# 7. Technology Integration

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 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 Technology Integration (TI) subprogram covers a broad technology portfolio that includes alternative fuels (e.g., biofuels, electricity, hydrogen, natural gas, propane) and energy efficient mobility systems. These technologies can strengthen national security through fuel diversity and the use of domestic fuel sources, reduce transportation energy costs for businesses and consumers, and support energy resiliency with affordable alternatives to conventional fuels that may face unusually high demand in emergency situations.

The TI subprogram supports Data and Systems Research activities, which include "living lab" projects—competitively selected, cost-shared projects to validate data, technologies, and systems in the field and inform future research—as well as statutory requirements related to alternative fuels, the annual Fuel Economy Guide, and the State and Alternative Fuel Provider Fleet regulatory program. The subprogram also includes the Advanced Vehicle Competitions activity, which supports science, technology, engineering, and mathematics (STEM) and workforce development interests. The Advanced Vehicle Technology Competitions activity supports a collegiate engineering competition that provides hands-on, real-world experience in advanced vehicle technologies and designs. By engaging university students in advanced technology research and providing specialized training, the Advanced Vehicle Technology Competitions activity helps address workforce development needs for more highly trained engineers and supports national efforts that encourage students to pursue careers in science, technology, engineering, and math.

## 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 7-1 – Project Feedback

| Presentation ID | Presentation Title | Principal Investigator (Organization) | Page Number | Objectives | Approach | Accomplish-ments | Collaborations | Overall Impact | Weighted Average |
|---|---|---|---|---|---|---|---|---|---|
| ti091 | Solutions for Curbside-Charging Electric Vehicles Planned for Urban Growth | Robert Cox (University of North Carolina at Charlotte) | 7-5 | 3.60 | 3.50 | 3.60 | 3.90 | 3.60 | 3.61 |
| ti092 | Vehicle Charging Innovations for Multi-Unit Dwellings (VCI-MUD) | Kevin Wood (Center for Sustainable Energy) | 7-9 | 3.38 | 2.88 | 2.88 | 3.38 | 2.88 | 3.03 |
| ti093 | Electric Vehicle Supply Equipment (EVSE) Innovation: Streetlight Charging in City Right-Of-Way | Miriam Bouallegue (Metropolitan Energy Center) | 7-13 | 3.40 | 3.10 | 3.00 | 3.40 | 3.00 | 3.14 |
| ti094 | Advanced Transportation Hub Efficiency using Novel Analysis (ATHENA) | Caleb Phillips (NREL) | 7-17 | 3.38 | 3.50 | 3.63 | 3.75 | 3.63 | 3.56 |
| ti095 | High-Performance Computing (HPC) for O'Hare Hub | Aymeric Rousseau (ANL) | 7-21 | 3.38 | 3.50 | 3.38 | 3.63 | 3.50 | 3.44 |
| ti096 | Technology Integration to Gain Commercial Efficiency for the Urban Goods Delivery System | Anne Goodchild (University of Washington) | 7-25 | 3.25 | 3.38 | 3.13 | 3.63 | 3.25 | 3.26 |

| Presentation ID | Presentation Title | Principal Investigator (Organization) | Page Number | Objectives | Approach | Accomplish-ments | Collaborations | Overall Impact | Weighted Average |
|---|---|---|---|---|---|---|---|---|---|
| ti097 | Drones, Delivery Robots, Driverless Cars, and Intelligent Curbs for Increasing Energy Productivity of First-/Last-Mile Goods Movement Agreement | Constantine Samaras (Carnegie Mellon University) | 7-29 | 3.13 | 3.50 | 3.38 | 3.25 | 3.38 | 3.34 |
| ti098 | Transportation Energy Analytics Dashboard (TEAD) | Michael Pack (University of Maryland) | 7-33 | 3.17 | 3.50 | 3.33 | 3.50 | 3.00 | 3.32 |
| ti099 | Understanding and Improving Energy Efficiency of Regional Mobility Systems by Leveraging System-Level Data | Zhen Qian (Carnegie Mellon University) | 7-36 | 3.00 | 3.33 | 3.33 | 3.33 | 3.00 | 3.23 |
| ti100 | High-Dimensional, Data-Driven Energy Optimization for Multi-Modal Transit Agencies | Philip Pugliese (Chattanooga Area Regional Transit Authority) | 7-40 | 3.33 | 3.50 | 3.33 | 3.50 | 3.33 | 3.38 |
| ti101 | Mobility and Energy Improvements Realized through Prediction-Based Vehicle Powertrain Control and Traffic Management | Thomas Bradley (Colorado State University) | 7-43 | 3.33 | 3.50 | 3.33 | 3.50 | 3.00 | 3.35 |
| ti102 | Advancing Platooning with Advanced Driver-Assistance Systems Control Integration and Assessment | Hoseinali Borhan (Cummins-Peterbilt) | 7-46 | 3.50 | 3.50 | 3.33 | 3.50 | 3.50 | 3.43 |
| ti103 | Fuel-Efficient Platooning in Mixed Traffic Highway Environments | Jeff Rupp (American Center for Mobility) | 7-49 | 3.33 | 3.33 | 3.33 | 3.50 | 3.33 | 3.35 |
| ti104 | Using Real-Time Mass Transit in First-/Last-Mile Solution | Andrea Broaddus (Ford) | 7-53 | 3.25 | 3.25 | 2.50 | 2.75 | 2.75 | 2.85 |

| Presentation ID | Presentation Title | Principal Investigator (Organization) | Page Number | Objectives | Approach | Accomplish-ments | Collaborations | Overall Impact | Weighted Average |
|---|---|---|---|---|---|---|---|---|---|
| Overall Average | | | | 3.33 | 3.37 | 3.27 | 3.50 | 3.25 | 3.32 |

**Presentation Number: ti091**
**Presentation Title: Solutions for Curbside-Charging Electric Vehicles Planned for Urban Growth**
**Principal Investigator: Robert Cox (University of North Carolina at Charlotte)**

*Presenter*

Robert Cox, University of North Carolina at Charlotte

*Reviewer Sample Size*

A total of five reviewers evaluated this project.

*Effective Use of Project Resources*

40% of reviewers indicated that resources are being used wisely, 20% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

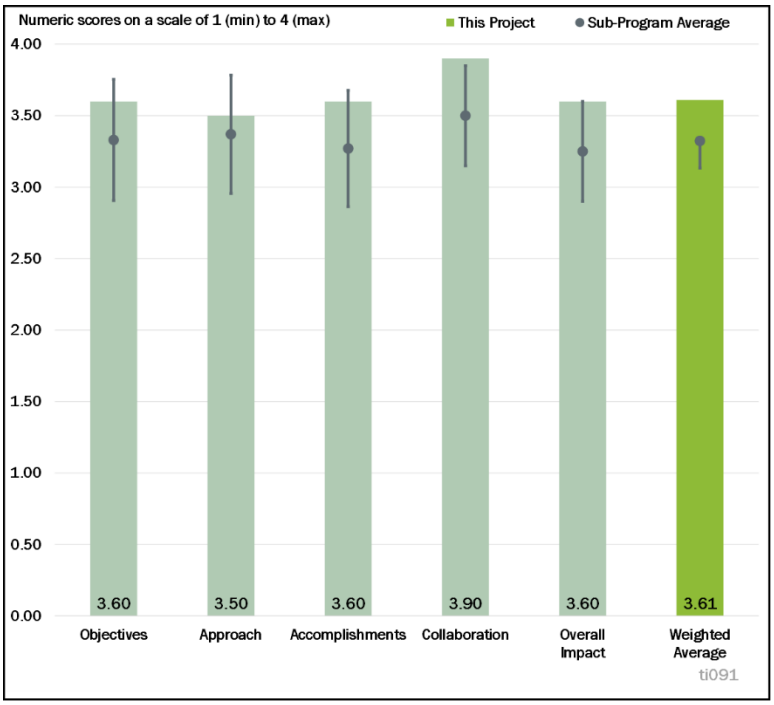


Figure 7-1 - Presentation Number: ti091 Presentation Title: Solutions for Curbside-Charging Electric Vehicles Planned for Urban Growth Principal Investigator: Robert Cox (University of North Carolina at Charlotte)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
Providing opportunities for charging electric vehicles (EVs) for households and businesses that do not have off-street parking with access to electricity is essential to expanding the market for EVs. This project addresses a promising approach that has the potential to cost effectively enable such charging opportunities, thereby increasing fuel diversity via alternative fuels and increasing energy efficiency via electrification of vehicle travel.

**Reviewer 2:**
The project supports the Vehicle Technologies Office (VTO) objectives for fuel diversity by supporting a significant expansion of electric vehicle service equipment (EVSE) infrastructure through streetlight retrofits. The prototype includes hardware, software, enclosure, and integration.

In addition, the project team has written a paper that documents the barriers, both policy and technical, to deploying charging EVSE. The paper will ensure findings reach VTO's broader set of stakeholders.

**Reviewer 3:**
It appeared to this reviewer that the objective to develop effective streetlight-based EVSE with versatile curbside integration is a strong project objective. There did not appear to be a cost target for developed EVSE units in relationship to other level 2 (L2) charging solutions.

**Reviewer 4:**
Professor Cox was able to describe succinctly the goals and objectives of the program and provide a clear understanding of the program elements and the status of progress to date.

**Reviewer 5:**
This reviewer observed that the project team is attempting to deploy an important charging technology that does not have a long track record in the United States.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The reviewer observed an excellent team that covers all the bases as well as a thoughtful, technical approach to developing and evaluating new hardware. The project appears to be on time and a detailed description of enabling technology was noted by the reviewer.

**Reviewer 2:**
The project design effectively addresses all key elements necessary for success: engineering design of appropriate and economical EVSE; siting in collaboration with communities and relevant agencies; laboratory and in situ testing; assessment of technical and economic potential and development of a business model; and commercialization.

**Reviewer 3:**
Despite the challenges of COVID-19, the project appears to be on schedule and on track. The project partners have been working well together in a coordinated fashion. The approach seems straightforward; the results achieved to date are tangible.

**Reviewer 4:**
The presentation demonstrated a logical project design, with balanced and well-organized task areas (prototype development, community engagement, and techno-economic analysis). It seems that the project is not really exploring the utility rate implications of streetlight charging. It is not clear to what extent the project will examine potential demand-charge management or EVSE load sharing to reduce charging rates and ensure local grid capacity (in the case that the streetlight EVSE were widely deployed in a given area). Details on the methodology for choosing field demonstration sites were not covered in the presentation. The reviewer commented that the approach may be good, but it was not mentioned.

**Reviewer 5:**
The project approach is divided into three discrete tasks: prototype development, stakeholder engagement, and techno-economic analysis. The approach offers the opportunity for adjustments to the field test via stakeholder input. One area of uncertainty for the project team to consider is how to ensure the 2021 commercial demonstration in parking lots is representative of other urban cities, some of which may have few parking lots or more parking and access restrictions compared to Charlotte, North Carolina.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
Progress on using Azure cloud technology to control hardware is impressive. The reviewer observed a strong vision for the project potential, specifically about greater use of light poles.

**Reviewer 2:**
The reviewer remarked that the project accomplishments (development of a prototype, field deployment, grid testing, and documentation) are excellent. The project team is encouraged to accurately address questions around utility barriers, including zoning and permitting issues. Accomplishments should include clear answers to the key questions identified by the team, both policy and technical. The technical questions provided are excellent and should be answered so a non-technical audience can understand findings.

**Reviewer 3:**
The enabling technology appears to be working as designed, and the alpha prototype seems ready for field testing.

**Reviewer 4:**
Although the project is only 45% complete, the behind the fence work appears to have been successfully completed along with the groundwork for community involvement and support. Negotiating agreements appear to have taken longer than expected and required some adaptation, but the project remains on schedule, which appeared to the reviewer to be quite an accomplishment in such challenging times.

**Reviewer 5:**
The project appears to be well on schedule and on track at 45% complete and 18 months into the project. Substantive technology prototype development milestones have been met, and all field EVSE pilot demonstration sites have been selected. The project is on track to likely deploy five demonstration units, which is five times more than originally planned (the project Statement of Project Objectives [SOPO] called for one demonstration site). Unfortunately, COVID-19 may likely reduce on-campus EVSE use and hinder needed data collection. It would likely make sense to consider extending this project's period of performance to ensure decent data collection.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The team is collaborating effectively and also coordinating with VTO stakeholders, including Clean Cities.

**Reviewer 2:**
The project team seems to be working well together in a very well-coordinated manner.

**Reviewer 3:**
The project team seems to be a diverse, well-rounded team that must be working well together to achieve the progress demonstrated so far.

**Reviewer 4:**
The project includes a comprehensive team, including a strong technology commercialization partner, an engaged utility, and community outreach and deployment partners. The utility partner, Duke Energy, has control over the EVSE devices, which would help demonstrate demand-charge management and load-sharing opportunities.

**Reviewer 5:**
With only minor adaptation from the original plan, the researchers have developed all the necessary agreements with local agencies and industry partners.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The potential for impact on low-cost charging deployment is high.

**Reviewer 2:**
The project has made good progress developing prototype units, advancing field demonstrations, and identifying issues and best approaches for integrating with existing streetlight types. The applicant is working with Eaton to develop a licensing agreement, and the University of North Carolina at Charlotte (UNCC) to

provide design files for manufacture at a U.S.-based facility. More headway is needed under the project to address community and curbside policy and deployment.

**Reviewer 3:**
Successfully developing a final design for a feasible and economical streetlight EVSE unit including cellular connectivity is a major accomplishment. Up to this point, all barriers have been overcome. The plan for future field testing and commercialization appears to be appropriate and on schedule. It may be that the researchers could have gained insights from the efforts of others in this type of application but were somewhat constrained by the interests of industry partners. This does not appear to have been an impediment to their work, however.

**Reviewer 4:**
The impact of using streetlights to address lack of urban EVSE has the potential to change the approach that state and local governments take to build out EVSE, and to reduce the cost of public investment. Findings are encouraging as long as communicated to key audiences.

**Reviewer 5:**
A successful commercial deployment of this technology will be a significant milestone in bringing curbside charging to communities that do not have it, especially underserved communities.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
The partnership with the utility is a great move. It is a key factor in ensuring infrastructure is available to a wide swath of society.

**Reviewer 2:**
This project is a good use of valuable DOE resources. Curbside charging is a critical consideration for charging infrastructure. Successfully achieving this outcome will contribute greatly to the expansion and requirements of community charging.

