



Electric Vehicle Charging and Systems Integration

Our Expertise

Advanced Charging Hardware System Development | Advanced Grid Modeling | Fleet Charging Demand Forecasting | Charging Infrastructure Network Planning | At-Scale Behind-the-Meter Storage Experiments | Cybersecurity Evaluations | Charging Infrastructure Financial Analysis | Off-Nominal Vehicle and Electric Vehicle Supply Equipment Characterization | Smart Charge Management Development | Charging Hardware, Site Design, Cost Estimation, and Optimization | Megawatt Charging for On-Road and Off-Road Applications

The Need

Fast, Safe, and Integrated Charging

To meet the nation's ambitious decarbonization goals, buildings and vehicles are being electrified on a massive scale, but the power grid must be shored up to meet the increased demand for electricity that comes with widespread electrification. Challenges include enabling drivers to charge in less than

30 minutes at a reasonable cost, all while ensuring safe, secure, and resilient charging operations. Electric vehicle charging must also be coordinated with buildings, energy storage, the power grid, and other energy systems.

The Solution

Evaluate Real-World Systems at Scale

NREL researchers leverage the Electric Vehicle Research Infrastructure (EVRI) platform to understand and develop solutions for preventing grid disruptions caused by the increase in high-power electric vehicle supply equipment. The platform's research bays allow researchers to conduct experiments that integrate advanced high-power chargers to determine how electric vehicle charging affects the grid, vehicle users, supply equipment networks, charging costs, and charging efficiency.

NREL also employs a state-of-the-art virtual grid emulation capability through the lab's premier Advanced Research on Integrated Energy Systems (ARIES) research platform of which EVRI is a part. ARIES' world-class capabilities allow researchers

to evaluate and de-risk the interaction and performance of real-world systems including energy storage, power electronics, hybrid energy storage, future energy infrastructure, and cybersecurity, while employing novel solutions such as smart charge management and behind-the-meter storage. Developing these scalable and customizable scenarios helps researchers identify challenges and create mitigation strategies before any costs associated with build-out are incurred.

Between the Electric Vehicle Research Infrastructure and ARIES platforms, NREL can study everything from the impacts of a single electric vehicle charger to hundreds or thousands of chargers interacting with the grid.

The Impact

Affordable, Convenient, and Integrated Charging

NREL's electric vehicle charging and systems integration research is enabling safe, convenient, and affordable high-power charging that is well integrated with buildings, renewables, storage, and the power grid. Improving grid integration

and stability, as well as lowering the cost of electricity for multimegawatt charging of on-road and non-road commercial vehicles and beyond, will support the nation's transition to an electric fleet and net-zero-emissions future.

Partners

21st Century Truck Partnership | ABB | Behind-the-Meter Storage Consortium | BTC Power | ChargePoint | Charging Interface Initiative e. V. (CharIN) | Dallas/Fort Worth International Airport | Eaton | Electric Power Research Institute (EPRI) | Electric Vehicles at Scale Laboratory Consortium | Ford Motor Company | Hyundai | Joint Office of Energy and Transportation | SAE International | Tritium | U.S. Department of Energy | Xcel Energy