV) Control Development Principal Investigator: Dominik Karbowski (Argonne National Laboratory)

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 project is clearly laid out with ample evidence (including earlier successful development and application of the RoadRunner tool)- that it will be successful in meeting the project purpose.

Reviewer 2:

The project seems feasible, with a lot in the hands of Hyundai Kia America Technical Center (HATCI) with respect to providing high-resolution temporal driving data to inform and validate the model. It is unclear how much of the driving trace data have already been shared. The reviewer saw that the data collection from the dedicated testing vehicle goes through the end of 2020, but it is not clear if the team is receiving data every month or only at the end. The reviewer also appreciated the variety in vehicle classes and types and hoped the team is able to show if there is a different type of driving depending on the vehicle class and type for comparison with future CAVs, or if the majority of the driving occurs due to different types of drivers (aggressive, calm, etc.).

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 project has just started, so progress is slow. The reviewer suggested that the team work on alpha release and GUI. Additionally, the reviewer liked that ANL has already received some customer data and has been able to use innovative techniques to decipher what is happening during the trip—turning, intersection, entering and exiting the highway, etc.).

Reviewer 2:
It is early in the project, and milestone due dates are in the future. The presentation notes COVID-related delays in the start of on-road data collection.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
Work is mainly between ANL and HATCI. It seems that the team is working well together and already sharing data. The first deliverable between the teams is in July 2020.

Reviewer 2:
The only partner is Hyundai, which has crucial roles in generating data and testing the RoadRunner 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. Note: if the project has ended, please state project ended.

Reviewer 1:
The description of the future work is clear and sensible.

Reviewer 2:
Most of the work is left, but the plan to accomplish it seems logical and appropriate.

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

Reviewer 1:
The project supports DOE objectives well. It is specifically for the purpose of maximizing the energy savings of CAV technologies.

Commercialization of RoadRunner is an objective of the work. It would be desirable to ensure that this lab-developed product does not become cost prohibitive to the research community.

Reviewer 2:
Having a tool that enables the quantification and improvements of CAVs with respect to energy efficiency is relevant to DOE.

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

Reviewer 1:
The resources seem reasonable for the project scope.

Reviewer 2:
There is no indication of insufficient funding.

Presentation Number: eems087 Presentation Title: Computation of Metropolitan-Scale, Quasi-Static Traffic Assignment Models Using High-Performance Computing Principal Investigator: Jane Macfarlane (Lawrence Berkeley National Laboratory)

