### 7. Vehicle Analysis

The Vehicle Technologies Office (VTO) supports research, development, demonstration, and deployment (RDD&D) of new, efficient, and clean mobility options that are affordable for all Americans. The office's investments leverage the unique capabilities and world-class expertise of the national laboratory system to develop new innovations in vehicle technologies, including: advanced battery technologies; advanced materials for lighter-weight vehicle structures and better powertrains; energy-efficient mobility technologies and systems (including automated and connected vehicles as well innovations in connected infrastructure for significant systems-level energy efficiency improvement); innovative powertrains to reduce greenhouse gas (GHG) and criteria emissions from hard to decarbonize off-road, maritime, rail, and aviation sectors; and technology integration that helps demonstrate and deploy new technology at the community level. In coordination with the other offices across the Office of Energy Efficiency and Renewable Energy (EERE) and the U.S. Department of Energy (DOE), VTO advances technologies that assure affordable, reliable mobility solutions for people and goods across all economic and social groups; enable and support competitiveness for industry and the economy/workforce; and address local air quality and use of water, land, and domestic resources. The VTO Analysis (VAN) subprogram provides critical information and analyses to prioritize and inform VTO research portfolio planning through technology-, economic-, and interdisciplinary-based analysis, including target-setting and program benefits estimation. VAN projects support analytical capabilities and tools unique to DOE's national laboratories. For data activities, trusted and public data are critical to VTO's efforts and are an integral part of transportation and vehicle modeling and simulation. For modeling activities, the subprogram supports the creation, maintenance, and utilization of vehicle and system models to explore energy impacts of new technologies relevant to the VTO portfolio. Finally, for analysis activities, integrated and applied analyses bring together useful findings and analysis of the energy impacts of transportation systems through the integration of multiple models including vehicle simulation and energy accounting of the entire transportation system. The result creates holistic views of the transportation system, including the opportunities and benefits that advanced vehicle technologies create by strengthening national security, increasing reliability, and reducing costs for consumers and businesses. Overall, VAN activities explore energy-specific advancements in vehicles and transportation systems to inform VTO early-stage research and offer analytical direction for potential and future research investments.

#### **Project Feedback**

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

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
VAN033	Analysis of Employment and Other Economic Impacts of Transportation Electrification	Joann Zhou (Argonne National Laboratory)	7-4	3.25	3.75	3.75	3.75	3.63
VAN050	Holistic Modeling of Future Transportation Energy Use and Emissions	Matteo Muratori (National Renewable Energy Laboratory)	7-7	3.75	3.75	3.63	3.75	3.73
VAN051	Regional Optimization of Application and Infrastructure Architecture in Heavy Duty Vehicle Electrification	Vivek Sujan (Oak Ridge National Laboratory)	7-11	3.25	3.50	3.25	3.38	3.39
VAN052	Enhancing the EVI-X National Framework to Address Emerging Questions on Charging Infrastructure Deployment	Eric Wood (National Renewable Energy Laboratory)	7-14	3.50	3.50	3.25	3.25	3.44
VAN053	Medium- and Heavy-Duty Electric Vehicle Load, Operations, and Deployment (HEVI-LOAD) Augmentation for National-Scale Infrastructure Assessment	Bin Wang (Lawrence Berkeley National Laboratory)	7-16	3.50	3.75	2.75	3.50	3.53
VAN054	Managing Increased Electric Vehicle Shares on Decarbonized Bulk Power Systems	Brennan Borlaug (National Renewable Energy Laboratory)	7-18	3.63	3.63	3.63	3.75	3.64

#### 2023 VTO ANNUAL MERIT REVIEW RESULTS REPORT - VEHICLE ANALYSIS

Presentation ID	Presentation Title	Principal Investigator (Organization)	Page Number	Approach	Technical Accomplishments	Collaborations	Future Research	Weighted Average
VAN055	Assessing Opportunities for Travel Demand Management in the Context of Decarbonization and Equity	Chris Hoehne (National Renewable Energy Laboratory)	7-22	3.33	3.67	3.00	3.50	3.48
VAN056	Agent Based, Bottom Up Medium and Heavy duty Electric Vehicle Economics, Operation, Charging, and Adoption	Thomas Bradley (Colorado State University)	7-25	3.17	3.50	3.33	3.00	3.33
VAN057	Scalable Truck Charging Demand Simulation for Cost-Optimized Infrastructure Planning	Ann Xu (ElectroTempo)	7-28	3.17	3.17	2.67	3.33	3.13
VAN058	ACT States Trucking Analysis	Lynn Daniels (Rocky Mountain Institute)	7-31	3.63	3.63	3.38	3.63	3.59
Overall Average				3.42	3.59	3.26	3.48	3.49

Presentation Number: VAN033 Presentation Title: Analysis of Employment and Other Economic Impacts of Transportation Electrification Principal Investigator: Joann Zhou (Argonne National Laboratory)

#### Presenter

Joann Zhou, Argonne National Laboratory

#### Reviewer Sample Size

A total of two reviewers evaluated this project.

#### **Project Relevance and Resources**

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



Figure 7-1 - Presentation Number: VAN033 Presentation Title: Analysis of Employment and Other Economic Impacts of Transportation Electrification Principal Investigator: Joann Zhou (Argonne National Laboratory)

## Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

The reviewer felt the project is well designed. After having been involved in several similar studies, this reviewer saw it as critical to having an industry insider like the Center for Automotive Research (CAR) as a partner to get the best up-to-date information on suppliers, emphasizing, "Well done." Economic impact studies have well-known challenges because of the many assumptions needed. The reviewer believed that the research team is doing the best they can with this limited tool. One of the most helpful pieces of this research (to the reviewer as a researcher in the field) is the methodology, not necessarily the results (e.g., which North American Industry Classification System [NAICS] codes are used, how certain values are being aggregated or disaggregated, what assumptions regarding time horizon are being used, etc.). The reviewer felt it is important for DOE to stress that this study only deals with the vehicle-side and not with the fuel side impacts. The reviewer stated that there is an open question about which of the two (vehicles or fuels) will have the larger economic impact in decarbonization.

