FY25 Q2 PROGRESS UPDATE
APRIL 2025

Vehicle Technologies

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R&D HIGHLIGHTS

BATTERY TECHNOLOGIES

Battery R&D

Redox Mediator Relithiation Successfully Restores Cycle Performance of End-of-Life Cathode Materials

NREL researchers are developing approaches to scale up direct recycling of cathode materials using redox mediator relithiation—a process that seeks to restore inactive lithium and extend the life of battery materials within the domestic supply chain. Relithiated cells must demonstrate excellent cycle performance to ensure this method can successfully reintroduce recycled batteries into the marketplace. Researchers evaluated nickel manganese cobalt (NMC) 622 material from commercial cells cycled to 20% capacity loss to determine how the altered surface chemistry and structural degradation of a cycled NMC cathode material affects lithium restoration efficiency. The results show that full cell cycle performance of redox mediator relithiated NMC materials was comparable to pristine NMC performance. Researchers will continue to explore opportunities to decrease costs associated with this technique by analyzing the reusability of the redox mediator solution through multiple applications. In addition, researchers plan to verify this method can apply to additional compositions of end-of-life commercial cathodes, such as lithium iron phosphate.

Data Repository Supports Accelerated Life Prediction for Heavy-Duty Vehicle Batteries

Shared access to crucial battery data is key to supporting nationwide research on electrified heavy-duty vehicles. NREL researchers consolidated recent insights from battery degradation simulations within a GitHub repository, linked from DOE's Vehicle Technologies Office Battery Data Hub (batterydata.energy.gov). So far, the repository includes code for differential voltage-capacity fitting and electrochemical impedance spectroscopy analysis, with planned examples for processing/handling battery data, analyzing DC pulse using algebraic or equivalent circuit models, and predicting degradation trajectory. Ongoing collaboration between NREL and Idaho National Laboratory plans to add several more tools, pending their approval for open-source release.

Advanced Characterization To Guide and Validate the Design of Long-Life, Earth-Abundant Cathode Active Material Lithium-Ion Cells

The lithium-ion batteries widely used today depend on critical minerals, such as cobalt, that are susceptible to supply chain bottlenecks and volatile pricing. New battery designs, such as lithium- and manganese-rich (LMR) electrodes, use widely available materials to avoid supply concerns and ensure long-term viability of future battery technologies. However, LMR electrodes are currently unable to achieve the same performance as commercial electrodes. NREL researchers are using multimodal tomographic imaging to evaluate morphological and chemical changes causing degradation in LMR electrodes. Results show that LMR particles undergo significant damage during manufacturing and cycling, including severe cracking, crushing, and dissolution of transition metals during operation. Next, researchers will use X-ray diffraction to evaluate crystallographic degradation before publishing the complete results of these characterization efforts.

Reactive Molecular Dynamics Reveals Cathode-Electrolyte Interphase (CEI) Formation Pathways in Batteries

This research investigates how the electric double layer (EDL) structure governs CEI formation. Because interfacial reactions depend on local chemical environments, uncovering these correlations is essential. However, their molecular-level link remains largely unexplored, limiting progress in optimizing battery interfaces for improved performance and stability. The NREL research identified key CEI formation mechanisms and validated predictions using X-ray absorption spectroscopy on lithium manganese oxide cathodes, leading to a publication in *Advanced Energy Materials*. The simulations also revealed previously unknown EDL trends, which are still under evaluation. A forthcoming review paper summarizes past studies

and establishes a framework for atomistic simulations of EDL and CEI formation. The NREL team also initiated a collaboration with Sabrina Wan's team at Lawrence Livermore National Laboratory to further investigate battery interfaces. Although CEI formation is widely studied, the direct link between EDL structure and reaction pathways remains poorly understood. This work provides molecular-level insights into how surface charge and electrolyte composition drive interfacial reactions, offering a predictive framework for electrolyte and interface design—critical for improving battery stability and performance. Next steps include extending this approach to other cathode materials and exploring different electrolyte compositions to identify universal trends in EDL-CEI interactions and guide the development of next-generation battery chemistries.

New Modeling Frameworks Provide Uncertainty Analysis in Lifetime Prediction of Silicon Batteries

Silicon anodes are a promising advancement for lithium-ion batteries due to their high energy density, but batteries with silicon anodes typically demonstrate calendar lives of <2 years, far below the 10-year industry standard for commercialization. The NREL-led Silicon Consortium Project is leveraging integrated modeling and machine learning using early-life signals to predict calendar aging. However, experiments have cell-to-cell variability and contain noise, presenting a challenge for accurate predictions. In response, researchers are developing two expanded frameworks for early-life prediction based on parametric trajectory modeling to quantify uncertainty. The first predicts power law fade parameters using high-dimensional electrochemical features from early testing, with uncertainty quantification based on quantile loss, bootstrapping, and conformal intervals. The second uses Bayesian regression to quantify uncertainty using power law fade parameter distributions. By effectively capturing the effect of measurement noise, dataset variability, and lack of representative data on the resulting predictions, researchers can enable robust and well-informed decision-making on design iterations that influence calendar life.

ELECTRIFICATION TECHNOLOGIES

Electric Drive Technologies

Power Electronics Researchers Accelerate Development of Next-Generation Silicon Carbide Power Modules

In partnership with Eaton, one of the largest Tier 1 suppliers to the automotive industry, NREL researchers have successfully built and evaluated the performance of five highly efficient silicon carbide power modules using an advanced double-sided cooling method. These modules can enable increased efficiency in vehicle powertrains by lowering thermal resistance by up to 22%. Together with the University of Arkansas, NREL's power electronics researchers designed, fabricated, and experimentally evaluated the performance of the prototype power modules through power cycling and thermal cycling experimentation. The rigorous testing process revealed the potential for failure in the solder interconnects along the joints of the power module. This knowledge allows Eaton to improve the design and reliability of their next-generation silicon carbide power module.

Grid and Infrastructure

Researchers Develop Mechanism To Improve Safety of Lithium-Ion Batteries

NREL researchers have developed a proof of concept for a solid-state circuit breaker (SSCB) that can halt thermal runaway while allowing the rest of a battery to remain in service. Thermal runaway is a key safety issue for lithium-ion batteries and can lead to extremely high temperatures and fire. The SSCB isolates faulty lithium-ion battery cells in a pack to safely and quickly discharge them down to safer energy levels. NREL's solution has the potential to greatly increase the reliability and resiliency of behind-the-meter storage systems.

The proof-of-concept test involved controlled discharge testing with 20-Ah lithium iron phosphate prismatic battery cells from 0.5C to 5C discharge rates. The test demonstrated the feasibility of the SSCB design, which addresses design problems unique to low-voltage, high-current SSCBs, and provided essential data on its performance and thermal characteristics. The NREL team will test their second prototype SSCB board at a high, 10C discharge rate to validate its thermal performance when operating with a peak discharging current of 200 A. Then, the team will conduct a functional test with real/emulated thermal abuse to demonstrate the safe disconnect and discharge of the faulty cell.

OFF-ROAD, RAIL, MARINE, AND AVIATION TECHNOLOGIES

Heavy-Duty R&D

Evaluation of Synthetic Jet Fuel Soot Formation Mechanisms Supports Development of Improved Jet Fuels

Cycloalkanes are desirable components of synthetic jet fuels because of their high energy density, and they are found in many synthetic aviation turbine fuel blendstocks produced from biomass. Yale University evaluated the soot formation tendency for cycloalkanes formed from three different synthetic aviation turbine fuel production processes, and NREL conducted laminar flow reactor experiments that revealed how soot precursors form from cycloalkanes. NREL's experiments on these cycloalkanes show that cycloalkanes with fused rings (bicyclic cycloalkanes) more directly and rapidly form an aromatic ring—the primary soot precursor—than cycloalkanes with single rings (monocycloalkanes). Bicyclic cycloalkanes have higher energy density than monocycloalkanes, but monocycloalkanes tend to break down and form soot precursors more slowly than bicyclic cycloalkanes. Soot formation from jet fuel combustion during airplane takeoff and landing operations causes significant negative public health impacts near large airports. NREL's research to understand how fuels make soot will lead to improved fuels and air quality for the surrounding areas. Next, NREL plans to develop combustion kinetics simulations that can be used to simulate aerocombustor soot formation.

