FY25 Q3 PROGRESS UPDATE
JULY 2025

Vehicle Technologies

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R&D HIGHLIGHTS

BATTERY TECHNOLOGIES

Battery R&D

Blended Electrolyte Additives Improve Stability of Earth-Abundant Battery Cathodes

Today's lithium-ion batteries rely on cobalt, which is expensive, toxic, and geographically restricted, with 70% of cobalt mined in the Democratic Republic of Congo. Earth-abundant alternatives—such as lithium- and manganese-rich lithium nickel manganese oxide cathodes—offer high energy densities but fail to demonstrate stability during long-term cycling. In collaboration with Argonne National Laboratory, NREL scientists used cryogenic scanning transmission electron microscopy with electron energy loss spectroscopy to investigate how electrolyte additives influence battery performance. The team found that blending two common additives—2 wt % lithium difluoro(oxalate)borate plus 1 wt % tris(trimethylsilyl) phosphite—achieved a 28% improvement in battery capacity over the baseline electrolyte after long-term cycling. These additives complement each other, mitigating manganese dissolution to stabilize the cathode surface and enhancing the structure and chemistry of the cathode-electrolyte interphase. By using advanced electron microscopy to uncover key nanoscale mechanisms, these insights can guide new approaches to electrolyte engineering that support the development of more affordable and reliable energy storage.

Researchers Optimize Fabrication Techniques To Create Ideal Microstructures for High-Performance Solid-State Battery Cathodes

All-solid-state batteries (ASSBs) replace the liquid electrolyte in traditional lithium-ion batteries with solid material, offering potential improvements in energy density, life span, and safety. However, microstructure defects in ASSB catholytes, such as poor material dispersion and voids, can leave active material underutilized and block lithium-ion transport, degrading both capacity and rate performance. NREL researchers are exploring opportunities to optimize fabrication techniques and catholyte composition for higher-performing ASSBs. The team developed a robust manufacturing pipeline for ASSB catholytes, incorporating nanoscale X-ray computed tomography and custom in-house image analysis software to characterize the resulting microstructures. This process allowed researchers to identify two key parameters for optimization—the particle size distribution of the nickel manganese cobalt active material and the solid electrolyte—which were shown to correlate with higher rate capability and capacity in electrochemical tests. This work lays the foundation for high-loading ASSB cathodes, a critical step toward achieving the energy density advantages enabled by solid-state technologies. These findings will be used to predict and experimentally test the theoretical limits for active material loading in ASSB cathodes.

Automated Machine-Learning Pipeline Advances Silicon Battery Lifetime Predictions

Silicon-based batteries offer high energy density but suffer from limited calendar lifetime: typically less than 2 years, far below the 10-year industry standard for commercialization. To manage the growing body of silicon cells under evaluation, the NREL-led Silicon Consortium Project developed an automated pipeline for data processing, lifetime projection, uncertainty quantification, and outlier flagging. This pipeline compiles the entirety of the project's suite of battery lifetime models, including a new tool that scores the aging behavior of a new cell based on its similarity to previous data, to manage the continued uptake of new testing data. By generating multiple metrics for calendar lifetime and analyzing which metadata most strongly influence aging trajectories, researchers are enabling robust and well-informed decision-making on design iterations that influence calendar life. For example, researcher analysis of recent data found that electrolyte, prelithiation method, and areal capacity most strongly affect aging trajectory shapes. This automated pipeline and relevant findings to reduce uncertainty will be submitted as a manuscript on early state-of-health and lifetime estimation.

Scaling Plasma-Enhanced Silicon Anodes for Roll-to-Roll Battery Manufacturing Demonstrates Promising Feasibility for Market Success

The NREL-led Silicon Consortium Project is working to scale up a novel silicon anode active material synthesized via plasma-enhanced chemical vapor deposition (PECVD) of silane gas, followed by polyethylene oxide (PEO) surface modification. Early full-cell results from single-layer pouch cell batteries with this PECVD-PEO silicon material project more than 10 years of calendar life, making it a strong candidate for next-generation batteries. NREL researchers successfully synthesized and delivered more than 200 grams of PECVD-PEO silicon to the Cell Analysis, Modeling, and Prototyping (CAMP) Facility at Argonne National Laboratory. Although this was enough material for several roll-to-roll coatings, further work is required to enable a high-loading electrode print of the anodes. Demonstrating the feasibility of scaling PECVD-PEO silicon using conventional manufacturing methods is an important step in enabling the market success of silicon anodes. Additionally, achieving consistent area loading of silicon anodes using roll-to-roll processing will allow for full cell matching and further calendar life studies to optimize battery designs.

High-Performance Computing

NREL's Expanded Supercomputing Capabilities Prove Critical to Supporting 26 FY25 Vehicle Technologies Office Projects, Accounting for Highest Kestrel Usage Across EERE

High-performance computing (HPC) is critical for conducting complex simulations and optimizations, leading to scientific advancements, improved products, and competitive advantages for organizations. In recent years, the HPC needs of DOE's Vehicle Technologies Office (VTO) have exceeded the capacity of NREL's former HPC resources, prompting the advanced computing and computational science experts at NREL to design expanded computing capabilities for VTO projects. This expanded capacity for VTO provides 26 FY25 projects with increased capabilities for large-scale artificial intelligence (AI) and accelerated computing workloads, which is critical to supporting the office's growing computing needs. This year, NREL worked with VTO and the Kestrel HPC vendor, Hewlett Packard Enterprise, to design and install the VTO "buy-in" on Kestrel in December 2024. The Kestrel buy-in provides priority access to 10 million allocation units (AUs) of Kestrel graphics processing unit (GPU) node capacity to VTO projects. Kestrel GPUs were used for VTO projects including optimization of cathode-electrolyte interphase formation in lithium-ion batteries, modeling and simulation to develop sulfide-based anode-free lithium batteries with high energy density, investigating disordered rocksalt cathode materials for enhanced battery performance, and developing robust 3D solid-state lithium batteries using multiscale modeling. VTO has utilized the NREL supercomputer extensively, especially the new GPUs, accounting for approximately 25% of Kestrel usage in FY 2025, marking the highest usage across the Office of Energy Efficiency and Renewable Energy this year. In addition, Kestrel's overall availability for Q3 was greater than 95%, and VTO's buy-in usage was at full capacity most days, showing excellent transition of work to Kestrel as NREL's Swift HPC system enters its last year of service.

ELECTRIFICATION TECHNOLOGIES

Electric Drive Technologies

Accelerated Aging Station Will Demonstrate How To Build a Better Commercial Powertrain

An accelerated aging station for electrified medium- and heavy-duty powertrains, built by three national laboratories, is poised to inform safer, more durable, and more reliable commercial vehicle designs. Under VTO's Electric Drive Technologies program, researchers from NREL, Oak Ridge National Laboratory, and Sandia National Laboratories built a powertrain digital twin for electrified medium- and heavy-duty vehicles. Then, NREL researchers designed an accelerated aging station to discover how and why the vehicles' power

modules and converters degrade. Once the aging platform prototype is fabricated, NREL researchers will program it to exhaustively evaluate 10 load conditions and 5 aging mechanisms, such as excess heat, humidity, and vibration. The degradation data they generate will feed into the powertrain digital twin—creating an essential tool to understand why electric-drive powertrains degrade over time, and how they can be designed for greater durability.

Grid and Infrastructure

Benchmarking Electric Vehicle Supply Equipment Costs Improves Accuracy of Charging Infrastructure Installation Estimates and Planning Process

NREL researchers identified, categorized, and quantified electric vehicle supply equipment (EVSE) soft costs to benchmark the time and capital costs of EVSE—an effort that, once completed, will allow organizations to implement electric vehicle (EV) charging with more consistent, cost-effective, and accurate installation estimates and planning. EVSE installations vary significantly, resulting in a general lack of understanding of the costs of implementing charging infrastructure, including both the direct and indirect costs, like time and capital. NREL partnered with Idaho National Laboratory and Lawrence Berkeley National Laboratory to gather inputs from more than 75 stakeholder engagement interviews and perform quantitative and qualitative analysis of more than 4,000 station build-out invoices across different states. After gathering and analyzing the EVSE installation costs and user feedback, the team benchmarked the time and capital costs of EVSE, developed a webpage to share the analysis, and authored a stakeholder engagement report on the findings. This exhaustive analysis of EVSE installation costs is also informing the cost estimates generated by NREL's EVI-LOCATE tool, which helps users create an EV charging station deployment plan for the entire process, from layout to cost estimates. In the near term, the NREL team will continue collecting data to augment the analysis and reports.

OFF-ROAD, RAIL, MARINE, AND AVIATION TECHNOLOGIES

Heavy-Duty R&D

Group Contribution Method Solidifies Accuracy of Fuel Property Prediction Models for Jet Fuels

NREL examined the group contribution method (GCM) to predict thermophysical and combustion properties of jet fuel. Efficiently and accurately calculating fuel properties and their effect on fuel performance builds a foundation for studying fuel and combustion properties during SAF development, reducing costs and time by requiring only a small volume of the prototype fuel for testing and producing results within hours. This compares with a longer process of many weeks to produce adequate volumes of fuel for characterization and additional weeks for costly experimental measurements. Property prediction leads to much more rapid progress toward certification of new SAFs by providing an efficient approach for studying fuel and combustion properties, as the molecular composition of aviation fuels—including conventional and SAFs—influences their performance, safety, and environmental impact. NREL researchers built FuelLib, an open-source Python tool built around GCM, to calculate individual compound and fuel mixture properties that determine fuel performance using various mixing rules. The use of FuelLib for this work helps evaluate whether the GCM can capture isomeric effects, which are often overlooked in traditional fuel property estimation. Capturing isomeric effects is particularly important for SAFs, which are often made up of fewer compound classes than conventional fuels, increasing the impact of isomeric differences. NREL can improve predictive accuracy by updating GCM coefficients to better reflect aviation fuel and refining the selection of reference compounds for fuels characterized by comprehensive two-dimensional gas chromatography (GCxGC) data. Researchers will next conduct further research to evaluate the reliability of GCM predictions for SAFs.

MATERIALS TECHNOLOGY

Lightweight Materials

NREL Determines Hybrid Composites of Multiple Fiber Types and Reusing Carbon Fibers Can Maintain Performance and Lower Second-Life Costs by up to 95%

Today's carbon-fiber-reinforced composites face multiple barriers to entry for the automotive industry, namely high associated costs, extensive manufacturing requirements, and brittleness. To address this problem, NREL researchers designed hybrid composites in which carbon fiber components can maintain the material's strength while a second fiber can lower its cost and provide ductility. Recent analysis to supplement the experimental results shows that the material aligns with VTO goals; depending on the loading of the alternative fiber, the cost can be less than $2 per kilogram of mass saved. Energy use and emissions reductions can also exceed 30%. This work helps pave the way for the implementation of carbon fiber composites in vehicles through lower cost and better performing materials. Additionally, the resultant materials are recyclable, which could help increase the carbon fiber supply chain. Early analysis shows that reusing carbon fibers can reduce second-life costs by up to 95% compared to first-use materials, while also lowering energy intensity—delivering both economic and environmental benefits. NREL researchers will next continue to explore these hybrid composites and expand the scope of alternative fibers used to see what other advantages in performance, manufacturing requirements, and supply chain energies can be achieved.

