athena

Wisdom to guide mobility transformations at U.S. ports

EVI-Rental: A Scalable Model To Quantify the Impact of Rental Car Electrification

Electric Vehicle Infrastructure – Rental Car (EVI-Rental) is a flexible and comprehensive simulation tool that addresses key questions about the charging demand, infrastructure needs, and business impacts of adding growing numbers of electric vehicles (EVs) to rental fleets.

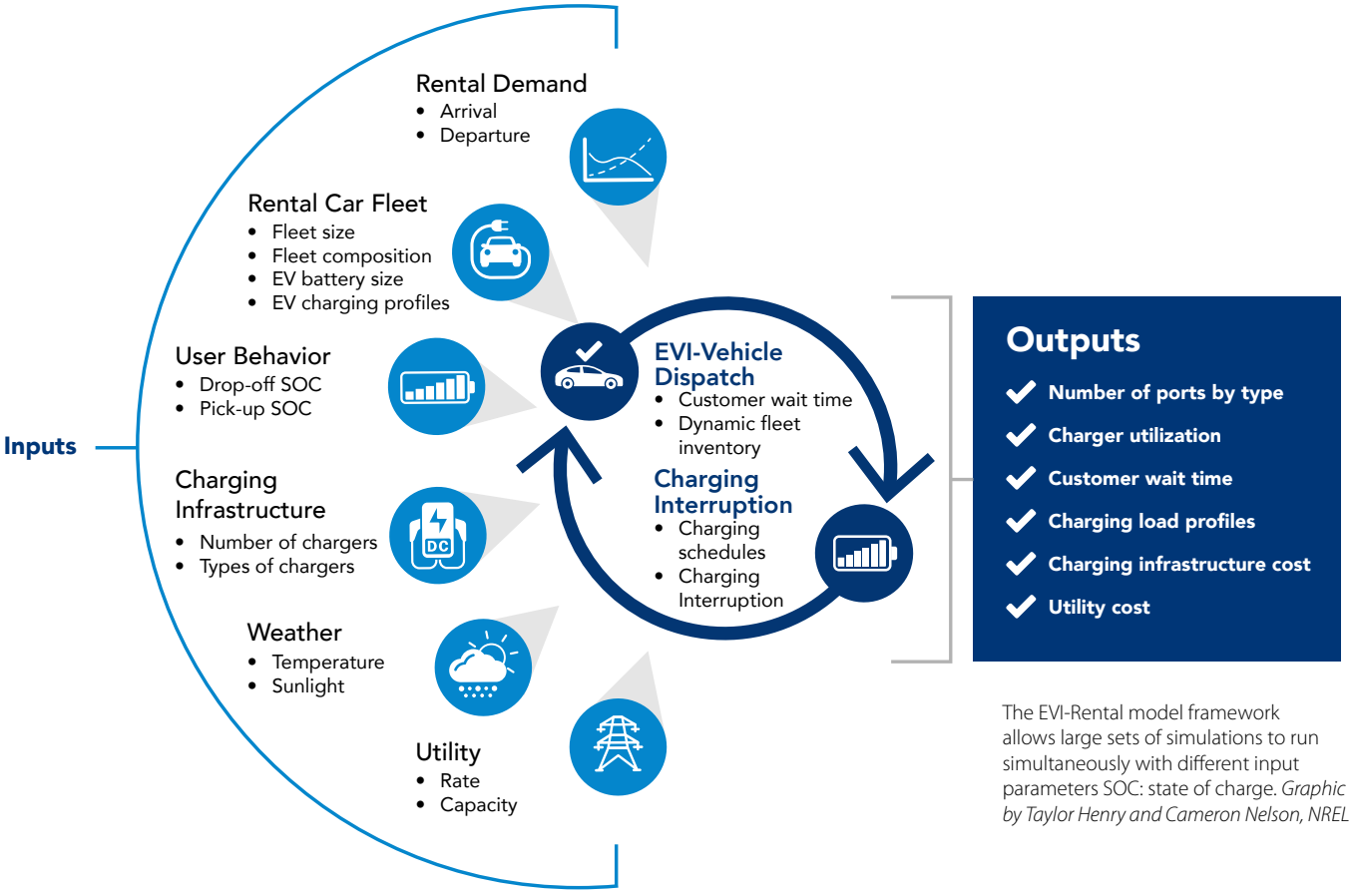
The Challenge

As rental car companies transition from conventional fleets to include more EVs, they must develop strategies to avoid potential power supply challenges and increased energy costs due to EV charging demand and the pressure to avoid vehicle downtime.