MATERIALS TECHNOLOGY

Lightweight Materials

Polyester Covalent Adaptable Network (PECAN) Hybrid Composites Exhibit Excellent Reproducibility, Carbon Fiber Recovery and Reuse

Many materials technologies being developed cannot be easily replicated while maintaining quality standards, especially when scaling up in production. NREL researchers fabricated PECAN hybrid composites five separate times and tested the flexural and tensile properties of the resulting materials. During these scenarios, researchers observed less than 15% variance between set averages (<10% variance within replicated sets), showing excellent reproducibility. Additionally, the composites were subject to low-temperature chemical deconstruction and yielded pristine-like fibers that were subsequently reused in composite manufacture. This demonstration furthers the technical readiness level of the PECAN materials by quantifying the expected variance in manufacturing. Additionally, successful fiber recovery and reuse only bolsters the impact of the

PECAN technology. NREL researchers will next evaluate alternative reinforcing materials to polyethylene for compatibility and performance, expanding the accessible phase space of the PECAN technology.

Natural Fiber Composites Offer a Promising Replacement for Glass Fiber Polypropylene Composites

Today's emergent composites for vehicles are often limited by their ability to be used just one time. Even routine materials like polypropylene are not easily reclaimable or recyclable at the end of life, leading to increasing material waste and a limited material supply chain. In this work, NREL researchers established a baseline for the performance of natural fiber composites made with a recyclable resin relative to glass fiber composites made with polypropylene resins. This work shows that similar performance is maintained between the two composite systems. However, the natural fiber mats can be synthesized from waste biomass, offering the potential to expand the material supply chain. Additionally, the recyclability afforded by the recyclable resin could further lower its cost. The research team partnered with Z&S Tech, the University of North Texas, and Columbia University to provide the baseline for material analysis and modeling. Further work will optimize material properties and analysis.

TECHNOLOGY INTEGRATION

Data and Systems

New Resource Provides Key Electric Vehicle (EV) Charging Network Information for Users

NREL developed a new page for EV charging networks (afdc.energy.gov/stations/charging-networks) on the Alternative Fuels Data Center to provide clarity about the difference between EV charging networks and other EV charging components, increase transparency around the timeliness of the data provided on the Alternative Fueling Station Locator, and ensure users have the most updated information. Page updates include definitions for network terms, the number of charging ports in each EV charging network, information on the methods for collecting Station Locator data, and details about how and when the data are imported from each charging network. The page also includes a table that will automatically update so it always reflects the current data in the tool. The Station Locator tool receives more traffic than any other tool on the Alternative Fuels Data Center, totaling more than 5 million page views and more than 20 million API requests in FY 2024.

Partnerships With Practitioners Advance Understanding of Shared Micromobility

Much of the work to support recent growth in shared micromobility, especially outside of major metropolitan areas, is done by community-based organizations. They have a wealth of knowledge about what does and does not work when it comes to providing more affordable and accessible transport options, but their knowledge has not been widely disseminated. To address knowledge gaps in the research and practitioner spaces, the NREL-led Technologist in Communities team partnered with Shared Mobility Inc., a community-based organization in Buffalo, New York, on a case study and research paper focused on the design of e-bike libraries. Such libraries serve as systems for borrowing and returning shared bicycles, typically for a week or more. The paper—"Community-Controlled Transportation: The Western New York E-Bike Library Network"—received strong positive feedback from federal, state, and local government sectors when it was presented at the 2025 Transportation Research Board Annual Meeting. This case study is both timely and important, as it aims to understand and support the recent rapid growth of less formal shared micromobility, exploring its implications for transportation affordability and energy efficiency. E-bikes can be viewed as substitutes for automobiles, reducing the economic barrier to car-equivalent transportation. They also require very little energy to operate, using about 10–15 watt-hours/mile compared to about 250 watt-hours/mile for an electric car and 1,300 watt-hours/mile for an internal combustion engine car. Next, the team plans to partner with Shared Mobility Inc. to document its charging practices and user education system across personally owned e-bikes, e-bike libraries, and e-bike-share program.

Analysis of Clean Cities and Communities (CC&C) Activities Shows Cumulative Impact of Coalitions

NREL's latest annual analysis of CC&C data shows how coalition activities generate emissions reductions and facilitate shifts in transportation energy use. CC&C coalitions collect these data to support the goals of the Energy Policy Act of 1992 (EPAct), which requires certain vehicle fleets to acquire alternative fuel vehicles. DOE created CC&C the following year to provide informational, technical, and financial resources to EPAct-regulated fleets and voluntary adopters of alternative fuels and vehicles. The latest assessment, published in the *Clean Cities and Communities Partnership 2023 Activity Report* (www.nrel.gov/docs/fy25osti/92098.pdf), showed a cumulative (1994–2023) emissions reduction of 81 million tons of greenhouse gases and an energy use impact of 15 billion gasoline gallon equivalents. Energy use impact measures combined progress in energy savings from efficiency projects and increased fuel diversity, through use of domestic alternative fuels. Coalitions generated these impacts by advancing the adoption of alternative and renewable fuels, idle reduction measures, fuel economy improvements, and emerging transportation technologies. NREL's analysis provides concrete evidence that CC&C is a successful framework for advancing transportation energy solutions nationwide. NREL will continue generating annual coalition activity reports and is adopting the annual reporting tool to facilitate streamlined quarterly reporting for coalitions.

NREL Analysis Sets the Stage for Validation of New Charging Controls

As part of the Athena Project, NREL has taken a critical step toward validating new smart charge management (SCM) technologies to help sites like airport car rental facilities prepare for increased coincident charging demand as they grow the number of EVs in their fleets. NREL's approach enables researchers to assess communication and algorithmic complexity at scale, while optimizing power needs. The team developed new SCM algorithms that will allow sites to avoid increased peak demand and potential costly equipment upgrades by coordinating EVs with facility loads and distributed energy resource assets, ensuring site loads remain within grid capacity constraints. The team also conducted cutting-edge EV supply equipment performance characterization to inform controller hardware-in-the-loop physics models that emulate more than 100 pieces of EV supply equipment sending and receiving real-world protocol messages. These models will be used in controller hardware-in-the-loop scenarios to validate the new SCM, stress-testing the technology to ensure energy objectives are met in real time with dynamic responses. The EV supply equipment models will allow the researchers to verify full systems integration between transportation, facility, and grid needs under power ceiling limits. Results will prepare the technology for field demonstrations at scale or further refinement of SCM integration with fleet operations for more precise forecasts and load management.

Replicable Stakeholder Engagement Workshop Strengthens Core Capabilities of CC&C Partnership

NREL developed and facilitated an interactive stakeholder engagement workshop for CC&C coalition staff and interns to build their capacity to create and maintain the relationships necessary to sustain a coalition. Nearly 16,000 stakeholders are part of CC&C coalitions nationwide, representing fleets, industry, academia, and nonprofits. Effective engagement enables coalitions to successfully support local and regional transportation markets and provides a conduit for NREL to gather crucial insights that facilitate strategic responses to research and deployment needs. NREL's workshop covered stakeholder identification, engagement versus outreach, bidirectional value propositions, and stakeholder relationship management skills. NREL plans to offer an expanded version of this workshop in the future and is adapting the content to create online learning modules that will be accessible to all coalition staff.

Hands-On Workshop Fosters Skills To Craft Compelling Grant Proposal Concepts

NREL developed and executed an in-person, hands-on grant writing workshop to build the capacity of CC&C coalitions to craft compelling proposal concepts. Participants engaged in pre-writing visioning and planning activities and learned how to write project narratives that clearly convey how their proposed project aligns with a funder's goals. The workshop was designed to maximize engagement by blending individual work with large- and small-group discussions while minimizing lecture time. NREL also created a workbook that allowed attendees to practice what they were learning and incrementally build a proposal narrative, so they left the workshop with a tangible product. This workshop was part of a series of grant trainings for coalitions, and NREL is currently creating the next training on grant budget development.