**Reviewer 3:**
The project addresses a real barrier to expansion of the EV market. In collaboration with qualified industry partners and relevant government agencies, the researchers have produced what appears to be an appropriate solution. The project plan is well designed, has been successfully accomplished, and is on schedule thus far.

**Reviewer 4:**
The Department of Energy (DOE) should continue funding streetlight charging development and demonstration projects across different geographies and settings.

**Reviewer 5:**
Unless the private sector develops a business case for EVSE deployment, DOE should consider future investments in this work.

**Presentation Number: ti092**
**Presentation Title: Vehicle Charging Innovations for Multi-Unit Dwellings (VCI-MUD)**
**Principal Investigator: Kevin Wood (Center for Sustainable Energy)**

*Presenter*

Kevin Wood, Center for Sustainable Energy

*Reviewer Sample Size*

A total of four reviewers evaluated this project.

*Effective Use of Project Resources*

75% of reviewers indicated that resources are being used wisely, 25% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

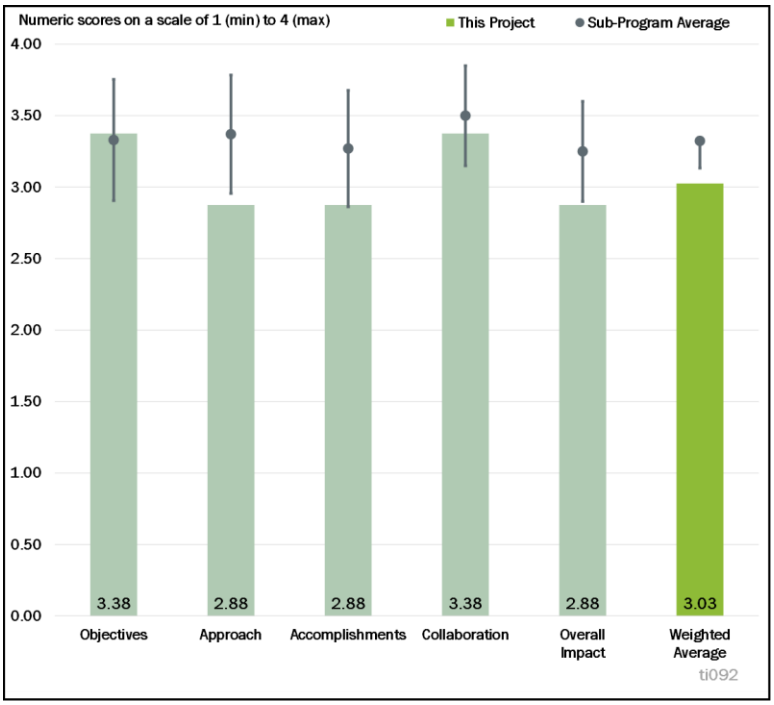


Figure 7-2 - Presentation Number: ti092 Presentation Title: Vehicle Charging Innovations for Multi-Unit Dwellings (VCI-MUD) Principal Investigator: Kevin Wood (Center for Sustainable Energy)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project supports VTO objectives for fuel diversity by supporting a significant expansion of EVSE infrastructure through multi-unit dwellings, a key limitation to current EVSE. The study's national scope further supports VTO's broad goals of fuel diversity.

**Reviewer 2:**
It is great to get an update on a critical gap in charging access. Multi-unit dwellings (MUDs) have always been difficult to access for charging providers and it would be good to see where the technology stands and where opportunities exist.

**Reviewer 3:**
Facilitating EV charging for residents of MUDs is essential to expanding the EV market, especially in urban areas where EVs can make an important contribution to improving local air quality and where low-cost EV travel can benefit all income groups.

**Reviewer 4:**
Overall, the project's objective to address the limited availability, high installation costs, and lack of awareness of plug-in electric vehicle (PEV) charging stations for MUD residents is very supportive of EERE's objectives of increasing fuel diversity and increasing transportation system efficiency. Objectives around toolkit development and site demonstrations are less clear from the presentation. The planned toolkit seems ill-defined.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The project has an ambitious agenda from baselining to demonstration to evaluation. It is a lot to undertake in a single project, and the reviewer applauded the team for taking this on all at once. The output—the toolkit—could be a very valuable resource for others to build on the efforts of this project.

**Reviewer 2:**
The survey tool is an effective way to access data on EVSE. Despite data limitations, the approach of survey data and national review of programs via the partners provides a broad set of information. The data limitations— lack of feedback from partners—could have been offset by more survey participants or other means. The demonstration should look to fill gaps in the data collection effort.

**Reviewer 3:**
The project's general task approach appears reasonably structured, divided into four key discrete task areas. It was not clear to the reviewer how the toolkit would be tested. The tool validation and evaluation approach—working with Idaho National Laboratory (INL), the National Renewable Energy Laboratory (NREL), and Clean Cities (CC) coalitions—does not appear to be fully thought out yet. The project approach was presented at a very high level; details around pilot demonstrations (e.g., criteria or rubric for how demonstration sites have been or will be selected) and what work would go into infrastructure innovation development were not discussed.

**Reviewer 4:**
The plan calls for first investigating existing MUD EVSE installations, and next identifying innovative solutions developed by technology companies. Not enough information was provided about what the key barriers were (what new insights were gained based on the investigation of existing installations), and how the innovative technologies would be evaluated to determine their ability to overcome the barriers. The reviewer stated that there should be and may be a mechanism to enable feedback from the demonstrations to the technology companies to facilitate product innovation, but this was not described in the presentation. Perhaps this is what was meant by capture stakeholder input on barriers and motivation, but it does not come across as a complete plan for feedback and innovation.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The reviewer commented that creation of a toolkit, as described, will be useful to VTO stakeholders and partners. The demonstration project appears to be on track with a number of partners lined up to participate.

**Reviewer 2:**
So far, the project is on schedule and under budget. However, it seems that MUD infrastructure installations have been more difficult than the project plan anticipated. It would have been appropriate to present an analysis of the problems and barriers found, how the problems and barriers might be addressed by the innovative EVSE to be tested, and what barriers might remain that either technology or policy could address.

**Reviewer 3:**
The reviewer stated that the team is doing well adjusting to the realities of COVID-19 by doing more webinars. The first year has been a lot of contracting, which is an understandable time sink. It looks like a strong effort to collect information to establish a baseline. The loss of some partners and lack of valuable data from other partners may hinder the value of the results. It seems like the data may not be accurate.

**Reviewer 4:**
The project has had substantial difficulty identifying additional potential MUD EV charging infrastructure data providers, which has hampered progress. Data collection has been impacted by partners that have dropped out or not participated as anticipated. This may have impacted baseline data results. Only 10% of charger data collected thus far is from MUDs.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The project has an impressive and appropriate list of collaborating stakeholders, technology companies, and governmental agencies. The reviewer opined that this should help to maximize the impact of the demonstration project.

**Reviewer 2:**
The project team seems to be working well together with frequent check-ins. A very large number of organizations is involved in this project, and that requires a lot of coordination.

**Reviewer 3:**
Numerous EVSE evaluation and demonstration site stakeholders are currently identified. The project involves a large number of geographically dispersed CC Coalitions. Some committed project partners had less useful data than expected while others decided not to participate. Ensuring that these partners were fully secured, ideally at the time of project application, would have likely led to a better result.

**Reviewer 4:**
The team appears to be collaborating effectively. However, it was unclear why some partners chose not to participate in the survey or provide data.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The creation of a toolkit that includes input from utilities and other stakeholders will be a valuable contribution to the literature on multi-unit EVSE needs. The reviewer indicated that a discussion of business models and associated challenges therein is also important to the project's impact.

**Reviewer 2:**
Plans for keeping the envisioned toolkit updated beyond the end of the project are not readily clear. Based on current data collection barriers, it is not yet clear how impactful this project might be.

**Reviewer 3:**
It is unclear how much new information will come from the project at this time. There is still a lot of potential, but it is a little too early to tell. Project team progress to date does not indicate that it will learn a lot of new information.

**Reviewer 4:**
This could easily have received a higher rating if more information had been presented about the following: what was learned about barriers from the literature review and initial data collection; how to possibly overcome these barriers via the innovative technologies that will be tested; what might inspire innovation to overcome remaining barriers; and what impact that would likely have on stakeholders and government agencies. This is a very important subject, and the reviewer suspected that the researchers were doing more analysis that could inform these points than what the project team shared in its presentation.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
DOE should continue to fund projects seeking to advance MUD charging. It may be most effective however to focus funds on projects that have a tighter scope and more defined objectives, as well as demonstrate well-secured, data-provider partnerships at the time of application.

**Reviewer 2:**
It is difficult to overstate the importance of expanding the EV market to solve the MUD charging issue. The overwhelming majority of EV owners live in detached housing and do 80%-90% of their charging at home. Those living in MUDs must have the same kind of opportunities if the market for EVs is to fully develop. Overcoming the barriers to MUD charging through information, innovation, and policy changes is key.

**Reviewer 3:**
The project appears to provide good value to the U.S. DOE. The only risk is a lack of new information that is not already known.

**Reviewer 4:**
It is not clear if the project will add new information, data, or findings to the topic of EVSE business models or how partnerships may be developed to support infrastructure that fills gaps, including multi-unit dwellings. If the project has new findings, DOE investment could continue.

**Presentation Number: ti093**
**Presentation Title: Electric Vehicle Supply Equipment (EVSE) Innovation: Streetlight Charging in City Right-Of-Way**
**Principal Investigator: Miriam Bouallegue (Metropolitan Energy Center)**

*Presenter*

Miriam Bouallegue, Metropolitan Energy Center

*Reviewer Sample Size*

A total of five reviewers evaluated this project.

*Effective Use of Project Resources*

80% of reviewers indicated that resources are being used wisely, 20% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

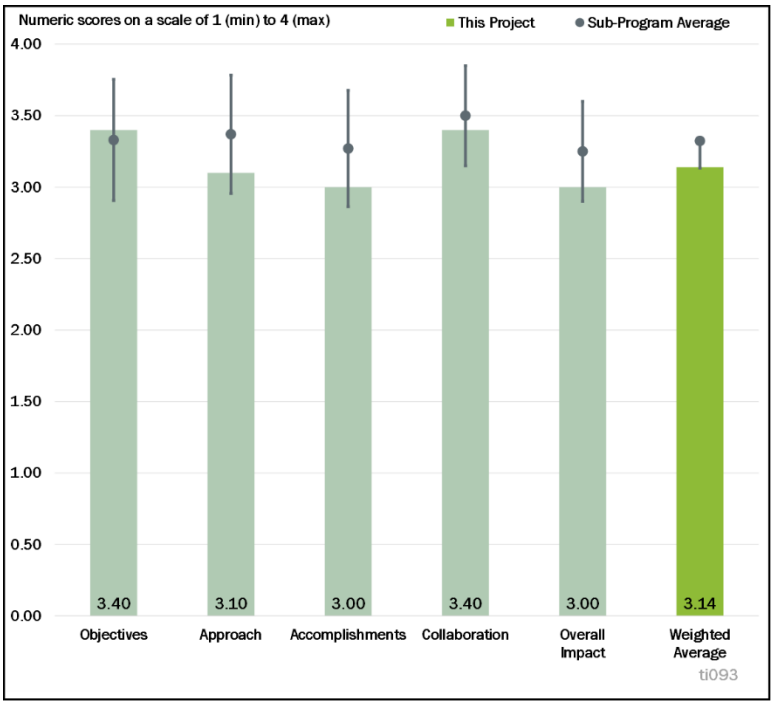


Figure 7-3 - Presentation Number: ti093 Presentation Title: Electric Vehicle Supply Equipment (EVSE) Innovation: Streetlight Charging in City Right-Of-Way Principal Investigator: Miriam Bouallegue (Metropolitan Energy Center)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project supports VTO objectives for fuel diversity by supporting a significant expansion of EVSE through the use of streetlight infrastructure. The project also supports VTO goals for fuel diversity, mobility, and equal access to mobility options.

**Reviewer 2:**
The reviewer stated that streetlight charging in city rights-of-way can clearly provide some electric charging solutions that are not currently available to city dwellers, particularly those without space in their dwellings in which to charge their electric vehicles.

**Reviewer 3:**
This project aims to demonstrate the feasibility and impact of streetlight EVSE in Kansas City. If this could be accomplished, it would prove that streetlight chargers are a practical solution for providing charging in areas without adequate off-street parking. On-street charging infrastructure is necessary to expand the market for EVs and realize their full potential as efficient, clean, and alternative energy transportation.

**Reviewer 4:**
The objective to evaluate streetlight-based EVSE infrastructure and study adoption and use data is very supportive of DOE and VTO goals for advancing EVSE availability and increasing fuel diversity. The main thrust of the project is to better understand where to specifically locate streetlight EVSE. Other practical issues, such as how to package such infrastructure, how to integrate it well with the local grid and utility, and how to make it as accessible and easy to use as possible for EV drivers, seem to be missed or deemphasized, perhaps to a fault.

**Reviewer 5:**
The project has a limited geographic scope (Kansas City only) so it is unclear how replicable it will be.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The project has a straightforward approach. The market analysis is a good idea before identifying charging sites.

**Reviewer 2:**
The plan for deployment and evaluation is appropriate and includes the essential technology, institutional, siting, and evaluation components.

**Reviewer 3:**
The project's approach—to collect data on site locations and overlay demographics, EV ownership, and environmental conditions—is appropriate. The use of a model that predicts future EV usage patterns helps ensure any investment in new streetlight-based EV charging models will be appropriately targeted.

**Reviewer 4:**
Budget Period 3 is completely dedicated to putting together the final study and model. This provides an abundant amount of time to conduct technical and market analysis. The underserved model is a good way for identifying areas with high renter-ship, and low EVSE access.

Site selection has been challenging, with the demand model generating 330 potential sites; the project team had to eliminate over 200 of these based on street and parking policy. This suggests the scope of the project effort may have been a bit too large and/or that the modeling methodology requires substantive revision.

**Reviewer 5:**
While the project approach to supporting the growth of electrification infrastructure options makes sense, the presentation left many questions unanswered concerning the methodology for selecting actual streetlight charging locations.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
Despite uncertain conditions with the worldwide pandemic, the project has made considerable progress. The development of the predictive model, collection of site data and culling of less than ideal site data are important. The lack of access to city data and input from local government leadership is likely the result of the COVID-19 pandemic. The development of a spreadsheet model on parking and streetlight data seems very valuable; more information would be beneficial to other communities.