#### Reviewer 2:

The key technical barriers appeared to the reviewer to be: (1) determining how to understand economic impacts of on-road electric vehicles (EVs), in this case, impacts on employment; and (2) determining how to understand how employment will be impacted by EV adoption (shift in auto industry occupations/skills). The approach to this stage of the project (database development only)—collecting and synthesizing data (literature

review and interviews) on current automotive sector employment (magnitude, type, geography), analyzing/summarizing trends, and delivering a database explaining employment by industry corresponding to different stages of the EV lifecycle—is logically reasonable (collect–analyze–summarize) and is a good starting point from which to address the key technical barriers. It would have been helpful to include a concise summary of the full project approach—this presentation does not provide one. It is not clear whether the team intends to compare employment in a hypothetical EV future to a business-as-usual internal combustion engine (ICE) case, or just to estimate "EV jobs created" (what is shown in the Accomplishments Slide 10). Additionally, while scenario modeling is mentioned, it is not clear whether the team intends to address key uncertainties around the trade balance (domestic share of critical minerals mining/processing, battery component manufacturing) and manufacturing improvements. Both of these—a net employment impact along with addressing key uncertainties—are needed to fully address the barriers.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

Based on the presentation, it seemed to the reviewer like the technical accomplishments are: (1) data collection (literature review and interviews) has started; and (2) the preliminary assessment of jobs required to meet different levels of future EV demand in the U.S. has been completed. The reviewer notes an assumption that the team intends to review more literature finding the current findings to be very limited. The reviewer stated that there has been a large amount of research in this space already (think tanks, academia). The reviewer pointed out that the final accomplishments slide does not appear to account for any impacts of scale— projecting the jobs required for 6.3 times more EV production to be simply 6.3 times greater. And the reviewer believed that it does not account for any job losses due to lowered ICE production (unless the assumption is that ICE production will increase and those vehicles will be exported to countries where ICEs will continue to dominate, like Africa, Central/South America, and others). It should also include context regarding supply chain uncertainties - i.e., how much of the supply chain (particularly critical mineral mining and extraction, as well as battery production) will be domestic? Those clarifications should be clearly stated since the presentation uses a headline of "50% EV sales share in 2030 will create 600,000 jobs."

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

There appeared to be collaboration planned, notably with CAR, but nothing specific as of yet.

#### **Reviewer 2:**

The research team has an ideal set of collaborators-both original equipment manufacturers and CAR.

## Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

This reviewer found that the work has a clear path on future research and suggests that the research team address the question about whether economic impacts will differ between light-duty (LD) vehicles versus medium-duty (MD)/heavy-duty (HD) vehicles. The reviewer recognized that decarbonization of MD/HD vehicles is at a different market maturity level than LD vehicles but believes that it would be helpful to understand this difference from a policy-making perspective.

#### **Reviewer 2:**

This reviewer believed that the proposed future research supports the overarching goals set earlier in the presentation and progresses logically along the project pathway. The presentation lacked any milestones or timelines; so, determining the project team's progress was difficult for the reviewer. The future research was also defined very generically; so, it might be difficult to say whether it is actually "done" or not.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

This project is very relevant to high-level decision makers, such as politicians, regulators, and policymakers. The primary challenge in economic impact studies is clearly conveying the results.

#### Reviewer 2:

This supports the data component of the VAN subprogram's objectives. Macro impacts are not clearly called out in the Analysis section of the 2020 VTO Annual Merit Review, but they are clearly important to consider when thinking about EV adoption in the U.S.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

The reviewer suggests that, at minimum, the project team coordinate with other entities that do a lot of work on economic impacts of decarbonization to trade methodologies.

#### **Reviewer 2:**

The reviewer points out that there is a lot of work to be done, but the team has another two years to do it, so the reviewer thinks that it is possible given the amount of time. The reviewer professes to not have a good gauge on the macro expertise of the project team—this project requires a lot more than just transportation expertise—but assumes that Argonne National Laboratory has that covered.

Presentation Number: VAN050 Presentation Title: Holistic Modeling of Future Transportation Energy Use and Emissions Principal Investigator: Matteo Muratori (National Renewable Energy Laboratory)

#### Presenter

Paige Judan, National Renewable Energy Laboratory

#### **Reviewer Sample Size**

A total of four reviewers evaluated this project.

#### **Project Relevance and Resources**

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



Figure 7-2 - Presentation Number: VAN050 Presentation Title: Holistic Modeling of Future Transportation Energy Use and Emissions Principal Investigator: Matteo Muratori (National Renewable Energy Laboratory)

## Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

This reviewer believed that the Transportation Energy and Mobility Pathway Options<sup>TM</sup> (TEMPO) model fills a critical gap transportation energy modeling. Overall, the project approach is sound and scenario results will likely make important contributions in this area. The stated goals of this project are ambitious, but there seemed to be a good balance in the proposed model enhancements, covering the more specific objectives of improving the zero-emission vehicle (ZEV) adoption scenarios/analysis but also broadening model capabilities to include representatives of other modes and responding to requests. Maintaining a balance will be important throughout the project.

#### Reviewer 2:

This reviewer believed that the key technical barrier is the current lack of sufficient modeling capabilities to comprehensively assess the range of possible mobility futures and their impacts on research and development (R&D) portfolios, and to do so with a quick turnaround to enable agile decision making. The approach successfully addresses the technical barrier (and sub-components of that barrier). The TEMPO model aims to include the major levers that could change mobility in the future—particularly mode switching, vehicle/fuel choice, policy/standards, and R&D/investment. The approach to taking on this [massive] task is logical—model development and enhancement (supplemented by a steering committee), model maintenance/upkeep,

and completing specific analyses using the model in its current state (for the VTO and other National Renewable Energy Laboratory [NREL] scenarios).

#### **Reviewer 3:**

This reviewer opined that, overall, TEMPO is an impressive tool with wide applicability throughout the United States among decisionmakers. The technical barriers are being addressed. Many of the reviewer's comments on TEMPO can be seen in other presentations.

#### Reviewer 4:

This reviewer found that the approaches to overcoming barriers were discussed including the Inflation Reduction Act, treatment of non-LD vehicles and dissemination of modeling methodology but it was acknowledged that there are significant challenges. The project is at an early stage so it appears that decisions will need to be made to allocate budget to barriers that can be overcome and acknowledge where TEMPO may have limitations, e.g., impact of bike lanes and micro-mobility). The reviewer suggests that the team consider the risks/rewards of expected emissions reductions for some of these alternatives to keep the project on track. For impacts of legislation and supply side changes, the reviewer suggests that the team identify models or suites of models that it thinks will assist with this. The reviewer believes that model documentation should continue to be updated on a regular cadence.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

The reviewer noted that this project is in the early stages but appears to be off to a strong start with interesting preliminary results on ZEV adoption. The inclusion of an equity-focused steering committee member is an important step in advancing equity goals for this project. Equity considerations should continue to be a primary focus in this work, according to the reviewer. The tie-in of the "Convenient" and "Efficient" strategies by including modes other than LD EVs is also promising, and their potential impact on EV adoption scenarios should be interesting.

#### **Reviewer 2:**

This reviewer listed a number of accomplishments of the project to date: the steering committee was expanded and a meeting was held; priority Fiscal Year 2023 model enhancements were identified; and initial targeted LD vehicle sales share scenarios were implemented. These accomplishments suggest that the project is on schedule (Slide 6, milestones).

#### Reviewer 3:

This reviewer believed that a version of "TEMPO-light" would be very useful to practitioners who do not have access to other trusted, national decarbonization models.