Presenter

Jane Macfarlane, Lawrence Berkeley National Laboratory

Reviewer Sample Size

A total of two reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

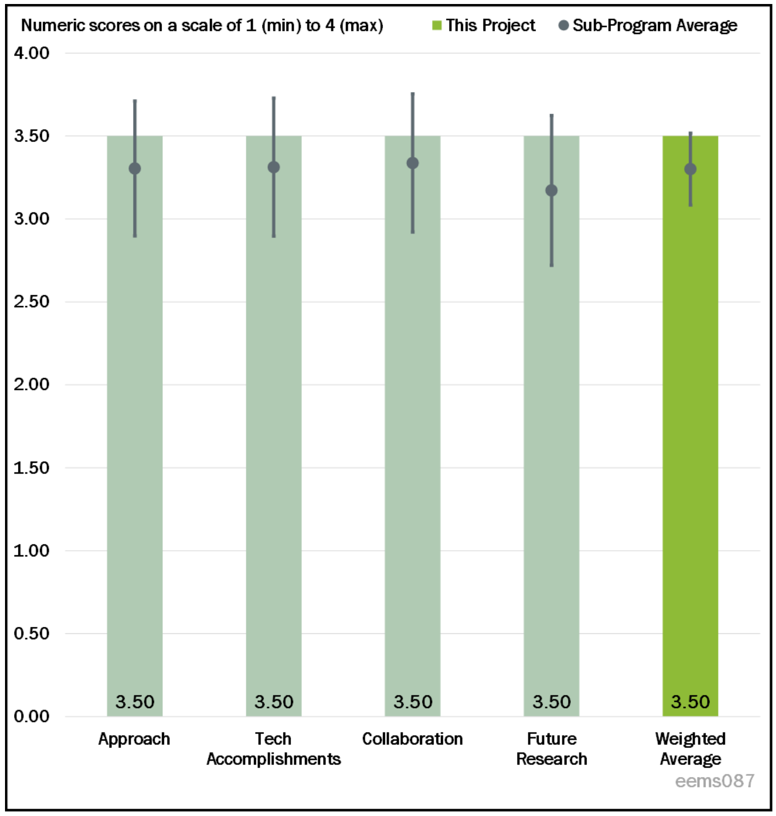

Figure 3-42 - Presentation Number: eems087 Presentation Title: Computation of Metropolitan-Scale, Quasi-Static Traffic Assignment Models Using High-Performance Computing Principal Investigator: Jane Macfarlane (Lawrence Berkeley National Laboratory)

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 project focused on HPC for assessing optimal energy use in metropolitan-scale transportation networks. The approach employed quasi-dynamic, parallel traffic assignment simulation comparing four cases involving user, system time, and fuel optimization. The researcher utilized an existing LBNL platform, Mobiliti, to facilitate the large-scale simulations.

Reviewer 2:

The project is well designed and is addressing current technical barriers.

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 researcher stated that about 50% of the project scope has been completed as of the AMR presentation. The research appears to be on track for completion in fall 2020. Through utilization of the existing Mobiliti platform, significant progress has been achieved to date in deriving large-scale network results efficiently using HPC. The quasi-dynamic traffic assignment (QDTA) approach has yielded promising early optimization results for Bay Area simulations in terms of improved congestion flows and energy use. Results indicate that fuel-based optimization is very sensitive to speed profiles, and time-based optimization is sensitive to assumed time intervals.

Reviewer 2:
The team has generated impressive results, but in terms of reduced computational time and improvements of traffic flow on different parameters, it was unclear to the reviewer if the model output is sufficient for local traffic planners to improve traffic flow or if the team would also need to run the model as things change. If so, would the team need super computers, even with the computational optimization?

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
The researcher has exhibited good collaborative efforts across both government (e.g., the city of San Jose, the Southern California Association of Government [SCAG], and the San Francisco County Traffic Authority [SFCTA]) and industry organizations HERE Technologies, Uber) in terms of relevant database and information sources. The research also leveraged the use of an existing LBNL simulation platform, Mobiliti, for performing the work.

Reviewer 2:
It is clear that there is collaboration and coordination across the team and collaborators.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
The researcher has laid out a reasonable plan for completing the work and meeting the original project objectives. The researcher plans further collaboration with the San Jose government to incorporate city sensor data and to validate the optimization models, which will be a critical next step. The researcher also plans to improve the adaptive learning functions and time intervals of the model for quicker convergence, especially for time-based optimization under high travel-demand periods. Finally, the researcher will translate QDTA results into training samples as a first step toward machine learning-based simulations for traffic management.

Reviewer 2:
Now that the project team has gotten this far, it makes sense to include travel modalities and to continue innovating with machine learning to address traffic-flow issues.

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

Reviewer 1:
This project is relevant as it applies HPC to large-scale transportation network modeling and aims to support an eventual simulation framework for machine learning-based traffic congestion and energy use management.

Reviewer 2:
Improving the traffic flow increases mobility while decreasing energy, making the project very relevant to DOE goals.

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

Reviewer 1:
The funding for this project seems sufficient for a 1-year project and the technical progress achieved.

Reviewer 2:
The budget allocated to this project seems reasonable, given the scope.

Presentation Number: eems088
Presentation Title: Chicago Transit Authority Transit Network Efficiency and the Changing Mobility Landscape
Principal Investigator: Joshua Auld (Argonne National Laboratory)

Presenter

Joshua Auld, Argonne National Laboratory

Reviewer Sample Size

A total of three reviewers evaluated this project.

Project Relevance and Resources

100% of reviewers indicated that the project was relevant to current DOE objectives, 0% of reviewers indicated that the project was not relevant, and 0% of reviewers did not indicate an answer. 100% of reviewers indicated that the resources were sufficient, 0% of reviewers indicated that the resources were insufficient, 0% of reviewers indicated that the resources were excessive, and 0% of reviewers did not indicate an answer.