TECHNOLOGY INTEGRATION

Data and Systems

Researchers Evaluate Emerging On-Demand and Automated Technologies To Enhance Public Mobility Options

Mobility technologies for public transportation are rapidly evolving, often faster than many transit agencies can keep up. The Technologist in Communities project is identifying, tracking, and evaluating new mobility deployments in different geographies and contexts to inform the next generation of public mobility. Through the project, NREL researchers have identified both energy and mobility advantages of on-demand and automated transportation modes for public mobility. An analysis of on-demand transit scenarios for Arlington, Texas, for example, found that reducing wait times by 50%—compared to a baseline scenario with service levels similar to traditional transit—resulted in a nearly 160% increase in the area's Mobility Energy Productivity (MEP) score, which reflects mobility quality in terms of cost, energy, and time. Automated system management that efficiently matches autonomous vehicles to ride requests can further reduce wait times. On-demand and automated technologies are converging in a race for robotaxi and similar services nationwide. Such services can provide public mobility options in places where traditional public transit may not be viable. Project partners include the municipalities of Arlington and Dallas, Texas, as well as on-demand mobility providers like Waymo. This work is important because, despite the rapid advent of robotaxi and similar services, little is known about their real-world impacts related to energy use, costs, access, and other operational factors. NREL researchers will next incorporate findings from a scanning tour of mobility deployments earlier this year into a planning tool to help communities estimate how on-demand and automated public mobility could meet their needs—efficiently, and with improved mobility choice and access.

Collaboration Enhances Understanding of Strategies and Resource Needs To Help First Responders Safely Address Electric Vehicle Incidents

Comprehensive training to provide safety training to emergency responders to prepare them for their role in safely handling incidents involving electric vehicles is largely lacking or conflicting in the United States. To address this need, NREL collaborated with Drive Clean Colorado, a Clean Cities and Communities coalition, to identify strategies and resources to help emergency responders understand safe and appropriate processes for responding. NREL and the coalition convened a working group to gather input from firefighters, paramedics, police officers, hazardous materials specialists, and tow truck operators. Participants discussed techniques for safely responding to EV incidents under a variety of scenarios and conditions, including damaged EVs, fires involving an EV, and transportation and storage of an EV after an incident. Discussions underscored the large amount of conflicting information first responders must sort through and the continued need for clear, concise, and consistent resources. Drive Clean Colorado shared findings from the listening sessions with other Clean Cities and Communities coalitions to inform potential additional efforts beyond Colorado. They also plan to summarize best practices for emergency responders and continue fostering opportunities for responders across Colorado to connect and learn from their peers about safely addressing EV incidents. This project was part of a broader NREL effort to better understand the risks first responders face when addressing incidents involving EVs, and researchers will continue collaborating with government and industry partners to gather data and develop resources.

NREL Athena Researchers Develop Models To Inform Critical, Cost-Effective Airport Infrastructure Planning

Airports, which are increasingly busy with more passengers and flights, need to identify how to meet growing demands on key energy infrastructure while maintaining operating costs at manageable levels. The NREL-led Athena project team developed a suite of computational models to inform airports' efforts to increase efficiencies by electrifying ground support operations and airport fleets. Athena's integrated models consider the complexity and critical nature of airport operations, enabling them to evaluate grid impacts, infrastructure needs, and operational feasibility of electrified airport equipment. The models will be integrated into the Aeroportal—a web-based platform designed to help airports of all sizes assess electrification needs and provide stakeholders with actionable, location-specific insights for infrastructure and grid planning. These tools enable airports to make data-driven decisions that reduce costs, ensure reliable operations, and support emissions reduction goals. NREL Athena researchers will simulate these models across a wide range of input parameters and under different microgrid configurations. Looking forward, these results will form the foundation for the initial set of stakeholder-facing solutions.

Strategic Management Guidance Helps Clean Cities and Communities Coalition Secure Future Growth

NREL helped a Clean Cities and Communities coalition navigate an organizational transition, enabling the coalition to grow and diversify funding sources and increase capacity. This work is part of a larger NREL-led effort to build coalition organizational capacities so they can efficiently and effectively serve stakeholders interested in exploring transportation fuel and technology choices. NREL provided change management guidance to Vermont Clean Cities as they transitioned to a new host organization, Net Zero Vermont, that better supports the coalition's mission. NREL's guidance helped the coalition make the decision to transition from their previous host and guided them through the necessary steps, including developing a new stakeholder advisory committee and advising committee members on steps and criteria for the transition. This effort involved leveraging NREL's deep familiarity with coalition operations and expertise in organization management. NREL will incorporate learnings from Vermont Clean Cities' host transition process in other coalition-building efforts to ensure coalitions receive the organizational support they need to provide transportation expertise and energy choices to their stakeholders.

ANALYSIS

Data

Fleet Chromosomes Project Defines Innate Patterns in Commercial Vehicle Driving to Boost Manufacturing Economies and Overall Efficiency

While more than 30 commercial vehicle vocations and weight classes exist, manufacturers frequently use just a few to form the baseline for engine design and optimization—which can create a mismatch between the engine's design and its ultimate use. For the first time, NREL researchers designed a state-of-the-art clustering methodology and automated naming system to define "Fleet Chromosomes": innate patterns in commercial vehicle drive cycles, from vehicle stopping and starting to acceleration and average speeds. Just like mapping human DNA, the newly defined fleet "chromosomes" illustrate how commercial vehicles as diverse as long-haul trucks, parcel delivery vans, airport shuttles, and yard tractors are driven in the real world. Manufacturers can now apply the methodology to align vehicle component designs with real-world operations, create manufacturing economies of scale across vehicle platforms, and boost overall fleet efficiency. The Fleet Chromosomes team will soon publish their results to expand access to the methodology and allow manufacturers, fleet owners, and researchers to apply this advanced pattern recognition tool.

Applied Analysis

Research Team Lays Groundwork for a National Medium- and Heavy-Duty Vehicle Charging Needs Assessment

Medium- and heavy-duty EVs have the potential to place significant demands on the grid and require large-scale, high-capacity charging infrastructure. To support strategic planning for these vehicles, this study uses a scenario-based approach to reduce uncertainty around when, where, and how much charging will be needed across the United States, helping industry make informed decisions and avoid costly over- or underinvestment. NREL's research team recently developed an initial modeling approach and set of assumptions to estimate nationwide medium- and heavy-duty EV charging needs. These will be reviewed with industry stakeholders to provide transparency and incorporate feedback before infrastructure simulations are conducted. Final analysis results will include infrastructure quantities, capital costs, and power requirements broken down by location type and charging type.

ENERGY EFFICIENT MOBILITY SYSTEMS (EEMS)

Computational Modeling and Simulation

Integrating Thermal Effects Improves Accuracy of Energy Predictions and Driving Range in RouteE Powertrain

Predicting the energy use and range of battery-electric vehicles (BEVs) under varying ambient temperatures is challenging, as temperature significantly affects the rate of energy consumption. Accurate modeling of these thermal impacts is essential to reliably estimate real-world vehicle energy efficiency and operational range. The NREL research team has enhanced the lab's Route Energy Prediction (RouteE) Powertrain BEV models by integrating temperature sensitivity using large-scale thermal simulations from the Future Automotive Systems Technology Simulator (FASTSim™). These improved models—reducing prediction errors by nearly 50%, with even greater accuracy at extreme hot and cold temperatures—accurately predict how ambient temperatures

affect vehicle energy consumption and driving range. This advancement expands the capabilities of NREL's RouteE software ecosystem and enables better informed vehicle energy assessments under realistic temperature conditions. Accurate temperature-sensitive models significantly improve predictions of BEV energy use and driving range, enabling more reliable fleet planning, route optimization, and vehicle performance assessments. This accuracy is crucial for broader adoption of BEVs by addressing range anxiety and infrastructure planning concerns. Next steps include expanding temperature-sensitive modeling to additional RouteE Powertrain vehicle models and integrating these enhanced models into downstream analyses, fleet optimization, and broader transportation research applications.

NREL's T3CO Tool Research Team Develops Robust Methodologies to Quantify Commercial Vehicle Technology Opportunity Costs

Total cost of ownership is a key metric for assessing the competitiveness of new vehicle technologies compared to conventional options. However, most total-cost-of-ownership calculations do not consider harder-to-quantify opportunity costs that impact operations and decision-making—such as reduced payload capacity or increased downtime for fueling or charging. To address these gaps, NREL's Transportation Technology Total Cost of Ownership (T3CO) team built on prior work to develop robust methodologies that quantify and value lost revenue opportunities due to vehicle downtime for fueling, charging, maintenance, and repair. These methodologies account for attended and unattended fueling/charging events, partial charging, and station queuing. The open-source T3CO tool offers flexible approaches for valuing downtime, by either applying a fixed rate or estimating the value endogenously based on lost productivity. This is particularly important in cases where charging electric trucks mid-shift could be disruptive and costly. Most total-cost-of-ownership tools either neglect these costs or rely on average daily mileage, which can significantly underestimate the impacts. T3CO's integration with NREL's FASTSim tool enables it to simulate vehicle operation over actual drive cycles. When combined with batch mode, T3CO can rapidly analyze hundreds of cycles representing the full variation of a vehicle's operations to accurately estimate dwell time and the lost opportunities for generating revenue. After publishing an article on T3CO's current opportunity cost methodologies, researchers will implement a new methodology for assessing payload opportunity costs for medium-duty vocations where operators may opt to purchase vehicles in a higher weight class to offset reduced payload capacity.

FASTSim Thermal Models Account for Impact of Ambient and Pre-Trip Temperatures on Vehicle Range

Ambient temperatures and pre-trip conditions can have a significant impact on BEV energy consumption rates and driving range. Researchers successfully integrated thermal models for various BEV components into NREL's FASTSim, tool, enabling its simulations to now account for these factors. Using a minimal set of parameters calibrated against vehicle dynamometer test data from Argonne National Laboratory, researchers demonstrated that FASTSim accurately matches calibration and validation data, and that a sweep of conditions across drive cycles and temperatures can predict trends in line with real-world data. Next, researchers will acquire more data to broaden the calibration and validation range of FASTSim thermal models.

New Generalized E-Commerce Demand Modeling Framework Enables Automated Data Processing, Supports Comprehensive Analyses of Online Shopping's Mobility Impacts

E-commerce demand models require extensive manual data processing and region-specific customization due to data availability and variability when deployed across different regions. From a local stakeholder perspective, this poses significant barriers to adapting the models and limits the ability to conduct comprehensive analyses. NREL researchers have successfully developed a generalized, input-oriented e-commerce demand modeling framework and demonstrated its capabilities using data from the Puget Sound Regional Council's Household Travel Survey. The new modeling framework automatically accommodates regional data structures and estimates model parameters—eliminating the need for extensive and time-consuming manual data processing steps. It also enables rapid deployment of e-commerce demand modeling nationwide, facilitating comprehensive analyses of online shopping's impact on urban mobility, last-mile delivery, and related externalities. The generalized model supports the addition of new modeling and simulation capabilities to traditional passenger-focused travel demand models as well. Next, researchers will develop an automated process to calibrate and validate the modeling framework—ensuring it maintains accurate predictions for a target region—and integrate it into a regional travel demand model.

