

4.2 Smart Grid Application – A Vehicle-to-Grid Bi-directional Charging System

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Taipower Partnered with Gogoro to Build the World's First Electric Scooter V2G Battery Exchange Station ▶▶

As a result of the trends of energy transition, working to achieve net-zero-carbon emissions, and the increasingly widespread adoption of electric vehicles, the effective conversion of substantial electricity demand into power supply poses a significant challenge. To meet this challenge, Taipower, in addition to actively pursuing the development of renewable energy sources, is exploring innovative approaches beyond the conventional paradigm of large-scale power plant construction. By leveraging emerging technologies, Taipower aims to introduce diverse power sources. As part of this effort, Taipower is collaborated with Gogoro, a prominent electric scooter manufacturer, to establish the world's first electric scooter battery swapping station featuring Vehicle-to-Grid (V2G) functionality. This pioneering initiative expands upon the internationally acclaimed battery swapping business model by incorporating the added capability of bidirectional power transmission. Consequently, it not only facilitates the creation of a decentralized energy storage virtual power plant but also fosters enhanced grid stability and cultivates novel business models for electricity trading, thus fostering a mutually beneficial future.

Unlike the current battery swapping stations that only support one-way charging, the V2G battery swapping station has the capability of bidirectional charging and discharging. It also has a power capacity of 60 kWh, which can provide electricity for an average household's needs for 4 to 5 days. With the integration of an energy management system, it can intelligently schedule charging, turning the distributed battery swapping stations into decentralized energy storage stations that can also feed electricity back to the grid. As of November 28, 2022, Gogoro has deployed a total of 12,292 battery swapping cabinets across Taiwan, with a total system battery capacity of 1.59 GWh (including the battery swapping stations and batteries on electric scooters). This amount of electricity is sufficient to power the entire city of Taipei for 53 minutes.

At the demonstration site of Taipower's V2G technology, the Energy Management System (EMS) has integrated V2G battery swapping stations/charging piles, small-scale green energy/storage units, and controllable loads. The system has successfully completed functional verification related to V2G technology. Currently, the demonstration site is conducting tests with a schedule of charging from 8 a.m. to 12 p.m. and discharging from 4 p.m. to 8 p.m. This will provide understanding on whether there is an incentive for business operators to feed electricity back to the grid under different electricity pricing schemes. It also allows for the calculation of energy consumption during the charging and discharging process. The results show that from January 1, 2022 to November 18, 2022, a total of 10,452 kWh of electricity has been fed back to the grid, indicating that there is an incentive to attract business operators to feed electricity back to the grid.

In addition to focusing on system design to reduce electricity loss, ongoing research endeavors also involve leveraging the advanced capabilities of the Gogoro Network, such as its big data analytics, artificial intelligence (AI), and machine learning. By harnessing these technologies, participants aim to enhance the intelligent management of batteries, and ultimately achieve grid balance. The ultimate goal is to transform the smart battery swapping platform into an indispensable energy storage facility within the power grid.

Future Research Development and Prospects ▶▶

In response to the government's energy transition and the transformation of the power industry ecosystem, as well as to achieve the phase goal of net-zero transformation by 2025, Taipower is making changes to both generation forms and fuel types. Simultaneously, the Company is decommissioning and replacing old units with high-efficiency and environmentally friendly equipment such as advanced ultra-supercritical units to improve power generation efficiency and reduce air pollutant emissions.

Furthermore, the power generation, grid, and user consumption patterns are shifting from the traditional centralized model to a decentralized model where distributed generation facilities are combined with energy storage systems to form microgrid structures. User demand response is coordinated through neighboring microgrids, while the overall power supply stability is balanced through a large-scale transmission network. This approach aims to simultaneously meet electricity demand and grid reliability, reducing the probability of grid accidents.

Taipower's research and development efforts focus on promoting new technologies, addressing operational issues, and dealing with significant company and government decisions. The "6-3-1 Research and Development Investment Portfolio" is used to plan and formulate research and development directions. The Future Power Technology Forecasting Program is utilized to identify key technological developments that enhance grid resilience, ensure stable power supply, drive energy transition, and facilitate corporate transformation. The development of high and low voltage systems, energy storage, and other technological plans are designed to meet future operational development trends, align with electricity market demands, achieve a sustainable balance in society, the economy, ecology, and environment, and to create new value in the development of innovative technologies for the enterprise.