**Reviewer 2:**
Delays in the project are understandable, given the COVID-19 pandemic. The project team is in the process of developing a risk mitigation plan. The predictive model for site identification looks very promising. The reviewer asserted that it would be interesting to know how reusable it is. The underserved model is also a very interesting output from this project.

**Reviewer 3:**
The project team has made important accomplishments, including evaluating potential sites, analyzing the grid infrastructure to support those sites, and evaluating EVSE and its mounting and connection to the streetlights.

A market-demand model was constructed to inform site selection and evaluation. Unfortunately, the project is somewhat behind schedule with respect to deployment. The COVID-19 pandemic has hindered these efforts. It is reasonable to expect that the pandemic would have a greater impact on demonstration projects than on inside-the-fence projects, such as analytical studies or laboratory projects.

**Reviewer 4:**
Understandably, the project is behind schedule because of COVID-19. What is still a matter of concern is how the final site selection for deployment will be undertaken. Very little detail was presented on the market-demand model and progress toward the selection of 300 sites that will be required for further evaluation.

**Reviewer 5:**
The project budget appears to have underspent. The presentation did not describe how the team expects to catch up on its progress.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The team is a great group of diverse individuals with well-rounded experience. It is well positioned to achieve the project goals. The reviewer was particularly interested in how the team can use the model outputs to help deploy EV charging in underserved communities.

**Reviewer 2:**
The project team has a well-targeted set of collaborators in industry, government, and research institutions. The team holds regularly scheduled discussions to communicate shared knowledge gained and lessons learned.

**Reviewer 3:**
The project involves a diverse team, including key municipal, academic, lab, industry, and non-profit partners. All appear to have a substantive role in carrying out the project.

**Reviewer 4:**
The project team has deep connections and has engaged appropriate partners, including NREL and environmental justice organizations. More detail on the role of key partners would have been helpful. The team is also communicating with another VTO-funded project with related goals for deployment of EVSE at streetlights. DOE EERE's Stakeholder Engagement Guide for Low- and Moderate-Income Communities is a resource available to the project team.

**Reviewer 5:**
The market-demand model requires the interaction with apartment building owners, restaurants, grocery stores, community centers, parks, churches, shopping malls, and underserved communities. The reviewer's impression was that, based on the presentation, the interactions have not been fully developed and most probably the result of having to address these introductions and discussions virtually instead of in person.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
Valuable progress has been made setting the stage for a successful demonstration. The reviewer hoped that the demonstration can proceed in spite of the pandemic, with appropriate caution. If so, by demonstrating the feasibility and consumer acceptance of streetlight charging, the project will make an important contribution to expanding the market for EVs.

**Reviewer 2:**
The impact of using streetlights to address lack of urban EVSE has the potential to change how state and local governments address EVSE build-out and reduce the cost of public investment. The project has added significance by focusing on minority and low-income populations with less access to dedicated charging sites at the workplace or at home.

**Reviewer 3:**
The project will provide modeling methodology from NREL in the final report, but the actual modeling work or model itself will not be publicly shared. The EVSE technology and street pole integration itself were not discussed much in the presentation. It is unclear what the future impact would be of the developed technology.

**Reviewer 4:**
For the reasons already mentioned, the overall impact of this project has largely not yet been felt. Personal interactions and site visits that can facilitate and accelerate the decision-making process have unfortunately been deferred because of COVID-19, which is certainly not the fault of the grant recipients. In short, because of these external facts over which the grant recipients have no control, the process is taking longer, and the impact is yet to be felt.

**Reviewer 5:**
It is too early to tell if this project will succeed, given delays associated with COVID-19. The role of NREL in helping with analysis is promising, but it is disappointing that only the process is being shared and not the technology that was being developed.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
This project has great merit. The success of the project is likely, and the results should be generally deployable across the country. Patience is required to achieve the milestones that are behind schedule. It seemed to the reviewer that consideration should be given to time extensions if this is necessary to complete the project successfully.

**Reviewer 2:**
DOE should continue funding streetlight charging development and demonstration projects across different geographies and settings.

**Reviewer 3:**
The reviewer stated that DOE should consider future investments in this work unless the private sector develops a business case for EVSE deployment. This is especially true in low- and moderate-income communities that lack EVSE and whose residents may lack opportunities for charging at home or at the workplace.

**Reviewer 4:**
Creating convenient and economic opportunities for on-street parking is important to fully developing the market for EVs and extending the opportunity to use clean vehicles with low operating and maintenance costs to underserved communities. The reviewer suggested that a successful demonstration of streetlight EVSE would make a major contribution toward the goals of increasing fuel diversity and energy efficiency.

**Reviewer 5:**
The reviewer thought that the U.S. DOE should include more requirements around the sharing of technology developed with grant funds (e.g., models).

**Presentation Number: ti094**
**Presentation Title: Advanced Transportation Hub Efficiency using Novel Analysis (ATHENA)**
**Principal Investigator: Caleb Phillips (National Renewable Energy Laboratory)**

*Presenter*

Caleb Phillips, National Renewable Energy Laboratory

*Reviewer Sample Size*

A total of four reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

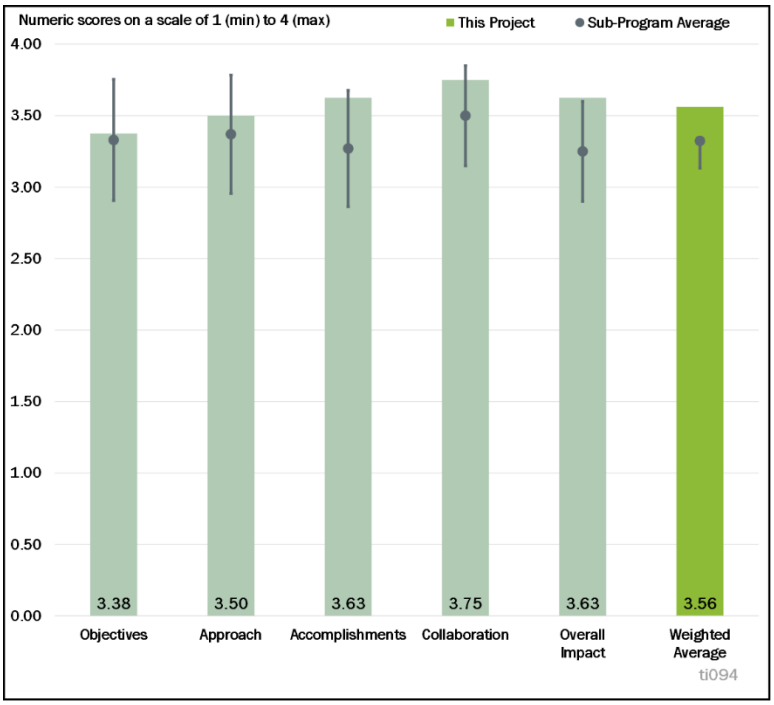


Figure 7-4 - Presentation Number: ti094 Presentation Title: Advanced Transportation Hub Efficiency using Novel Analysis (ATHENA) Principal Investigator: Caleb Phillips (National Renewable Energy Laboratory)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The reviewer remarked that the project objectives were well aligned with VTO goals. The project focused on better understanding advanced mobility technologies at airports, and how advanced technology vehicles and new mobility services impact surface transportation energy use and time efficiencies at the airport.

**Reviewer 2:**
Project objectives clearly address the need for more efficient airport and travel terminal traffic planning to maximize efficiencies.

**Reviewer 3:**
The project seems focused on possible electrification, which would move away from gas and diesel but not necessarily diversify to other alternative fuels.

**Reviewer 4:**
This reviewer cited several items. Firstly, the application of operational models to support near-term needs in planning for shuttle fleet electrification and terminal congestion. Secondly, regarding the project objective of enabling Dallas/Fort Worth (DFW) to demonstrate a 50% reduction in ground transportation energy use for the airport and its connected transportation infrastructure by 2045, the reviewer quoted the following: increasing systemwide affordability, emissions reduction, and improving convenience and efficiency at the connected regional transportation system; and adoption of future technologies. Thirdly, the reviewer noted the next project objective of demonstrating a decoupling between population growth and energy use. Fourthly, the reviewer reported that the process will be replicable to other regional hubs.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The reviewer said that the project clearly recognizes the ultimate goal and how to approach identifying the solution(s).

**Reviewer 2:**
The project approach seems to encompass all of the available resources for information gathering and follows a clear and logical progression toward creating a transportation plan for DFW as well as a blueprint for other transportation hubs to follow.

**Reviewer 3:**
The approach has the appropriate collaborative partners identified, the collective data identified, and methods for capturing the data.

**Reviewer 4:**
DFW is working with police to get data on traffic entering and exiting the airport from cameras (not for surveillance purposes, but for tracking the type, number, and occupancy of vehicles and traffic density). This represents a project strength. The project appears to have some notable data gaps; both flight occupancy data (number of passengers on arriving and departing flights) as well as what terminal the flights are arriving into are largely unknown. It is not clear if better airline partnering would aid this (or not). It seemed to the reviewer that circulator fleets from outside the airport (hotel shuttle vans and outside shared van services) are not targeted for data capture. The degree of data capture from individual PEV drivers is not clear either.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The project is well ahead of schedule. It has 20 advisors and 3 partners on the project. Data were collected and gaps identified; the Mobility Energy Productivity (MEP) metric, the operational data-driven model, and the bus electrification and route optimization are all complete.

**Reviewer 2:**
The project is well underway and has collected good data and identified desired data.

**Reviewer 3:**
Significant progress has been made in identifying information sources and setting up the data-gathering process. The project team is collecting and analyzing huge amounts of data.

**Reviewer 4:**
The reviewer found that the project accomplishments made to date appear reasonably sufficient.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The project has identified good and diverse partners and seems to have a structured communication plan between partners.

**Reviewer 2:**
The reviewer affirmed that the project has over 20 different port advisors and industry advisors supporting the Advanced Transportation Hub Efficiency using Novel Analysis (ATHENA) goals and research objectives.

**Reviewer 3:**
In addition to the primary research team, the project benefitted from the inclusion of several strong port partners and good industry advisors.

**Reviewer 4:**
The project team is demonstrating a common commitment to achieve project goals, and individual team members seem to be contributing equally to the project.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project has already made substantial contributions by creating a consortium around mobility among numerous ports around the country and by developing and running an operational model of the DFW airport on NREL's high-performance computer (HPC).

**Reviewer 2:**
This project addresses a crucial need by planning and creating a system for maximizing the traffic efficiency around major transportation hubs, encouraging the use of alternative fuels, and providing a framework for making the system repeatable at other locations.

**Reviewer 3:**
The project team impact includes creating a consortium around mobility at ports; gathering and identifying key data sets for operational models; creating a metric, MEP, for understanding mobility and energy; developing an operational model of the DFW airport on NREL's (HPC; and evaluating bus electrification and bus route optimization using NREL's HPC.

**Reviewer 4:**
As the project team identifies metrics to allow comparisons to accurately measure changes, the ability to use the information elsewhere would be very valuable.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
The reviewer remarked that the budgeted funds have been allocated wisely and effectively and appear to provide a great return for the investment.

**Reviewer 2:**
The project funds are being used wisely. Airport-focused projects that concentrate on alternative, advanced, automated, and connected transportation are very much worth continued DOE investment.

**Reviewer 3:**
Identifying how to measure possible fuel efficiency strategies at a transportation hub is very useful if transferable.

**Reviewer 4:**
DFW is a unique airport with a very inefficient configuration. By building models for other airports and developing standards that can be used in other applications, this work can be utilized in existing locations and as a template to build more efficient airport configurations in the future.

**Presentation Number: ti095**
**Presentation Title: High-Performance Computing (HPC) for O'Hare Hub**
**Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)**

*Presenter*

Joshua Auld, Argonne National Laboratory

*Reviewer Sample Size*

A total of four reviewers evaluated this project.

*Effective Use of Project Resources s*

75% of reviewers indicated that resources are being used wisely, 25% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

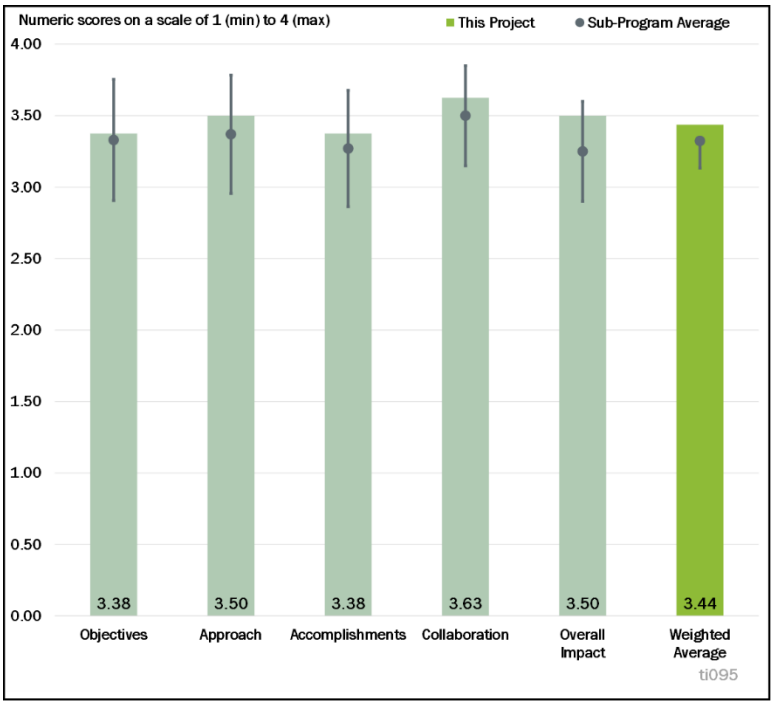


Figure 7-5 - Presentation Number: ti095 Presentation Title: High-Performance Computing (HPC) for O'Hare Hub Principal Investigator: Aymeric Rousseau (Argonne National Laboratory)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project, focused on better understanding how advanced mobility technologies and connected transportation impact airport mobility energy productivity, strongly supports VTO priority objectives.

**Reviewer 2:**
The project objectives are clear, focused, and hit an area of great need. There is a good opportunity to build for the future with traffic efficiency and incorporation of alternative fuel infrastructure in and around transportation hubs.

**Reviewer 3:**
The reviewer cited the following project objectives: increasing economic growth through commercialization opportunities for vehicle trajectory data; increasing transportation efficiency and reducing time cost to access O'Hare transportation hub to address affordability for business and consumers; and increasing O'Hare traffic reliability through data acquisition and active management to address reliability/resiliency.