CC&C Coalition Transition Ensures Access to Advanced Transportation Expertise Continues in Iowa

NREL provides critical guidance to CC&C coalitions navigating organizational changes, facilitating their ability to remain a DOE-designated coalition in the CC&C partnership. In Q2, NREL helped successfully transition the Iowa Clean Cities Coalition to a new host organization, nearly a year after the previous organization announced they could no longer host the coalition. This effort involved leveraging NREL's deep familiarity with coalition operations and expertise in organizational management to develop transition options, engage key stakeholders, and identify and vet new host candidates. Moving through this process instead of disbanding the coalition ultimately resulted in a stronger coalition serving transportation stakeholders in Iowa, hosted by an organization that will collaborate with a new advisory board to foster long-term support of the CC&C mission. NREL is engaging in other coalition-building efforts with other coalitions and will apply the Iowa model when similar transitions are needed to help ensure local transportation stakeholders continue to have access to the expertise provided by CC&C coalitions.

ANALYSIS

Data

Fleet Research, Energy Data, and Insights (FleetREDI) Analysis Finds Opportunities for Rural Truck Platooning

While truck platooning has the potential to reduce energy use and operating costs for national freight movement, most platooning studies have focused on major interstates without acknowledging the unique challenges of rural mobility—such as roads that may lack robust lane markings and separation. Now, NREL researchers have teamed up with DriveOhio to create a real-world picture of truck platooning on rural roads. The unique dataset shows that rural truck drivers were able to utilize platooning for the majority—51%—of their traveled miles, meaning that significant opportunities exist for drivers to utilize platooning on the rural routes that form a critical part of our freight supply chain. These findings will be available as a research highlight on the FleetREDI website, and the new dataset will be available to users through the Livewire platform. The NREL research team plans to expand the analysis to identify additional opportunities for increased operational efficiency.

Modeling

Research Informs Update of TEMPO Model's Representation of Vehicle Ownership and Preferences

Improving the understanding of owners' personal light-duty vehicle preferences of vehicle cost, age, and powertrain and how they are distributed across the United States is key to enhancing models that depict new powertrain adoption for both new and used vehicles. An NREL research team has analyzed several datasets—including the National Household Travel Survey, Experian, and the U.S. Census Bureau's American Community Survey and Public Use Microdata Areas—to develop a robust model that captures household vehicle preferences. The model accounts for factors such as vehicle age, upfront costs, and operating and maintenance costs. Still under development, this model will ultimately be integrated into NREL's flagship Transportation Energy & Mobility Pathway Options (TEMPO™) model. Understanding the likely adoption of alternative vehicle powertrains is important to prepare for an increase in alternative fuel vehicles. Understanding the population characteristics of likely adopters enables improved planning and forecasting. Next steps involve further improving the model's calibration via evaluation and hindcasting.

Applied Analysis

Analysis Quantifies EV Charging Demand Flexibility Potential in the United States

The extent of EV demand flexibility—particularly across vehicle types, charger types, locations, and times of day—remains highly uncertain. A lack of detailed modeling prevents grid planners and operators from understanding and fully leveraging this latent resource. To address this gap, researchers are quantifying the potential of EV demand flexibility, assessing its implications for grid integration, and assessing its evolution through 2050. They are also evaluating how alternative EV charging infrastructure deployment strategies may influence flexibility. Their findings offer actionable data and recommendations to help grid planners and researchers develop optimized managed charging strategies while informing infrastructure planning and policy decisions to maximize the benefits of EVs for the grid. Effectively managing EV loads on the power system can enhance grid stability, lower costs, and reduce the curtailment of renewables. Study results will be published in a forthcoming journal article.

LAB-BASED CROSSCUTTING PROJECTS

Locomotive Survey To Identify Energy Use at a National Scale

Industrial locomotives represent significant opportunities for innovation: The current stock largely comprises older models, which can be costly to operate, and their localized operations are well suited to emerging technologies that could reduce operating costs, energy, and emissions. But because there are so few data on the number of industrial locomotives in use by private companies or their age, fuel consumption, or emissions, it is difficult to develop effective research strategies or measure the potential impact of technology investments. In response, NREL researchers have defined a new methodology to estimate total locomotive energy use and harmful emissions from usage data collected from locomotive owners and operators. Together with informed assumptions from literature, NREL can extrapolate these estimates at a national scale. NREL is now poised to begin conducting data collection and preliminary analyses, including extrapolation of collected results.

ENERGY EFFICIENT MOBILITY SYSTEMS (EEMS)

Computational Modeling and Simulation

New Geographic Search Function Allows More Targeted User Analysis for Livewire Transportation Project Data

The Livewire Data Platform team added a new geographic search feature, allowing users to easily find data by location and conduct spatially targeted analyses for transportation projects. This feature opens doors to new analysis topics by enabling users to study datasets based on elements such as weather. Livewire users can search for datasets using geographic information such as state, and latitude and longitude information is also available for all public datasets. The new search feature is available in the platform's "Datasets" section, and a map visualizes the geographic distribution of the datasets. Users can click on the map to zoom into datasets from a particular region or state, enter a search term, or layer multiple search features to further refine their research. The Livewire team plans to add the ability to further filter data by date.

NREL OpenPATH Updates Reduce Cost of Collecting Travel Behavior Data From Stakeholders

The increased number of deployments supported by NREL's Open Platform for Agile Trip Heuristics (NREL OpenPATH™) has led to backend scalability issues and slower response times for phone app users and administrators accessing the dashboard, requiring enhancements to ensure a positive user experience. Similarly, operating costs have also increased, primarily due to increased input/output loads on the DocumentDB database service. Changes made last quarter improved the scalability of the administrator dashboard but resulted in higher input/output loads and more timeouts in the app. To remedy this, the research team reverse-engineered the inconsistent DocumentDB behavior that restored user performance to prior levels while maintaining increased scalability. Next, the team plans to reduce the burden on the database service and improve consistency in how the system behaves between development and production.

Enhanced Demographic Microsimulation Tool Expands User Access and Flexibility

The Demographic Microsimulator (DEMOS) models the evolution of individual and household populations, enabling realistic behavior forecasting to inform transportation and urban planning. It simulates the occurrence and sequence of life cycle events—such as birth, marriage, divorce, employment, and mortality—and supports the modeling of transportation and housing choices where demographic events play an important role. Previously, DEMOS depended on a third-party tool that potential users such as metropolitan planning organizations can lack access to. To remedy this, researchers developed a stand-alone version of DEMOS by removing dependencies on the third-party tool, restructuring the modules, and streamlining the data flow, enabling broader adoption and easier integration into diverse transportation and urban planning workflows. The stand-alone version also offers greater flexibility, allowing users to incorporate customized inputs. A comparison of the outputs from both the previous version and the new version confirmed that the tool's functionality was preserved. Next, researchers will continue refining and developing the stand-alone version of DEMOS before publishing it on GitHub, making it widely accessible.

RouteE Commercialization Opportunities To Accelerate the Transition to Energy-Efficient Fleets

Improving transit and commercial fleets with the addition of more efficient vehicles requires tools for accurate energy modeling and route optimization. NREL's Route Energy Prediction (RouteE) modeling tools address this, enabling informed decisions for diverse, energy-efficient fleet deployments. Deploying RouteE capabilities with external partners provides the most viable option for reaching more end users and driving broader adoption. A prototype dashboard clearly conveyed NREL's vision for end use and allowed transit stakeholders to validate it. With funding from the Federal Transit Administration, researchers are actively deploying RouteE by developing a low-/no-emission bus selection tool for transit agencies. They are also collaborating with the startup ReVolt to incorporate RouteE and other NREL capabilities into the company's bus fleet operations software. Optimized vehicle selection is crucial for integrating energy-efficient technologies into fleets, benefiting both the public and private sectors by providing cost saving and efficiency improvement opportunities.

