



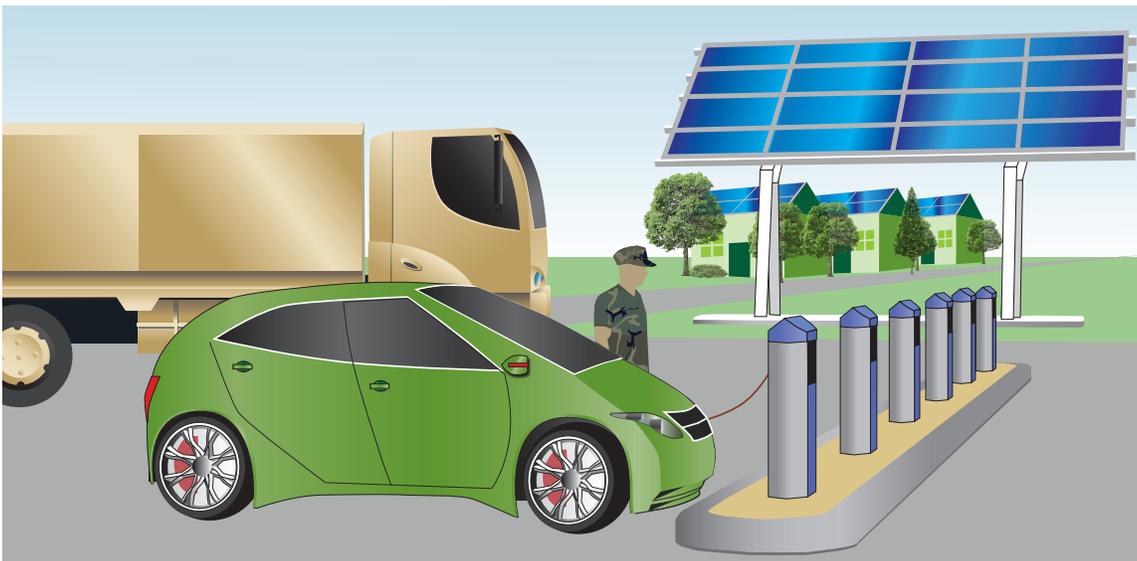
## Responsive to National Security, Environmental & Economic Priorities

On the front lines of national security, the Department of Defense (DOD) recognizes how adoption of renewable energy is vital to reducing dependence on foreign oil, addressing greenhouse gas emissions and maximizing resource utilization. NREL is working with DOD and the U.S. Army Corps of Engineers to specify a system that integrates solar photovoltaics, plug-in electric vehicles and a renewable energy management unit with a microgrid at Fort Carson, a large Army facility in Colorado.

Through the coordination of generators and loads, the Fort Carson microgrid will make it possible to maintain electricity delivery to a portion of the facility that is critical to sustained operations. During this multi-year project, NREL will develop critical modeling tools to optimize components needed to link vehicles to the microgrid. Funded with \$1.7 million from the DOD's Energy Conservation Investment Program (ECIP), the project will be rolled out in four phases:

- Development of an operational model of the microgrid using dynamic modeling and leveraging Fort Carson data gathered in previous DOE projects
- Creation of a modeling tool to explore a spectrum of renewable charging station configurations
- Identification of optimized operational scenarios for the integrated system
- Generation of a request for proposal for system construction and deployment

“The ability to integrate electric vehicle charging with renewables supports several Army energy security challenges for the future,” explains Vince Guthrie, utility programs manager, Fort Carson Directorate of Public Works. “Fort Carson is excited to have NREL working with the U.S. Army Corp of Engineers to develop the tools and systems needed to create value, both in the normal and microgrid operation of electric vehicles.”



## Designed for Adoption in a Variety of Locations

Accommodating renewable energy generation, including photovoltaic arrays or wind turbines is a high priority for DOD facilities. Parking facilities can present ideal locations for systems connecting electric vehicles with solar energy sources and microgrids. A microgrid that integrates renewable generation and vehicle energy storage offers energy security, cost savings, and reliability benefits.