**Reviewer 4:**
This project could decrease overall fuel usage but does not necessarily lead to fuel diversity.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The approach is outstanding. System controls are captured, and valuable data is collected. The reviewer noted the project team's subsequent activities: characterize data; edge computing; data management; and short-term forecasting to produce system optimization and continual improvement.

**Reviewer 2:**
The project creates interesting technology to measure traffic flow and identify real-world fuel usage.

**Reviewer 3:**
The project is approaching the issue of transportation efficiency from multiple angles and is really leveraging the expertise and experience of Argonne National Laboratory (ANL).

**Reviewer 4:**
The project takes a fairly comprehensive approach for data collection and analysis, effectively linking disparate data streams for the O'Hare MEP optimization model. O'Hare's use of curbside security cameras is helping better observe and collect data on vehicle occupancy, which is important for estimating accurate MEP. Although, it is not clear how widely this is being done across terminals. The project draws on live traffic data from Illinois Department of Transportation (IDOT) dataset that has been collected for 10 years, which is a strength. Privacy policies may limit data collection, or substantively complicate it.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The reviewer commented that the project is progressing well and should collect good data.

**Reviewer 2:**
The project is about 35% complete and has faced significant barriers, but has accomplished a lot under the circumstances.

**Reviewer 3:**
The project accomplished a large degree of technical development and data collection work up until March 2020. Due to COVID-19 delays, and subsequent shut down of air travel, the robustness of the project's data collection tasks has been critically affected. The reviewer recommends granting a performance period extension to help ensure better data collection potential.

**Reviewer 4:**
The project accomplishments include node design prototyping. Prototype 2 development was based on lessons learned from Prototype 1, with advanced resilience and expandability features. This prototype was designed with support for higher quality power over ethernet (POE) cameras and future edge-class central processing units (CPUs) from NVIDIA, Google, and Intel. The project team also has a vehicle classification system to track makes, models, and traffic flows by model. This system provides the flow pattern by vocation and numbers of people per vehicle. According to the reviewer, the project provides valuable information in planning traffic flows.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The reviewer found the project team to be very strong. The team includes the Chicago Department of Aviation (O'Hare Airport), Chicago Department of Transportation, Chicago Metropolitan Agency for Planning, Arity, the University of Chicago, and Argonne National Laboratory.

**Reviewer 2:**
The project includes a strong project team.

**Reviewer 3:**
It seemed to the reviewer that the project team has built a team of collaborators that will be valuable to the project tasks.

**Reviewer 4:**
Project partners appear to be fully engaged and collaborating effectively. Data collected from IDOT are crucial to the project success.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
When complete, this project will be able to create real, viable solutions to manage the traffic flow and parking around transportation hubs.

**Reviewer 2:**
The overall market impact is to produce sustainability and replication of developing a traffic and vehicle energy sensing platform that can be used at any airport or traffic hub. This reviewer reported the following impacts: identifying make and model of cars to allow for energy estimation; learning traffic flow characteristics for data input, which will help characterizing traffic conditions and flows at key transportation hubs; allowing for quick expansion to other key transportation hubs and airports; and expanding sensing and coupling with other data sources in a management platform to allow for development of traffic management and optimization capabilities.

**Reviewer 3:**
The waggle node platform developed and demonstrated under the project could readily be deployed at other airports to collect key airport surface-mode mobility data. The effort is highly replicable.

**Reviewer 4:**
The project when complete should create methods to analyze traffic patterns and fuel usage, allowing for strategies to increase efficiency. It does not appear to necessarily diversify fuel types.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
The project is making excellent use of resources, getting input and data from numerous sources, and returning good value for the money spent.

**Reviewer 2:**
The reviewer said that the DOE resources are appropriate for this project. However, the project has uncovered many areas in which the project team can further optimize traffic flows that will reduce fuel usage and improve time spent in high traffic areas. Replication of the process is very important, and this research should continue.

**Reviewer 3:**
Funds are being used wisely. Airport projects focused around alternative, advanced, automated, and connected transportation are very much worth continued DOE investment.

**Reviewer 4:**
It seemed to the reviewer that the project can lead to fuel-use reductions through the identification of traffic and transportation-use patterns and strategies to maximize efficiency. If the project goal is to shift from gas and diesel to alternative fuels, it may not be designed to do so.

**Presentation Number: ti096**
**Presentation Title: Technology Integration to Gain Commercial Efficiency for the Urban Goods Delivery System**
**Principal Investigator: Anne Goodchild (University of Washington)**

*Presenter*

Anne Goodchild, University of Washington

*Reviewer Sample Size*

A total of four reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

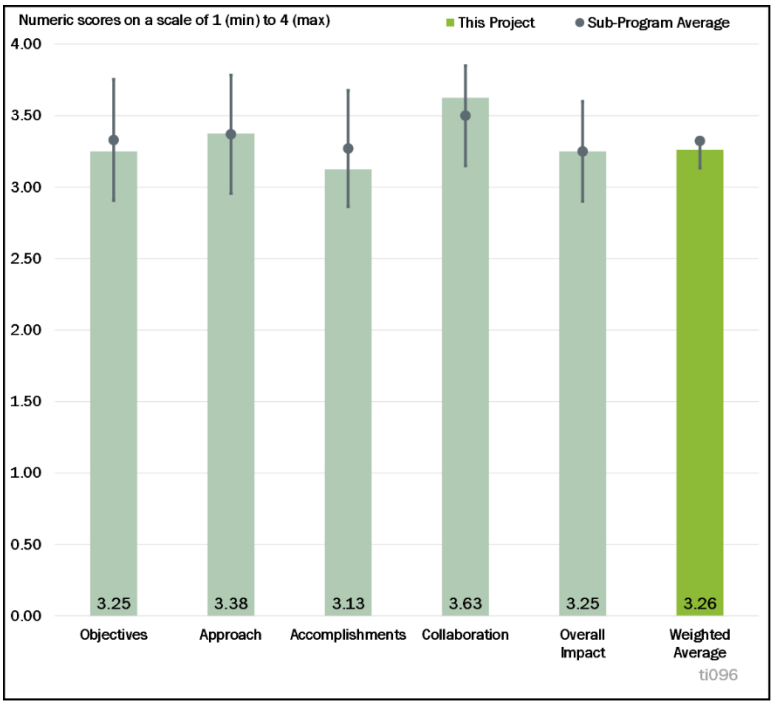


Figure 7-6 - Presentation Number: ti096 Presentation Title: Technology Integration to Gain Commercial Efficiency for the Urban Goods Delivery System Principal Investigator: Anne Goodchild (University of Washington)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project objective is timely and important. Urban goods delivery is plagued by bottlenecks, inefficient traffic flow and increased fuel consumption. Finding a solution for more efficient delivery of goods will be very beneficial.

**Reviewer 2:**
The reviewer asserted that the project objectives to reduce parking-seeking behavior and parcel truck dwell time will increase curb and alley space occupancy rates. The project has developed valuable information to reduce fuel usage and emissions as well as improve delivery efficiency.

**Reviewer 3:**
The project does not necessarily increase fuel diversity, but would contribute to increased transportation efficiency in urban environments.

**Reviewer 4:**
The project objective and overview slides describe the project's specific objectives and barriers addressed, as well as how the project clearly supports the DOE and VTO objectives of increasing transportation efficiency. The project addresses several of VTO's technology integration goals, such as economic growth and affordability for business and consumers, through activities meant to foster the adoption of energy -efficient logistics initiatives for urban goods delivery. The project objectives appear to be generally effective for the planned scope.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The reviewer remarked that this is a really smart way to approach the issue of vehicle idling and wasted fuel.

**Reviewer 2:**
The project team's approach includes installing lockers and finalizing the plan for placing sensors and lockers on public and private property. The approach also includes selecting a pilot test area and obtaining permissions to execute the plan for the lockers. In addition, the approach calls for issuing a request for proposals (RFPs) and selecting locker vendors; designing and prototyping an app to display real-time parking space availability; and developing models to simulate parking behaviors. These are important areas for project success.

**Reviewer 3:**
The project approach follows a clear logical path to gather data, identify problems and potential solutions, and work toward achieving goals.

**Reviewer 4:**
The project approach section provides a generally effective methodology to accomplishing the project objectives and supporting the integration of advanced transportation technologies and practices. The project's approach is to provide real-time information and prediction on commercial vehicle parking occupancy, and the installation and operation of common locker systems. Adequate detail is provided on the approach and milestone slides with regard to the planned tasks and activities.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The project team still has a way to go but has identified good data and tactics at this stage of the project.

**Reviewer 2:**
Considering the recent hurdles, project seems to be on track. Significant research and data gathering have occurred, and the project is moving into more active phases.

**Reviewer 3:**
The reviewer indicated that generally effective progress has been made toward achieving project goals. The project has completed several key activities: characterized commercial parking behavior through ride-alongs; estimated commercial vehicles' parking-seeking time; designed a prototype app and prediction model for connected vehicle (CV) parking occupancy; and contracted with a locker vendor and identified locations. Despite delays associated with COVID-19, the project team does not anticipate impacts on meeting annual milestones. Furthermore, no concerns have been identified.

**Reviewer 4:**
This reviewer cited the following accomplishments: estimated commercial vehicles' parking seeking time; designed a prediction model for commercial vehicle parking occupancy and trained on synthetic data; designed and coded a prototype app (currently implemented as a website) to which all drivers will have access; selected and contracted with a locker vendor and Identified locations; and convened stakeholder groups for engagement and information sharing to keep the team informed on the project.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The project team has put together a very good group of organizations with vested interests and diverse points of view.

**Reviewer 2:**
The reviewer observed a good team that includes The University of Washington's Urban Freight Lab as project lead; Pacific Northwest National Laboratory (PNNL) as project collaborator; Seattle Department of Transportation, Bellevue Department of Transportation, King County Metro Transit Department, Sound Transit, CBRE, Kroger and Puget Sound Clean Air Agency as cost-share partners; Parcel Pending as locker vendor; and United Parcel Service (UPS), United States Postal Service (USPS), PepsiCo, Building Owners and Managers Association King County (BOMA) as other contributing partners.

**Reviewer 3:**
This effective project team of academia, a National Laboratory, public agencies, and private industry has assembled to carry out the project and has provided an excellent mix of expertise among team members. Collaboration and communication among the project partners appear to be appropriate for the scope.

**Reviewer 4:**
Project partners are fully engaged and actively participating, with good communication flow and strong leadership.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The reviewer remarked that the project has good potential to contribute to increasing transportation efficiency by building knowledge of impacts of insufficient commercial parking, as well as increasing support for urban freight activities from public sector agencies. The finished deployment and evaluation of the package lockers should provide transportation practitioners with a potential solution to the increasing vehicle miles traveled (VMT) and congestion associated with urban package and goods delivery.

**Reviewer 2:**
It seems to the reviewer that the project addresses a crucial issue facing the transportation industry and will provide much needed solutions for maximizing efficiency in the future.

**Reviewer 3:**
The project has engaged with independent technology and infrastructure companies to procure and implement solutions. These businesses have economic models that ensure sustaining solutions and implementation in other cities. The reviewer noted that this will improve delivery efficiency and reduce fuel usage and emissions.

**Reviewer 4:**
The project still has a way to go but shows excellent potential for addressing a serious urban concern. While the project may not advance fuel diversity, it would contribute to efficiency.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
The reviewer remarked that the project is well managed, appears to be getting good return for the investment, and is leveraging value from project partners.

**Reviewer 2:**
DOE resources are appropriate for this project, according to the reviewer.

**Reviewer 3:**
The project has a good cost-share design and seems reasonable, given its potential.

**Reviewer 4:**
The use of DOE funding to identify activities that foster the adoption of energy-efficient logistics is a critical strategy and activity to increase transportation system efficiency. Projects that serve as "living labs" are important to test new ideas, collect data, and inform research on energy-efficient transportation technologies and systems.

**Presentation Number: ti097**
**Presentation Title: Drones, Delivery Robots, Driverless Cars, and Intelligent Curbs for Increasing Energy Productivity of First-/Last-Mile Goods Movement Agreement**
**Principal Investigator: Constantine Samaras (Carnegie Mellon University)**

*Presenter*

Constantine Samaras, Carnegie Mellon University

*Reviewer Sample Size*

A total of four reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

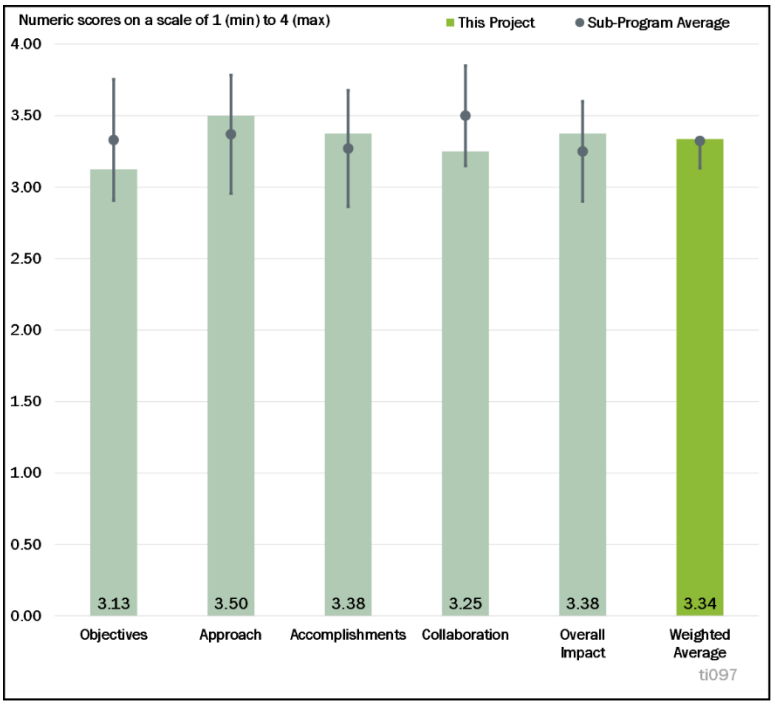


Figure 7-7 - Presentation Number: ti097 Presentation Title: Drones, Delivery Robots, Driverless Cars, and Intelligent Curbs for Increasing Energy Productivity of First-/Last-Mile Goods Movement Agreement Principal Investigator: Constantine Samaras (Carnegie Mellon University)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project objective and overview slides describe the project's specific objectives and barriers addressed, as well as how the project supports the DOE and VTO objectives of increasing transportation efficiency. The project addresses several of VTO's technology integration goals, such as national/energy security, economic growth, affordability for business, and reliability/resiliency, through the piloting of goods delivery using drones, ground delivery robots, and automated vehicles. The project objectives appear to be generally effective for the planned scope.