#### **Reviewer 4:**

According to this reviewer, the project appears to have received valuable feedback from the expanded steering committee. Results for initial implementation of LD vehicle sales shares are in line with what would be expected, e.g., preference for smaller vehicles would lead to less electricity demand. While difficult to present on a slide, it would be helpful to learn more about any potential observations from the range of sensitivities that were run. The reviewer understood that 50% adoption by 2030 is a goal of the current Administration but believes that it is extremely aggressive.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

This reviewer pointed out that collaboration appears to drive a lot of the major decision making on TEMPO, in particular the steering committee. The reviewer stated that it is remarkable that the team managed to get such an expertise-packed group to find time to meet and discuss this project and that it is "great work."

#### **Reviewer 2:**

This reviewer found it very helpful to see the list of partners and has confidence they will provide strong guidance on the direction of this tool.

#### **Reviewer 3:**

The reviewer stated that the steering committee is diverse, and the inclusion of an equity expert can be applauded. In addition, there are obvious tie-ins with other VTO/NREL work and it appears that the team is working in collaboration with these teams. The reviewer felt that continuing to improve documentation and expand collaboration with stakeholders will be important going forward, particularly on the demand-related factors and communication of scenarios.

#### **Reviewer 4:**

This reviewer found that NREL is coordinating with a good range of public and private entities and assumes that funding was limited such that bringing on partners for this project outside NREL was not feasible.

### Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

This reviewer found the work is very relevant to VTO objectives and the transportation sector more broadly. The model will be a valuable tool going forward, especially as much as it can support quick turn-around, policy-relevant analysis. The future milestones seem to be achievable while not being too prescriptive and are good markers for success of the project moving forward. The model documentation and publicly available results in particular are of key importance.

#### **Reviewer 2:**

The reviewer said that the proposed future research has a clearly defined purpose—it has been prioritized by a diverse steering committee that represents a range of key stakeholders. It is likely this work will achieve its targets given the proven expertise of the team and their past accomplishments.

#### **Reviewer 3:**

This reviewer believed that the project has a clearly definite purpose for work for the foreseeable future but that it is unclear at this early stage if the project will fully achieve its targets.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

The reviewer stated simply that the project is relevant to VTO in a multitude of ways.

#### **Reviewer 2:**

This reviewer described how the work and, in particular, the TEMPO model supports all three VAN objectives. It is noted that the latter two, (1) to build, maintain, and exercise relevant analytical models; and (2) to execute insightful integrated analyses that provide greater understanding of critical transportation energy problems, are both directly supported by this project.

#### Reviewer 3:

This reviewer anticipates that TEMPO will continue to provide needed capabilities to further VTO analysis and inform R&D prioritization. The utility of the model should increase as additional capabilities are added over time.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

The reviewer found that the resources are sufficient for this project. The large budget will enable rapid/timely results that can be helpful for policy.

#### Reviewer 2:

The reviewer said that resources appear to be sufficient given the team's past experience and proven ability to build out the TEMPO framework.

#### Reviewer 3:

This reviewer believed that additional resources could be useful, but it appears that the project is achieving milestones with the level of funding provided. A cautious approach is likely merited as the policy and technology landscapes have shifted significantly in recent years.

Presentation Number: VAN051 Presentation Title: Regional Optimization of Application And Infrastructure Architecture In Heavy Duty Vehicle Electrification Principal Investigator: Vivek Sujan (Oak Ridge National Laboratory)

#### Presenter

Vivek Sujan, Oak Ridge National Laboratory

#### Reviewer Sample Size

A total of four reviewers evaluated this project.

#### Project Relevance and Resources

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



Figure 7-3 - Presentation Number: VAN051 Presentation Title: Regional Optimization of Application And Infrastructure Architecture In Heavy Duty Vehicle Electrification Principal Investigator: Vivek Sujan (Oak Ridge National Laboratory)

## Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

This reviewer held that, overall, this project is well designed and utilizes a novel approach to integrating vehicle and infrastructure data. The approach of first focusing on developing a solid framework makes a lot of sense. The reviewer would have liked to hear more about the future scenario visioning and how larger transformation in the sector, such as recent policy and investments, may impact the results.

#### **Reviewer 2:**

This reviewer said that the project appears to be well structured to address the technical barriers.

#### Reviewer 3:

This reviewer found that the energy demand as a function of weather is a good advancement and addition to the approach. The reviewer was dissatisfied with the answer to a question posed on multi-day charging, which is usually key to understanding charging needs and the sizing of batteries across vehicle types.

#### **Reviewer 4:**

This reviewer believed that this project will face numerous data barriers as it progresses. It is not entirely clear how successful the team will be in overcoming proprietary data challenges and how this project can be successfully translated to the national level (e.g., whether suggested data sets provide the necessary level of

detail), and whether aspects of the Port of Savannah that lend itself to the project, will be available for other ports.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

This reviewer believed that the project is off to a great start and has met its goals for Fiscal Year 2023 ahead of schedule. The initial progress is promising.

#### Reviewer 2:

This reviewer noted that the project is on schedule and that the team is well positioned to complete the project as planned.

#### **Reviewer 3:**

The reviewer noted that the technical progress at this stage includes a lot of data gathering. This progress appears appropriate at this stage.

#### **Reviewer 4:**

This reviewer found that that the team has made good progress on the initial weather data collection and port HD truck freight mobility.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

This reviewer pointed out that the project team has partnered with academia and is also working with industry groups and with other national laboratories. The reviewer was surprised not to hear about collaboration with the actual ports. The reviewer noticed the mention of a partner study related to community impacts but would have liked to hear more about this and how it will be integrated into the project.

#### **Reviewer 2:**

The reviewer found that the project has good collaborations with the National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, and Idaho National Laboratory, but the short presentation did not make clear what the specific value of contributions are. There are also specific partnerships with Ohio State University and Stanford Linear Accelerator Center, plus advisory input from others. This reviewer wonders if such detailed cell level battery modeling is needed due to the uncertain results when predicting future scenarios because, while temperature matters, weather is very variable.

#### **Reviewer 3:**

This reviewer found that the project coordinates across universities, national laboratories and others and wonders what the interaction and distinctions are with HEVI-LOAD which also sites infrastructure and deals with similar topics. How are they distinct?

#### **Reviewer 4:**

This reviewer believed that team diversity appears to be a strength for this project, with members from multiple organizations as well as additional collaborators and consultants.

### Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

The reviewer believed that the work to date has set up a strong methodology for the project going forward. As noted by the team, scaling up the data integration nationally could be challenging. The reviewer would have liked some more detail on feasibility and how to overcome barriers.

#### Reviewer 2:

This reviewer found that future work appears to be well planned to achieve the project goals and targets.

#### **Reviewer 3:**

This reviewer said that research targets will move from scenario analysis to optimization between the vehicle and charging. Vehicle-grid integration would be a great addition as it may be important in the future.

#### **Reviewer 4:**

This reviewer pointed out that the project is still in year one. It was not entirely clear if the project will fully meet future goals given complexity of modeling and expansion to additional ports.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

The reviewer thought that the project is relevant and fills an important gap. The data integration itself will be valuable across several goals.