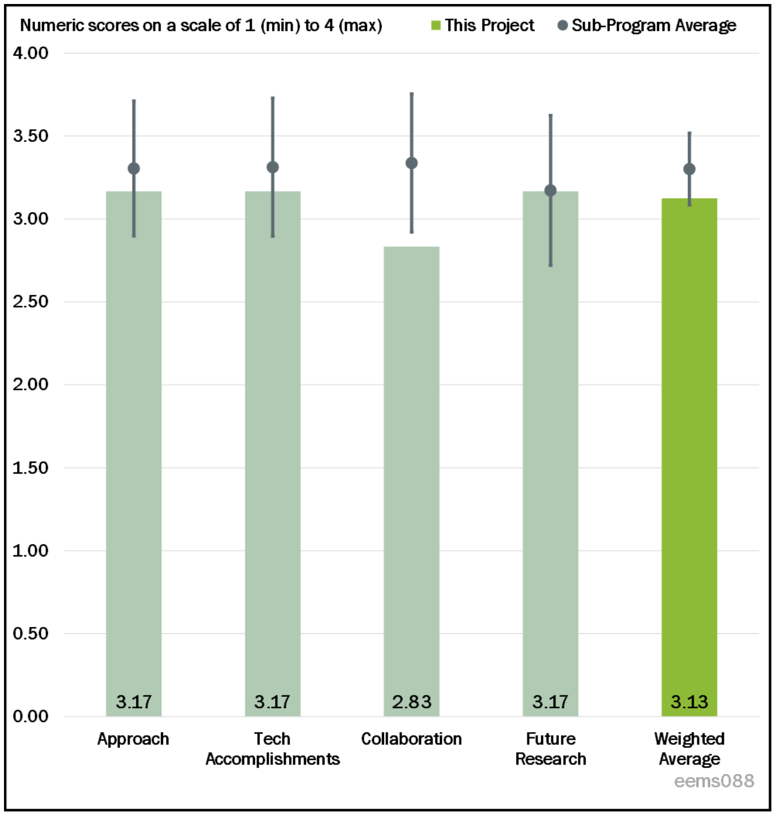

Figure 3-43 - Presentation Number: eems088 Presentation Title: Chicago Transit Authority Transit Network Efficiency and the Changing Mobility Landscape Principal Investigator: Joshua Auld (Argonne National Laboratory)

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 project approach was well laid out and progressive involving collecting and analyzing data; developing transit frequency and a schedule optimization algorithm; and using POLARIS for large-scale transportation network scenario development and iterative modeling.

Reviewer 2:

How to reshape the future of transit service for improved mobility and energy resiliency is the primary research question this project aims to answer, at a high level. This includes potential reconfiguration of traditional transit services and potential integration (or competition) with new transportation modes, such as shared and electrified mobility.

The approach encompasses three primary steps: data analysis to determine significant factors impacting Chicago Transit Authority (CTA) ridership; open-loop implementation to develop optimization algorithms for identified targets and to simulate the optimized network in POLARIS; and closed-loop implementation to develop algorithms for identified targets and to simulate the optimized network in POLARIS through multiple scenarios and iterations.

Targets will be redefined as part of the open-loop simulations and subsequently combined with feedback from the CTA to test and evaluate hundreds of new scenarios. These efforts look to answer multiple questions through new algorithm development and modeling in POLARIS to identify new and modified routes, frequencies, timetables, electrified routes, and new strategies to improve performance. Closed-loop implementation will be similar to open-loop simulation but will be optimized using HPC.

This transit modeling emphasizes new CTA schedules integrated within a multi-modal algorithm framework. The project has identified three high-level barriers, including high uncertainty in technology deployment, functionality, usage, and system-level impact; complexity of the computational models, design, and simulation methodologies; and integration of many model frameworks, including land use, demand, flow, vehicles, grid, and economy.

Overall, the project is well designed, largely addresses key barriers, and is completely feasible.