**Reviewer 2:**
The project objectives are to use empirical testing, life cycle assessment, and systems analysis to research and demonstrate an improvement of at least 20%, compared to a baseline network, in energy productivity of goods delivery using drones, ground delivery robots, and automated vehicles. The project team also plans to develop proof-of-concept testing, a model, and simulation for a smart curb space as an intelligently managed urban delivery zone, with a goal of demonstrating at least an additional 10% improvement in energy productivity.

**Reviewer 3:**
The reviewer indicated that this project could enhance efficiency but may or may not significantly increase fuel diversity.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The reviewer commented that the project approach is well conceived and follows a logical progression to identify and test solutions.

**Reviewer 2:**
The reviewer reported that the project approach includes the following: designing an experimental protocol for air and ground drone testing; empirically measuring the energy use of air and ground drones; constructing a model of drone and vehicle efficiency, including simulating energy use of a range of driverless delivery vehicles. The approach also includes collecting traffic and delivery data for the test site. Specifically, collecting existing traffic data and validating existing commercial vehicles arrivals data at test site data using sensors, cameras, and existing data sets, and initiating network model development. It appeared to the reviewer that this is a sound approach to meet the project goals.

**Reviewer 3:**
The project approach section provides a satisfactory methodology to accomplishing the project objectives and supporting the integration of advanced transportation technologies and practices. The approach is divided by project periods, each containing relevant hypotheses and associated tasks. Good detail is provided on the approach and milestone slides with regard to the planned tasks and activities and progress to date.

**Reviewer 4:**
The project is about integrating multiple methods and modes to increase the efficiency of the first- and last-mile/kilometer delivery. The reviewer remarked that this is very interesting.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The reviewer has articulated that good progress has been made toward achieving project goals. The presentation highlighted progress related to drone package delivery and driverless delivery robots. The work associated with smart curb space is on track to finish in budget period 3. No significant concerns have been identified.

**Reviewer 2:**
The project is reporting good progress, with all of the baseline tasks completed and next steps well underway.

**Reviewer 3:**
The team seems to be well on its way to identifying potential fuel savings, which are complicated by a lack of existing real-world data.

**Reviewer 4:**
Regarding project accomplishments, the reviewer reported that the project team recorded testing environment conditions of wind speed, temperature, and other factors. On-board sensors recorded voltage and current, GPS location, speed, wind speed, and drone movement characteristics for each flight, which enabled the team to estimate the energy used for each flight at a high resolution. Another accomplishment cited by this reviewer is that the team designed and executed an experimental protocol to empirically measure the energy use of ground delivery robots carrying a range of payloads through various campaigns. The team also estimated the theoretical propulsion energy use of an electric, rubber-tired delivery vehicles of various masses and assessed the energy tradeoffs between vehicle, battery, and payload mass across a range of existing and potential battery

specific energy values. Furthermore, the team has completed more than 200 package drone test flights and completed more than 100 driverless delivery robot test campaigns.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The reviewer affirmed that the team was very strong, and all members are making contributions to the project goals. The project team includes Carnegie Mellon University, Pittsburgh Region Clean Cities (PRCC), Amazon, and the City of Pittsburgh.

**Reviewer 2:**
The team has a strong structure with a diversity of talent and experience. The project team's communication is strong and consistent, and partners are well informed and involved in the process.

**Reviewer 3:**
An effective project team, assembled to carry out this project with private industry and public partners involved, provides an appropriate mix of expertise among team members. However, the reviewer asserted that the unclear role of Amazon and Pittsburgh Clean Cities in this project was a minor weakness.

**Reviewer 4:**
It appeared to the reviewer that there were fairly limited partners, but the project is advancing so communication and coordination must be acceptable.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The potential for cost savings and overall efficiency improvements in this area are significant. This project should provide valuable information to build on as this type of goods movement infrastructure continues to evolve.

**Reviewer 2:**
The project has good potential to contribute to increasing transportation efficiency through the piloting of goods delivery using drones, ground delivery robots, and automated vehicles. The project has identified several different potential strategies to increase energy productivity of first- and last-mile goods movement, which if proven successful may be utilized and integrated into target markets.

**Reviewer 3:**
The reviewer said that the current contribution to efficiency and fuel diversity may be limited as the research is still in process, but the potential is significant. Presumably, some of these delivery methods will be electric powered, replacing traditional gas- and diesel-powered vehicles for the first and last mile.

**Reviewer 4:**
The project team's overall impact was the development of empirical energy-use data generated for package delivery drones and driverless delivery robots. The reviewer stated that this replicable drone energy-use model development can be used in many applications to reduce energy and emissions for package delivery.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
DOE resources were properly used to develop publicly available, real-world data on drone energy use, which are extremely limited, and the team generated vehicle energy-use data and delivered it to DOE.

**Reviewer 2:**
The reviewed remarked that this is an area of intense interest to all in the pickup and delivery space. Accomplishments in this area can have significant effects.

**Reviewer 3:**
The project team has accomplished a lot already and should deliver great value for the investment moving forward.

**Reviewer 4:**
The use of DOE funding to identify activities that foster the adoption of energy-efficient logistics is a critical strategy and activity to increase transportation system efficiency. Projects that serve as "living labs" are important to test new ideas, collect data, and inform research on energy-efficient transportation technologies and systems.

**Presentation Number: ti098**
**Presentation Title: Transportation Energy Analytics Dashboard (TEAD)**
**Principal Investigator: Michael Pack (University of Maryland)**

*Presenter*

Mark Franz, University of Maryland

*Reviewer Sample Size*

A total of three reviewers evaluated this project.

*Effective Use of Project Resources*

67% of reviewers indicated that resources are being used wisely, 33% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

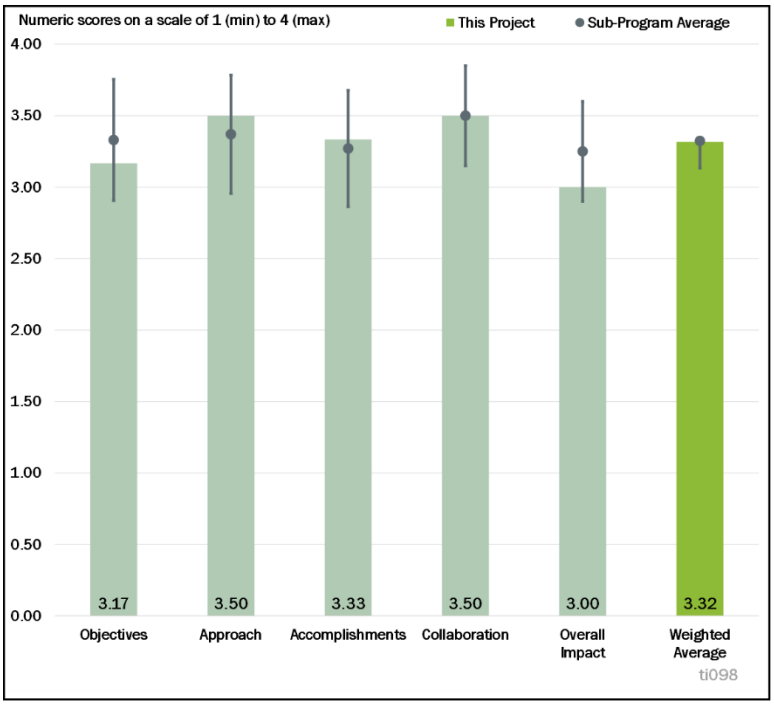


Figure 7-8 - Presentation Number: ti098 Presentation Title: Transportation Energy Analytics Dashboard (TEAD) Principal Investigator: Michael Pack (University of Maryland)

**Reviewer 1:**
The project has the potential to allow users to match vehicle, route, etc., to maximize efficiency and emissions reductions. The reviewers remarked this is critically valuable.

**Reviewer 2:**
The project objective and overview slides describe the project's specific objectives and barriers addressed, as well as how the project supports the DOE- VTO objectives of increasing transportation efficiency. The project addresses several of VTO's technology integration goals, such as national/energy security, economic growth, and affordability for business and consumers, through the development and validation of energy and emissions estimation, as well as on-line analysis tools and real-world use case studies. The project objectives appear to be generally effective for the planned scope.

**Reviewer 3:**
The reviewer asserted that the researchers did not articulate how this project would lead to increased fuel diversity by use of alternative fuels and increase energy efficiency. The connection appears to be through improving the alignment of goals among safety, congestion, energy use, and emissions. The project team should provide a more explicit connection from the alignment of goals to alternative fuel use and energy efficiency. It seems likely that the tools developed will provide some new insights about traffic and travel behavior and energy use and emissions. Although there seemed to be interest on the part of planners on the stakeholder engagement team, the researchers did not clearly explain how the information generated would be useful to DOE VTO or how stakeholders planned to use the tools to change how they planned and managed transportation systems. This information would be very helpful for evaluating the degree to which the project objectives will support the goals of DOE VTO. For example, perhaps the stakeholders plan to use this modeling framework to plan and/or certify compliance with air-quality standards.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The project relies on integrated data collection and analysis. Once complete, it would provide users decision-making data not currently available.

**Reviewer 2:**
The researchers have a well thought out design for their data acquisition, processing, and prediction/estimation system. The project has a strong team of researchers, system developers, and stakeholders. The project team has chosen appropriate and state of the art data sources and component models (e.g., Motor Vehicle Emissions Simulator [MOVES] and Automotive Deployment Options Projection Tool [ADOPT]) to integrate into their system. Transferability to other states and metropolitan areas is an issue that the reviewer would like to have seen addressed because it will strongly affect the ultimate impact of the project.

**Reviewer 3:**
The project approach section provides a satisfactory methodology to accomplishing the project objectives and supporting the integration of advanced transportation technologies and practices. The approach is divided by project objectives, each containing associated tasks. Good detail is provided on the approach and milestone slides with regard to the planned tasks, activities, and progress to date.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The reviewer indicated that good progress has been made toward achieving project goals. The presentation included nine slides describing the various accomplishments to date. The majority of the tool development, as well as the Transportation Energy Analytics Dashboard (TEAD) interface, has been completed. The work associated with demonstrating the user cases and final deliverables are on track to finish on time. No significant concerns have been identified.

**Reviewer 2:**
The project appears to be progressing at a good pace and making potentially meaningful strides forward.

**Reviewer 3:**
The research team has clearly accomplished a great deal with respect to development of the system. The slides state that the project is 60% complete, which is roughly two-thirds of the way along the timeline. However, only 10 of 24 tasks appear to have been completed. Of course, the remaining tasks may well take less time than the earlier ones. The amount and quality of software developed is impressive. The reviewer would like to have seen evidence of stakeholder input, feedback, and their effects on design. This needs to start early in the design process and be sustained throughout. The reviewer was sure this occurred to some extent but would like to have heard about how the process worked and enhanced the usefulness to the stakeholders.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The selection of partners was good for the project as well as the locations chosen for validation.

**Reviewer 2:**
The reviewer would have given a higher mark on this if the extent and impact of collaboration with stakeholders had been more fully demonstrated. The collaboration among the methodological and design teams appears to have been excellent. The teams are strong, as mentioned above; the product developed thus far is impressive and appears to have been appropriately validated.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The reviewer affirmed that the project has good potential to contribute to increasing transportation efficiency by quantifying the benefits of system-level strategies to improve mobility and energy efficiency. However, until the development and launching of the TEAD online tool has been completed and used by the pilots in Columbus and Washington, D.C., it is difficult to evaluate the effectiveness of this research at this time.

**Reviewer 2:**
It is a little difficult to say how much of the project's current achievements would be useable and valuable today, but the potential is quite significant. If a data dashboard could be created allowing users to look at their routes and identify the optimal times, routes, and vehicle types (and fuels?), it would be an enormous accomplishment.

**Reviewer 3:**
On this subject, the reviewer was not sure what to say. The reviewer did not think enough of the right kind of information was presented to make a well-informed evaluation. The reviewer was willing to give the researchers the benefit of the doubt, but suspected a higher score would have been given if the team had provided more information on this criterion.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
Yes, this is a good use of DOE funds. Dashboards that can help users make efficient decisions is a "holy grail" for many vehicle fleets.

**Reviewer 2:**
The reviewer said that it is important that DOE VTO have data and tools for analysis and evaluation of current and future energy use in transportation. Especially with DOE's focus on transportation system efficiency, tools such as this one could fulfill an important need for DOE and for state and metropolitan agencies.

**Reviewer 3:**
The use of DOE funding to identify activities that foster the adoption of energy-efficient mobility solutions is an important strategy/activity to increase transportation system efficiency. That being said, it was difficult for this reviewer to understand the project benefits and how they would be used by transportation practitioners.

**Presentation Number: ti099**
**Presentation Title: Understanding and Improving Energy Efficiency of Regional Mobility Systems by Leveraging System-Level Data**
**Principal Investigator: Zhen Qian (Carnegie Mellon University)**

*Presenter*

Zhen Qian, Carnegie Mellon University

*Reviewer Sample Size*

A total of three reviewers evaluated this project.

*Effective Use of Project Resources*

67% of reviewers indicated that resources are being used wisely, 33% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

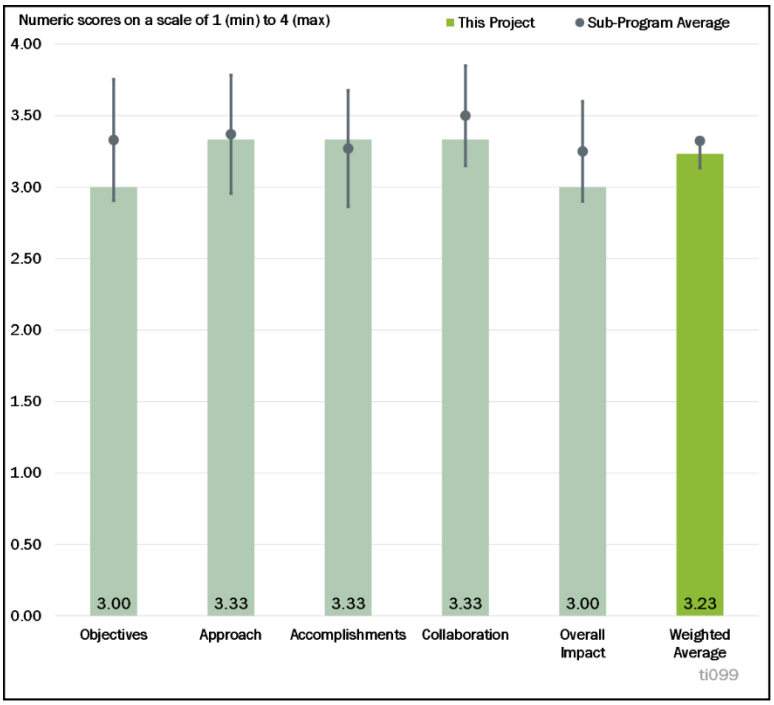


Figure 7-9 - Presentation Number: ti099 Presentation Title: Understanding and Improving Energy Efficiency of Regional Mobility Systems by Leveraging System-Level Data Principal Investigator: Zhen Qian (Carnegie Mellon University)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project should result in opportunities to increase transportation efficiencies. The results could increase the justification for electric vehicles and infrastructure.