Linking Transportation Models Provides Deeper Transportation Planning and Travel Demand Insights at National and Regional Scales

There is a lack of forward-looking, national-scale modeling focused on improving transportation planning and travel demand management across the United States. To address this gap, researchers are linking Argonne National Laboratory's regionally detailed POLARIS microsimulation workflow with NREL's nationally resolved Transportation Energy & Mobility Pathway Options (TEMPO™) model. The multi-laboratory research team has designed scenarios for transit-oriented development and road pricing, to be applied in three representative metropolitan areas: Chicago, Atlanta, and Austin. Analysis results from these scenarios will inform the final mapping via a typology framework developed by Lawrence Berkeley National Laboratory to ensure all travel behavior trends—such as those related to mode shifting or changes in vehicle miles traveled or travel demand—are captured in TEMPO modeling. By mapping key microsimulation insights from POLARIS to TEMPO, researchers are developing a nationwide, county-level approach that can provide national and regional insights into vehicle miles traveled, transportation energy savings and affordability, shifting travel cost burdens, and the potential for mode shifts to transit. Moving forward, researchers will refine scenario assumptions for transit and road pricing based on stakeholder feedback, followed by expanding TEMPO modeling to all U.S. counties under the scenarios.

Transitioning Mobility Metrics From Private to Open-Source Data Enables Greater Portability and Collaboration

Historically, NREL's MEP metric calculations—which reflects mobility quality in terms of cost, energy, and time—have relied on proprietary data sources, limiting portability and posing challenges when collaborating with external partners. While tooling exists for working with open data providers such as OpenStreetMap and Overture Maps, it is not geared for national-scale data pipelines. As a first step toward open-sourcing the MEP metric, NREL researchers have developed data ingestion pipelines to import national-scale data from OpenStreetMap and Overture Maps. By leveraging parallel computing, these automated workflows enable large-scale data imports to be completed within minutes, representing a substantial reduction in both time and cost compared to the weeks previously required for manually executed workflows. Additionally, the transition to open-source data fosters transparency, collaboration, portability, and accessibility across the research community. With the national workflow established, NREL researchers will enhance the metric's route planning with previously developed multimodal travel behaviors for walk, bike, drive, and transit mode travel. They will also begin the technology transfer process for migrating the code for open-source release.

Connectivity and Automation Technology

Co-Simulation of Cooperative Driving Automation Vehicles and Cellular Vehicle-to-Everything Wireless Communications Leverages Parallel Computing, AI, and HPC to Support Large-Scale Studies

Cellular vehicle-to-everything (C-V2X) is a new vehicular communication standard whose large-scale impact remains largely unexplored. Previously, cooperative driving automation vehicles and C-V2X wireless communications had not been modeled together in a co-simulation environment. One major challenge was the long computational time required to simulate C-V2X wireless communications. To address this, NREL developed a high-performance co-simulation framework that integrates a model of cooperative driving automation vehicles, developed by Lawrence Berkeley National Laboratory, with an NREL-developed C-V2X wireless communications model. Leveraging parallel computing, AI, and HPC resources radically improved the computational efficiency of the simulations. The co-simulation framework is the first of its kind to support large-scale experimental studies, enabling researchers to assess the impacts of increased C-V2X deployment before conducting field trials. Next, NREL will further enhance the realism of C-V2X communications modeling.

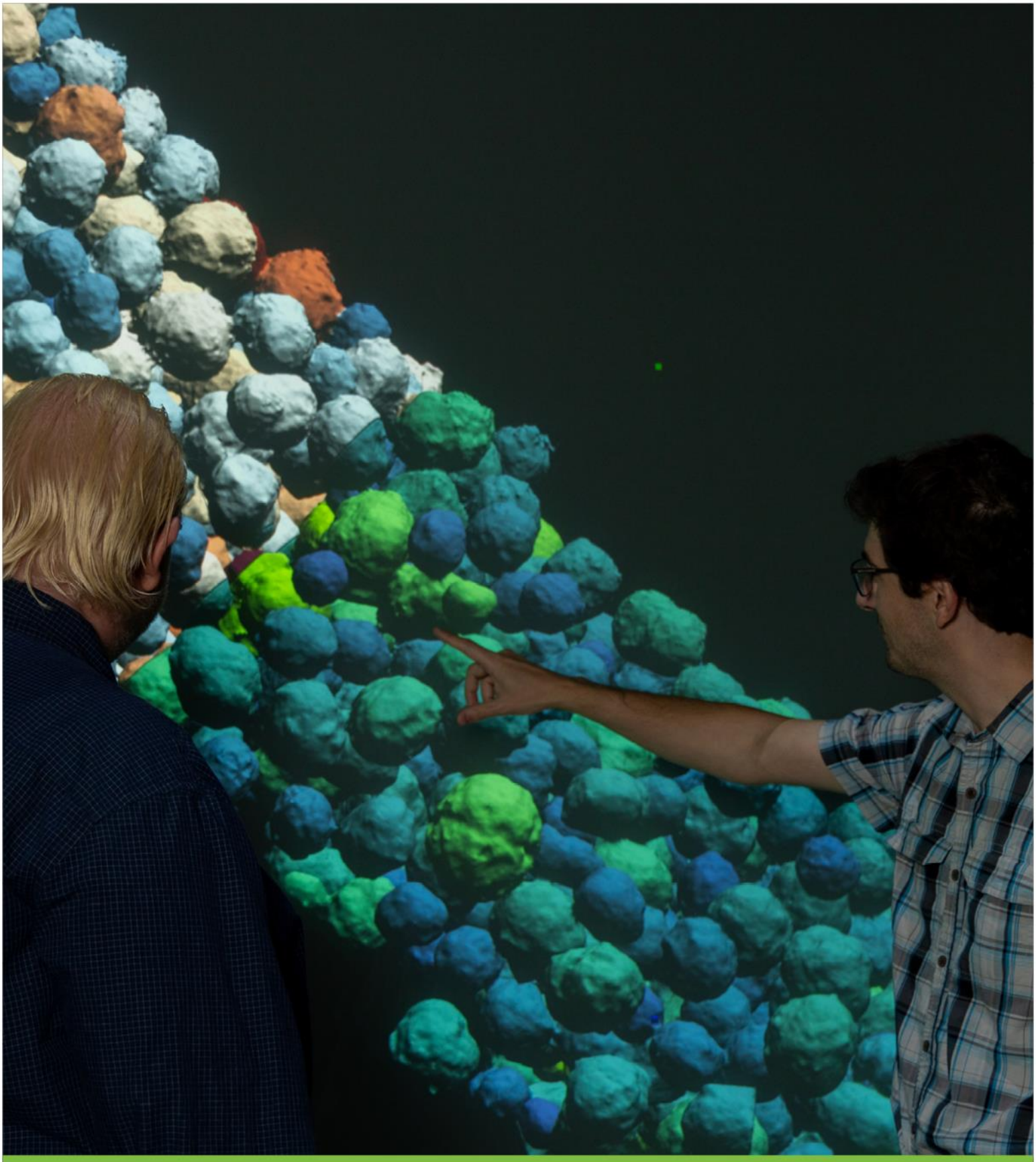
Literature Review Informs Development of New Book on Cooperative Driving Automation

A deep understanding of the current state of the art in cooperative driving automation is critical for advancing the technology, which has the potential to significantly improve energy consumption, traffic systems efficiency, and safety. Researchers from NREL, in collaboration with Lawrence Berkeley, Argonne, and Oak Ridge national laboratories, are coauthoring a new book on the latest developments in the field based on a comprehensive literature review. The book, to be published by Springer Nature, will help guide future research leveraging the latest developments. The next step is the formal publication of the book.

Augmented Reality Application To Track Test Connected and Automated Vehicles Offers Simulated Validation Opportunities Ahead of Real-World Deployments

Track testing of connected and automated vehicles has typically relied on vehicle-in-the-loop simulations. However, the simulation scenarios were not based on real-world drive cycles, and test track observers could not see the virtual vehicles, limiting their ability to anticipate behavior or identify issues. To address these challenges, NREL researchers collaborated with Leidos, the American Center for Mobility, and the Michigan Tech Research Institute to develop simulated scenarios informed by real-world drive cycles. They also created an augmented reality application that provides observers with an immersive visualization of virtual vehicles alongside real vehicles on the test track. Funded by the Advanced Research Projects Agency – Energy (ARPA-E), this work established a framework for developers to track test connected and automated vehicles in a simulated environment, enabling early-stage evaluation without the risk of public road testing and reducing costs by substituting simulated vehicles for real ones. It can also help identify potential issues with virtual traffic and allows for fuel economy assessments under more realistic conditions. The research team is currently exploring commercial applications of this technology to support industry needs.

Using an augmented reality application system, researchers can visualize virtual CAVs alongside real vehicles in a mixed simulated and real environment to identify potential issues. *Photo by Qichao Wang, NREL*



AOP CHANGES & MILESTONE STATUS

AOP CHANGES

A compilation of all Q3 FY 2025 Annual Operating Plan (AOP) changes recorded to date is provided on the next page.

MILESTONE STATUS

Sixty Q3 milestones have been completed and delivered on time, as detailed on the following pages. Select milestones have been delayed with DOE approval.