New Model More Accurately Predicts On-Road Operating Speeds, Enhancing Accessibility Analysis Metric

While OpenSteetMap (OSM) provides speed limits, it lacks operating speeds, which can lead to inflated accessibility scores when speed limits are used as a substitute for actual travel speeds. To address this limitation, researchers developed a national-scale model using observed speed data to predict operating speeds on OSM network links, enabling more accurate accessibility calculations with NREL's Mobility Energy Productivity (MEP) metric. NREL's approach integrates multiple data sources, including speed limits, link and traffic characteristics, and points of interest from OSM; historical probe speeds from a commercial vendor; and population and employment data from the census. Several machine-learning models were trained to predict operating speeds on network links; the best-performing models were selected for prediction. Accessibility calculation results—using operating speeds from the developed models versus OSM speed limits—can identify urban areas where congestion significantly impacts access to mobility options. This information is essential for prioritizing congestion management strategies to improve accessibility. Next, researchers will use the MEP metric to compare accessibility scores calculated using OSM speed limits with those derived from operating speeds predicted by national-scale models for several cities.

Walking Comfort Index Incorporated Into MEP Tool for Enhanced Pedestrian Accessibility Measure

An NREL research team has incorporated walking comfort calculations into the MEP tool, providing a more realistic assessment of how well walking infrastructure supports pedestrian mobility and access to various opportunities. By incorporating factors such as sidewalks, traffic signals, cycleway tags, and maximum allowable speed, the Walking Comfort Index enhances the assessment of walk accessibility in urban environments. This in turn enables cities and planning agencies to better assess pedestrian infrastructure, identify gaps, and prioritize projects that enhance walkability. A pedestrian-friendly environment supports improved transportation and public health and increases convenience to key destinations such as transit stops, workplaces, and recreational areas. Next steps involve expanding the methodology to compute MEP scores for five cities, refining the approach, and comparing nonmotorized accessibility to provide insights into pedestrian infrastructure across urban environments.

AOP CHANGES

A compilation of all Q2 FY 2025 Annual Operating Plan (AOP) changes recorded to date is provided on the next page.

MILESTONE STATUS

Forty-eight Q2 milestones have been completed and delivered on time, as detailed on the following pages. Select milestones have been delayed with DOE approval.

FY25 Q2 AOP Changes

Program Name	Activity Name	WBS Number	Project Title	PI Name	Type of Change
Technology Integration	Alternative Fuels Regulatory Program	6.4.0.400	Alternative Fuels Regulatory Program	Andrews-Sharer, Erin	Delayed with DOE approval until 5/31/2025
EEMS	Computational Modeling and Simulation	9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	Spath Luhring, Lauren	Cancelled with DOE approval
		9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	Spath Luhring, Lauren	Cancelled with DOE approval
		9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	Spath Luhring, Lauren	Added to AOP with DOE approval
		9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	Spath Luhring, Lauren	Added to AOP with DOE approval
		9.1.2.405	Core Modeling & Decision Support Capabilities: FASTSim, RouteE, T3CO, and OpenPATH	Gonder, Jeff	Delayed with DOE approval until 6/30/2025
		9.1.2.407	Energy Metrics in Traffic Signal Performance Measures	Fish, Joseph	Delayed with DOE approval until 6/30/2025
		9.1.2.408	National Impacts of Community-Level Strategies to Decarbonize and Improve Convenience of Mobility (NREL)	Hoehne, Christopher	Delayed with DOE approval until 4/30/2025

FY25 Q2 Milestone Status								
Program	**Activity**	**WBS Number**	**Project Title**	**Milestone**	**Milestone Type**	**Due Date**	**Lab Lead**	**Q2 Status**
Battery Technologies	Battery R&D	1.1.10.425	Li-ion Battery Recycling R&D Center	Redox Relithiation: Use redox mediator relithiation to relithiate commercial end-of-life NMC cathode material to attain 200 cycles at 1C in a full cell. Capacity fade of relithiated cell should be within 3% of pristine NMC full cell.	Quarterly Milestone Regular	3/31/2025	Keyser, Matthew	Met On Time
		1.1.10.441	Lithium-ion Battery Recycling Prize (Cash & Vouchers)	Finalize Breakthrough Competition and Kick-off Phase IV	Quarterly Milestone Regular	3/31/2025	Lynch, Lauren	Met On Time
		1.1.10.441	Lithium-ion Battery Recycling Prize (Cash & Vouchers)	Host Introductory Webinar & Meet and Greet Event	Quarterly Milestone Regular	3/31/2025	Lynch, Lauren	Met On Time
		1.1.10.442	Lithium-Ion Battery Recycling Prize Administration	Finalize Breakthrough Competition and Kick-off Phase IV	Quarterly Milestone Regular	3/31/2025	Lynch, Lauren	Met On Time
		1.1.10.442	Lithium-Ion Battery Recycling Prize Administration	Host Introductory Webinar & Meet and Greet Event	Quarterly Milestone Regular	3/31/2025	Lynch, Lauren	Met On Time
		1.1.14.435	VTO High Performance Computing (HPC) Cluster	Q2 Progress Measure	Quarterly Milestone Regular	4/30/2025	Andersen, Aaron	Met On Time
		1.1.19.444	EVALs: Validation of Advanced battery supply chains	Establish and characterize baseline LFP material.	Quarterly Milestone Regular	3/31/2025	Burrell, Anthony	Met On Time

		1.1.19.444	EVALs: Validation of Advanced battery supply chains	Hold an industry and stakeholder engagement meeting that focuses on the need and opportunities on enhanced validation of new material sources	Quarterly Milestone Regular	3/31/2025	Burrell, Anthony	Met On Time
		1.1.2.434	Heavy-Duty Vehicle Optimized Li-ion Technologies (HD VOLTS)	Identify method and tool to release on batterydata.energy.gov that can be used for accelerated life prediction	Quarterly Milestone Regular	3/31/2025	Smith, Kandler	Met On Time
		1.1.3.439	Advanced Characterization to Guide and Validate the Design of Long Life EaCAM Li-ion Cells	Complete description of morphological and chemical evolution of LMR electrodes during life-cycling	Annual Milestone (Regular)	3/31/2025	Tremolet de Villers, Bertrand	Met On Time
		1.1.3.440	Mechanistic Studies of Cathode-Electrolyte-Interface	Report on molecular dynamics determination of EDL and CEI structure/morphology above NMC811	Quarterly Milestone Regular	4/15/2025	Tenent, Robert	Met On Time
		1.1.9.429	Integrated Modeling and Machine Learning of Solid-Electrolyte Interface Reactions of the Si Anode	Calendar Lifetime Update + Uncertainty Analysis	Quarterly Milestone Regular	3/31/2025	Colclasure, Andrew	Met On Time
		1.1.9.433	NREL Silicon Consortium Project (SCP)	Define the electrode loading and formulation for PECVD-PEO Si from CAMP, that will enable double sided electrodes for the Q4 build. Single sided electrodes will be available to the consortium as a whole.	Quarterly Milestone Regular	3/31/2025	Burrell, Anthony	Met On Time