Reviewer 3:
The research question of how to reshape the future of transit seems much broader than the research, which investigates optimization of scheduling and routing. Slide 6 indicates that an early step was analysis of factors impacting CTA ridership, including TNC level of service and price, but it is not clear how this analysis informed the research design.

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:
In spite of delays in getting an NDA signed with the project partner, significant progress was made on the 1-year project. The researcher stated that about 50% of the project scope has been completed as of the AMR presentation. The delay in the signed NDA resulted in delays in getting the actual transit data from CTA and their subsequent analysis. However, the researcher was able to complete the initial transit frequency and scheduling optimization algorithm and obtained preliminary results from POLARIS using simulation data to show increased boarding and reduced wait time. The researcher was also able to organize the workflow necessary for calibrating POLARIS with the CTA data and evaluating full scenarios using HPC. The project appears to be on track to completing the work by the end of FY 2020, as planned.

Reviewer 2:
The project achieved three significant technical accomplishments including solving the optimal transit frequency problem; integrating new schedules into POLARIS; and establishing the automated workflow for HPC implementation.

Strong, preliminary results have been achieved, including at a 5.1% increase in boardings and fare revenue, a 3.3% reduction in average waiting time, and a 22.4% decrease in rerouting due to missed connections or full vehicles (i.e., people are more satisfied with the new service). Technical analysis has also indicated the recommendation to shift the Chicago transit service to the outer and southern parts of the city.

Reviewer 3:
Results on boardings and wait time look reasonable and useful. There was a delay in model calibration due to an earlier delay in signing an NDA and obtaining data. However, the team did an analysis in the meantime with uncalibrated simulation data.

Question 3: Collaboration and Coordination Across Project Team.

Reviewer 1:
ANL is the lead for this project, and the CTA is the sole partner, which is reasonable given the project emphasis and scope. CTA is providing data, setting goals, discussing results, and implementing agreed upon changes.

Reviewer 2:
The project has only one collaborator, which is the CTA. Although the NDA resulted in early delays for the project, the CTA provided relevant, in-depth data and information for the project and provides active feedback on results.

Reviewer 3:
CTA is the only partner, and their role is important (provide data, implement changes, etc.) but largely outside of the research itself.

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. Note: if the project has ended, please state project ended.

Reviewer 1:
Remaining challenges and barriers have been identified, including calibrating POLARIS to match CTA boarding and alighting counts and discussing preliminary results with CTA to obtain further guidelines. These are very reasonable and surmountable.

Proposed future activities include transit route design and redesign, transit frequency setting and timetabling, transit route electrification, and schedule adherence and performance improvement. It makes sense to further optimize POLARIS modeling to enhance the performance and energy efficiency of the CTA. If successful, which seems likely, it will lead to many benefits, including improved mobility, utilization, and revenue.

Reviewer 2:
The researcher's proposed future research will involve calibration of POLARIS using the CTA data and transit optimization scenario development and iterative evaluation using full-scale HPC. As part of the latter phase, the researcher plans to evaluate transit route design and redesign, transit frequency, transit bus route electrification, and transit schedule adherence and performance.

Reviewer 3:
Future work includes transit "performance improvement" beyond route design and scheduling, but the kind of improvement is not specified.

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

Reviewer 1:
Yes, this project is very relevant as a result of the extreme disruption underway in the transportation system from vehicle electrification, shared mobility, e-commerce, automation, traveler behavior, and so forth, which provides new opportunities to improve transit performance and efficiency. Additionally, this effort has demonstrated it can lead to overall transit system performance and efficiency improvement, even without integration of new mobility options.

Reviewer 2:
The project is relevant in that it aims to evaluate the impacts of optimization of transit systems on large-scale transportation networks using HPC.

Reviewer 3:
Energy impacts are not shown as a direct output of the work. Presumably, the increase in boardings would save energy, but an explicit energy finding would be desirable in this multi-modal urban setting.

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

Reviewer 1:
The project resources are reasonable at $300,000 and appear sufficient to achieve the project's objectives.

Reviewer 2:
The funding for this project seems sufficient for a 1-year project and the technical progress achieved.

Reviewer 3:
There is no indication of insufficient funding. It looks as though the project is slightly behind schedule, but this is probably due to the delay in the NDA, which required a recalibration of the model to CTA data.