Airports, where the majority of rental events happen, can invest in high-power and fast charging infrastructure to enable rental car centers to meet this new demand. But to make cost-effective decisions, they need to accurately predict charging needs and grid impacts and identify efficient solutions.

Our Approach

Researchers with the U.S. Department of Energy's Athena project designed and implemented **EVI-Rental**, a simulation tool that incorporates various aspects of EV rental car operations to simulate real-world rental scenarios. This flexible modeling framework allows large sets of simulations to run in parallel with different input parameters. EVI-Rental uses rental car demand,



The EVI-Rental model framework allows large sets of simulations to run simultaneously with different input parameters SOC: state of charge. *Graphic by Taylor Henry and Cameron Nelson, NREL*

fleet composition, and existing charging infrastructure data as input, generating power demand estimates, charging load profiles, charging port utilization rates, and cost assessments of EV infrastructure expansion.

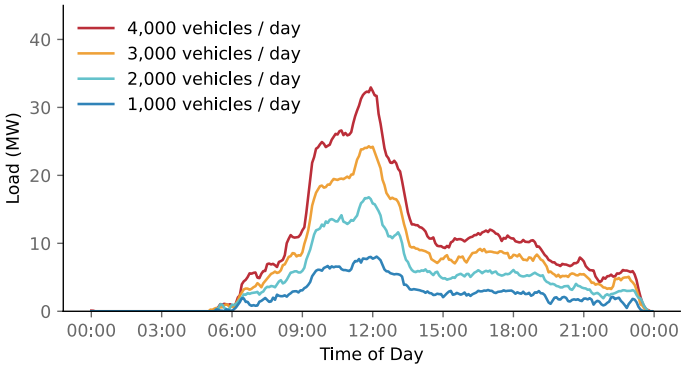
To validate the EVI-Rental model, the Athena research team conducted a case study at Dallas-Fort Worth International Airport (DFW) to understand the impact of state-of-charge requirements, different charger types and charging schedules, solar power generation, and behind-the-meter storage on a fully electrified rental car fleet.

DFW Case Study

To demonstrate the model, researchers analyzed the outcome of a scenario at DFW in which rental vehicles were returned with 20% charge and would need to be charged to 80%. Using 350-kW DC fast chargers, the system needed 264 DC fast chargers to support a fully electric rental fleet and would generate an immense 29.7 MW of peak electrical load. This highlighted the need for creative solutions.

For the next step, the team used the National Renewable Energy Laboratory's Electric Vehicle Infrastructure – Enabling Distributed Generation Energy Storage (**EVI-EDGES**) tool to understand whether a microgrid system with solar generation and behind-the-meter storage could help DFW address the potential peak load and power demands.

The Athena team's analysis showed that the integrated microgrid solution will cut life cycle costs by 41% compared to traditional grid-only approaches, while meeting the same electrical demand.



EVI-Rental generates estimates of power demand based on user-provided data on the EV fleet and charging infrastructure. *Graphic by Roberto Vercellino, NREL*

The Impact

Athena's EVI-Rental tool can simplify the rental fleet electrification planning process for airport and car rental staff. EVI-Rental, in combination with other Athena tools, supports any airport with making data-informed decisions on charging and energy infrastructure, scheduling, and costs of their EV transition.

For more information, visit **athena-mobility.org** or contact **athena.mobility@nrel.gov**.

NREL

15013 Denver West Parkway, Golden, CO 80401
303-275-3000 • www.nrel.gov

NREL prints on paper that contains recycled content.

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated under Contract No. DE-AC36-08GO28308

NREL/FS-2C00-93701 • September 2025