Electrification Technologies	Electric Drive Technologies R&D	2.2.6.401	Electric Drive System Technology R&D	Perform the experimental reliability evaluation of the baseline power modules.	Quarterly Milestone Regular	3/31/2025	Narumanchi, Sreekant	Met On Time
		2.2.7.402	NREL Next-Generation Reliable Electric Drive Systems for MD/HD Vehicles	Compile a database with the publicly available thermo-physical properties for automatic transmission fluid/oil and other fluids commonly used for motor cooling.	Quarterly Milestone Regular	3/31/2025	Narumanchi, Sreekant	Met On Time
	Grid & Infrastructure R&D	2.3.2.451	VTO Electrification Program, FY25 - EV Modeling	U.S. Mexico Medium- & Heavy-Duty EVSE Needs Assessment Presentation outlining the scope and key assumptions, including medium- and heavy-duty EV adoption scenarios, trip and charging behavioral assumptions and EVSE parameters, for the study. Stretch: Includes outline of U.S. Mexico LDV datasets, scenarios, and assumptions.	Quarterly Milestone Regular	3/31/2025	Borlaug, Brennan	Met On Time
		2.3.2.452	Support for IEA HEV Task 47	Support task progress chapters for IEA HEV-TCP annual report	Annual Milestone (Regular)	3/31/2025	Lammert, Michael	Met On Time
		2.3.5.423	Beyond Batteries: Behind the Meter Storage	18650 cells tested at SNL using the new non-flammable electrolytes (Two electrolytes in duplicate (four tests total).	Quarterly Milestone Regular	3/31/2025	Burrell, Anthony	Met On Time
		2.3.5.423	Beyond Batteries: Behind the Meter Storage	Go/No-Go decision for active cell isolation mechanism. Cell-level SSCB-based Active Discharge Mechanism: Design Completed and Hardware Evaluation Finalized.	Go/No-Go	3/31/2025	Burrell, Anthony	Met On Time
Off-Road, Rail, Marine and	Heavy Duty R&D	3.5.2.404	NREL DORMA AOP	Mechanisms of cycloalkane soot precursor generation. Assess mechanisms of soot	Quarterly Milestone Regular	3/31/2025	McCormick, Robert	Met On Time

Aviation Technologies				precursor formation for SAF relevant cycloalkanes.			
Materials Technology	Lightweight Materials	4.2.4.401	Materials and Manufacturing Innovation for Sustainable Automotive Composites - NREL	Demonstrate the reproducibility of the hybrid PECAN composites in their first life by manufacturing at least three different samples and demonstrating a <20% variance in properties. Further demonstrate consistency is second+ life properties by recycling and remanufacturing the PECAN CFRCs.	Quarterly Milestone Regular	3/31/2025	Rorrer, Nicholas	Met On Time
		4.2.4.431	Zero-Emission Natural Fiber Composites (ZENC) for Fire-Detecting Fireproof EV Battery Enclosure	MS2. TEA LCA data collection (Y1/Q2) - Data for fire-detection/proof TEA LCA collected	Quarterly Milestone Regular	3/31/2025	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.	Quarterly Milestone Regular	4/15/2025	Rahill, Matt	Met On Time
		6.3.2.403	Technologist in Communities (TIC)	Summary on progress of TIC support for the NYSERDA Clean Transportation Prizes program including relevant case studies and conference papers.	Quarterly Milestone Regular	3/31/2025	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	4/15/2025	Cardinali, Sarah	Met On Time
		6.3.2.405	DFW Electrification	Report on reference implementation for energy management and charging network operation.	Quarterly Milestone Regular	3/31/2025	Lunacek, Monte	Met On Time

		6.3.2.405	DFW Electrification	Determine scope with FAA and NASAFY25	Quarterly Milestone Regular	3/31/2025	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	4/15/2025	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	4/15/2025	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	3/31/2025	Andrews-Sharer, Erin	Delayed with DOE Approval
Analysis	Data	7.1.0.401	Heavy Truck Data Framework Project	Drive Ohio CAVs data available to stakeholders and preliminary analysis complete.	Quarterly Milestone Regular	3/31/2025	Birky, Alicia	Met On Time
	Modeling	7.2.0.402	VTO Analysis Program Modeling Activities at NREL	Quarterly check-in with DOE-VTO summarizing model and data updates and impact on results, summary of quick-turnaround analysis, prioritization of model enhancements, and the needs and timeline for publication of analysis insights and/or datasets (internally or publicly)	Quarterly Milestone Regular	3/31/2025	Jadun, Paige	Met On Time
		7.2.0.404	NREL - Electric Vehicle Load Shape ResStock - TEMPO	Q2 progress report	Quarterly Milestone Regular	3/28/2025	Yip, Arthur	Met On Time
	Applied Analysis	7.3.0.402	VTO Analysis Program Applied Analysis Activities at NREL	EV-Bulk Power Systems A draft journal article will be shared with VTO describing the impact of different EVSE deployment strategies on	Quarterly Milestone Regular	3/31/2025	Borlaug, Brennan	Met On Time

				system-level costs, electricity demand, and emissions.				
Vehicle Technologies Office Crosscutting	Lab-Based Crosscutting Projects	8.3.0.402	Locomotive Fleet Survey	Energy and emissions estimation methodology and parameters defined.	Quarterly Milestone Regular	1/31/2025	Birky, Alicia	Met On Time
		8.3.0.402	Locomotive Fleet Survey	Extrapolation methodology defined.	Quarterly Milestone Regular	3/31/2025	Birky, Alicia	Met On Time
EEMS	Computational Modeling and Simulation	9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	Convene one Livewire Data Working Group (DWG) meeting with goals of:- demoing new and/or little-known capabilities (e.g. uploader client) to data owners- understanding data priorities through distribution of a survey	Quarterly Milestone Regular	3/31/2025	Spath Luhring, Lauren	Cancelled with DOE Approval
		9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	Develop Livewire Data Platform user guide to ensure consistent guidance across projects and provide a searchable resource for stewards of data.	Quarterly Milestone Regular	3/31/2025	Spath Luhring, Lauren	Met On Time
		9.1.2.403	FY19 Lab Call – Livewire Data Sharing Platform	Distribute questionnaire to data owners, Livewire users, and EEMS stakeholders to increase awareness of LDP and improve Livewire's user experience and value to researchers.	Quarterly Milestone Regular	3/31/2025	Spath Luhring, Lauren	Met On Time
		9.1.2.405	Core Modeling & Decision Support Capabilities: FASTSim, RouteE, T3CO, and OpenPATH	Implement at least 2 high-priority bug fixes and at least 1 high-priority incremental update to OpenPATH, as determined by deployer feedback. An example of an incremental update would be supporting bulk downloads in the admin dashboard.	Quarterly Milestone Regular	3/31/2025	Gonder, Jeff	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 3 different BEV models.	Quarterly Milestone Regular	3/31/2025	Gonder, Jeff	Delayed with DOE Approval
			9.1.2.406	BEAM CORE Core Tools (NREL)	Task 3: SynthFirm - National-scale baseline fleet generation using 2022 Experian registration data, 2021 US VIUS data, and other data sources complete. Baseline fleet validation performed for states with currently available model runs, such as CA and WA.	Quarterly Milestone Regular	3/31/2025	Gonder, Jeff	Met On Time
			9.1.2.407	Energy Metrics in Traffic Signal Performance Measures	ATSPM-E integration demonstrated at case study locations	Annual Milestone (Regular)	3/31/2025	Fish, Joseph	Delayed with DOE Approval
			9.1.2.408	National Impacts of Community-Level Strategies to Decarbonize and Improve Convenience of Mobility (NREL)	Using available modeled outputs (baseline and at least one scenario) for all currently modeled regions in both models, an initial mapping will be constructed to regionalize parameters in MEP calculations. TEMPO results will be regionalized using variations across household type and mode at the county level. Where feasible, POLARIS inputs and/or outputs	Quarterly Milestone Regular	3/31/2025	Hoehne, Christopher	Met On Time

				summarized by typology (down to census tracts) will also be leveraged for regionalized MEP parameters.				
		9.1.2.408	National Impacts of Community-Level Strategies to Decarbonize and Improve Convenience of Mobility (NREL)	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	3/31/2025	Hoehne, Christopher	Delayed with DOE Approval
		9.1.2.409	Multi-Region Stakeholder Driven BEAM CORE Application (NREL)	Calibrated SynthFirm/FRISM model using Seattle local data and initial documentation of the calibration process, designed to be as study area-agnostic as possible.	Quarterly Milestone Regular	3/31/2025	Gonder, Jeff	Met On Time
		9.1.2.409	Multi-Region Stakeholder Driven BEAM CORE Application (NREL)	Final determination of what modules to deploy and integrate for each partner MPO.	Go/No-Go	3/31/2025	Gonder, Jeff	Met On Time
		9.1.2.410	FY24 Spring Energy I-Corps Topic 3 – NREL: RouteE-BEAT	NREL will release the refined tools that incorporate stakeholder feedback from testing in FY25Q1 (Q3 of this project) along with demonstrations of the tools addressing critical challenges in transit or commercial fleets. Project team to provide VTO & OTT with access to the released tools and demonstrations and summarize stakeholder responses to the release in the quarterly report slides, uploaded to PICS.	Quarterly Milestone Regular	2/28/2025	Gonder, Jeff	Met On Time