**Reviewer 2:**
The project objective and overview slides describe the project's specific objectives and barriers addressed, as well as how the project supports the DOE and VTO objectives of increasing transportation efficiency. The project addresses several of VTO's technology integration goals, such as national/energy security, economic growth, affordability for business, and reliability and resiliency, by quantifying the benefits of system-level strategies to improve mobility and energy efficiency, in Philadelphia and Pittsburgh regions. The project objectives appear to be generally effective for the planned scope.

**Reviewer 3:**
This project is developing a data and modeling system for estimating and predicting the impacts of various kinds of policies and technologies on energy efficiency and mobility. Like other research and development (R&D) projects of its kind, it would benefit from more precise identification of the kinds of strategies it is designed to evaluate; validation of its methods for the intended analyses; and the kinds and magnitude of effects expected. Clearly, this kind of tool can be useful for VTO for analysis purposes (understanding the magnitudes of energy uses for various types of travel by different types of vehicles in different geographical locations), but the lack of clarity about the questions to be answered and how they will be answered means the reviewer must infer answers to those key questions. Will the key question be just traffic and parking management? Ride sharing is mentioned, but the key issue there is behavioral. How will that be addressed, or will it not be addressed?

Another strategy mentioned is to estimate the impacts of replacing conventional internal combustion engines with EVs, but will choice be considered and the provision of charging infrastructure? Additionally, how much better will this model be than existing aggregate stock-turnover type models? Will the questions be about land use? If so, what controls are to be evaluated? Will it be about vehicle choice? Does it have a vehicle choice model? Will it be about transit and transportation network companies? If so, why are transit trips not included?

The reviewer thought that the system will be valuable to VTO and will make considerable progress in the area of modeling vehicle activity at a detailed spatiotemporal level. And that, in itself, will be an important methodological contribution.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
Based on the results of this project, when complete, there could be additional justifications for creating infrastructure to better integrate electric vehicles into the system and incentivize more efficient travel patterns.

**Reviewer 2:**
The project approach section provides a generally effective methodology to accomplishing the project objectives and supporting the integration of advanced transportation technologies and practices. Adequate detail is provided on the approach and milestone slides with regard to the planned tasks and activities and progress to date. The inclusion of two geographically and varied urban environments and cities should help to support the adoption in other locations across the country, if the project approach is successful.

**Reviewer 3:**
Developing transportation models from the kinds of data and employing the kinds of methods this project is using is the future of transportation modeling. Given a limitation to vehicle travel, the project design is just what it should be: focused on available, geographically, and temporally detailed data with calibration via machine learning. Transferability of the tool depends critically on data structure and availability, a topic addressed by carefully selecting data from generally available sources and creating a data guide.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
According to the reviewer, the researchers are progressing toward their goals at a good pace. The work completed so far is of value.

**Reviewer 2:**
Good progress has been made toward achieving the project goals. With only 40% of the time and budget expended, the project has completed many of the milestones and tasks, such as the development of the data guide and web app, as well as starting the Pittsburgh region case study work. The remaining work of budget period 2 appears to be on track to finish on time. It seems to the reviewer that no significant concerns have been identified.

**Reviewer 3:**
The system has been completed with apparently quite successful calibration, except for the critical step of implementing the different strategies that will affect energy efficiency and alternative fuel use. Development of the software as an open-source tool is exactly the right concept.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The reviewer remarked that this looks like a good and collaborative effort with appropriate partners for the locations. The meeting schedule should keep the project team on track.

**Reviewer 2:**
The reviewer indicated that an effective project team has been assembled to carry out this project, with academia, a National Laboratory, public agencies, and Clean Cities Coalition partners involved, and provides an excellent mix of expertise among team members. Team members are well suited to project work, and their working relationships appear to be appropriate for a project of this scope. However, a minor weakness was the unclear role of Pittsburgh Clean Cities in this project.

**Reviewer 3:**
The reviewer affirmed that the R&D team is very strong both technically and in terms of subject matter knowledge. On the other hand, the role of "Partners" is not as clearly explained as it should be. The Delaware Valley Regional Planning Commission, for example, has relevant expertise that has probably helped by providing inputs to data choice, system design, and strategy evaluation decisions but this is not explained.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
This project could in the future significantly increase overall transportation efficiency. There is some question as to whether the results alone would necessarily increase fuel diversity.

**Reviewer 2:**
This rating is based on evaluating the project from the perspective of developing spatially and temporally detailed transportation models that can be transferred from one region to another because they can be readily calibrated using widely available data. At present, the reviewer was less certain of its value for evaluating alternative fuel and energy-efficient technologies and policies.

**Reviewer 3:**
The project has good potential to contribute to increasing transportation efficiency by quantifying the benefits of system-level strategies to improve mobility and energy efficiency. At this point, the progress to date has not delivered any measurable results; however, once the work in Pittsburgh and Philadelphia has been completed, it will be a more appropriate time to evaluate the effectiveness of this research.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
This project apparently builds on previous data and model development by the U.S. Department of Transportation (DOT), thereby saving substantial resources.

**Reviewer 2:**
It appears to the reviewer that helping a community to assess the best ways to address transportation needs and efficiency is always going to be helpful. Based on an individual community's findings, using tools such as this, the community may or may not end up diversifying fuels.

**Reviewer 3:**
The use of DOE funding to identify activities that foster the adoption of energy efficient mobility solutions is a critical strategy and activity to increase transportation system efficiency. That being said, the benefits of this project and how they would be used by transportation practitioners were difficult to understand.

**Presentation Number: ti100**
**Presentation Title: High-Dimensional, Data-Driven Energy Optimization for Multi-Modal Transit Agencies**
**Principal Investigator: Philip Pugliese (Chattanooga Area Regional Transit Authority)**

*Presenter*

Philip Pugliese, Chattanooga Area Regional Transit Authority

*Reviewer Sample Size*

A total of three reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

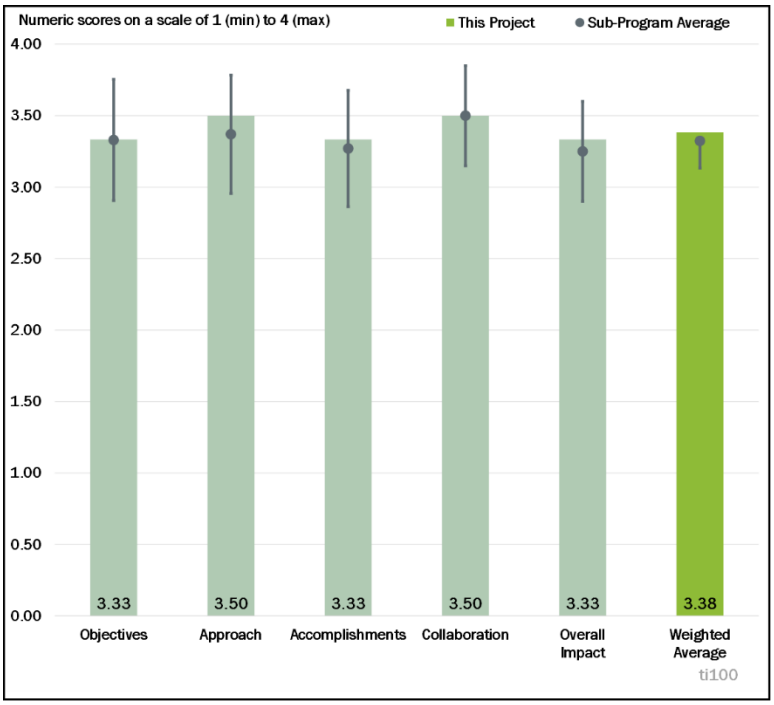


Figure 7-10 - Presentation Number: ti100 Presentation Title: High-Dimensional, Data-Driven Energy Optimization for Multi-Modal Transit Agencies Principal Investigator: Philip Pugliese (Chattanooga Area Regional Transit Authority)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The reviewer stated that this project could result in an excellent data-driven decision-making tool for transit agencies. The likely result would be increased efficiencies and some shift to electric vehicles.

**Reviewer 2:**
Understanding with a high degree of resolution how alternative fuel technologies, such as electric and hydrogen fuel cell buses, will perform in use before purchasing them will be of substantial value to transit agencies. In addition, a tool that can accurately predict how vehicles will perform on specific routes under varying duty cycles will help optimize operations.

**Reviewer 3:**
The project objective and overview slides describe the project's specific objectives and barriers addressed, as well as how the project supports the DOE-VTO objectives of increasing fuel diversity through the use of alternative fuels. The project addresses several of VTO's technology integration goals, such as national/energy security, economic growth, and affordability for business and consumers, through activities meant to reduce energy consumption of public transit fleets through vehicle optimization. Project objectives appear to be generally effective for the planned scope.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The project plan addresses data collection, model development and validation, visualization of outputs, and analysis. Key stakeholders are project team members and have clearly had a strong influence on the project design.

**Reviewer 2:**
The reviewer stated that this project utilizes advanced data-gathering and analysis technologies to support its goal of energy optimization in a transit system.

**Reviewer 3:**
The project approach section provides a satisfactory methodology to accomplishing the project objectives and supporting the integration of advanced transportation technologies and practices. The milestone slide provides adequate detail with regard to the planned tasks and progress to date. A weakness is that little detail is provided on the approach slide.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
Five key milestones have been met and all others are on schedule. The project has already developed useful insights about energy use by electric and diesel buses on different routes, times of day, and weather conditions that will help agencies evaluate the benefits of alternative fuel technologies and optimize their deployment. The finding that optimization of bus operation with the system can produce energy savings of at least 10%, if it holds up across transit properties, will make the system valuable to transit operators.

**Reviewer 2:**
At this point in the project's budget cycle, the project team has created achievements regarding predictive data that could be of value on their own. Completion of the project will be useful if transferable by location.

**Reviewer 3:**
The reviewer remarked that good progress has been made toward achieving project goals. The presentation highlighted progress related to energy-analysis comparisons of electric and diesel buses, in terms of energy use per route, as well as minimizing energy use through vehicle assignment and electric charge scheduling. The remaining work of budget period 2 appears to be on track to finish on time. No significant concerns have been identified.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The reviewer noted that there are strong team partners for the project and its location.

**Reviewer 2:**
An effective project team provides an excellent mix of expertise among team members, with a transit agency, academia, public agencies, and Clean Cities Coalition partners involved. Team members are well suited for this project work and their working relationships appear to be appropriate for a project of this scope.

**Reviewer 3:**
The key stakeholders (the Chattanooga Area Regional Transportation Authority, City of Chattanooga, and East Tennessee Clean Fuel Coalition) are well integrated into the project and have clearly had a major positive influence on its design and execution.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The reviewer asserted that this is one of the best targeted projects evaluated. Transit is a small but important part of the U.S. transportation system and will play a key role in the transition to clean energy in transportation. This project provides transit agencies with a useful tool to help them make decisions about acquisition, deployment, and assignment of electric and fuel cell buses.

**Reviewer 2:**
The project has good potential to contribute to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency by reducing energy consumption of public transit fleets through vehicle optimization. The ability to optimize vehicle charging, for activities such as in-route charging or as a strategy to minimize demand charges, will be important to ensure that transit agencies will be able to operate these buses in as efficient manner as possible. These results should be shared with the Federal Transit Administration.

**Reviewer 3:**
The reviewer remarked that, conceptually, this project has significant potential. There is a concern that the data set may not be collected over a long enough period of time to prove out temperature-related issues. However, weather and topography, which can vary quite significantly geographically, would not be material if the dashboard analysis is replicable elsewhere. Allowing an urban transit agency to maximize efficiency and minimize fuel usage could result in major contributions nationwide.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
The reviewer articulated that the potential to provide transit agencies a method to make data-driven and efficiency-based decisions would result in major economic and fuel savings.

**Reviewer 2:**
The use of DOE funding to develop models, tools, and other strategies to optimize the deployment of electric transit buses are an appropriate use of federal funds. As more transit fleets are moving toward the deployment of electric transit buses (either through mandates or by choice), it will be critical to incorporate strategies and approaches that will optimize vehicle routes for these new buses.

**Reviewer 3:**
Key stakeholders are not only providing financial resources but also invaluable expertise that has helped design and guide the project.

