4

Leader of Smart Grid Development

Development Vision

Technology is changing our world at an astonishing pace. The wave of artificial intelligence (AI), rapid changes in information and communications technology (ICT), breakthroughs and innovations of big data, blockchain, and cloud technology have all overturned the business models of the past and revolutionized many industrial applications. Taipower is committed to using R&D and innovation to propel the development of low-carbon electric power. The Company actively invests in smart grid deployment, introduces new technologies, improves its management efficiency, and increases its operational effectiveness. It has also applied itself to meeting the important infrastructural demands of renewable energy.

Taipower is in alignment with the government's policies and plans. In the policy short term (2020), the Company focused on enhancing operational flexibility, developing a stable power supply network with a high proportion of renewable energy, and strengthening the flexible dispatching capabilities of grid supply, demand, and outage. In the medium term (by 2025), the Company will be focused on reinforcing grid resilience and establishing a safe and highly adaptable grid in response to climate change. In the long term (by 2030), Taipower will have implemented reforms in the electricity industry, increased the use of low-carbon energy, devoted itself to the development of a safe and reliable grid, and propelled open and transparent information and fair market transactions.

Performance Highlights

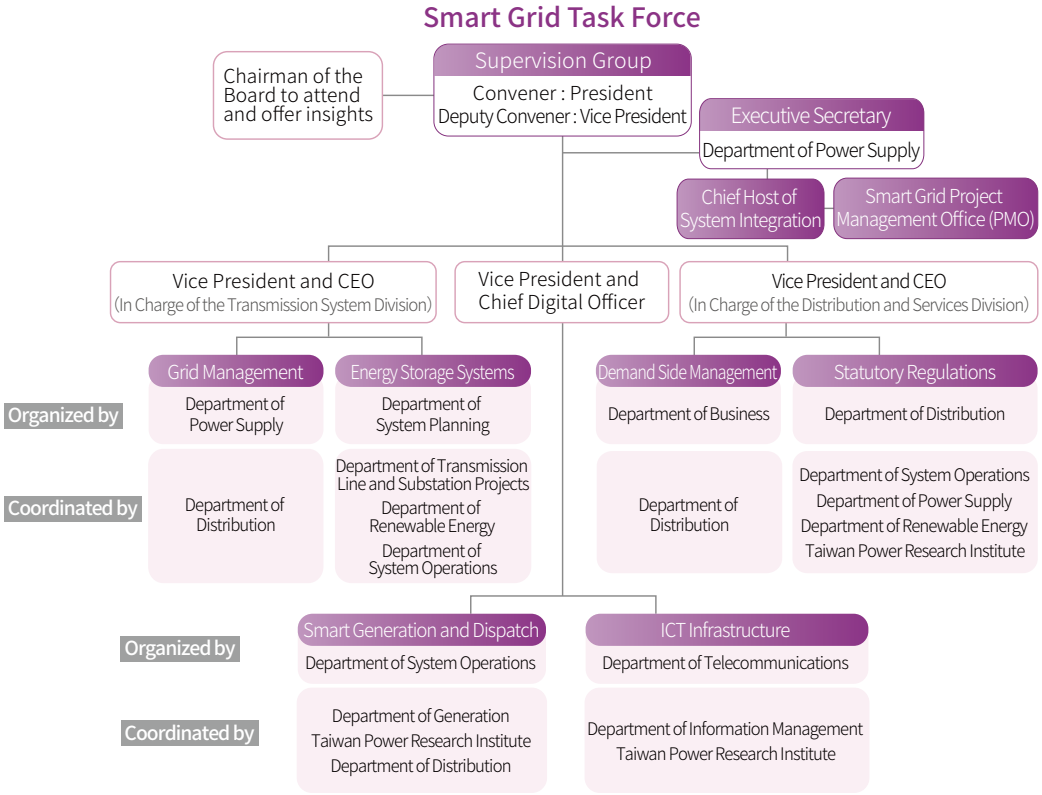
- By the end of 2021, there had been more than **1.5 million** AMI installations encapsulating 72% of the nation's power use information. It is estimated that **7 million** AMI smart meters will be deployed by 2030.
- In 2021, the real-time monitorable capacity of renewables reached **3GW**.
- The deployment of **80.7 kilometers** of optical cables, **85 sets** of fiber optic communication systems, **1,225 communication circuits**, and **215 sets** of backbone (10G) routers was completed in 2021.