The model of a system specific to Fort Carson will include a photovoltaic canopy that provides shade for vehicles while feeding energy to the microgrid and vehicle charging stations. The charging stations will act as energy management portals, enabling uni-directional and bi-directional power flow with vehicle energy storage.

The project's ultimate goals are to minimize fuel consumption, energy cost and emissions, by integrating renewables, vehicles and the microgrid with intelligent controls which can maximize operational duration. The control strategies would utilize the resources to improve diesel generator efficiency, reduce electricity costs, and offset fossil fuel consumption.

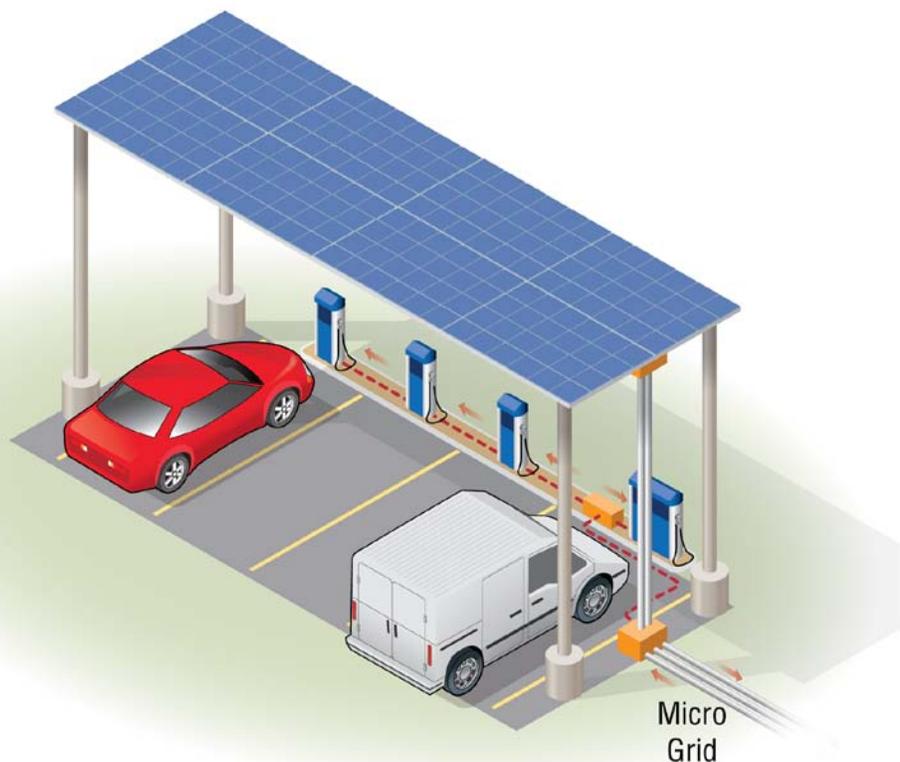
NREL's analysis will explore design parameters leading to optimal vehicle-to-grid functionality. The effort will lead the way toward specification and implementation of similar systems at other DOD installations. NREL and DOD expect to transfer technology from this collaborative project to the DOE Office of Electricity Delivery and Energy Reliability (OE) and the Office of Energy Efficiency and Renewable Energy (EERE) for civilian applications.

## About NREL's Electric Vehicle Grid Integration Effort

Strategies and models created by NREL's Electric Vehicle Grid Integration team accelerate development of transportation electrification and expand renewable generation through:

- Understanding vehicle usage profiles, EV benefits, and battery life challenges
- Integration of renewable resources with vehicle charging
- Development and testing of grid interoperability standards
- Exploration of grid services technology opportunities

For more information on this DOD/NREL systems integration project or other electric vehicle and microgrid research, contact Tony Markel: (303) 275-4478 or [Tony.Markel@nrel.gov](mailto:Tony.Markel@nrel.gov).



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