#### **Reviewer 2:**

This reviewer noted that the highly integrated system modeling of HD trucking at ports supports many of VTO programs and objectives.

#### Reviewer 3:

This reviewer agreed that heavy duty charging needs a significant amount of analysis and believes that this project addresses a few key aspects well, including weather.

#### Reviewer 4:

This reviewer believed that the project should provide useful insights for the VTO Analysis program as well as inform other VTO programs such as Batteries, Electrification, Energy Efficient Mobility Systems (EEMS) and Decarbonization of Off-Road, Rail, Marine, and Aviation (DORMA).

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

This reviewer found that the resources for this project seem sufficient.

#### Reviewer 2:

The reviewer believed that the resources seem sufficient, and project is on-time and on-budget.

#### **Reviewer 3:**

The reviewer said that \$1.5 million over 3 years seems about right.

#### Reviewer 4:

This reviewer felt that the staging for this project seems appropriate. In light of the challenges throughout the life of the project, thoughtful consideration at go/no-go periods should help to ensure that the project remains on track and within budget.

Presentation Number: VAN052 Presentation Title: Enhancing The EVI-X National Framework To Address Emerging Questions On Charging Infrastructure Deployment Principal Investigator: Eric Wood (National Renewable Energy Laboratory)

#### Presenter

Eric Wood, National Renewable Energy Laboratory

#### **Reviewer Sample Size**

A total of two reviewers evaluated this project.

#### **Project Relevance and Resources**

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





### Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

This reviewer opined that the research team is doing an incredible job addressing the technical barriers and continues to be very impressed with the quality of the research coming from this group at NREL.

#### **Reviewer 2:**

This reviewer stated only that the project is still in early stages.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

This reviewer stated that it appears that the project is on track for the two milestones that were presented. It was not clear what milestones there are for the project beyond Fiscal Year 2023.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

The reviewer found that, while the team is collaborating with a wide range of stakeholders, it could be useful to consider engaging with a few additional states beyond California and New York that have less ambitious climate goals and/or incentives for electric vehicle purchasing.

### Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

The reviewer questioned, based on the relatively low overall budget, whether the work identified on the presentation's Slide 17 – "Proposed Future Work" is in scope for this project.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

The reviewer pointed out that the findings should be particularly relevant for the mission of the Joint Office of Energy and Transportation.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

The reviewer stated that it is not entirely clear from the presentation whether what is shown on Slide 17 as "Proposed Future Work" is in scope for this project, which makes it difficult to assess the appropriateness of the overall budget.

Presentation Number: VAN053 Presentation Title: Medium- and Heavy-Duty Electric Vehicle Load, Operations, And Deployment (HEVI-LOAD) Augmentation For National-Scale Infrastructure Principal Investigator: Bin Wang (Lawrence Berkeley National Laboratory)

#### Presenter

Bin Wang, Lawrence Berkeley National Laboratory

#### Reviewer Sample Size

A total of two reviewers evaluated this project.

#### **Project Relevance and Resources**

100% of reviewers felt that the project was relevant to current DOE objectives, 0% of reviewers felt that the project was not relevant, and 0% of reviewers did not indicate an answer. 50% of reviewers felt that the resources were sufficient, 50% of reviewers felt that the resources were insufficient, 0% of reviewers felt that the resources were



Figure 7-5 - Presentation Number: VAN053 Presentation Title: Mediumand Heavy-Duty Electric Vehicle Load, Operations, And Deployment (HEVI-LOAD) Augmentation For National-Scale Infrastructure Principal Investigator: Bin Wang (Lawrence Berkeley National Laboratory)

excessive, and 0% of reviewers did not indicate an answer.

### Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

The reviewer found that the approach for this work is sound and is built on a good foundation to be successful. The bottom-up approach will be especially informative for identifying candidate locations for charger deployment, considering areas with sufficient grid capability as well as identifying gaps.

#### Reviewer 2:

This reviewer believed that the project could be improved with better data calibration from fleet sources and better validation of consumer behavior.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

The reviewer stated that the project has shown good progress so far with some promising preliminary results.

#### Reviewer 2:

This reviewer said that progress is good overall.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

This reviewer was pleased to see NREL as a partner because collaboration and coordination with related infrastructure modeling (e.g., Electric Vehicle Infrastructure Projection Tool [EVI-Pro]) will be important. The main critique on collaboration is that the outreach and feedback to stakeholder should happen before and concurrently with web-tool development to make sure the investment is meeting their needs.

#### Reviewer 2:

This reviewer believed that more feedback from fleets on charging behavior examples would be beneficial and that more comparison with results from other studies would improve the explanatory power of the modeling.

### Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

This reviewer found the future research to be well-planned and that the targets are achievable. But the reviewer also believes that, as far as developing a useful stakeholder tool is a goal of the project, it would help to put more focus on how to do this effectively.

#### Reviewer 2:

This reviewer believed that the team is working through the identified shortcomings.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

This reviewer believed the project is highly relevant to VTO Analysis objectives.

#### Reviewer 2:

This reviewer stated that MD and HD charging is of large importance to electrification and more modeling is needed to begin to understand the issues and tradeoffs.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

The reviewer believed that the resources for this project are sufficient for the stated targets, but to make this tool even better, VTO might consider more investment.

#### Reviewer 2:

This reviewer said that the project could use more resources given the scope of the issue. More data is needed and will require budget resources and more outreach to companies and institutions would also be desirable.

Presentation Number: VAN054 Presentation Title: Managing Increased Electric Vehicle Shares on Decarbonized Bulk Power Systems Principal Investigator: Brennan Borlaug (National Renewable Energy Laboratory)

#### Presenter

Brennan Borlaug, National Renewable Energy Laboratory

#### **Reviewer Sample Size**

A total of four reviewers evaluated this project.

#### **Project Relevance and Resources**

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



Figure 7-6 - Presentation Number: VAN054 Presentation Title: Managing Increased Electric Vehicle Shares on Decarbonized Bulk Power Systems Principal Investigator: Brennan Borlaug (National Renewable Energy Laboratory)

# Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

According to this reviewer, the key barriers included that: (1) electric vehicle (EV) charging demand is uncertain; (2) the benefits of managed charging are unclear; and 3) the bulk power system development in response to increased EV adoption is under-researched. The approach of this project makes sense—using estimates of electricity demand from a high-EV adoption scenario projection and then seeing the power system would meet that demand using NREL Demand Side Grid model (dsgrid-flex) and Regional Energy Deployment System model (ReEDS), i.e., model both supply of and demand for electricity. In order to accurately assess grid capacity and dispatch capability, the team is doing this at a very granular level (hourly, county/region). And to assess the impact of managed charging, the team is running two different load profiles: managed and unmanaged. There did not appear to the reviewer to be any pricing mechanism. The reviewer pointed out that TEMPO uses an electricity price for its projection of demand. It then sends that demand to the supply-side models. The reviewer asked if those models simply show that demand being met at the electricity price assumed in TEMPO. The reviewer did not find anything saying that the supply and demand models are linked, or are iterating, to balance the market using price. While this project may be aiming solely to assess grid impacts of a given level of demand, the reviewer believed that demand cannot be determined independently of a fuel price. If meeting TEMPO's EV demand requires increased electricity prices, that should be fed back through TEMPO so demand can respond.