		9.1.2.410	FY24 Spring Energy I-Corps Topic 3 – NREL: RouteE-BEAT	The team will prepare a commercialization plan by the end of FY25Q1 (Q3 of this project) that consists of transitioning some RouteE technology to the private sector for integration and application or maturation of NREL-hosted resources that are publicly available and have national coverage, in the case of transit agencies. At least 1 partner will be identified if private sector transition is the most likely commercialization pathway for any of the RouteE tools, otherwise, a follow-on funding source for the NREL-led nationally available services will be identified. Team to upload one commercialization plan to PICS with justification for the hosting path selected and include in PICS update at least 1 partner or follow-on funding source identified.	Quarterly Milestone Regular	3/31/2025	Gonder, Jeff	Met On Time
		9.1.2.410	FY24 Spring Energy I-Corps Topic 3 – NREL: RouteE-BEAT	NREL will upload a Final Report to PICS before the end of the project period of performance.	Quarterly Milestone Regular	3/31/2025	Gonder, Jeff	Met On Time
		9.1.2.411	MEP Core Tools	Task1.3: Enhance the level-of-traffic stress (LTS) methodology for bikes, and develop an LTS methodology for walk mode. Impact of LTS on walk and bike mode MEP scores will be demonstrated in at least five cities.	Quarterly Milestone Regular	3/31/2025	Garikapati, Venu	Met On Time

		9.1.2.411	MEP Core Tools	Identify at least two focus groups of stakeholders (with 3–4 members per focus group) for the user needs assessment task. The two focus groups should represent at least two different backgrounds of interested parties (e.g., one group on DOTs and local stakeholders, and one group on industry).	Quarterly Milestone Regular	3/31/2025	Garikapati, Venu	Met On Time
		9.1.2.411	MEP Core Tools	Developing a national model that predicts the congestion accounted speeds for different hours and days of the week using OSM and third-party data sources, and presenting the impact of congestion on MEP scores for at least five cities.	Quarterly Milestone Regular	3/31/2025	Garikapati, Venu	Met On Time

PUBLICATIONS
& MEDIA **OUTREACH**

FY 2025 YTD NREL VT PUBLICATIONS – Q1–Q2

VT Publication Metrics

Publication Type	Q1	Q2	Total
Books/Chapters	0	0	0
Brochures	0	0	0
Conference Papers	7	4	11
Fact Sheets	10	2	12
Journal Articles	23	8	31
Newsletters	0	0	0
Other Marketing Materials	0	0	0
Patents	0	1	1
Posters	7	8	15
Presentations	19	8	27
Technical, Management, and Subcontractor Reports	16	7	23
Total YTD Publications	82	38	120

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

VT Journal Article Impact Factors: Q1–Q2 FY 2025

Article	Journal	Impact Factor
Assessing Cathode-Electrolyte Interphases in Batteries	*Nature Energy*	49.7
Unveiling the Mechanism of Mn Dissolution Through a Dynamic Cathode-Electrolyte Interphase on $LiMn_2O_4$	*Advanced Energy Materials*	24.4
Tetrahedral Tilting and Lithium-Ion Transport in Halide Argyrodites Prepared by Rapid, Microwave-Assisted Synthesis	*Advanced Functional Materials*	18.5
Finding Gaps in the National Electric Vehicle Charging Station Coverage of the United States	*Nature Communications*	14.7
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
Predicting U.S. Federal Fleet Electric Vehicle Charging Patterns Using Internal Combustion Engine Vehicle Fueling Transaction Statistics	*Applied Energy*	10.1
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
Fast-Charging Lithium-Ion Batteries: Synergy of Carbon Nanotubes and Laser Ablation	*Journal of Power Sources*	8.1
Generating Multi-Scale Li-Ion Battery Cathode Particles with Radial Grain Architectures Using Stereological Generative Adversarial Networks	*Communications Materials*	7.5
a priori Uncertainty Quantification of Reacting Turbulence Closure Models Using Bayesian Neural Networks	*Engineering Applications of Artificial Intelligence*	7.5
Mitigating Calendar Aging in Si-NMC Batteries with Advanced Dual-Salt Glyme Electrolytes	*Chemistry of Materials*	7.2
Porous Mesh Manifold for Enhanced Boiling Performance	*Applied Thermal Engineering*	6.1
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
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
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
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
Analyzing School Bus Electrification in Richmond, Virginia	*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
Overcoming Limitations of Higher Biomass-Based Diesel Blends	*Biodiesel Magazine*	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)		**8.7**

VT Publications – Q2 FY 2025

Conference Papers

1. Islam, Sarwar; Khan, Faisal. 2025. "Wireless Pulse-Width Modulation Control of Power Converters Using Ultra-Wideband Technology for Distributed High-Voltage Systems." Presented at the 2024 IEEE Energy Conversion Congress and Exposition (ECCE), 20–24 Oct. 2024, Phoenix, AZ. dx.doi.org/10.1109/ECCE55643.2024.10861532.

2. Siddiquee, Ashraf; Uzum, Alper; Hasan, Syed Imam; Sozer, Yilmaz; Kisacikoglu, Mithat John. 2025. "Traction Inverter Integrated On-Board DC Fast Charging through Partial Power Processing." Presented at the 2024 IEEE Energy Conversion Congress and Exposition (ECCE), 20–24 Oct. 2024, Phoenix, AZ. doi.org/10.1109/ECCE55643.2024.10861726.

3. 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.

4. Vercellino, Roberto; Campos, Gustavo; Lunacek, Monte; Ge, Yanbo; Ugirumurera, Juliette; Sigler, Devon; Mann, Margaret. 2025. "Behind-the-Meter Energy Storage and Generation in Support of Electrified Rental Car Centers." Presented at the 2025 IEEE Electrical Energy Storage Applications and Technologies Conference (EESAT), 20–21 Jan. 2025, Charlotte, NC. doi.org/10.1109/EESAT62935.2025.10891234.

Fact Sheets

5. 2025. "Electric Vehicle Basics (French Translation)." www.nrel.gov/docs/fy25osti/90243.pdf.

6. 2025. "Hydrogen Fuel Cell Electric Vehicles." www.nrel.gov/docs/fy25osti/91717.pdf.

Journal Articles

7. 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.

8. 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.

9. Khan, Md Shafquat Ullah; Thurlbeck, Alastair; Watt, Edward; Kisacikoglu, Mithat J.; Ucer, Emin; Meintz, Andrew; Mahmud, Rasel. 2025. "Development and Experimental Validation of a High-Power DC Distribution Testbed for Advanced Charging Infrastructure and Energy Management." *IEEE Transactions on Industry Applications*: 1–10. doi.org/10.1109/TIA.2025.3550147.

10. 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.

11. 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.

12. 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.

13. Usseglio-Viretta, Francois L.E.; Gasper, Paul; Prakash, Nina; Popeil, Melissa; Smith, Kandler; Finegan, Donal P. 2025. "Concavity-Based Local Erosion and Sphere-Size-Based Local Dilation Applied to Lithium-Ion Battery Electrode Microstructures for Particle Identification." *Computational Materials Science* 251: 113758. doi.org/10.1016/j.commatsci.2025.113758.

14. Vennam, Geetika; Singh, Avtar; Dunlop, Alison R.; Islam, Saiful; Weddle, Peter J.; Mak, Bianca Yi Wen; Tancin, Ryan; Evans, Michael C.; Trask, Stephen E.; Dufek, Eric J.; Colclasure, Andrew M.; Finegan, Donal P.; Smith, Kandler; Jansen, Andrew N.; Gering, Kevin L.; Yang, ZhenZhen; Tanim, Tanvir R. 2025. "Fast-Charging Lithium-Ion Batteries: Synergy of Carbon Nanotubes and Laser Ablation." *Journal of Power Sources* 636: 236566. doi.org/10.1016/j.jpowsour.2025.236566.