Acronyms and Abbreviations

21CTP	21st Century Truck Partnership
ACC	Adaptive cruise control
ACES	Automated, connected, electric and/or shared
ACM	American Center for Mobility
AEV	Autonomous electric vehicle
AFI	Advanced Fueling Infrastructure
AI	Artificial intelligence
AIMSUN	Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks
AMBER	Advanced Model Based Engineering Resource
AMD	Automated Mobility District
AMR	Annual Merit Review
ANL	Argonne National Laboratory
API	Application programming interface
AR	Augmented reality
ARPA-E	Advanced Research Projects Agency - Energy
ATM	Active traffic management
AV	Autonomous vehicle; Automated vehicle
BEAM	Behavior, Energy, Autonomy, and Mobility
BEV	Battery electric vehicle
CACC	Cooperative adaptive cruise control; coordinated adaptive cruise control
CARB	California Air Resources Board
CAV	Connected and autonomous vehicle
CARLA	Computer-Assisted Related Language Adaptation
CC	Cruise control
CRM	Coordinated ramp metering
CTA	Chicago Transit Authority
DCFC	Direct-current fast charging
DOE	U.S. Department of Energy

DOT	U.S. Department of Transportation
DPWT	Dynamic wireless power transfer
DTG	data.transportation.gov
EAD	Eco-approach and departure
eco-CAC	Eco-cooperated automated control
e-commerce	Electronic commerce
EEMS	Energy Efficient Mobility Systems
e-scooter	Electric scooter
EV	Electric vehicle
FAF	Freight Analysis Framework
FedEx	Federal Express
FHWA	Federal Highway Administration
F-MEP	Freight mobility energy productivity
FMLM	First-mile and last-mile
FOA	Funding Opportunity Announcement
FY	Fiscal Year
GM	General Motors
GPS	Global positioning system
GPU	Graphics processing unit
GUI	Graphical user interface
HATCI	Hyundai Kia America Test Center
HD	Heavy-duty
HIL	Hardware-in-the-loop
HPC	High performance computing
INL	Idaho National Laboratory
IP	Intellectual property
IT	Information technology
kW	Kilowatt

L2	Level 2
LBNL	Lawrence Berkeley National Laboratory
LD	Light-duty
LDP	LiveWire Data Platform
LDV	Light-duty vehicle
LLNL	Lawrence Livermore National Laboratory
LRRM	Local responsive ramp metering
MD	Medium-duty
MENNDL	Multi-node Evolutionary Neural Networks for Deep Learning
MEP	Mobility energy productivity
MIMO	Multi-input and multi-output
ML	Machine learning
MMIFE	Multi-modal intercity freight energy
MOD	Mobility-on-demand
MOTIVE	Mobility and Technology Insight Validation Evidence
mph	Miles per hour
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Commission
NDA	Non-disclosure agreement
NEXTCAR	Next-Generation Energy Technologies for Connected and Automated On-Road Vehicles
NGO	Non-governmental organizations
NHTSA	National Highway Traffic Safety Administration
OEM	Original equipment manufacturer
ORNL	Oak Ridge National Laboratory
PI	Principal investigator
PNNL	Pacific Northwest National Laboratory
POLARIS	Planning and Operations Language for Agent-based Regional Integrated Simulation
Q	Quarter

Q&A	Question and answer
QDTA	Quasi-dynamic traffic assignment
RM	Ramp metering
SAV	Shared and automated vehicles
SFCTA	San Francisco County Transportation Authority
SIL	Software-in-the-loop
SMART	Systems and Modeling for Accelerated Research in Transportation
TNC	Transportation network company
TPO	Transportation Planning Organizations
U.S. DRIVE	U.S. Driving Research and Innovation for Vehicle efficiency and Energy sustainability
UPS	United Parcel Service
UrbanSim	Urban Simulation
V2X	Vehicle-to-anything
VIL	Vehicle-in-the-loop
VMT	Vehicle-miles traveled
VOTT	Value of travel time
VSA	Variable speed advisory
VTO	Vehicle Technologies Office
ZANZEFF	Zero and Near-Zero Emissions Freight Facilities