#### **Reviewer 2:**

This reviewer found that the project has an impressive and ambitious technical scope and has no issues with the framework presented in Slides 4, 5, 17, etc. One aspect of this the reviewer believed is lacking in the slides and presentation is upgrades to the distribution system. The reviewer questioned whether ReEDS models those upgrades. Most MD charging requires some upgrades both to-the-meter and behind-the-meter. In an evaluation of 14 utility programs in California, these costs were found to be \$50,000-\$450,000 for MD/HD sites (not including the cost of the electric vehicle supply equipment [EVSE] itself). See Figure 56 as an example of these costs of last year's evaluation for a snapshot of these costs https://www.cpuc.ca.gov/-/media/cpucwebsite/divisions/energy-division/documents/sb-350-te/sb-350-standard-review-programs-annualtransportation-electrification-evaluation-2021.pdf. The reviewer also wondered how the team is modeling the human behavioral aspect of managed charging. The load that vehicle operators are willing to shift may be well short of what can technically be shifted. In the referenced evaluation of 14 utility programs in California, very few fleets were shown to manage charging even when they had a strong financial incentive to do so (via time of use rates) and even when they had time each night in off-peak hours when their vehicles were plugged in but no longer charging. Just as surprising, many of the MD/HD vehicle operators simply needed to push a button on their EVSE to enable the charge management. The reviewer concluded that there is a major difference between economically rational behavior and actual observed behavior with charge management. The reviewer suspected that, as MD/HD electrification scales up, so too will the knowledge of managed charging, making the point possibly moot when modeling to 2050.

#### **Reviewer 3:**

The reviewer said that the project leverages expertise and existing modeling tools at NREL in transportation demand, EV energy demand, and bulk grid modeling to estimate the impact of LD and MD/HD vehicle electrification on grid energy demand and capacity expansion. The approach makes use of scenario analysis to estimate how different potential futures may result in different electricity demands. The team has experience integrating different assumptions into these models and can make use of NREL computing resources to integrate these large models.

#### Reviewer 4:

This reviewer said that the project appears to be well structured to address the technical barriers.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

This reviewer found that the accomplishments are significant given the small amount of project time that has progressed. These include assembling the advisory committee, meeting with that committee to narrow down a list of research questions, developing scenario factors to answer those questions, enhancing the LD vehicle model to more accurately analyze differing charging station locations, and a big lift on the MD/HD vehicle data analysis side (Freight Analysis Framework, Vehicle Inventory and Use Survey, registrations, NREL Fleet DNA). This aligns with what the reviewer believes to be the project plan on Slide 13—finishing the Q1 milestone and building toward the Q3.

#### **Reviewer 2:**

The reviewer noted that the project is still in early stages, so deliverables to date have focused on assembling a technical advisory committee (TAC) and defining how scenarios will be selected. The project seems to be on track.

#### **Reviewer 3:**

This reviewer considered the project to be on schedule and making progress but suggests that it is difficult to evaluate the progress this early in the project. More results in the coming year will probably show more accomplishments.

Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

This reviewer pointed to the large diverse group of stakeholders in the TAC. It seems like the team is engaging them at most of the important decision points and before most of the publications.

#### **Reviewer 2:**

The project team leverages diverse teams at NREL and a TAC with original equipment manufacturers, utilities, etc. The project proposes to hold meetings with the TAC several times per year to solicit feedback.

#### **Reviewer 3:**

There is planned coordination with several national laboratories, but it is not clear what the contributions are so far. Coordination with VAN051 should be demonstrated. The TAC has been established and appears to provide very good input and guidance.

### Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

This reviewer opined that the proposed future work progresses logically toward addressing the overall technical barriers. Given the current modeling capability, and the proven expertise of the project team, the reviewer expected the future work to achieve the targets laid out.

#### **Reviewer 2:**

According to this reviewer, the project is still in early stages, the proposed work includes key tasks with respect to developing models of transportation demand (and associated energy demand) for each county on an hourly basis. The team has identified parameters to guide its scenario selection and will use these scenarios to handle some of the uncertainty associated with the analysis. The reviewer would encourage the team to include "stress test" cases, either based on typical energy demand but higher/lower values of adoption of different technologies. Because transportation data are limited to "typical" values, it may be helpful to model even historical peak travel demand (and energy) data with other electrification energy trends to contextualize how vehicle electrification compares to other electrification trends for driving changes on the grid.

#### **Reviewer 3:**

This reviewer said only that future work appears to be well planned to achieve the project goals and targets.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

The reviewer stressed that the project is specifically relevant to all three of the VAN Annual Progress Report objectives, but specifically to, (1) build, maintain, and exercise relevant analytical models and (2) execute insightful integrated analyses that provide greater understanding of critical transportation energy problems. This expands beyond vehicle-level analysis as well, into grid-side impacts, which is a significant consideration in any potential future with high EV adoption.

#### **Reviewer 2:**

The reviewer stated that the project is aligned with VAN subprogram objectives to provide analysis of the impact of medium/heavy duty vehicle electrification on the energy system more broadly.

#### Reviewer 3:

The reviewer says that the project goals should serve many of the VTO objectives, including for HD trucks interacting with the electric grid.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

The reviewer found that the project resources appear to be sufficient and voices no concerns.

#### **Reviewer 2:**

The reviewer determined that the resources for this project are sufficient for the size of the team and scope of work.

#### Reviewer 3:

This reviewer said that resources appear sufficient, and that the project is on-time and on-budget.

Presentation Number: VAN055 Presentation Title: Assessing Opportunities for Travel Demand Management in the Context of Decarbonization and Equity Principal Investigator: Chris Hoehne (National Renewable Energy Laboratory)

#### Presenter

Chris Hoehne, National Renewable Energy Laboratory

#### **Reviewer Sample Size**

A total of three reviewers evaluated this project.