FY25 Q3 AOP Changes					
Program Name	**Activity Name**	**WBS Number**	**Project Title**	**PI Name**	**Type of Change**
Battery Technologies	Battery R&D	1.1.10.441	Lithium-ion Battery Recycling Prize (Cash & Vouchers)	Lynch, Lauren	Delayed with DOE approval until 3/30/2026
		1.1.10.442	Lithium-Ion Battery Recycling Prize Administration	Lynch, Lauren	Delayed with DOE approval until 3/30/2026
		1.1.14.443	Coupled multiscale modeling and diagnostics for lithium-sulfur battery design	Colclasure, Andrew	Language of milestone description was modified with DOE approval
Electrification Technologies	Grid & Infrastructure R&D	2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	Borlaug, Brennan	Cancelled milestone with DOE approval
		2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	Borlaug, Brennan	Delayed with DOE approval until 7/31/2025
		2.3.2.453	EV Charging Infrastructure Soft Costs Benchmarking	Desai, Ranjit	Delayed with DOE approval until 9/30/2025
		2.3.2.453	EV Charging Infrastructure Soft Costs Benchmarking	Desai, Ranjit	Delayed with DOE approval until 9/30/2025
Technology Integration	Alternative Fuels Regulatory Program	6.4.0.400	Alternative Fuels Regulatory Program	Andrews-Sharer, Erin	Delayed with DOE approval until 12/31/2025
Analysis	Modeling	7.2.0.402	VTO Analysis Program Modeling Activities at NREL	Jadun, Paige	Delayed with DOE approval until 9/30/2025
	Applied Analysis	7.3.0.402	VTO Analysis Program Applied Analysis Activities at NREL	Borlaug, Brennan	Delayed with DOE approval until 9/30/2025
Vehicle Technologies Office Crosscutting	Lab-based Crosscutting Projects	8.3.0.402	Locomotive Fleet Survey and Associated Projects	Birky, Alicia	Delayed with DOE approval until 7/31, 2025
		8.3.0.402	Locomotive Fleet Survey and Associated Projects	Birky, Alicia	Delayed with DOE approval until 9/30/2025
EEMS	Computational Modeling and Simulation	9.1.2.407	Energy Metrics in Traffic Signal Performance Measures	Fish, Joseph	Delayed with DOE approval until 9/30/2025

FY25 Q3 Milestone Status								
Program Name	**Activity**	**WBS Number**	**Project Title**	**Milestone**	**Milestone Type**	**Due Date**	**Lab Lead**	**Q3 Status**
Battery Technologies	Battery R&D	1.1.10.425	Li-Ion Battery Recycling R&D Center	Second-use study: Update second-use battery repurposing cost calculator spreadsheet. Survey present second-use literature, business models, best practices, and barriers. Circulate first draft of white paper to DOE management on the business and technical viability of battery second use for feedback.	Quarterly Milestone Regular	6/30/2025	Keyser, Matthew	Met On Time
		1.1.10.425	Li-Ion Battery Recycling R&D Center	Upcycle LFP: Synthesize novel LMFP material from EOL LFP that has 10% higher energy density than pristine LFP material as measured at a C/10 rate in a coin cell.	Quarterly Milestone Regular	6/30/2025	Keyser, Matthew	Met On Time
		1.1.10.441	Lithium-Ion Battery Recycling Prize (Cash & Vouchers)	Assist teams and evaluation entities and prepare for concept update	Quarterly Milestone Regular	6/30/2025	Lynch, Lauren	Delayed with DOE Approval
		1.1.10.442	Lithium-Ion Battery Recycling Prize Administration	Assist teams and evaluation entities and prepare for concept update	Quarterly Milestone Regular	6/30/2025	Lynch, Lauren	Delayed with DOE Approval
		1.1.14.435	VTO High-Performance Computing (HPC) Cluster	Progress measure	Quarterly Milestone Regular	7/31/2025	Andersen, Aaron	Met On Time
		1.1.14.443	Coupled multiscale modeling and diagnostics for lithium-sulfur battery design	Operando diagnostics provide quantitative measures of electrolyte speciation	Quarterly Milestone Regular	6/30/2025	Colclasure, Andrew	Met On Time

		1.1.19.444	EVALs: Validation of Advanced battery supply chains	Develop and implement initial accelerated testing procedures on a commercial and at least one EVALS synthesized material.	Quarterly Milestone Regular	6/30/2025	Burrell, Anthony	Met On Time
		1.1.2.434	Heavy-Duty Vehicle Optimized Li-ion Technologies (HD VOLTS)	Adapt data-driven pipeline for diagnosis of LFP cells, including for 21st Century Truck dynamic drive cycle	Quarterly Milestone Regular	6/30/2025	Smith, Kandler	Met On Time
		1.1.3.439	Advanced Characterization to Guide and Validate the Design of Long Life EaCAM Li-ion Cells	Identification of local areas of degradation across millimeter to micrometer length scales, with structural and chemical maps	Quarterly Milestone Regular	6/30/2025	Tremolet de Villers, Bertrand	Met On Time
		1.1.3.439	Advanced Characterization to Guide and Validate the Design of Long Life EaCAM Li-ion Cells	Provide a quantitative description of manufacturing defects in LMR particles and inefficiencies in conductive carbon distributions within electrodes. Provide guidance to synthesis and manufacturing groups	Annual Milestone (Regular)	6/30/2025	Tremolet de Villers, Bertrand	Met On Time
		1.1.3.439	Advanced Characterization to Guide and Validate the Design of Long Life EaCAM Li-ion Cells	Understanding of electrolyte additive role in Mn dissolution on LMR-NM surfaces.	Annual Milestone (Regular)	6/30/2025	Tremolet de Villers, Bertrand	Met On Time
		1.1.3.440	Mechanistic Studies of Cathode-Electrolyte-Interface	Report on XAS studies of cathode-electrolyte interface formation at NMC 811 model cathode materials	Quarterly Milestone Regular	7/15/2025	Tenent, Robert	Met On Time
		1.1.4.436	Low-Pressure All-Solid-State Cells	Determine the influence of microstructural defects (such as poor dispersion and voids) on cell performance, and	Quarterly Milestone Regular	6/30/2025	Burrell, Anthony	Met On Time

				identify fabrication methods to reduce defects				
		1.1.4.436	Low-Pressure All-Solid-State Cells	Demonstration of potentiostatic intermittent titration technique experiments to better understand redox stability of solid-state electrolytes with Li metal.	Quarterly Milestone Regular	6/30/2025	Burrell, Anthony	Met On Time
		1.1.9.429	Integrated Modeling and Machine Learning of Solid-Electrolyte Interface Reactions of the Si Anode	Calendar lifetime + automation + testing suggestions	Quarterly Milestone Regular	6/30/2025	Colclasure, Andrew	Met On Time
		1.1.9.433	NREL Silicon Consortium Project (SCP)	Prelithiation method for the Q4 2-Ah build has been determined and demonstrated	Quarterly Milestone Regular	6/30/2025	Burrell, Anthony	Met On Time
		1.1.9.433	NREL Silicon Consortium Project (SCP)	Go/No-Go on PECVD-PEO for the CAMP Q4 Build by May 1. PECVD-PEO for the CAMP Q4 Build.	Go/No-Go	5/1/2025	Burrell, Anthony	Met On Time
Electrification Technologies	Electric Drive Technologies R&D	2.2.6.401	Electric Drive System Technology R&D	Novel cooling design for the wound rotor synchronous motor development at BorgWarner.	Annual Milestone (Regular)	6/30/2025	Narumanchi, Sreekant	Met On Time
		2.2.7.402	NREL Next-Generation Reliable Electric Drive Systems for MD/HD Vehicles	Expand the accelerated aging station for power modules by designing new features to induce comprehensive aging conditions.	Quarterly Milestone Regular	6/30/2025	Narumanchi, Sreekant	Met On Time
		2.2.7.402	NREL Next-Generation Reliable Electric Drive Systems for MD/HD Vehicles	Develop/identify power module fabrication procedures. Develop/identify fabrication procedure to integrate aluminum oxynitride (AlON) coatings into power module designs. NREL will work	Go/No-Go	6/30/2025	Narumanchi, Sreekant	Met On Time

				with Nitride Global and other partners to evaluate the bond strength of AlON on various materials and develop methods to metalize copper onto AlON.				
	Grid & Infrastructure R&D	2.3.2.450	EVs@Scale Lab Consortium	EV-CENTS (vehicle-grid integration [VGI]/smart charge management [SCM]) – 1.1.e Define cost of charging metrics from identified cost components and determine financial analysis framework for multiple use cases.	Quarterly Milestone Regular	6/30/2025	Bennett, Jesse	Met On Time
		2.3.2.450	EVs@Scale Lab Consortium	EVOLVE (VGI/SCM) – 1.2.e Develop DERMS-integrated SCM through partnership with Mitsubishi SGS by modifying objective functions to operate within DERMS.	Quarterly Milestone Regular	6/30/2025	Bennett, Jesse	Met On Time
		2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	Grid Loads for "Overlooked" EV Segments Review preliminary 2025–2035 (+100% electrification) EV load profiles for: 1. Transit buses, enhanced by additional General Transit Feed Specification data.	Quarterly Milestone Regular	6/30/2025	Borlaug, Brennan	Met On Time
		2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	Grid Loads for "Overlooked" EV Segments Review preliminary 2025–2035 (+100% electrification) EV load profiles for: 2. Government fleets (data dependent), enhanced by additional data outreach.	Quarterly Milestone Regular	6/30/2025	Borlaug, Brennan	Cancelled Milestone with DOE Approval
		2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	Grid Loads for "Overlooked" EV Segments Review preliminary 2025–2035 (+100% electrification) EV load profiles for: 3. Port cargo handling	Quarterly Milestone Regular	6/30/2025	Borlaug, Brennan	Met On Time

				equipment at all U.S. ports (data dependent) differentiated by port type – e.g., container, bulk, breakbulk, inland.				
		2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	Grid Loads for "Overlooked" EV Segments Review preliminary 2025–2035 (+100% electrification) EV load profiles for: 4. Airport ground support equipment at all U.S. airports, tuned to align with bottom-up DFW GSE modeling in the Athena project.	Quarterly Milestone Regular	6/30/2025	Borlaug, Brennan	Met On Time
		2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	Grid Loads for "Overlooked" EV Segments Review preliminary 2025–2035 (+100% electrification) EV load profiles for: 5. Construction vehicles at appropriate spatial resolution (target: as granular as possible).	Quarterly Milestone Regular	6/30/2025	Borlaug, Brennan	Delayed with DOE Approval
		2.3.2.453	EV Charging Infrastructure Soft Costs Benchmarking	Milestone 2.3a: Hold stakeholder workshops to review progress, identify gaps, and refine efforts.	Annual Milestone (Regular)	6/30/2025	Desai, Ranjit	Met On Time
		2.3.2.453	EV Charging Infrastructure Soft Costs Benchmarking	Milestone 2.3b: Produce second annual EVSE cost benchmark that includes updates and refinements for installation and other trends not previously considered.	Annual Milestone (Regular)	6/30/2025	Desai, Ranjit	Delayed with DOE Approval
		2.3.2.453	EV Charging Infrastructure Soft Costs Benchmarking	Milestone 2.3c: Updated benchmarking analysis to identify priority cost reduction opportunities and pathways.	Annual Milestone (Regular)	6/30/2025	Desai, Ranjit	Delayed with DOE Approval