Patents

15. Smith, Kandler Alan; Santhanagopalan, Shriram; Sunderlin, Nathaniel Alexander; Colclasure, Andrew Michael; Ban, Chunmei; Li, Xuemin; Netter, Judy C.; Finegan, Donal Patrick; Fink, Kaitlin Elizabeth; Coyle, Jaclyn Elizabeth. 2025. "Methods and Devices for Electrochemical Relithiation of Lithium-Ion Batteries." Patent No. US 12,199,252 B2. image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/12199252.

Posters

16. Carroll, G. Michael; Veith, Gabriel. 2025. "Understanding LIB Battery Electrodes Through Classical Electrochemical Interface Theory." Presented at the Electrochemistry Gordon Research Conference (GRC), 7–12 Jan. 2024, Ventura, CA. www.nrel.gov/docs/fy25osti/88450.pdf.

17. Laarabi, Haitam; Xu, Xiaodan; Poliziani, Cristian; Jeong, Kyungsoo; Birky, Alicia; Needell, Zachary; Spurlock, C. Anna. 2025. "Understanding Regional Freight-Related Air Pollution Using Agent-Based Models: A Case Study Across Nine Counties of the San Francisco Bay Area (Citation Only)." Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington, D.C.

18. Mir, Faizan; Young, Stanley; Sandhu, Rimple; Wang, Qichao; Tripp, Charles; Osborn, Todd. 2025. "Infrastructure-Based Cooperative Perception at a Traffic Intersection: Overview and Challenges." Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington, D.C. www.nrel.gov/docs/fy25osti/91777.pdf.

19. Preimesberger, Juliane; Carroll, Gerard Michael; Coyle, Jaclyn. 2025. "The Effect of Silicon Nanoparticle Size on Cycle and Calendar Life (Citation Only)." Presented at the 245th Electrochemical Society (ECS) Meeting, 26–30 May 2024, San Francisco, CA.

20. Preimesberger, Juliane; Coyle, Jaclyn. 2025. "Characterizing the Mechanical Properties of Battery Materials (Citation Only)." Presented at the Gordon Research Conference on Batteries, 25 Feb.–1 March 2024, Ventura, CA.

21. Reinicke, Nicholas; Fitzgerald, Robert; Holden, Jacob; Jonas, Tim. 2025. "Energy-Aware Route Planning with RouteE Compass." Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington, D.C. www.nrel.gov/docs/fy25osti/90819.pdf.

22. Wang, Yuetong; Jeong, Kyungsoo; Garikapati, Venu. 2025. "Quantifying E-Commerce Efficiency: A Consumer-Centric Analysis of Online Shopping (Citation Only)." Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington, D.C.

23. Xu, Xiaodan; Yang, Hung-Chia; Laarabi, Haitam; Poliziani, Cristian; Birky, Alicia; Jeong, Kyungsoo; Lu, Hongyu; Guensler, Randall; Spurlock, C. Anna. 2025. "Improving Commercial Truck Fleet Composition in Emission Modeling Using 2021 US VIUS Data (Citation Only)." Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington, D.C.

Presentations

24. Beach, Ryan. 2025. "Manufacturing, Characterization and Recycling of 9- and 13-m Recyclable Wind Blades Made with Recyclable Resins." Presented at the 2nd Wind Turbine Blade Materials & Recycling Forum, 30–31 Oct. 2024, Amsterdam, Netherlands. www.nrel.gov/docs/fy25osti/91568.pdf.

25. Bennett, Jesse. 2025. "Smart Charge Management." Presented at the Energy Exchange, 26–28 March 2024, Pittsburgh, PA. www.nrel.gov/docs/fy25osti/89220.pdf.

26. Carroll, Mike. 2025. "Using the Principals of Electrochemistry to Understand and Overcome the Complicated Degradation Mechanisms of Silicon Anodes in Lithium-Ion Batteries." Presented at 2024 GRC Inorganic Chemistry, 4 June 2024. www.nrel.gov/docs/fy25osti/90535.pdf.

27. Carroll, Mike; Veith, Gabe. 2025. "The Solid Electrolyte Interphase Dispersion Can Predict Cycle and Calendar Lifetimes in Silicon Anodes for Lithium-Ion Batteries." Presented at the Pacific Rim Meeting on Electrochemical and Solid State Science (PRiME), 6–11 Oct. 2024, Honolulu, HI. www.nrel.gov/docs/fy25osti/91292.pdf.

28. Harrison, Katharine L. 2025. "Examples of X-Ray Characterization Techniques in Energy Storage Research." Presented at the 2024 Denver X-Ray Conference, 5–9 Aug. 2024, Westminster, CO. www.nrel.gov/docs/fy25osti/90753.pdf.

29. Kotz, Emily; Nobler, Erin; Singer, Mark; Lammert, Mike. 2025. "EV Champion Training Webinar 2: ZEV and EV Charging Planning." www.nrel.gov/docs/fy25osti/91219.pdf.

30. Powell, Bonnie; Sperling, Joshua; Esteban, Johnny; Serrano, Emily; Weigl, Dustin; Young, Stan. 2025. "An On-Demand Electric Transit Case Study of New Rochelle, New York." Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington, D.C. www.nrel.gov/docs/fy25osti/92497.pdf.

31. Rosner, Nicole; Blanco, Lis. 2025. "Community Engagement Planning: Key Concepts and Methods for Developing and Implementing a Collaborative Engagement Plan." www.nrel.gov/docs/fy25osti/92240.pdf.

Technical Reports

32. Cardinali, Sarah; Gonzales, John. 2025. *White Paper on Emergency Responder Guide Review Findings and Considerations (NREL Internal Use Only)*. www.nrel.gov/docx/gen/fy25/91842.pdf.

33. Esparza, Eliseo; Truffer-Moudra, Dana; Hodge, Cabell. 2025. *Electric Vehicle and Charging Infrastructure Assessment in Cold-Weather Climates: A Case Study of Fairbanks, Alaska*. www.nrel.gov/docs/fy25osti/92113.pdf.

34. Hodge, Cabell; Renganathan, Umapriya; Brooker, Aaron; Holloway, Alexia. 2025. *Privately Owned Electric Vehicle Analysis on U.S. Army Bases (Citation Only)*.

35. Kotz, Emily. 2025. *Federal Home-to-Work Electric Vehicle Program Guide*. www.nrel.gov/docs/fy25osti/92034.pdf.

36. Montgomery, David; Perry, Bruce; Yellapantula, Shashank; Mohamed, Samah; Day, Marc; Fioroni, Gina; McCormick, Robert. 2025. *Developing Open-Source Tools for Increasing the Efficiency of Synthetic Aviation Turbine Fuel Certification Process*. www.nrel.gov/docs/fy25osti/94009.pdf.

37. Singer, Mark; Johnson, Caley; Wilson, Alana; Reichelt, Lauren; Abdullah, Muhammad; Downs Dybas, Neah. 2025. *Clean Cities and Communities Partnership 2023 Activity Report*. www.nrel.gov/docs/fy25osti/92098.pdf.

38. Watt, Ed; Savargaonkar, Mayuresh; Gadamsetty, Pranav. 2025. *Timeouts Best Practices*. www.nrel.gov/docs/fy25osti/92307.pdf.