**Presentation Number: ti101**
**Presentation Title: Mobility and Energy Improvements Realized through Prediction-Based Vehicle Powertrain Control and Traffic Management**
**Principal Investigator: Thomas Bradley (Colorado State University)**

*Presenter*

Thomas Bradley, Colorado State University

*Reviewer Sample Size*

A total of three reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

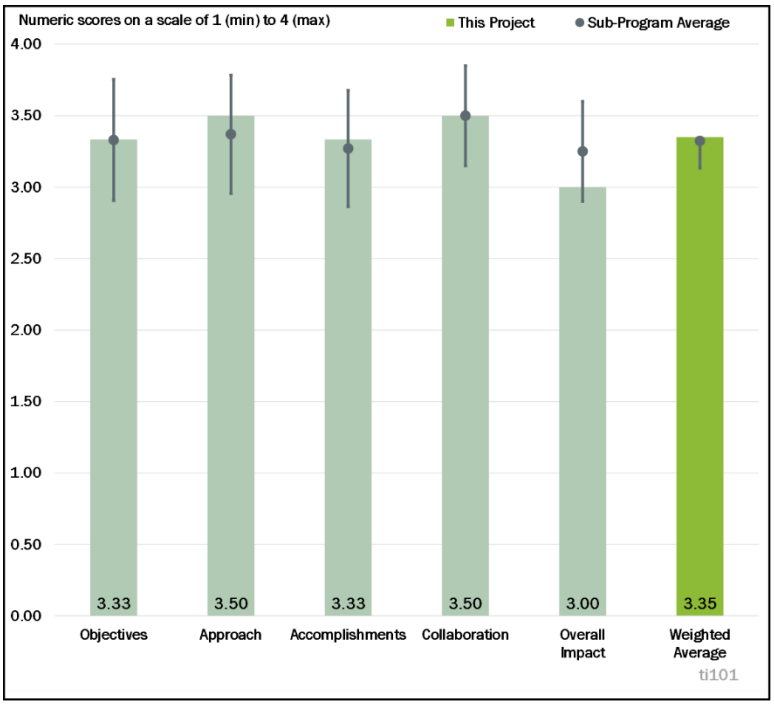


Figure 7-11 - Presentation Number: ti101 Presentation Title: Mobility and Energy Improvements Realized through Prediction-Based Vehicle Powertrain Control and Traffic Management Principal Investigator: Thomas Bradley (Colorado State University)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The key barrier addressed by this project is the estimation of energy savings to be expected from traffic and vehicle controls enabled by connected automated vehicles (CAVs). This is a key issue for VTO, which has devoted much energy and resources to understanding how advanced mobility systems can increase energy efficiency and support sustainable energy solutions for transportation.

**Reviewer 2:**
The project objective and overview slides describe the project's specific objectives and barriers addressed, as well as how the project supports the DOE-VTO objectives of increasing transportation efficiency. The project addresses several of VTO's technology integration goals, such as national/energy security, economic growth, and affordability for business, by testing scenarios demonstrating the synergistic benefits of system-level data sharing, infrastructure management, and CAV controls optimization. Project objectives appear to be generally effective for the planned scope.

**Reviewer 3:**
The reviewer commented that while the project may not necessarily increase fuel diversity, it would potentially provide data allowing for better transportation efficiency and reduced emissions.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The analysis of two separate approaches to see if a synergy exists via combined effort is valuable and not easy.

**Reviewer 2:**
The project approach section provides a generally effective methodology to accomplishing the project objectives and supporting the integration of advanced transportation technologies and practices. Adequate detail is provided on the approach and milestone slides with regard to the planned tasks and activities and progress to date. The inclusion of real-world traffic scenarios, such as traffic congestion along major travel corridors, the interface between bus rapid transit (BRT) and traffic intersections, and through-town Class 8 truck traffic, should provide data and solutions that can be replicated in other areas across the country.

**Reviewer 3:**
The project design includes all the components necessary to increase DOE's understanding of how CAVs could improve the energy efficiency of urban road transportation though advanced traffic and vehicle controls. The approach is based on answering specific hypotheses about how energy efficiency can be improved by system-wide traffic management and prediction and optimization of vehicle energy use, while at the same time measuring impacts on key performance metrics, such as travel time. Importantly, bus and heavy truck operations are included because, though relatively few in number compared to light- and medium-duty vehicles, they have a disproportionate impact on traffic flow.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The project team has made good progress. The achievements thus far are important and will allow for completion of the project.

**Reviewer 2:**
The reviewer expressed that good progress has been made toward achieving project goals. The project is approximately 66% completed and has completed many of the milestones and tasks, such as data collection and synthesis, microscopic traffic simulation, and model validation. The remaining work of budget period 2 appears to be on track to finish on time. No significant concerns have been identified.

**Reviewer 3:**
The reviewer indicated that 7 of 10 milestones have been accomplished, and the remaining 3 are on schedule. The main components of the modeling system are complete though integration work remains. This carefully designed and calibrated system demonstrated that, system wide, optimization of traffic controls could improve throughput by 1%-2%. Vehicle-level optimal control for energy use improved fuel economy by 2%-4%. On the one hand, these benefits are relatively minor but, given the size of U.S. transportation energy use, they are important. In addition, it is important to know what the potential for CAV energy-efficiency improvement is at a system-wide scale in order to make decisions about R&D priorities.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
An effective project team has been assembled to provide an excellent mix of expertise among team members; academia, a National Laboratory, public agencies, and Clean Cities Coalition partners are involved. Team

members are well suited for this project work, and their working relationships appear to be appropriate for a project of this scope.

**Reviewer 2:**
The reviewer remarked that this is a strong team that has clearly worked together effectively to meet milestones on time and within budget, and even at this stage it has created a valid and valuable tool for analysis.

**Reviewer 3:**
The project seems to have the right partners to accomplish its tasks.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
It is likely that this project will have an important impact on the direction of energy research on the subject of CAVs. To date, the answers are not definitive because the model takes existing infrastructure as a given and changing the roadway infrastructure could have important synergistic effects with CAVs. Still, important progress has been made, and the final results of this project will undoubtedly produce more valuable insights.

**Reviewer 2:**
The project's accomplishments thus far might not directly contribute to transportation efficiency and fuel diversity but are critical to completion, which could increase transportation efficiency. It does not necessarily appear that the project is designed to significantly increase fuel diversity.

**Reviewer 3:**
The project has good potential to contribute to increasing transportation efficiency by quantifying the benefits of system-level strategies to improve mobility and energy efficiency. At this point, the progress to date has not delivered any measurable results; however, once the work to reduce travel time and travel time variance in Denver and Fort Collins has been completed, it will be a more appropriate time to evaluate the effectiveness of this research.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
CAVs as part of an advanced mobility system have been a key focus for VTO for years. This project has produced some, and will produce more, important insights about the potential energy effects of CAVs that will inform future R&D investments.

**Reviewer 2:**
The use of DOE funding to identify activities that foster the adoption of energy-efficient mobility solutions is a critical strategy and activity to increase transportation system efficiency. Projects that serve as "living labs" are important to test new ideas, collect data, and inform research on energy-efficient transportation technologies and systems.

**Reviewer 3:**
According to the reviewer, looking at how combining optimized traffic management systems and connected/automated vehicle powertrain control may create transportation efficiencies will be of significant value in the future.

**Presentation Number: ti102**
**Presentation Title: Advancing Platooning with Advanced Driver-Assistance Systems Control Integration and Assessment**
**Principal Investigator: Hoseinali Borhan (Cummins-Peterbilt)**

*Presenter*

Hoseinali Borhan, Cummins

*Reviewer Sample Size*

A total of three reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

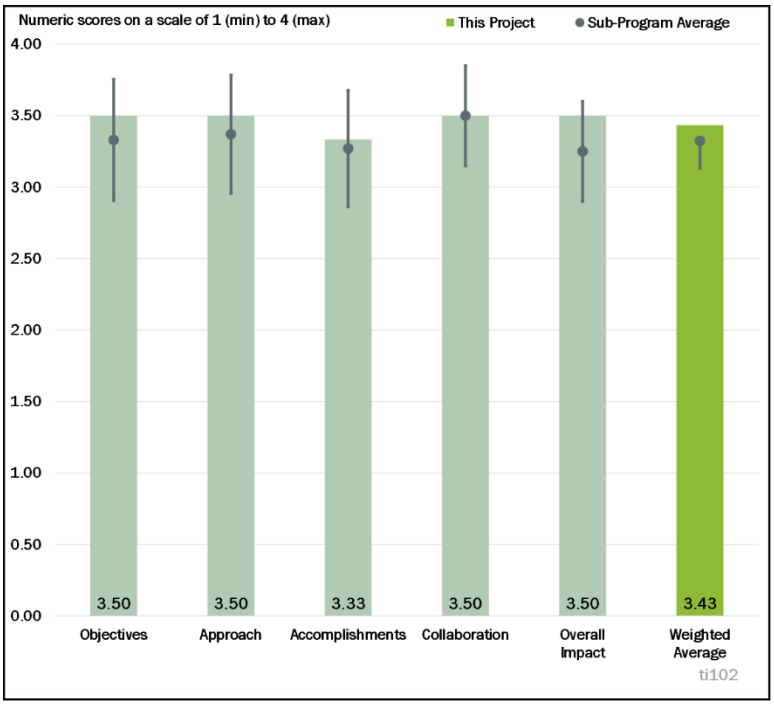


Figure 7-12 - Presentation Number: ti102 Presentation Title: Advancing Platooning with Advanced Driver-Assistance Systems Control Integration and Assessment Principal Investigator: Hoseinali Borhan (Cummins-Peterbilt)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
This reviewer observed well-defined project objectives, and cited the following: assess the impact of real-world driving conditions on truck platooning fuel saving; assess advanced driver-assistance systems and tire connectivity technology integration; and identify barriers to truck platooning

**Reviewer 2:**
The project objectives address the critical issue of big truck efficiency with an eye toward preparing for future technology developments.

**Reviewer 3:**
The project is addressing the increasing transportation efficiency objective. The potential fuel-saving increase from truck platooning is being calculated with real trucks driving in real traffic conditions along routes and driving cycles that represent a national average.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The project approach is excellent. Platooning trucks will be operated on roadways representing the national average with respect to terrain and speed profiles. Data on fuel savings will be collected. The initial tests will be for two-truck platoons followed by three-truck platoon tests. An additional component of the project is investigating the role of tire condition as it relates to tire performance and ultimately to how truck platooning

operating parameters may need to change as a function of tire condition. This is critical to maintaining the safety of platoon operations.

One potential area that could be explicitly documented or assessed is the truck driver's reaction, adaptation, etc., to the platooning system. Understanding how the drivers use the system, how they adapt, and their overall impressions on system acceptance are important to capture.

**Reviewer 2:**
The project approach is very sound in looking for opportunities in technology integration. The project team then plans on testing the technology and finally providing technology solutions for advanced platooning.

**Reviewer 3:**
The project approach is clear and follows a logical progression with realistic expectations and attainable goals.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The accomplishments and progress have been very good. The project team has equipped all three of the test trucks and developed baselines, completed the test factors, selected routes, and have full tire-data connectivity.

**Reviewer 2:**
The team appears to be making excellent progress on the project. As documented in the presentation, however, there may be some COVID-19 induced delays on the project. The two-truck platooning system has been tested and is ready for testing on real roads. The team has identified two potential routes that map very well to national averages on terrain. There appears to be no major impediments to the real-world tests.

**Reviewer 3:**
The project is about 30% complete, with much of the legwork and development tasks completed but not much of the actual testing has been done. The reviewer noted that recent disturbances have no doubt played a big role in that, but work is expected to pick up in earnest soon.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The reviewer commented that a very strong team has been assembled with good communication and data sharing with DOE. The team consists of Cummins, NREL, Clemson University, and Michelin North America.

**Reviewer 2:**
The team is holding regular bi-weekly meetings and sharing data among themselves and with DOE. All team partners—Cummins, NREL, Clemson University, and Michelin North America—seem to have played important roles already

**Reviewer 3:**
Partners have clearly defined roles, equal workloads, and responsibilities. The partners seem to be well chosen and represent a well-rounded team.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The reviewer remarked that this project should have a significant impact on the successful deployment of truck platooning in the future.

**Reviewer 2:**
The DOE objective for the project is to execute field evaluations of multi-truck platoon proof of concepts that assess both the potential fuel savings and barriers that need to be overcome for platooning to be effective. The reviewer asserted that this objective is being met for this project.

**Reviewer 3:**
The project has already made contributions to the knowledge base related to truck platooning. The reviewer commented that the project team has done the following: conducted fuel-savings tests of two-truck platoons on a test track; identified potential routes for real-world tests that map to national averages with respect to grade; collected data on tire braking performance with respect to road type, trailer load, brake type, tire brand, and tire wear; and designed a model predictive control) for platooning operations. The real-world road testing and the analysis of three-truck platoons will add to this knowledge base.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
The reviewer affirmed that DOE resources are properly being used in this project. This project calls for extensive on-road use of platooning and proper research prior to the test period.

**Reviewer 2:**
The testing done through this project is necessary to the development of truck platooning technology and for maximizing its efficiency. The project represents a wise of use of these funds.

**Reviewer 3:**
Although there is currently a bit of uncertainly in whether driver-assisted truck platoons (e.g., automation levels 1- 3 with a driver in each truck) will ultimately make business sense, there is new and continued interest in truck platooning with a driver-assisted lead truck and an automated following truck. This line of research supports both the purely driver-assisted truck platooning concepts as well as the “leader-follower” truck platooning concepts. This line of research is also still of interest to DOT, and continued cooperation and collaboration in these areas would be beneficial.

**Presentation Number: ti103**
**Presentation Title: Fuel-Efficient Platooning in Mixed Traffic Highway Environments**
**Principal Investigator: Jeff Rupp (American Center for Mobility)**

*Presenter*

Jeff Rupp, American Center for Mobility

*Reviewer Sample Size*

A total of three reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

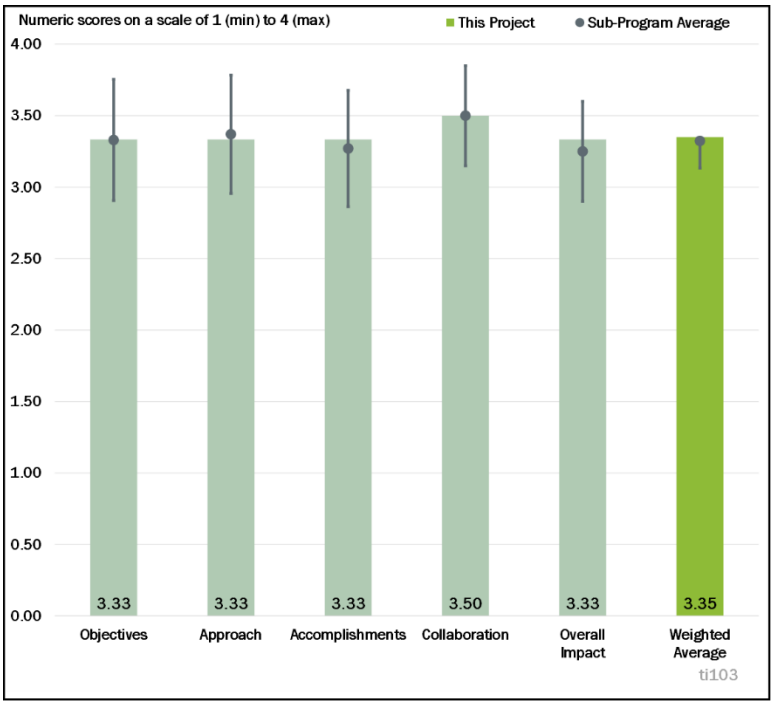


Figure 7-13 - Presentation Number: ti103 Presentation Title: Fuel-Efficient Platooning in Mixed Traffic Highway Environments Principal Investigator: Jeff Rupp (American Center for Mobility)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project objectives support the critical objective of increasing transportation efficiency. Exploring the technologies necessary to make platooning viable is valuable work.