		2.3.2.453	EV Charging Infrastructure Soft Costs Benchmarking	Milestone 3.4: Establish outward-facing website to host EVSE cost analysis results and data visualization.	Annual Milestone (Regular)	6/30/2025	Desai, Ranjit	Met On Time
		2.3.5.423	Beyond Batteries: Behind-the-Meter Storage	Fabricate (1 or 2) 1-kWh battery pack with active battery management system and safety discharge mechanism from selected behind-the-meter storage candidate cells, incorporating hazard mitigations developed in the project	Quarterly Milestone Regular	6/30/2025	Burrell, Anthony	Met On Time
		2.3.5.423	Beyond Batteries: Behind-the-Meter Storage	Design pack with passive mitigation (fusing, thermal dissipation, fire protection) and battery management system (rapid state-of-charge reduction)	Quarterly Milestone Regular	6/30/2025	Burrell, Anthony	Met On Time
Off-Road, Rail, Marine, and Aviation Technologies	Heavy-Duty R&D	3.5.2.404	NREL ORMA AOP	Accuracy of fuel property prediction models. Assess the accuracy of property prediction models used in computational fluid dynamics simulations and others in comparison to data at range of T and P. Joint milestone for Tasks 2 and 4.	Quarterly Milestone Regular	6/30/2025	McCormick, Robert	Met On Time
Materials Technology	Lightweight Materials	4.2.4.401	Materials and Manufacturing Innovation for Sustainable Automotive Composites - NREL	Implement techno-economic and life cycle (or supply chain) analysis to demonstrate that the use of alternative fibers can result in a ≥30% energy reduction of the first-life PECAN carbon-fiber-reinforced composite (CFRC) compared to a state-of-the-art CFRC (e.g., epoxy-amine CFRC, nylon-6 CFRC). Document cost of	Annual Milestone (Regular)	6/30/2025	Rorrer, Nicholas	Met On Time

				material per kilogram of mass saved with a target of $5/kg saved with a stretch of $2/kg saved.				
		4.2.4.431	Zero-Emission Natural Fiber Composites (ZENC) for Fire-Detecting Fireproof EV Battery Enclosure	MS3. Fiber resin bonding (Y1/Q3) - Bonding performance of BFM and biodegradable resin confirmed	Quarterly Milestone Regular	6/30/2025	Rorrer, Nicholas	Met On Time
		4.2.4.432	Cost-effective Circular Manufacturing of Lightweight Vehicle Shells and Battery Casing by Recyclable-by-Design Polymer Composites	1.3. Initial techno-economic analysis modeling (M9)	Quarterly Milestone Regular	6/30/2025	Rorrer, Nicholas	Met On Time
Technology Integration	Data and Systems Research	6.3.1.401	Info & Tools - Alternative Fuels Data Center	Provide a summary report of accomplishments and activities. Conduct a briefing with DOE on the datasets task.	Quarterly Milestone Regular	7/15/2025	Rahill, Matt	Met On Time
		6.3.2.403	Technologist in Communities (TIC)	TIC scanning tour for FY25 completed.	Quarterly Milestone Regular	6/30/2025	Young, Stanley	Met On Time
		6.3.2.404	NREL - Technical Assistance and EEMS Insight Sharing	Summary report of TA, TRS, Analysis, and EEMS activities, trends, and key collaborations	Quarterly Milestone Regular	7/15/2025	Cardinali, Sarah	Met On Time
		6.3.2.405	DFW Electrification	Athena ZEV and Athena AIR model updates	Quarterly Milestone Regular	6/30/2025	Lunacek, Monte	Met On Time
		6.3.3.402	NREL - Outreach, Training, Partnerships and Coalition Support	Provide a summary of activities for each task, including barriers overcome, successes, and ongoing challenges.	Quarterly Milestone Regular	7/15/2025	Melendez, Margo	Met On Time

		6.3.3.402	NREL - Outreach, Training, Partnerships and Coalition Support	Outreach and communications. Conduct a briefing with DOE to discuss the impact and successes of outreach and communications activities. Identify the benefits of key projects and priorities moving forward.	Go/No-Go	6/30/2025	Melendez, Margo	Met On Time
		6.3.4.403	Clean Cities and Communities Projects	Provide a summary of activities for each task, including barriers overcome, successes, and ongoing challenges.	Quarterly Milestone Regular	7/15/2025	Melendez, Margo	Met On Time
		6.3.4.403	Clean Cities and Communities Projects	Clean Energy to Communities (C2C). Conduct a briefing with DOE to review C2C activities and to discuss recommendations for future Clean Cities integration into C2C.	Go/No-Go	6/15/2025	Melendez, Margo	Met On Time
	Alternative Fuels Regulatory Program	6.4.0.400	Alternative Fuels Regulatory Program	Database built, tested, and ready for deployment (transfer of data).	Quarterly Milestone Regular	5/31/2025	Andrews-Sharer, Erin	Met On Time
		6.4.0.400	Alternative Fuels Regulatory Program	Make available results and details of SFP program at DOE VTO annual merit review, as appropriate.	Quarterly Milestone Regular	6/30/2025	Andrews-Sharer, Erin	Met On Time
		6.4.0.400	Alternative Fuels Regulatory Program	All SC and AC annual reports submitted and processed contingent on fleet compliance with regulatory deadlines and responses.	Annual Milestone (Regular)	4/30/2025	Andrews-Sharer, Erin	Delayed with DOE Approval
Analysis	Data	7.1.0.401	Heavy Truck Data Framework Project	Fleet Chromosomes methodology and/or application documented.	Quarterly Milestone Regular	6/30/2025	Birky, Alicia	Met On Time
	Modeling	7.2.0.402	VTO Analysis Program Modeling Activities at NREL	Used vehicle market: Slide deck summarizing implications of using regional light-duty vehicle survival curves in TEMPO to	Quarterly Milestone Regular	6/30/2025	Jadun, Paige	Delayed with DOE Approval

				represent the used vehicle market				
		7.2.0.402	VTO Analysis Program Modeling Activities at NREL	Model enhancement on energy and environmental justice: Implementation and related analysis on at least one model enhancement focused on environmental and energy justice implications	Quarterly Milestone Regular	6/30/2025	Jadun, Paige	Met On Time
		7.2.0.404	NREL - Electric Vehicle Load Shape ResStock - TEMPO	Q3 progress report	Quarterly Milestone Regular	6/30/2025	Yip, Arthur	Met On Time
	Applied Analysis	7.3.0.402	VTO Analysis Program Applied Analysis Activities at NREL	MHD national charging needs review preliminary MHD EVSE network sizing results with VTO. Pending feedback, modifications to the study's assumptions and/or approaches will be made prior to finalizing results by the end of FY25.	Annual Milestone (Regular)	6/30/2025	Borlaug, Brennan	Delayed with DOE Approval
Vehicle Technologies Office Crosscutting	Lab-Based Crosscutting Projects	8.3.0.402	Locomotive Fleet Survey and Associated Projects	M4: FY25Q3 – Preliminary extrapolation and analysis complete.	Quarterly Milestone Regular	6/30/2025	Birky, Alicia	Delayed with DOE Approval
		8.3.0.402	Locomotive Fleet Survey and Associated Projects	M6: FY25Q3 – Corridor and technology definition	Annual Milestone (Regular)	6/30/2025	Birky, Alicia	Delayed with DOE Approval
EEMS	Computational Modeling and Simulation	9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	(PNNL, NREL, INL – Task 1) Develop draft data and metadata standards doc that defines standard units, data tiers to ensure that users can easily use data across projects.	Quarterly Milestone Regular	6/30/2025	Spath Luhring, Lauren	Met On Time
		9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	(NREL, PNNL – Task 1) Develop plan for site refresh (to be implemented in FY26)	Quarterly Milestone Regular	6/30/2025	Spath Luhring, Lauren	Met On Time

		9.1.2.405	Core Modeling & Decision Support Capabilities: FASTSim, RouteE, T3CO, and OpenPATH	Implement thermally sensitive RouteE Powertrain models for BEVs. To include incorporation of the FASTSim battery thermal models for BEVs to accurately estimate energy rate and range impacts due to ambient temperature when validated against on-road energy consumption data for at least three different BEV models.	Quarterly Milestone Regular	6/30/2025	Gonder, Jeff	Met On Time
		9.1.2.405	Core Modeling & Decision Support Capabilities: FASTSim, RouteE, T3CO, and OpenPATH	Prepare a paper documenting T3CO opportunity cost methodologies for submission to a peer-reviewed journal and/or conference venue.	Quarterly Milestone Regular	6/30/2025	Gonder, Jeff	Met On Time
		9.1.2.405	Core Modeling & Decision Support Capabilities: FASTSim, RouteE, T3CO, and OpenPATH	Prepare a paper showing impact of ambient temperature and pre-trip conditioning on BEV range, including a sweep of thermal management control parameters to highlight the importance of thermal management in improving BEV range.	Quarterly Milestone Regular	6/30/2025	Gonder, Jeff	Met On Time
		9.1.2.406	BEAM CORE Core Tools (NREL)	Task 7: ACT - Generalized inputs identified and documented for integrating results from BEAM, POLARIS, or other agent-based models across key data types (vehicles, trips, freight).	Quarterly Milestone Regular	6/30/2025	Gonder, Jeff	Met On Time
		9.1.2.406	BEAM CORE Core Tools (NREL)	Task 4: FRISM - Generalized e-commerce demand model demonstrated for a test region (Seattle).	Quarterly Milestone Regular	6/30/2025	Gonder, Jeff	Met On Time

		9.1.2.406	BEAM CORE Core Tools (NREL)	Task 8: POLARIS Coordination - Share identified potential future pathways for BEAM CORE and POLARIS with DOE.	Annual Milestone (Regular)	6/30/2025	Gonder, Jeff	Met On Time
		9.1.2.407	Energy Metrics in Traffic Signal Performance Measures	Report identifying feasibility and plan for integrating criteria pollutants into ATSPM-E	Quarterly Milestone Regular	6/30/2025	Fish, Joseph	Met On Time
		9.1.2.407	Energy Metrics in Traffic Signal Performance Measures	FY25 Q2 Milestone: ATSPM-E integration demonstrated at case study locations	Annual Milestone (Regular)	6/30/2025	Fish, Joseph	Delayed with DOE Approval
		9.1.2.408	National Impacts of Community-Level Strategies to Decarbonize and Improve Convenience of Mobility (NREL)	(ANL, NREL; Task 2): Preliminary POLARIS & TEMPO model runs in (a) all three of selected regions for one scenario, and (b) in at least one region for a second scenario.	Quarterly Milestone Regular	4/30/2025	Hoehne, Christopher	Met On Time
		9.1.2.408	National Impacts of Community-Level Strategies to Decarbonize and Improve Convenience of Mobility (NREL)	(ANL, LBNL, NREL; Task 2): Preliminary POLARIS & TEMPO runs in all regions and scenarios to enable final typology mapping to TEMPO modeling of all scenarios, and an overview of preliminary TEMPO inputs that utilize typology-classified outcomes from POLARIS. Final typology mapping will comprise of all aspects that TEMPO requires and summarizes from POLARIS inputs/outputs across the scenarios of interest to capture changes beyond the granularity TEMPO.	Quarterly Milestone Regular	6/30/2025	Hoehne, Christopher	Met On Time

		9.1.2.409	Multi-Region Stakeholder Driven BEAM CORE Application (NREL)	Task 3 – Report out on stakeholder engagement socializing demonstration plan with CARB, MPOs, etc.	Quarterly Milestone Regular	6/30/2025	Gonder, Jeff	Met On Time
		9.1.2.409	Multi-Region Stakeholder Driven BEAM CORE Application (NREL)	Task 1 – SynthFirm: baseline fleet generation with electrification; FRISM: Preliminary results on EV tour planning and on-demand delivery; BEAM-Freight: Preliminary parking and charging infrastructure siting and initial results from on-demand delivery.	Quarterly Milestone Regular	6/30/2025	Gonder, Jeff	Met On Time
		9.1.2.411	MEP Core Tools	Task 2.1: Calculate national-scale MEP scores at hex8 resolution for three modes (walk, bike, and drive) and six activity types (jobs, shopping, recreation, meals, hospitals, schools + religious centers). Aggregate the hex id level scores to known geospatial resolutions such as a city boundary, county, and state.	Quarterly Milestone Regular	6/30/2025	Garikapati, Venu	Met On Time
	Connectivity and Automation Technology	9.2.0.402	Improved Mobility and Energy Savings Through Optimization of CDA Application in Signal Controls for Arterial Mixed Traffic Scenarios	Task 1: Evaluate the current state of the art in cooperative driving automation (CDA) publication of the collection of review papers as book; the candidate publisher is Springer Nature	Quarterly Milestone Regular	6/30/2025	Wang, Qichao	Met On Time
		9.2.0.402	Improved Mobility and Energy Savings Through Optimization of CDA Application in Signal	Energy consumption sensitivity analysis of CDA technology on arterial applications to communication requirements, architecture and connected	Quarterly Milestone Regular	6/30/2025	Wang, Qichao	Met On Time

