



Research on Vehicle-Grid Integration Development Trends and Policy Systems in China

Executive Summary

Acknowledgement:

This research project is a collaboration between the Energy Research Institute of the National Development and Reform Commission of China, the Natural Resources Defense Council, and the Tianjin Huadayidian Company, with support from the ClimateWorks Foundation and Energy Foundation, and input from the utility, auto and charging service industries. We extend our sincere appreciation to the State Grid Electric Vehicle Service Company, State Grid Shanghai Municipal Electric Power Company, Shanghai Electric Vehicle Data Collecting, Monitoring and Research Center (EVDATA), NIO, Great Wall Motors, and Teld New Energy Company for their contribution to this report.

Renewable energy and electric vehicles (EV) are currently driving a technological and industrial energy revolution in China. However, the large-scale production and consumption of variable renewable energy resources still face challenges, and the carbon-intensive power system diminishes the environmental value of electric vehicles. With continuous progress in battery technology development and large-scale adoption, EVs not only can contribute to emissions reductions of their own but also that of the power grid. By serving as an extremely cost-effective and flexible regulating resource for the power system, EVs can fundamentally resolve the constraints of insufficient power system flexibility and help accelerate the pace of renewable energy development, thereby helping China achieve its carbon peaking and carbon neutrality targets (the “dual carbon targets”) sooner. As such, breaking through the cross-sector barriers as quickly as possible to promote synergies between renewable energy and EVs is a crucial pathway for overcoming the respective constraints in the power and transportation sectors and achieve a win-win transformation in China.

Since 2019, there has been a rapid roll-out of vehicle-grid integration (VGI) pilot projects in China, and relevant technology and infrastructure have been improving at an accelerated rate. Pricing and market mechanisms also continue to be refined, with new business model innovations continuously emerging and the importance of EV resources to the “new power system”¹ becoming increasingly prominent. This report begins by summarizing the current progress of these domestic vehicle-grid integration pilot projects, focusing on electricity prices and market mechanisms. Next, the report evaluates future VGI resource potential, technological and economic trends, and the role and positioning of VGI in the new power system.

Research Findings:

- 1) There are no obvious resource constraints that limit vehicle-grid integration—i.e., VGI resources will be sufficient to meet the intra-day load-following demands imposed by large-scale, variable renewable energy generation on the power grid in the future.

¹ A power system characterized by high levels of renewable energy in the power mix.

- 2) The cost of current vehicle to grid integration/interaction efforts is lower than stationary energy storage, and the cost of managed EV charging is at the lower bounds of retrofitting thermal power for flexibility. As the number of EVs grows and battery technology improves, the potential scale and economics of vehicle-grid integration are enough for it to become a driving force for power system flexibility.
- 3) Combined with the case study of a western province, analysis finds that, compared to stationary energy storage, vehicle-grid integration is a more economical means of reducing renewable energy curtailment.

Policy Recommendations:

Based on the challenges observed in existing domestic vehicle-grid integration pilots projects, the report concludes with the following recommendations regarding construction standards, electricity pricing policies, market mechanisms, and user guidance.

- 1) Fast track the development of a top-level design for a coordinated transformation of the energy and transportation sectors, and establish a roadmap for VGI that is consistent with China's dual carbon targets. Take preliminary steps to establish an enabling environment for VGI operation that is fully open, intelligent & managed, and with flexible trading capability, by the end of the 14th FYP, and strive to form over 500 GW of flexible EV-based load-following resources by 2030.
- 2) Accelerate intelligent upgrading of distribution grids and promote cross-platform data sharing and communication.
- 3) Establish charging and discharging electricity pricing for EVs, refine charging and discharging pricing for peak and off-peak periods, and introduce mechanisms for dynamically adjusting charging and discharging prices.
- 4) Innovate market mechanisms, expand the scope of third-party ancillary services pilots, and incorporate EVs into the ancillary services market. Establish unified platforms for competition, using response capability as an indicator to widen earnings differential. Encourage EVs to participate in electricity spot markets.
- 5) Increase vehicle owner participation in vehicle-grid integration programs by increasing the ratio of EV charging piles, innovating new types of battery warranties, promoting the battery swap business model, and expanding social outreach.