#### **Project Relevance and Resources**

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



Figure 7-7 - Presentation Number: VAN055 Presentation Title: Assessing Opportunities for Travel Demand Management in the Context of Decarbonization and Equity Principal Investigator: Chris Hoehne (National Renewable Energy Laboratory)

### Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

This reviewer applauded the DOE for diving into this topic because it regularly arises in discussions about transportation decarbonization—in particular, when discussing the extent government should prioritize/incentivize travel demand management (TDM) versus electrification. The reviewer thought that the need for interagency coordination (in particular with state departments of transportation, Metropolitan Planning Organizations, and the Federal Highway Administration (FHWA) is critical for the success and acceptance of this study, given these other agencies' domain expertise. The reviewer has overseen two studies on 2050/net zero modeling that include TDM strategies in the states of Massachusetts and New York. The modeling used the Energy and Emissions Reduction Policy Analysis Tool (EERPAT) and VisionEval Tools, respectively. Based on this experience, the reviewer's main caution for the research team is that TDM impacts different regions in a heterogenous way (e.g., TDM strategies used in dense, urban regions will have a very different impact than the same strategies in rural regions; alternatively, TDM impacts regions with strong public transit differently than regions without public transit, etc.). This was seen in particular in the State of New York modeling of New York City (NYC) versus more rural regions in New York—the results in NYC simply did not make sense using the VisionEval models. The take-away for that team of modelers was that different model parameters are needed for different regions and even applying different urban/rural parameters

is insufficient for a place like NYC. Additionally, it was learned that any type of model validation becomes very arduous when including multiple regions. If TEMPO is to be used at the sub-national level, the DOE team should be especially careful.

#### Reviewer 2:

This project appears to be well structured to address the technical barriers. There will be a lot of uncertainty in trying to make predictions at the national scale.

#### Reviewer 3:

This reviewer found that the timeline for this project seems reasonable. The reviewer's main concern on the approach is that it is not clear what methodology is to be used for assessing equity impacts.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

The reviewer stated that the project appears to be on track and has achieved key objectives in the early stages.

#### **Reviewer 2:**

The reviewer felt that the project milestones look fine and expects the bulk of the work to be in validating model results in Fiscal Year 2024.

#### Reviewer 3:

This reviewer noted that only 15% of the project has been completed at this time. This project appears to be on schedule and making progress, but it is difficult to evaluate the progress this early in the project. More results in the coming year will probably show more accomplishments.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

Collaboration seems to be mainly through the TEMPO steering committee. It may be useful to connect more broadly with transportation planning community, including TDM practitioners. This could be in the works with the connection to Stanford and industry connections. The reviewer felt this could really strengthen this project.

#### **Reviewer 2:**

Slide 3 mentions convening an interagency group to develop tools/data around TDM but it is not clear if the bullets on Slide 13 are that group or just the TEMPO steering committee.

#### Reviewer 3:

This project overlaps with or make use of other VAN projects at NREL. The TEMPO Steering Committee seems like a very good resource for this project for input and collaboration.

## Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

The efforts to integrate TDM scenarios into TEMPO and the specific focus on equity impacts are valuable. Glad to see this work proposed. However, given the challenges with the lack of good national data and studies, coming up with robust inputs that meaningfully capture TDM strategies in TEMPO could be challenging. The reviewer wondered if expanding on available data by including impacts of actions that were not expressly taken for the purpose of TDM would be possible. For example, maybe the Department of Transportation has data on congestion mitigation approaches such as the Congestion Mitigation and Air Quality Improvement program, managed lanes, congestion pricing, etc., that may not appear in the academic literature. COVID travel was mentioned as a barrier, but maybe there is data from "natural experiments" that could be leveraged here.

#### **Reviewer 2:**

This reviewer stated that future work appears to be well planned to achieve the project goals and targets.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

The reviewer believed that this work is very relevant to VTO/VAN objectives, and broadly the goals laid out in the U.S. National Blueprint for Transportation Decarbonization. There is not enough work in this area.

#### Reviewer 2:

This reviewer found that the project supports the overall VTO subprogram objectives. The reviewer understands the need for including TDM in TEMPO and believes that the team is aware of the challenges of modeling TDM at the national level. The reviewer recommended that the team coordinate with VisionEval developers at FHWA or Resource Systems Group and suggested the following resource: <a href="http://pooledfund.org/Details/Study/621">http://pooledfund.org/Details/Study/621</a>.

#### **Reviewer 3:**

This reviewer held that the integrated system modeling of national travel demand supports many of VTO objectives.

## Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

The reviewer found that the resources seem reasonable.

#### Reviewer 2:

This reviewer said that the resources appear sufficient, and the project is on-time and on-budget.

#### **Reviewer 3:**

This reviewer suggested that, if it has not already, the research team should familiarize itself with the VisionEval strategic planning tools, funded in part by FHWA.

Presentation Number: VAN056 Presentation Title: Agent Based, Bottom Up Medium and Heavy Duty Electric Vehicle Economics, Operation, Charging, and Adoption Principal Investigator: Thomas Bradley (Colorado State University)

#### Presenter

Thomas Bradley, Colorado State University

#### Reviewer Sample Size

A total of three reviewers evaluated this project.

#### Project Relevance and Resources

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



Figure 7-8 - Presentation Number: VAN056 Presentation Title: Agent Based, Bottom Up Medium and Heavy Duty Electric Vehicle Economics, Operation, Charging, and Adoption Principal Investigator: Thomas Bradley (Colorado State University)

## Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

This reviewer noted that the project uses agent-based modeling to estimate adoption of MD and HD electric vehicles amongst types of fleets. The perception of EVs is driven by perceptions expressed in academic and industry-facing literature. Total costs of ownership included in the analysis are hardware driven. The reviewer found it unclear from the presentation what kind of validation activities have taken place. There were sample vehicle fleets included in the analysis, but it is unclear whether the use of academic and industry literature is truly the best predictor for changing agent behaviors in these fleets. Total costs of ownership also likely varies significantly by fleet application (e.g., downtime and associated labor costs may impact some industries, but not others where vehicle utilization is already low. Some sample statistics were displayed although other analyses show that labor costs/downtime are larger portions of vehicle costs).

#### Reviewer 2:

This reviewer found that the project appears to be well structured to address the technical barriers.

#### **Reviewer 3:**

This reviewer believed that it is still early to assess if this is the right tool, but it is novel, and the reviewer was excited to see how the project progresses. The reviewer would like to see the validation of the approach on real fleets' decision to electrify or not.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

This reviewer pointed out that progress to date has focused on developing the agent-based modeling framework along with some initial analysis of the role that different vehicle types/ranges might have on potential adoption. The project appears to be on track.

#### Reviewer 2:

This reviewer said that the project is on schedule and is well positioned to complete the project as planned and asked whether any of the peer reviews occurred?

#### Reviewer 3:

This reviewer found that there is a lot of progress on the methodological underpinnings.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

The reviewer pointed out that the project team includes a university lead organization with industry and nonprofit partners that can provide some insight into vehicle adoption and grid operations. Additional industry partners or interaction with some fleet operators may help to expand the types of fleets that can be examined/modeled and may help to identify other factors that influence vehicle adoption for fleets.

#### **Reviewer 2:**

This reviewer believed that the project appears to have good collaborations with the project partners. There is some synergy and overlap with other VAN projects and data, so the reviewer urged that the team be sure to coordinate with them where possible.

#### **Reviewer 3:**

This reviewer noted that the team appears to have lots of interaction with others but would like to see concrete examples of how the model has been influenced by others as the project progresses.

## Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

This reviewer described how the proposed future work will use the agent based and economic models developed to date to examine potential impacts of subsidies (and their long-term impact on the vehicle market) and the normalization of technology in some vehicle classes spilling over into other vehicle classes. The results will also expand to account for more simulated agents at state and entire transportation network levels. There are some technical (computing) challenges to scaling, but as the project expands, it would be helpful to continue to validate whether the agents across states or across entire networks have similar behavior/characteristics as those agents modeled at the regional level.

#### Reviewer 2:

This reviewer found that future work appears to be well planned to achieve the project goals and targets. The establishment of the quality and reliability of the projections needs to be defined. The reviewer asks whether there is any plan to support the new tools beyond the project?

#### **Reviewer 3:**

This reviewer would like to see external validation of some kind in the future research so that it can be determined whether it is capturing anything real otherwise.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

The reviewer found that the project is aligned with the VAN program objectives to analyze how technology, policy, and economic conditions impact the market demand for electrified MD and HD vehicles.

#### Reviewer 2:

This reviewer said that the project's integrated system modeling of MD and HD trucking EV adoption with charging supports many of the VTO objectives.

#### **Reviewer 3:**

This reviewer said that the project is relevant to electrification.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

The reviewer stated that the resources for this project are sufficient for the size of the team and scope of work.

#### Reviewer 2:

The reviewer stated that the resources appear sufficient, and the project is on-time and on-budget.

#### Reviewer 3:

The reviewer stated that it seems like there are sufficient resources.

Presentation Number: VAN057 Presentation Title: Scalable Truck Charging Demand Simulation for Cost-Optimized Infrastructure Planning Principal Investigator: Ann Xu (ElectroTempo)

#### Presenter

Ann Xu, ElectroTempo

#### **Reviewer Sample Size**

A total of three reviewers evaluated this project.

#### **Project Relevance and Resources**

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



Figure 7-9 - Presentation Number: VAN057 Presentation Title: Scalable Truck Charging Demand Simulation for Cost-Optimized Infrastructure Planning Principal Investigator: Ann Xu (ElectroTempo)

## Question 1: Please comment on the degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

This reviewer identified that the key barrier to be that truck data and modeling systems are not granular enough to accurately assess the potential impacts of electric vehicle (EV) adoption on local grids. The reviewer characterized the approach as to develop a high-resolution, detailed simulation model that is fast, affordable, and scalable to estimate infrastructure requirements for a given level of EV demand. and then to apply the framework to two different case studies to validate. This approach addresses the stated technical barrier. According to the reviewer, the project is well-designed, and the timeline appears to be reasonably planned (sufficient progress is being made; milestones and go/no-gos are well-defined).

#### Reviewer 2:

This reviewer found that the project appears to be well structured to address the technical barriers. The reviewer questions, however, how the fine time and space resolutions the team is attempting to use to model peak loads will provide more meaningful results considering the high uncertainty of many inputs.

#### **Reviewer 3:**

This reviewer would like to see more validation on real data and more explicit link to charging behavior such as whether this model could be applied to diesel trucks and fuel demand/ fuel usage. The reviewer questioned what could be learned without an explicit link to outside refueling behavior validation. The reviewer also asked

whether the model assumes that truck charging will mirror diesel refueling, suggesting that a lot of charging would be done at depots rather than at public truck stops.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

This reviewer affirmed that the team successfully generated estimates of truck travel demand and developed a model to site supporting truck depots, followed by estimating energy per truck and then total truck charging demand. The reviewer believed that it would be helpful for the team to expand on how the truck duty cycles (weight class and vocation/tractor) were estimated, since that strongly impacts both the daily miles driven per truck as well as the trucks' fuel economy.

#### **Reviewer 2:**

This reviewer noted that the project is on schedule and that the team seems well positioned to complete the project as planned.

#### Reviewer 3:

This reviewer said simply that the project seems to have potential.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

The reviewer pointed out that the team is working closely with Texas A&M University but did not see anything specific about the other partners. The reviewer believes, nonetheless, that it seems likely that other partners may be able to provide valuable assessment of the model results.

#### Reviewer 2:

This reviewer found the role of Texas A&M Engineering Experiment Services to be not clear. Because the reviewer believes that there is some overlap with other VAN projects and data, the reviewer advises the team to be sure to coordinate with those projects.

#### **Reviewer 3:**

This reviewer noted only that the project includes some project partners.

### Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

This reviewer agreed that the proposed future research progresses logically, stating that, now that the charging demand has been estimated, the team plans to identify grid impacts based on different levels of EV adoption. Hopefully the team will, in addition to estimating the aggregate cost of required upgrades, estimate the future cost per kWh (or some other pricing mechanism, like a demand charge) that electric trucking fleets would need to pay (including amortization of the new grid equipment).

#### Reviewer 2:

This reviewer found that the future work appears to identify studies to use the tools developed but with no plan to resolve the challenges identified.

#### Reviewer 3:

This reviewer believed that the model needs better representation of depot demand vs. en-route demand.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

This reviewer points out that the project directly addresses VAN 2020 Annual Progress Report objectives, including: (1) build, maintain, and exercise relevant analytical models; and (2) execute insightful integrated analyses that provide greater understanding of critical transportation energy problems. It does this via building a new simulation model that integrates both transportation demand as well as electricity supply to meet that demand, in order to assess the charging needs and grid impacts of those needs.

#### **Reviewer 2:**

This reviewer said that the integrated system modeling of HD EV trucking and electric grid infrastructure supports many of the VTO objectives.

#### **Reviewer 3:**

This reviewer said that the project is relevant to electrification.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

This reviewer found that the resources appear to be sufficient given the team's expertise and the amount of work allocated to the timeframe.

#### Reviewer 2:

This reviewer noted that the resources appear sufficient, and the project is on-time and on-budget.

#### **Reviewer 3:**

This reviewer said that the team seems to have enough people.

Presentation Number: VAN058 Presentation Title: ACT States Trucking Analysis Principal Investigator: Lynn Daniels (Rocky Mountain Institute)

#### Presenter

Emily Porter, Rocky Mountain Institute

#### **Reviewer Sample Size**

A total of four reviewers evaluated this project.

#### **Project Relevance and Resources**

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



Figure 7-10 - Presentation Number: VAN058 Presentation Title: ACT States Trucking Analysis Principal Investigator: Lynn Daniels (Rocky Mountain Institute)

#### Question 1: Please comment on the

degree to which technical barriers are addressed. Is the project well designed, and is the timeline reasonably planned?

#### Reviewer 1:

This reviewer believed that the approach used for this study is sound and is a good example of using a new real-world data source for insight on charging profiles. It is also well-balanced in the sense of using a novel methodology and contributing important analytical results, while also centering on stakeholders, which is important for the reach and broader impact of this work. The results are somewhat limited due to the focus on Advanced Clean Truck (ACT) states only, but the general approach has promise to replicate more broadly.