			Controls for Arterial Mixed Traffic Scenarios	and automated vehicle market penetration levels				

PUBLICATIONS & MEDIA OUTREACH

FY 2025 YTD NREL VT PUBLICATIONS – Q1–Q3

VT Publication Metrics

Publication Type	Q1	Q2	Q3	Total
Books/Chapters	0	0	1	1
Brochures	0	0	0	0
Conference Papers	9	9	0	18
Fact Sheets	10	2	0	12
Journal Articles	23	15	21	59
Newsletters	0	0	0	0
Other Marketing Materials	0	0	0	0
Patents	0	1	0	1
Posters	7	8	5	20
Presentations	19	8	15	42
Technical, Management, and Subcontractor Reports	16	8	8	32
Total YTD Publications	84	51	50	185

Note: This publications listing pertains to projects fully or partially funded by VTO.

VT Journal Article Impact Factors: Q1–Q3 FY 2025

Article	Journal	Impact Factor
Acetolysis for Epoxy-Amine Carbon Fibre-Reinforced Polymer Recycling	*Nature*	50.5
Assessing Cathode-Electrolyte Interphases in Batteries	*Nature Energy*	49.7
Addressing Inherent Challenges to Chemical Relithiation of Cycled End-of-Life Cathode Materials	*Advanced Energy Materials*	24.4
Heterogeneity of the Dominant Causes of Performance Loss in End-of-Life Cathodes and Their Consequences for Direct Recycling	*Advanced Energy Materials*	24.4
The Origin of Improved Performance in Boron-Alloyed Silicon Nanoparticle-Based Anodes for Lithium-Ion Batteries	*Advanced Energy Materials*	24.4
Understanding Structural and Compositional Evolution during NMC Cathode Direct Recycling via Solid-State NMR	*Advanced Energy Materials*	24.4
Unveiling the Mechanism of Mn Dissolution Through a Dynamic Cathode-Electrolyte Interphase on $LiMn_2O_4$	*Advanced Energy Materials*	24.4
Solvent-Free Melt-Processed Cathode Mitigates Li Anode Instability in Polymer-Based Solid-State Batteries	*ACS Energy Letters*	19.3
Characterizing Hazardous Gases from NMC811 Materials and Coin Cells with TGA and Tube-Furnace FTIR-MS Evolved-Gas-Analysis	*Energy Storage Materials*	18.9
Tetrahedral Tilting and Lithium-Ion Transport in Halide Argyrodites Prepared by Rapid, Microwave-Assisted Synthesis	*Advanced Functional Materials*	18.5
Hydrogen Technology for Maritime Applications: A Review of Challenges, Opportunities, and Lessons from the Port Authority of New York and New Jersey	*Renewable and Sustainable Energy Reviews*	16.3
Repurposing Post-Consumer Polyethylene to Access Cross-Linked Polyethylene with Reprocessabilty, Recyclability, and Tunable Properties	*Angewandte Chemie - International Edition*	16.1
Finding Gaps in the National Electric Vehicle Charging Station Coverage of the United States	*Nature Communications*	14.7
Spontaneous Sodium Ion Storage Behaviors of Reduced Graphene Oxide Anodes Exceeding 100% Coulombic Efficiency by Modulated Ion Solvation	*Journal of Energy Chemistry*	14

Characterization of Pitch Carbon Coating Properties Affecting the Electrochemical Behavior of Silicon Nanoparticle Lithium-Ion Battery Anodes	*Journal of Materials Chemistry A*	10.7
Mechanical and Electrical Changes in Electrochemically Active Polyimide Binders for Li-Ion Batteries	*Journal of Materials Chemistry A*	10.7
Does Electric Mobility Display Racial or Income Disparities? Quantifying Inequality in the Distribution of Electric Vehicle Adoption and Charging Infrastructure in the United States	*Applied Energy*	10.1
Predicting U.S. Federal Fleet Electric Vehicle Charging Patterns Using Internal Combustion Engine Vehicle Fueling Transaction Statistics	*Applied Energy*	10.1
Soft Costs and EVSE - Knowledge Gaps As a Barrier to Successful Projects	*Applied Energy*	10.1
Insights Into Thermal Runaway Mechanisms: Fast Tomography Analysis of Metal Agglomerates in Lithium-Ion Batteries	*Journal of Energy Storage*	8.9
Directing Ion Transport and Interfacial Chemistry in Pnictogen-Substituted Thio-LISICONs	*ACS Applied Materials & Interfaces*	8.3
Fast-Charging Lithium-Ion Batteries: Synergy of Carbon Nanotubes and Laser Ablation	*Journal of Power Sources*	8.1
Stress Engineering for Crack and Dendrite Prevention in Solid Electrolytes via Ion Implantation	*Cell Reports Physical Science*	7.9
Generating Multi-Scale Li-Ion Battery Cathode Particles with Radial Grain Architectures Using Stereological Generative Adversarial Networks	*Communications Materials*	7.5
Reciprocal Ternary Molten Salts Enable the Direct Upcycling of Spent Lithium-Nickel-Manganese-Cobalt Oxide (NMC) Mixtures to Make NMC 622	*ChemSusChem*	7.5
a priori Uncertainty Quantification of Reacting Turbulence Closure Models Using Bayesian Neural Networks	*Engineering Applications of Artificial Intelligence*	7.5
Electrifying Education: Exploring the Electrification Potential of U.S. School Bus Fleets	*Transportation Research Part D: Transport and Environment*	7.3
Mitigating Calendar Aging in Si-NMC Batteries with Advanced Dual-Salt Glyme Electrolytes	*Chemistry of Materials*	7.2
Lignin-Derived Methoxyterephthalates for Performance-Advantaged Polymers and Plasticizers	*ACS Sustainable Chemistry & Engineering*	7.1
High-Heat Transfer Lithium-Ion Batteries: A New Era in Battery Thermal Management	*Applied Thermal Engineering*	6.1
Porous Mesh Manifold for Enhanced Boiling Performance	*Applied Thermal Engineering*	6.1

In Situ Multi-Tier Auto-Ignition Detection Applied to Dual-Fuel Combustion Simulations	*Combustion and Flame*	5.8
Policy Implications of Net-Zero Emissions: A Multi-Model Analysis of United States Emissions and Energy System Impacts	*Energy and Climate Change*	5.8
Enriching OpenStreetMap Network Data for Transportation Applications: Insights Into the Impact of Urban Congestion on Accessibility	*Journal of Transport Geography*	5.7
A Comprehensive Assessment of the Marginal Abatement Costs of CO_2 of Co-Optima Multi-Mode Vehicles	*Energy & Fuels*	5.2
Chemical Kinetics Investigations of Dibutyl Ether Isomers Oxidation in a Laminar Flow Reactor	*Energy & Fuels*	5.2
Potential Adoption and Benefits of Co-Optimized Multimode Engines and Fuels for U.S. Light-Duty Vehicles	*Energy & Fuels*	5.2
PyFaults: A Python Toolkit for Stacking Fault Screening	*Journal of Applied Crystallography*	5.2
Cycloalkane-Rich Sustainable Aviation Fuel Production via Hydrotreating Lignocellulosic Biomass-Derived Catalytic Fast Pyrolysis Oils	*Sustainable Energy & Fuels*	5
One-Step Atmospheric Microplasma Synthesis of an NMC-Type Lithium-Ion Battery Cathode	*Electrochemistry Communications*	4.7
Nanoporous Carbon Coatings Direct Li Electrodeposition Morphology and Performance in Li Metal Anode Batteries	*Batteries*	4.6
Development and Experimental Validation of a High-Power DC Distribution Testbed for Advanced Charging Infrastructure and Energy Management	*IEEE Transactions on Industry Applications*	4.2
A Consumer-Centric Approach to Quantify Efficiency of Receiving Goods Purchased via Online	*Transportation Research Interdisciplinary Perspectives*	3.9
Concavity-Based Local Erosion and Sphere-Size-Based Local Dilation Applied to Lithium-Ion Battery Electrode Microstructures for Particle Identification	*Computational Materials Science*	3.1
Impact of Electrolyte Solvent on $Li_4Ti_5O_{12}/LiNi_{0.90}Mn_{0.05}Co_{0.05}O_2$ Battery Performance for Behind-the-Meter Storage Applications	*Journal of the Electrochemical Society*	3.1
Evaluating the Impacts of Autonomous Electric Vehicles Adoption on Vehicle Miles Traveled and CO_2 Emissions	*Energies*	3
Operando Freezing Cryogenic Electron Microscopy of Active Battery Materials	*Microscopy and Microanalysis*	2.9
Lightweighting Cost Impacts on Market Adoption and GHG Emissions in U.S. Light-Duty Vehicle Fleet	*Environmental Research Communications*	2.5

Accelerating Innovative Energy Solutions Using Combustion Simulations	*Computing in Science & Engineering*	1.8
Connected Traffic Signal Coordination Optimization Framework Through Network-Wide Adaptive Linear Quadratic Regulator-Based Control Strategy	*Journal of Transportation Engineering, Part A: Systems*	1.8
Exploring Electrode-Level State-of-Charge and State-of-Health Dynamics in Lithium-Ion Battery Cells: Modeling and Experimental Identification	*Journal of Dynamic Systems, Measurement, and Control*	1.7
Analyzing School Bus Electrification in Richmond, Virginia	*Transportation Research Record*	1.6
Demographic Microsimulator for Integrated Urban Systems: Adapting Panel Survey of Income Dynamics to Capture the Continuum of Life	*Transportation Research Record*	1.6
In Situ Characterization of the Oxidation Behavior of Carbonate-Based Electrolytes for Lithium-Ion Batteries by Scanning Electrochemical Microscopy	*ACS Electrochemistry*	n/a
Investigating the Impact of Preparation Routes on the Properties of Copper-Decorated Silicon Particles As Anode Materials for Lithium-Ion Batteries	*Next Energy*	n/a
Metal Decoration of Si Particles via High-Energy Milling for Lithium-Ion Battery Anodes	*RSC Applied Interfaces*	n/a
Overcoming Limitations of Higher Biomass-Based Diesel Blends	*Biodiesel Magazine*	n/a
The Effect of Nanoparticle Size on Calendar and Cycle Lifetimes of Silicon Anode Lithium-Ion Batteries	*EES Batteries*	n/a
The State of Electric Vehicle Adoption in Colorado for Multifamily Versus Single-Family Dwellings: A Methodology for Quantifying Deviation from Parity	*Findings*	n/a
Total Average Impact Factor (for journals with impact factors)		**10.7**

VT Publications – Q3 FY 2025

Chapters

1. Furat, Orkun; Fuchs, Lukas; Finegan, Donal P.; Smith, Kandler; Schmidt, Volker. 2025. “Methods of Machine Learning and Spatial Stochastics for Characterizing the 3D Morphology of Battery Materials at Various Length Scales.” In *Multiscale and Multiphysics Modelling for Advanced and Sustainable Materials*, 113–125. doi.org/10.1007/978-3-031-84379-2_9.