**Reviewer 2:**
The project objective is to develop vehicle automation for reduced headway that adapts to traffic, road curvature (vertical and lateral), bridges and tunnels, and weather. The team is also going to conduct testing with increasing complexity in four phases—simulation, baseline, advanced, and public (Michigan Department of Transportation [MDOT]-hosted demonstrations.

**Reviewer 3:**
The project is addressing the increasing transportation efficiency objective by investigating certain aspects of truck platooning systems, which promise to save fuel for trucks on the highway. Of particular interest is that the project is investigating "edge cases," such as vertical and horizontal road curvature, impact of bridges and tunnels on communications, and impacts of vehicle cut ins. The ability of a truck platooning system to handle these cases may impact both its fuel savings and its user acceptance.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The reviewer affirmed that the project approach is sound. The team will test vehicles in varying automated platoon configurations while measuring fuel consumption and then increase the complexity of driving scenarios.

**Reviewer 2:**
This project has a comprehensive approach to development of systems and testing a variety of trucks in numerous platooning configurations. This should provide valuable building blocks for improving the efficiency of trucking operations in the future.

**Reviewer 3:**
The approach seems to be good. It incorporates simulation, "simple" test-track testing on a flat oval track, and more advanced test -track testing of a more complex environment, the American Center for Mobility test track. The final component is a "demonstration" on real roads. However, it is unclear what the purpose of the demonstration will be. Will it be for further data collection and analysis of the truck platooning systems or will it truly just be a demonstration of the system on real roads?

The project is testing variations in a number of trucks and types of trucks, which is good. However, it is unclear why a lot of effort is being spent on four-truck platoons. It is unlikely that four-truck platoons will be operating in very many situations, at least for commercial vehicles. The reviewer asked if perhaps the Army has additional objectives. It is also not clear, at least in the presentation, what the plan is for testing the various combinations, such as number of trucks, truck types, and leader-follow positions. Will all combinations be tested or just some subset?

Determining safety margins for different types of weather is an important component of this project. Safety always needs to come first, so investigating if the platoon can still safely operate under different weather conditions is important. If the trucks can operate in platooning mode with increased gaps depending on weather, this allows fuel savings (though reduced) to still occur.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
The project has shown great progress, with development tasks completed as well as a good portion of the actual testing.

**Reviewer 2:**
The project has made progress testing a four-truck platoon at 45 miles per hour (mph). This testing showed that even at 45 mph, there were still fuel savings. While larger fuel savings will occur at higher speeds, there may be many instances where trucks need to travel at lower speeds, so if the platoon can be maintained at these lower speeds, fuel savings can still occur. Testing of vehicle-to-vehicle (V2V) communications under road curvatures, bridges and tunnels, and varying weather has also been accomplished. These results could provide important information for any platooning system that has "look ahead" capability to anticipate and adjust to some of these key infrastructure features and road-curvature geometrics along the route. Some progress on the project can be expected to be delayed due to COVID-19.

**Reviewer 3:**
Project progress and accomplishments include example fuel consumption testing with lap-averaged fuel analysis, controller area network fuel rate, and propagation of disturbances. Additionally, the team has indemnified radio and signal strength requirements as well as simulated the impacts of weather on project results.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
The reviewer stated that there is a very strong team assembled, with adequate communication between members. The team includes the American Center for Mobility; Auburn University; University of Michigan at Dearborn; MDOT; U.S. Army Combat Capability Development Center, Ground Vehicle Systems Center; and NREL.

**Reviewer 2:**
Each partner brings significant experience and expertise to the project, and the project appears to have effectively leveraged the strengths of each partner.

**Reviewer 3:**
The team appears to be collaborating very well. Various aspects of the project have been accomplished by different team members, and testing has occurred at two different team member locations.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
Experience and analysis gained from this testing will have a significant impact on the development of safe, effective platooning practices for future implementation as technology allows.

**Reviewer 2:**
This project will make a particular impact on understanding the "edge cases" related to truck platooning, such as how to operate on severe horizontal and vertical curves, around bridges and tunnels, and under various weather conditions. Some of this type of information has already been produced by this project, and more information will be collected. For the future data collection, it is important to understand what the project intends to collect, given the limited resources and the various combinations of truck type, number of trucks, truck loads, etc., that could potentially be tested.

**Reviewer 3:**
This reviewer reported that the project achieved reduced fuel consumption during four-truck platooning (45 mph, unloaded, mixed platoon) by 5%-10% for following vehicles and 0%-4% for the leading vehicle. Automation algorithms demonstrated the ability to lengthen headway gap for cut-in traffic. V2V communications have shown resilient to vertical road curvature, bridges, tunnels, and weather.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
Good use of DOE resources as platooning has a significant pathway to reduce fuel consumption and reduce vehicle emissions.

**Reviewer 2:**
This project has managed its resources well and represents a good return on funds invested.

**Reviewer 3:**
Although the reviewer answered "yes" to the question of continued DOE funding, the caveat would be to focus the truck platooning scenarios on more near-term platooning configurations. This project includes studying

four-truck platoons; however, this type of configuration does not seem to have a business case, at least in the nearer term commercial sector. Perhaps the Army has its own interests, though.

**Presentation Number: ti104**
**Presentation Title: Using Real-Time Mass Transit in First-/Last-Mile Solution**
**Principal Investigator: Andrea Broaddus (Ford)**

*Presenter*

Andrea Broaddus, Ford

*Reviewer Sample Size*

A total of two reviewers evaluated this project.

*Effective Use of Project Resources*

100% of reviewers indicated that resources are being used wisely, 0% of reviewers indicated that resources might be used wisely, 0% of reviewers indicated that resources are not being used wisely, and that 0% of reviewers did not indicate an answer.

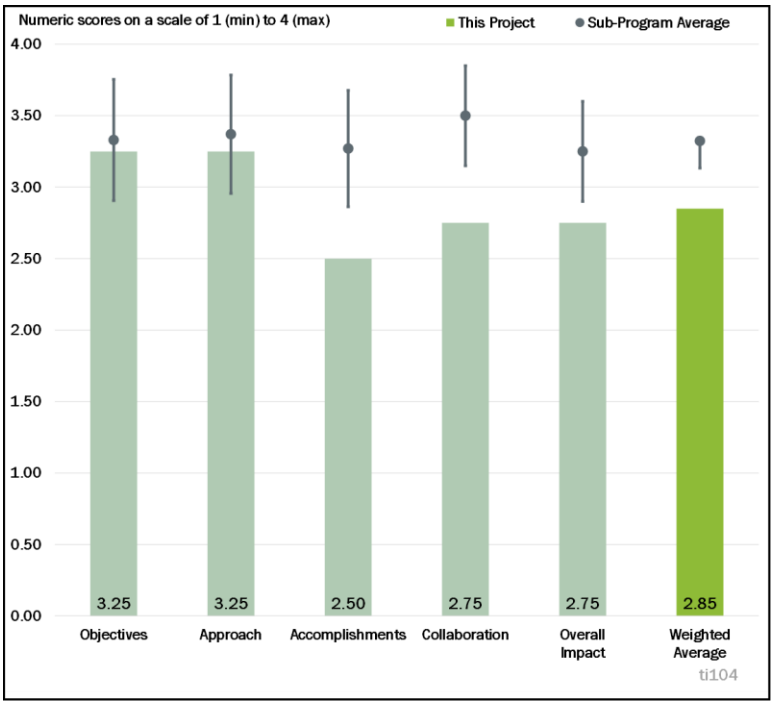


Figure 7-14 - Presentation Number: ti104 Presentation Title: Using Real-Time Mass Transit in First-/Last-Mile Solution Principal Investigator: Andrea Broaddus (Ford)

*Question 1: Project Objectives—the degree to which the project objectives support the DOE/VTO objectives of increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
Successful first- and last-mile mobility service for mainline transit could improve energy efficiency, increase the use of mobility powered by electricity, and provide more affordable mobility and accessibility.

**Reviewer 2:**
The project objective and overview slides describe the project's specific objectives and barriers addressed, as well as how the project supports the DOE-VTO objectives of increasing transportation efficiency. The project addresses several of VTO's technology integration goals, such as national/energy security, economic growth, affordability for business, and reliability and resiliency, by researching, developing, and demonstrating that a first- and last-mile mobility service, integrated with transit agencies' real-time transit and user data, works seamlessly in a simulation environment and a real-world pilot. Project objectives appear to be generally effective for the planned scope.

*Question 2: Project Approach to supporting the integration of advanced transportation technologies and practices to support overall project objectives—the degree to which the project is well-designed, feasible, and aligned with other efforts.*

**Reviewer 1:**
The project approach section provides a generally effective methodology to accomplishing the project objectives and supporting the integration of advanced transportation technologies and practices. Adequate detail is provided on the approach and milestone slides with regard to the planned tasks and activities and progress to date. The inclusion of two geographically and varied urban environments and cities should help to support the adoption in other locations across the country, if the project approach is successful.

**Reviewer 2:**
The approach combines initial stated-preference surveys and computer simulations with two real-world pilot projects to understand travelers' actual choices. It finishes with analysis, evaluation, and dissemination of results. The approach has a high probability of producing credible results that will influence investment decisions. Importantly, the pilot projects will include, rail, bus, and BRT services.

*Question 3: Project Accomplishments and Progress toward overall project and DOE objectives and goals—the degree to which progress/significant accomplishments have been achieved, measured against performance indicators and demonstrated progress toward project objectives and DOE goals.*

**Reviewer 1:**
To date, only 25% of the project is complete after about 50% of the scheduled time has elapsed. The project leaders have faced unexpected challenges in the loss of a transit service provider for the pilot projects and from the COVID-19 pandemic, which has had major negative impacts on mass transit. The shuttered provider has been replaced. However, only the service provider acquisition milestones have been completed. The simulation model development and stated-preference survey tasks are underway and appear to be nearing completion. The project has a year and a half left to go and may still finish on time.

**Reviewer 2:**
Slow progress has been made toward achieving project goals, due to the need to replace a micro-transit partner Chariot, which went out of business, and delays associated with COVID-19. The project is approximately 25% completed and has only completed 2 of 10 milestones, with 2 in progress. It is not clear if this project can finish without a project end-date extension.

*Question 4: Collaboration and Coordination Among Project Team—the degree to which the appropriate team members and partners are involved in the project work and the effectiveness of the collaboration between and among partners.*

**Reviewer 1:**
It appears to the reviewer that the project team is solid and will succeed. However, it is still early, and the pandemic is still having a major impact on mainline transit operations. The situation will have to be monitored, and an extension may be necessary.

**Reviewer 2:**
The project team appears to provide an appropriate mix of expertise among team members, with a major vehicle original equipment manufacturer, academia, transit agencies, and a micro-transit provider included. Team members are well-suited for this project work and their working relationships appear to be appropriate for a project of this scope.

*Question 5: Overall Impact—the degree to which the project has already contributed, as well as the potential to continue to contribute in the future, to increasing fuel diversity through the use of alternative fuels and increasing transportation efficiency.*

**Reviewer 1:**
The project has good potential to contribute to increasing transportation efficiency by demonstrating that a first- and last-mile mobility service, integrated with transit agencies' real-time transit and user data, can improve mobility and energy efficiency. At this point, the progress to date has not delivered any measurable results; however, once the work associated with the King County and Minneapolis pilot projects has been completed, it will be a more appropriate time to evaluate the effectiveness of this research. Additionally, because only 15 minutes (versus the usual 30 minutes) was allotted for the presentation, the presenter did not go through all of the slides or have an opportunity for Q&A.

**Reviewer 2:**
The project's contributions to date have been small due to unforeseen delays. However, if successful, the project could play an important role in the future by demonstrating the benefits of integrating line-haul transit with automated (or, less likely, un-automated) first- and last-mile services. This could be a substantial benefit for transit operators as well as current and potential transit riders in urban areas.

*Question 6: Use of Resources. Are DOE resources being leveraged and funds being used wisely? Should DOE fund similar projects in the future?*

**Reviewer 1:**
The use of DOE funding to pilot first- and last-mile micro-transit shuttles and evaluate technology solutions for transit is an important strategy and activity to increase transportation system efficiency. Projects that serve as "living labs" are important to test new ideas, collect data, and inform research on energy-efficient transportation technologies and systems.

**Reviewer 2:**
Transit is a small but important part of the U.S. transportation system. For many, it is the only viable option for getting to work. Demonstrating positive synergy between main-line transit service and first- and last-mile ride service could increase the importance of transit in the future mobility system in ways that increase energy efficiency, diversify energy sources, and expand the mobility and accessibility options for those needing affordable transportation.

## Acronyms and Abbreviations

| | |
|---|---|
| AFDC | Alternative Fuels Data Center |
| ANL | Argonne National Laboratory |
| ATHENA | Advanced Transportation Hub Efficiency using Novel Analysis |
| BOMA | Building Owners and Managers Association |
| BRT | Bus rapid transit |
| CAV | Connected automated vehicle |
| CC | Clean Cities |
| CPU | Central processing unit |
| CV | Connected vehicle |
| DFW | Dallas-Fort Worth International Airport |
| DOE | Department of Energy |
| DOT | U.S. Department of Transportation |
| EV | Electric vehicle |
| EVSE | Electric vehicle service equipment |
| HPC | High-performance computer |
| IDOT | Illinois Department of Transportation |
| INL | Idaho National Laboratory |
| L2 | Level 2 |
| MDOT | Michigan Department of Transportation |
| MEP | Mobility Energy Productivity |
| mph | Miles per hour |
| MUD | Multi-unit dwelling |
| NREL | National Renewable Energy Laboratory |
| PEV | Plug-in electric vehicle |
| PNNL | Pacific Northwest National Laboratory |
| POE | Power over ethernet |
| POP | unknown acronym |
| R&D | Research and development |

| | |
|---|---|
| RFP | Request for proposals |
| SOPO | Statement of Project Objectives |
| TEAD | Transportation Energy Analysis Dashboard |
| UNCC | University of North Carolina at Charlotte |
| UPS | United Parcel Service |
| USPS | United States Postal Service |
| V2V | Vehicle to vehicle |
| VMT | Vehicle-miles traveled |
| VTO | Vehicle Technologies Office |