#### **Reviewer 2:**

This reviewer considered the key technical barrier to be a lack of information on the charging infrastructure that might be required to support a large fleet of fully-electric trucks in California ACT states. The approach adequately addresses this barrier, by collecting real-world travel data from Geotab loggers, segmenting that data based on whether trucks can or cannot be electrified, and estimating the charging requirements needed to meet the electric truck travel demand. This should provide a reasonable estimate of the charging demands (by county) for a high-electric vehicle truck adoption scenario. According to the reviewer, it would be valuable to include an estimate of how representative these truck data are of the total freight truck population in the United States (Slide 7 says it "covers approximately 10% of MD and HD trucks based in 15 ACT states in 2019"). Another question the reviewer posed is whether this covers a large portion of the freight truck vehicle miles travelled (VMT), noting that 40% of the truck fleet is very different from 40% of the truck VMT.

#### **Reviewer 3:**

This reviewer found that the project appears to be well structured to address the technical barriers. The scope only includes ACT states.

#### Reviewer 4:

The reviewer liked the tie to real data, saying that it leverages what can be observed now to what will be needed to serve in the future and that it includes a good tie to policy.

### Question 2: Please comment on the technical progress that has been made compared to the project plan.

#### Reviewer 1:

This reviewer believed that the project has made excellent progress and is well on its way to completion. The team has demonstrated a successful methodology, has shared results to date, and is close to development of a public facing user interface.

#### **Reviewer 2:**

This reviewer said that the technical accomplishments indicate that a significant amount of the project plan has been completed, proportionate to the amount of time/resources that have been spent. The team has already collected logger data, processed that data (including extraction of vehicles that are "electrifiable"), and has started to draw conclusions from it. Additionally, it has been able to estimate hypothetical electricity consumption by county for those electrifiable vehicles.

#### **Reviewer 3:**

This reviewer said that the project is on schedule and is well positioned to complete the project as planned.

#### Reviewer 4:

This reviewer found that the project has provided useful data so far.

# Question 3: Please comment on the collaboration within the project team. Are there specific contributions made by industry, national laboratories, or other external entities? Are there areas where more collaboration is needed?

#### Reviewer 1:

This reviewer applauded the project as having excellent collaboration with partners, believing it to be smart of the team to get feedback from utilities and policy makers for the beta launch.

#### **Reviewer 2:**

This reviewer stated that the project team is optimally set up—a data collector (Geotab), assumption validator (North American Council for Freight Efficiency for miles per gallon, travel, stock), and analyst (Rocky Mountain Institute). Solid collaboration is what has enabled the progress so far.

#### **Reviewer 3:**

The reviewer believed that this project makes good use of collaborations with other organizations to source information for the modeling. Believing that there is a fair amount of synergy and overlap with other VTO Analysis projects, the reviewer urges the team to coordinate with these projects.

#### Reviewer 4:

This reviewer felt that the team could coordinate more with other entities and asks whether it has contacted ACT states.

### Question 4: Please comment on the proposed future research. Has the project clearly defined a purpose for future work? To what extent will future work likely achieve its targets?

#### Reviewer 1:

This reviewer pointed out that the project is 75% complete and has work already underway to meet the future research objectives. The team is well positioned to achieve their targets and has a good plan to overcome data barriers.

#### Reviewer 2:

The reviewer noted that the proposed future research supports the project goals, via refinement of existing results, as well as by developing ways to share findings (dashboards, tools, reports).

#### Reviewer 3:

This reviewer considered that the future work appears to be well planned to achieve the project goals and targets. The reviewer asked whether there a plan to support the proposed web tool past the project conclusion.

#### Reviewer 4:

This reviewer stated that the approach so far is good but that there is more work to do.

### Question 5: Please comment on the relevance of the project. Does the project support the overall VTO subprogram objectives?

#### Reviewer 1:

This reviewer confirmed that the project is relevant to the VTO objectives, especially given the importance of better understanding uncertainty in grid impacts.

#### **Reviewer 2:**

This reviewer said the project aligns with the VTO Analysis subprogram's goals to: (1) support quantitative assessment of vehicle and mobility technology impacts and (2) provide insights into transportation and energy use problems for a broad range of stakeholders.

#### Reviewer 3:

This reviewer found that the project supports many of the energy and infrastructure objectives of VTO.

#### Reviewer 4:

This reviewer stated that the project is relevant to electrification.

### Question 6: Please provide comments on the resources of the project. Are the resources sufficient for the project to achieve the stated milestones in a timely fashion?

#### Reviewer 1:

This reviewer said that the resources for this project are sufficient.

#### **Reviewer 2:**

According to this reviewer, the resources are sufficient—each of the team members is an expert in the task allotted, and the accomplishments so far suggest that the work is getting done on pace with the project plan.

#### Reviewer 3:

The reviewer found that the resources appear sufficient, and that the project is on-time and on-budget.

#### Reviewer 4:

This reviewer believed that the resources provided seem sufficient for the scope of the project.

#### Acronyms and Abbreviations – VAN

Abbreviation	Definition	
ACT	Advanced Clean Truck	
CAR	Center for Automotive Research	
COVID	Coronavirus disease (COVID-19), infectious disease caused by the SARS-CoV-2 virus	
DOE	U.S. Department of Energy	
DORMA	Decarbonization of Off-Road, Rail, Marine, and Aviation	
U.S. DRIVE	United States Driving Research and Innovation for Vehicle Efficiency and Energy Sustainability	
dsgrid-flex	NREL Demand Side Grid model	
EEMS	VTO Energy Efficient Mobility Systems subprogram	
EERPAT	Energy and Emissions Reduction Policy Analysis Tool	
EV	Electric vehicle(s)	
EVI-Pro	Electric Vehicle Infrastructure Projection Tool	
EVI-X	Electric Vehicle Charging Infrastructure Analysis Tools	
EVSE	Electric vehicle supply equipment	
FHWA	Federal Highway Administration	
HD	Heavy-duty	
HEVI-LOAD	Heavy-Duty Electric Vehicle Load, Operations, and Deployment	
ICE	Internal combustion engine	
LD	Light-duty	
MD	Medium-duty	
NAICS	North American Industry Classification System	
NREL	National Renewable Energy Laboratory	
NYC	New York City	
R&D	Research and development	
ReEDS	Regional Energy Deployment System model	
TAC	Technical advisory committee	
TDM	Travel demand management	
TEMPO	Transportation Energy and Mobility Pathway Options <sup>TM</sup>	
VAN	VTO Analysis subprogram	
VMT	Vehicle miles travelled	

#### 2023 VTO ANNUAL MERIT REVIEW RESULTS REPORT – VEHICLE ANALYSIS

Abbreviation	Definition
VTO	Vehicle Technologies Office
ZEV	Zero-emission vehicle

(This Page Intentionally Left Blank)