Journal Articles

2. Adhikari, Pashupati R.; Pach, Gregory F.; Quinn, Joseph; Wang, Chongmin; Singh, Avtar; Prakash, Nina; Verma, Ankit; Colclasure, Andrew; Kliegle, Gabrielle A.; Veith, Gabriel M.; Neale, Nathan R.; Carroll, G. Michael. 2025. “The Origin of Improved Performance in Boron-Alloyed Silicon Nanoparticle-Based Anodes for Lithium-Ion Batteries.” *Advanced Energy Materials*: 2501074. doi.org/10.1002/aenm.202501074.
3. Arano, Khryslyn G.; Armstrong, Beth L.; Tomich, Anton W.; Chambers, Matthew S.; Quinn, Joseph; Meyer III, Harry M.; Kumara, Chanaka; Huey, Zoey; Jiang, Chun-Sheng; Wang, Chongmin; Johnson, Christopher S.; Unocic, Raymond R.; Veith, Gabriel M. 2025. “Investigating the Impact of Preparation Routes on the Properties of Copper-Decorated Silicon Particles As Anode Materials for Lithium-Ion Batteries.” *Next Energy* 8: 100335. doi.org/10.1016/j.nxener.2025.100335.
4. Bistline, John E. T.; Binsted, Matthew; Blanford, Geoffrey; Boyd, Gale; Browning, Morgan; Cai, Yongxia; Edmonds, Jae; Fawcett, Allen A.; Fuhrman, Jay; Gao, Ruying; Harris, Chioke; Hoehne, Christopher; Iyer, Gokul; Johnson, Jeremiah X.; Kaplan, P. Ozge; Loughlin, Dan; Mahajan, Megan; Mai, Trieu; McFarland, James R.; McJeon, Haewon; Melaina, Marc; Mousavi, Seyed Shahabeddin; Muratori, Matteo; Orvis, Robbie; Prabu, Amogh; Rossman, Charles; Sands, Ronald D.; Sarmiento, Luis; Showalter, Sharon; Sinha, Aditya; Starke, Emma; Stewart, Eric; Vaillancourt, Kathleen; Weyant, John; Wood, Frances; Yuan, Mei. 2025. “Policy Implications of Net-Zero Emissions: A Multi-Model Analysis of United States Emissions and Energy System Impacts.” *Energy and Climate Change* 6: 100191. doi.org/10.1016/j.egycc.2025.100191.
5. Brow, Ryan; Engtrakul, Chaiwat; Fink, Kae; McKalip, Nicholas; Schulze, Maxwell; Colclasure, Andrew. 2025. “One-Step Atmospheric Microplasma Synthesis of an NMC-Type Lithium-Ion Battery Cathode.” *Electrochemistry Communications* 177: 107985. doi.org/10.1016/j.elecom.2025.107985.
6. Chen, Xi Chelsea; Musgrove, Amanda L.; Preefer, Molleigh B.; Moy, Alexandra C.; Owensby, Kyra D.; Long, Oliver; Zhang, Pu; Demchuck, Zoriana; Ward, Thomas Zac; Armstrong, Beth L.; Verma, Ankit; Usseglio-Viretta, Francois; Colclasure, Andrew M.; Sahore, Ritu; Nelson Weker, Johanna; Veith, Gabriel M. 2025. “Solvent-Free Melt-Processed Cathode Mitigates Li Anode Instability in Polymer-Based Solid-State Batteries.” *ACS Energy Letters* 10 (7): 3188–3195. doi.org/10.1021/acsenergylett.5c00790.
7. Jonas, Tim; Borlaug, Brennan; Bruchon, Matthew; Wood, Eric. 2025. “Electrifying Education: Exploring the Electrification Potential of U.S. School Bus Fleets.” *Transportation Research Part D: Transport and Environment* 144: 104801. doi.org/10.1016/j.trd.2025.104801.
8. Kirwa, Cyrus; Wang, Evelyna; Son, Seoung-Bum; Preimesberger, Juliane; Dogan Key, Fulya; Bai, Yaocai; Pupek, Krzysztof; Luo, Hongmei; Keyser, Matthew; Coyle, Jaclyn. 2025. “Addressing Inherent Challenges to Chemical Relithiation of Cycled End-of-Life Cathode Materials.” *Advanced Energy Materials*: 2501809. doi.org/10.1002/aenm.202501809.
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11. Piggott, Alfred J.; Allen, Jeffrey S.; Pesaran, Ahmad A. 2025. “High-Heat Transfer Lithium-Ion Batteries: A New Era in Battery Thermal Management.” *Applied Thermal Engineering* 272: 126347. doi.org/10.1016/j.applthermaleng.2025.126347.
12. Rosetto, Gloria; Chism, Katherine A.; Cardinale, Luana; Lazarenko, Daria; Curley, Julia B.; Wernke, Kevin M.; Hamernik, Levi J.; Lincoln, Clarissa; Haugen, Stefan J.; Ramirez, Kelsey J.; Konev, Mikhail O.; Liu, Xuan; Knott, Brandon C.; Rorrer, Nicholas A.; Stahl, Shannon S.; Beckham, Gregg T. 2025. “Lignin-Derived Methoxyterephthalates for Performance-Advantaged Polymers and Plasticizers.” *ACS Sustainable Chemistry & Engineering* 13 (17): 6342–6354. dx.doi.org/10.1021/acssuschemeng.5c01330.
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15. Sun, Bingrong; Sharda, Shivam; Garikapati, Venu M.; Bouzaghrane, Mohamed Amine; Caicedo, Juan; Ravulaparthy, Srinath; Lima, Isabel Viegas de; Jin, Ling; Spurlock, C. Anna; Waddell, Paul. 2025. “Demographic Microsimulator for Integrated Urban Systems: Adapting Panel Survey of Income Dynamics to Capture the Continuum of Life.” *Transportation Research Record*. doi.org/10.1177/03611981251333339.
16. Thomas, Charlotte; Zhang, Wei; Chancey, Matthew Ryan; Michiel, Marco Di; Garman, Kaitlin; Wang, Yangyang; Harris, Stephen; Finegan, Donal; Wang, Yongqiang; Ban, Chunmei. 2025. “Stress Engineering for Crack and Dendrite Prevention in Solid Electrolytes via Ion Implantation.” *Cell Reports Physical Science* 6 (4): 102544. doi.org/10.1016/j.xcrp.2025.102544.
17. Venturelli, Matteo; Broche, Ludovic; Buckwell, Mark; Pfaff, Jonas; Fordham, Arthur; Kirchner-Burles, Charlie; Reid, Hamish T.; Gedara, Mahesh Thalwaththe; Schopferer, Sebastian; Finegan, Donal P.; Robinson, James; Jervis, Rhodri; Rack, Alexander; Darcy, Eric; Shearing, Paul; Fransson, Matilda. 2025. “Insights Into Thermal Runaway Mechanisms: Fast Tomography Analysis of Metal Agglomerates in Lithium-Ion Batteries.” *Journal of Energy Storage* 131 (Part A): 117122. doi.org/10.1016/j.est.2025.117122.
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19. Wang, Tao; Wang, Xin; Luo, Huimin; Fan, Juntian; Wang, Qingju; Yang, Zhenzhen; Bai, Yaocai; Fink, Kae; Walker, Patrick; Belharouak, Ilias; Dai, Sheng. 2025. “Reciprocal Ternary Molten Salts Enable the Direct Upcycling of Spent Lithium-Nickel-Manganese-Cobalt Oxide (NMC) Mixtures to Make NMC 622.” *ChemSusChem*: 2500571. doi.org/10.1002/cssc.202500571.
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Posters

23. Jonas, Tim; Borlaug, Brennan; Bruchon, Matthew. 2025. “Empowering Tomorrow: The Electrification Potential of U.S. School Bus Fleets (Citation Only).” Presented at the Transportation Symposium on Environment, Energy, and Livable Economies, 25–28 Aug. 2024, Denver, CO.
24. Otten, Rhys A.; Gallawa, Jessica R.; Soliman, Hala E.; Peters, Autumn N.; Kirwa, Cyrus K.; Perez, Monika J.; Fink, Kae; Colclasure, Andrew M.; Prieto, Amy L.; Smith, Kandler. 2025. “Lifetime Extension of Alloying Anodes for Lithium-Ion and Sodium-Ion Batteries (Citation Only).” Presented at the 2025 Gordon Research Conference on Nanomaterials for Applications in Energy Technology, 23–28 Feb. 2025, Ventura, CA.
25. Palmer, Katie; Schulze, Max; Colclasure, Andrew; Maughan, Annalise. 2025. “Enabling Scalable Production of Composite Solid-State Lithium Electrolytes (Citation Only).” Presented at Graduate Research and Discovery Symposium (GRADS), 1–3 April 2025, Golden, CO.
26. Parish, Marli; Paul, Shane; Wilson, Alana. 2025. “Community-Controlled Transportation: The Western New York E-Bike Library Network (Citation Only).” Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington, D.C.
27. Preimesberger, Juliane I.; Usseglio-Viretta, Francois L. E.; Verma, Ankit; Singh, Avtar; Colclasure, Andrew M.; Walker, Patrick; Teeter, Glenn; Pach, Gregory F.; Westgard, John; Urias-Cordero, Fernando; Neale, Nathan R.; Coyle, Jaclyn E.; Carroll, Michael. 2025. “The Cycle and Calendar Life of Ultra-Small Silicon Nanoparticles (Citation Only).” Presented at the Nanomaterials for Applications in Energy Technology Gordon Research Conference (GRC), 23–28 Feb. 2025, Ventura, CA.