VT Publications – Q1 FY 2025

Conference Papers

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2. Islam, Sarwar; Khan, Faisal. 2024. "Wireless Pulse-Width Modulation Control of Power Converters Using Ultra-Wideband Technology for Distributed High-Voltage Systems: Preprint." Presented at ECCE 2024, 20–24 Oct. 2024, Phoenix, AZ. www.nrel.gov/docs/fy25osti/90684.pdf.
3. Jiang, Kaiying; Kong, Daeyoung; Kim, Kiwan; Sreekant, Narumanchi; Palko, James; Dede, Ercan M.; Ahn, Chulmin; Lee, Hyoungsoon; Asheghi, Mehdi; Goodson, Kenneth. 2024. "Pool Boiling Reliability Tests and Degradation Mechanisms of Microporous Copper Inverse Opal (CuIOs) Structures." Presented at the IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm), 28–31 May 2024, Aurora, CO. doi.org/10.1109/ITherm55375.2024.10709500.
4. Laarabi, Haitam; Xu, Xianodan; Poliziani, Cristian; Jeong, Kyungsoo; Birky, Alicia; Needell, Zachary; Spurlock, C. Anna. 2024. "Understanding Regional Freight-Related Air Pollution Using Agent-Based Models: A Case Study Across Nine Counties of the San Francisco Bay Area (Citation Only)." Presented at the Transportation Research Board Annual Meeting 2025, 5–9 Jan. 2025, Washington D.C.
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9. 2024. "Lessons Learned from the Clean Energy to Communities (C2C) Peer-Learning Cohort Enhancing Resilience at Critical Facilities through Solar, Storage, and Microgrids." www.nrel.gov/docs/fy25osti/91764.pdf.
10. 2024. "Lessons Learned from the Clean Energy to Communities (C2C) Peer-Learning Cohort Evaluating and Prioritizing Municipal Buildings for Energy Efficiency and Decarbonization Investment." www.nrel.gov/docs/fy25osti/91766.pdf.
11. 2024. "Lessons Learned from the Clean Energy to Communities (C2C) Peer-Learning Cohort Incorporating Community Priorities into Electric Vehicle Plans and Projects." www.nrel.gov/docs/fy25osti/91765.pdf.
12. 2024. "Sustainable Port Operations: Powered by NREL." www.nrel.gov/docs/fy25osti/89892.pdf.
13. 2024. "Transportation Secure Data Center: Frequently Asked Questions for Data Owners/Contributors." www.nrel.gov/docs/fy25osti/92143.pdf.
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15. Kotz, Andrew; Fakhimi, Setayesh; Ledna, Catherine; Lustbader, Jason. 2024. "Estimating Electrification Potential for Class 8 Regional-Haul Trucks." www.nrel.gov/docs/fy25osti/91369.pdf.
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19. Carlson, Nicholas A.; Talmadge, Michael S.; Zaimes, George G.; Hawkins, Troy R.; Jiang, Yuan. 2024. "A Comprehensive Assessment of the Marginal Abatement Costs of CO_2 of Co-Optima Multi-Mode Vehicles." *Energy & Fuels* 39 (1): 444–453. dx.doi.org/10.1021/acs.energyfuels.4c03451.

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Environmental Justice-Focused NYSERDA Clean Transportation Prize Program (Citation Only)." Presented at the Transportation Research Board (TRB) 2nd Conference on Advancing Transportation Equity (CATE), 15–18 July 2024, Baltimore, MD.

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MEDIA OUTREACH

Quarter Two

1. ChargeX Consortium Identifies Automated Solution To Fix Key Part of Electric Vehicle Charging User Experience (Jan. 15, 2025). www.nrel.gov/news/program/2025/chargex-consortium-identifies-automated-solution-to-fix-key-part-of-electric-vehicle-charging-user-experience.html

2. The Dawn of Electric Trucking Calls for High-Power Charging (Jan. 15, 2025). www.nrel.gov/news/features/2025/the-dawn-of-electric-trucking-calls-for-high-power-charging.html

3. Closing the Loop: How NREL's Advanced Diagnostics Enable a Circular Battery Future (Jan. 13, 2025). www.nrel.gov/news/program/2025/closing-the-loop-how-nrels-advanced-diagnostics-enable-a-circular-battery-future.html

4. NREL-Developed Silicon Carbide Inverter Part of Production-Intent Program at John Deere (Jan. 7, 2025). www.nrel.gov/news/program/2024/nrel-developed-silicon-carbide-inverter-part-of-production-intent-program-at-john-deere.html

Quarter One

1. Transportation Research Board To Recognize NREL Mobility Researchers at Annual Meeting (Dec. 31, 2024). www.nrel.gov/news/program/2024/transportation-research-board-to-recognize-nrel-mobility-researchers-at-annual-meeting.html

2. Two NREL Researchers Selected as Fellows of the American Society of Mechanical Engineers (Dec. 30, 2024). www.nrel.gov/news/program/2024/two-nrel-researchers-selected-as-fellows-of-the-american-society-of-mechanical-engineers.html

3. NREL's International Work Bridges Innovation and Development—With Benefits at Home and Abroad (Dec. 20, 2024). www.nrel.gov/news/program/2024/nrels-international-work-bridges-innovation-and-development-with-benefits-at-home-and-abroad.html

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NREL'S **VTO TEAM**

Technical Team and Facility Leaders

Advanced Biofuels and Combustion . . . . **Robert McCormick**

Commercial Vehice Technologies . . . . **Andrew Kotz**

Data Sciences . . . . **Monte Lunacek**

Electric Vehicle Grid Integration . . . . **John Kisacikoglu**

Energy Storage – Systems Data Science and Modeling . . . . **Kandler Smith**

Energy Storage – Advanced Cathode Material Development . . . . **Rob Tenent**

Energy Storage – Materials Development and Modeling . . . . **Andrew Colclasure**

Legislative/Regulatory Support . . . . **Erin Andrews-Sharer**

Lightweight and Recyclable Composite Materials . . . . **Nicholas Rorrer**

Mobility Systems . . . . **Andrew Duvall**

Power Electronics & Electric Machines . . . . **Doug DeVoto and Gilbert Moreno**

Technology Integration/ Data & Tools . . . . **Emmy Feldman**

Technology Integration/Technical Assistance . . . . **Abby Brown**

Vehicle Modeling and Analysis . . . . **Brennan Borlaug**

Directorate, Program & Center Leadership

Adam Bratis
Associate Lab Director, BioEconomy and Sustainable Transportation

Jao Van de Lagemaat
Director, Chemistry & Nanoscience

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Chief Engineer for EV Charging and Grid Integration

Marc Day
Group Manager, High-Performance Algorithms & Complex Fluids

Cabell Hodge
Group Manager, Analysis of Vehicles and Infrastructure Deployment

Margo Melendez
Chief Transportation Technology Deployment & Integration Engineer

Kristi Potter
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Liz Weber
Group Manager, Sociotechnical Transportation Engagement Projects

Alex Schroeder
Laboratory Program Manager (Acting), Vehicle Technologies Office

Tony Burrell
Chief Technologist, Energy Storage

Ahmad Pesaran
Chief Energy Storage Engineer

Gina Fioroni
Group Manager, Fuels & Combustion Science

Wesley Jones
Group Manager, Complex Systems Simulation and Optimization

Juliane Mueller
Group Manager, AI, Learning, and Intelligent Systems

Jibo Sanyal
Group Manager, Hybrid Energy Systems

Stan Young
Advanced Mobility Technical Lead

Chris Gearhart
Director, Integrated Mobility Sciences

Ken Kelly
Chief Engineer for Commercial Vehicle Electrification

Sarah Cardinali
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Matt Keyser
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Sreekant Narumanchi
Group Manager, Advanced Power Electronics & Electric Machines

Lauren Spath Luhring
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Ray Grout
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Faisal Khan
Principal Researcher, Power Electronics

Mark Chung
Group Manager, Mobility Infrastructure and Impacts Analysis

Jeff Gonder
Group Manager, Transportation Energy Transition Analysis

Jason Lustbader
Group Manager, Commercial Vehicle Technologies

Nate Neale
Group Manager, Interfacial Materials Chemistry

Alex Schroeder
Group Manager, Electric Vehicle Charging

Affiliated Lab-Wide Leadership

Jaquelin Cochran
Associate Lab Director (Acting) Strategic Energy Analysis and Decision Sciences

John Farrell
Associate Lab Director Mechanical & Thermal Engineering Sciences

Juan Torres
Associate Lab Director Energy Security, Resilience, and Integration

Bill Tumas
Associate Lab Director Materials, Chemical & Computational Sciences