Presentations

28. Acharya, Sailesh; Allen, Michael; Garikapati, Venu. 2025. “Developing Congestion Factors to Enhance Accurate Accessibility Calculation Using OSM Dataset (Citation Only).” Presented at the International Conference on Transportation and Development (ICTD 2024), 15–18 June 2024, Atlanta, GA.
29. Burrell, Anthony. 2025. “Low-Pressure All-Solid State Cells (Citation Only).” Presented at the U.S. Department of Energy (DOE) Vehicle Technologies Office (VTO) 2024 Annual Merit Review, 3–6 June 2024, Arlington, VA.
30. Garikapati, Venu. 2025. “Future of Mobility (Citation Only).” Presented at the 2023 Urban Tech Academy, 13 Nov. 2023, New York, NY.
31. Gearhart, Chris. 2025. “H2 Briefing - Medium and Heavy Duty Working Group (Citation Only).”
32. Jeong, Kyungsoo; Lustbader, Jason; Birky, Alicia; Wang, Qichao; Ugirumurera, Juliette; Harris, Tom; Morris, James; Dick, C. Tyler; Kontou, Eleftheria; Anderson, Garrett; Xie, Weiwen; Mesineni, Shilpa; Schlenker, Marty. 2025. “INFORMES: Intermodal Freight Optimization for a Resilient Mobility Energy System (Citation Only).”
33. Lustbader, Jason. 2025. “INFORMES - InCoDis: Intelligence for Constructive Disruption of the National Intermodal Freight System (Citation Only).” Presented at the ARPA-E INTERMODAL Annual Meeting, 10 Jan. 2025, Washington, D.C.
34. Narumanchi, Sreekant. 2025. “Advanced Power Electronics and Electric Machines (APEEM) Packaging, Thermal Management, and Reliability for Electric-Drive Vehicles (Citation Only).” Presented at the ASME TEC Talk Webinar, 26 Sept. 2024.
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36. Neale, Nathan. 2025. “From Milligrams to Kilograms: Taking a Lab Discovery to a Lithium-Ion Battery Anode Technology (Citation Only).” Presented at the American Chemical Society (ACS) Spring 2025 Meeting & Expo, 23–27 March 2025, San Diego, CA.
37. Neale, Nathan. 2025. “Silicon Anodes from Plasma-Enhanced Chemical Vapor Deposition of Silicon Nanoparticles (Citation Only).” Presented at the Center for Research in Extreme Batteries 2024/2025 Winter Meeting, 24 Jan. 2025, College Park, MD.
38. Paret, Paul; DeVoto, Doug; Major, Josh; Narumanchi, Sreekant. 2025. “Reliability of Bonded Interface Materials for Power Electronics (Citation Only).” Presented at the 2024 IEEE REPP Symposium, 7–8 Nov. 2024, West Lafayette, IN.

39. Paret, Paul; Glaws, Andrew; Narumanchi, Sreekant. 2025. “Artificial Intelligence (AI) and Machine Learning (ML) for Power Electronics for Electric-Drive Vehicles (Citation Only).” Presented at the 2024 InterPACK Conference & Exhibition, 8–10 Oct. 2024, San Jose, CA.
40. Thurlbeck, Alastair P.; Siddique, Ashraf; Kisacikoglu, Mithat John; Sozer, Yilmaz. 2025. “Virtual Resistance Control for an Active Battery Management System (Citation Only).” Presented at the 2025 IEEE Applied Power Electronics Conference and Exposition (APEC), 16–20 March 2025, Atlanta, GA.
41. Wheelis, Abigail; Barry, Sebastian; Shankari, K. 2025. “Mobility Behavior in Lao PDR: Early Collection Results (Citation Only).” Presented at the Bridging Transportation Researchers (BTR) Conference, 7–8 Aug. 2024.
42. Yin, Zehui; Rybarczyk, Greg; Zheng, Anran; Su, Lin; Sun, Bingrong; Yan, Xiang. 2025. “Shared Micromobility as a Last-Mile Transit Solution? Insights from a Novel Dataset (Citation Only).” Presented at the Transportation Research Board (TRB) 103rd Annual Meeting, 7–11 Jan. 2024, Washington, D.C.

Technical Reports

43. Birky, Alicia; Sittler, Lauren; Yip, Arthur; Yang, Fan; Polemis, Katerina. 2025. *HD ADOPT: Heavy-Duty Vehicle Choice Model Documentation*. www.nrel.gov/docs/fy25osti/92890.pdf.
44. Holden, Jacob; Reinicke, Nicholas; Hoshiko, Joshua; Gonder, Jeffrey. 2025. *Route Energy Prediction (RouteE) Powertrain Validation Report*. www.nrel.gov/docs/fy25osti/83057.pdf.
45. Liu, Bo; Jonas, Tim; Podkaminer, Kara; Borlaug, Brennan. 2025. *Hourly Load Profile Dataset for Electric Transit Bus Depots in the United States*. www.nrel.gov/docs/fy25osti/92140.pdf.
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49. Singer, Mark; Hodge, Cabell; Podkaminer, Kara; Borlaug, Brennan. 2025. *Hourly Load Profile Dataset for Federal, State, and Municipal Electric Vehicle Fleets in the United States*. www.nrel.gov/docs/fy25osti/92142.pdf.
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VT Publications – Q2 FY 2025

Conference Papers

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3. Jackson, Derek; Ucer, Emin; Kisacikoglu, Mithat John; Thurlbeck, Alastair. 2025. “A Comparison of AC and DC Distribution Architectures for Electric Vehicle High Power Charging Facilities.” Presented at the 2024 IEEE Energy Conversion Congress and Exposition (ECCE), 20–24 Oct. 2025, Phoenix, AZ. doi.org/10.1109/ECCE55643.2024.10861280.
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8. Ucer, Emin; Pawaskar, Vaibhav; Jackson, Derek; Thurlbeck, Alastair; Watt, Ed; Kisacikoglu, Mithat John. 2025. “Hybrid Energy Management with Real-Time Control of a High-Power EV Charging Site.” Presented at the 2024 IEEE Energy Conversion Congress and Exposition (ECCE), 20–24 Oct. 2024, Phoenix, AZ. dx.doi.org/10.1109/ECCE55643.2024.10861282.
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Fact Sheets

10. 2025. “Electric Vehicle Basics (French Translation).” www.nrel.gov/docs/fy25osti/90243.pdf.
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12. Arano, Khryslyn G.; Armstrong, Beth L.; Sacci, Robert L.; Chambers, Matthew S.; Jiang, Chun-Sheng; Quinn, Joseph; Meyer, III, Harry M.; Tomich, Anton W.; Musgrove, Amanda; Lam, Steven; Toups, Elena; Wang, Chongmin; Johnson, Christopher S.; Veith, Gabriel M. 2025. “Metal Decoration of Si Particles via High-Energy Milling for Lithium-Ion Battery Anodes.” *RCS Applied Interfaces* 2: 648–664. doi.org/10.1039/D4LF00393D.

13. Benoliel, Peter; Taylor, Margaret; Coburn, Timothy; Desai, Ranjit R.; Schey, Stephen; Gerdes, Mindy; Peng, Peng. 2025. “Soft Costs and EVSE - Knowledge Gaps As a Barrier to Successful Projects.” *Applied Energy* 389: 125749. doi.org/10.1016/j.apenergy.2025.125749.
14. Fuchs, Lukas; Furat, Orkun; Finegan, Donal P.; Allen, Jeffery; Usseglio-Viretta, Francois L. E.; Ozdogru, Bertan; Weddle, Peter J.; Smith, Kandler; Schmidt, Volker. 2025. “Generating Multi-Scale Li-Ion Battery Cathode Particles with Radial Grain Architectures Using Stereological Generative Adversarial Networks.” *Communications Materials* 6: 4. doi.org/10.1038/s43246-024-00728-5.
15. Hanig, Lily; Ledna, Catherine; Nock, Destenie; Harper, Corey D.; Yip, Arthur; Wood, Eric; Spurlock, C. Anna. 2025. “Finding Gaps in the National Electric Vehicle Charging Station Coverage of the United States.” *Nature Communications* 16: 561. doi.org/10.1038/s41467-024-55696-8.
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18. Ou, Wenhan; Marks, Samuel D.; Ferreira de Menezes, Rafael; He, Rong; Zhang, Zihan; Sindt, Collin; Thurston, Jonathan; Jaye, Cherno; Cowie, Bruce; Thomsen, Lars; Zhuo, Zengqing; Guo, Jinghua; Yang, Wanli; Dong, Ziyue; Tenent, Robert; Sprenger, Kayla G.; Toney, Michael F. 2025. “Unveiling the Mechanism of Mn Dissolution Through a Dynamic Cathode-Electrolyte Interphase on $LiMn_2O_4$.” *Advanced Energy Materials*. doi.org/10.1002/aenm.202404652.
19. Pereira, Drew J.; Schulze, Maxwell C.; Ha, Yeyoung; Zhang, Yicheng; Gim, Jihyeon; Trask, Stephen E.; Kahvecioglu, Ozgenur; Teeter, Glenn R.; Burrell, Anthony K.; Harrison, Katharine L. 2025. “Impact of Electrolyte Solvent on $Li_4Ti_5O_{12}$/$LiNi_{0.90}Mn_{0.05}Co_{0.05}O_2$ Battery Performance for Behind-the-Meter Storage Applications.” *Journal of the Electrochemical Society* 172 (2): 020527. doi.org/10.1149/1945-7111/adb51f.
20. Popeil, Melissa; Usseglio-Viretta, Francois L. E.; Pu, Xiaofei; Gasper, Paul; Dutta, Nikita; Wang, Evelyna; Allen, Eva; Mangum, John S.; Sunderlin, Nathaniel; Fink, Kae; Allen, Jeffery M.; Weddle, Peter J.; DeCaluwe, Steven C.; Finegan, Donal P. 2025. “Heterogeneity of the Dominant Causes of Performance Loss in End-of-Life Cathodes and Their Consequences for Direct Recycling.” *Advanced Energy Materials*: 2405371. doi.org/10.1002/aenm.202405371.
21. Preimesberger, Juliane I.; Usseglio-Viretta, Francois L. E.; Verma, Ankit; Singh, Avtar; Colclasure, Andrew M.; Walker, Patrick; Teeter, Glenn; Pach, Gregory F.; Westgard, John; Urias-Cordero, Fernando; Neale, Nathan R.; Coyle, Jaclyn E.; Carroll, G. Michael. 2025. “The Effect of Nanoparticle Size on Calendar and Cycle Lifetimes of Silicon Anode Lithium-Ion Batteries.” *EES Batteries* 1: 298–309. doi.org/10.1039/D4EB00020J.
22. Sattarzadeh, Sara; Colclasure, Andrew M.; Smith, Kandler; Li, Xuemin; Dey, Satadru. 2025. “Exploring Electrode-Level State-of-Charge and State-of-Health Dynamics in Lithium-Ion Battery Cells: Modeling and Experimental Identification.” *Journal of Dynamic Systems, Measurement, and Control* 147 (4): 041012. doi.org/10.1115/1.4067951.
23. Shotwell, Austin M.; Schulze, Maxwell C.; Yox, Philip; Alaniz, Cade; Maughan, Annalise E. 2025. “Tetrahedral Tilting and Lithium-Ion Transport in Halide Argyrodites Prepared by Rapid, Microwave-Assisted Synthesis.” *Advanced Functional Materials.* doi.org/10.1002/adfm.202500237.
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NREL'S **VTO TEAM**

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Energy Storage – Advanced Cathode Material Development ..... **Rob Tenent**
Energy Storage – Materials Development and Modeling ..... **Andrew Colclasure**
Legislative/Regulatory Support ..... **Erin Andrews-Sharer**
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Mobility Systems ..... **Andrew Duvall**
Power Electronics & Electric Machines ..... **Doug DeVoto and Gilbert Moreno**
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