4.1 Smart Grid General Planning

103-2 103-3 203-2

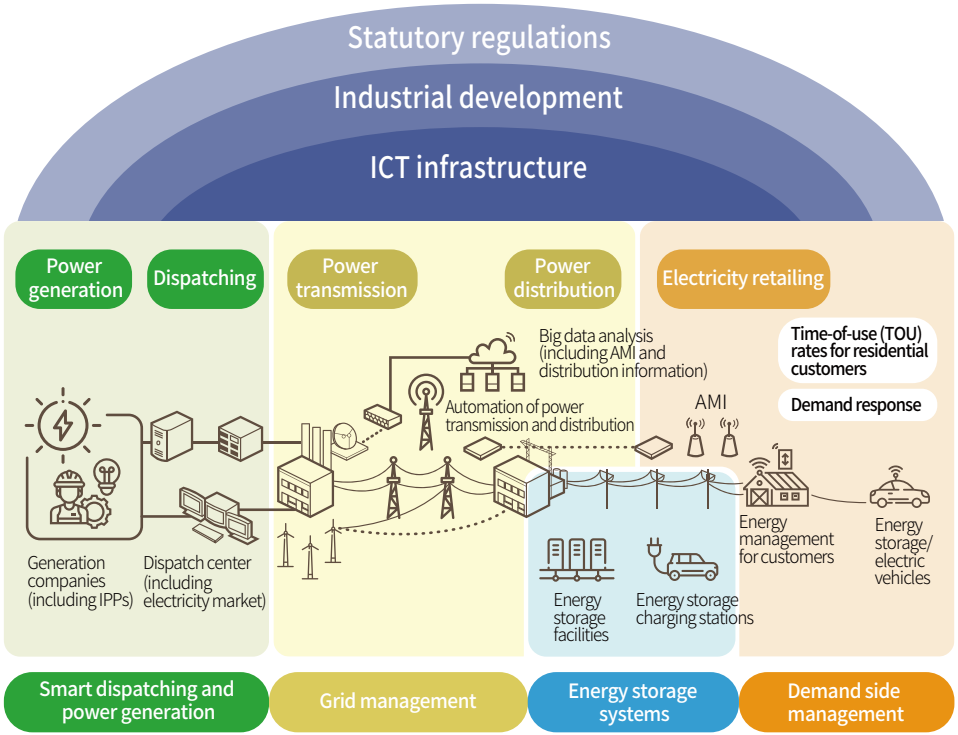
Smart grids are vital to driving energy transition, leading industrial transformation and new economic development. Taipower is proactively reducing the impact of renewable energy generation's intermittency, enhancing grid resilience, and strengthening and consolidating power transmission and distribution systems. The Company is committed to improving disaster prevention and troubleshooting capabilities while increasing the system's supply and demand performance, incorporating load management methods, enhancing user participation opportunities, and progressively building a stable and effective smart grid.

In developing the smart grid, the priority objectives are: (1) responding to the challenges of renewable energy grid connection, (2) strengthening the resilience of existing grids to enhance power supply quality in the face of extreme climates, and (3) encouraging user participation in energy conservation to improve power system operating efficiency. In response to the broader Smart Grid General Plan, Taipower formed an internal Smart Grid Task Force with the Company's president as convener. Regular meetings with relevant units are held to review projects, execution status, and future planning directions.



Smart Grid Action Plan

On March 27, 2020, Taipower began to carry out smart grid construction in accordance with The Smart Grid Master Plan as approved and amended by the Executive Yuan's Bureau of Energy. The plan is oriented towards problem-solving and system integration, and is divided into 7 key strategic areas, 21 specific practices, and 14 checkpoint objectives. Taipower is mainly responsible for five areas, 17 specific practices, and 13 checkpoint targets. The Company continuously implements and reviews its performance to strengthen its energy management and grid resilience.



The Smart Grid General Planning Framework

Seven key strategic areas	Specific Practices (21 items)
Smart dispatching and power generation	• Establish the renewable energy generation monitoring system • Establish the energy trading platform • Establish the big data damage monitoring system for the boiler tubes of coal-fired units • Ancillary service demand research
Grid management	• Application and promotion of transmission system data in planning, operation, and maintenance • Application and promotion of feeder automation system data
Energy storage systems	• Construction of an energy storage system at a Taipower site • Establish an ancillary service procurement mechanism
Demand side management	• Low voltage Automated Meter Infrastructure (AMI) • AMI data application • Review electricity price structure and run trials on dynamic prices • Review and run trials on various demand response schemes
ICT infrastructure	• Enhance security of the smart grid information program • Smart grid data application plan • Upgrade plan for backbone / regional fiber optics communication systems • Introduction of an electrical IoT communication system to the plan
Industrial development	• Expand product and system servicesDrive enterprises to participate in the electricity market
Statutory regulations	• Review current electricity-related regulations • Refine renewable generation system interconnection technology • Develop national standards for smart grids and establish an equipment testing platform

Performance of Smart Grid in 2021

Taipower experienced several major achievements this year within the five fields under its purview. They are described as follows:

Smart dispatching and power generation

Consolidated existing renewable energy generation and established an information management platform, created platforms for power market trading and coal-fired unit big data monitoring, and introducing a Distribution-level Renewable Energy Advanced Management System (DREAMS). The real-time monitoring capacity of reneable energy (GW) reached 3 GW in 2021.

Grid management

Plan, operate, and maintain transmission system data, and consolidate information to strengthen the management of power transmission and distribution assets. The ratio of power outage recoveries for downstream automated feeders (within five minutes) reached 45%.

Energy storage system

The target capacity of energy storage systems was achieved in 2021 and reached 57 MW.

Demand side management

Taipower is targeting potential power-saving users in its deployment of smart meters. By the end of 2021, a total of 29,621 high-voltage AMIs and 1,096,869 low-voltage AMIs had been installed. The meters now encapsulate 72% of the country's electricity consumption information.

ICT infrastructure

Completed the installation of 80.7 kilometers of optical cables, 85 optical fiber communication systems providing 773 communication circuits, and installing 215 sets of backbone (10G) routers in 2021.

Performance and Target of Smart Grid

Review Objectives		2021 Performance	2022 Target
1. Real-time monitorable capacity of renewables (GW)		3 (Wind power 0.9; Solar photovoltaics 2.1)	7
2. Accuracy of renewable forecasts (Day-ahead / hour-ahead error rate %)	Wind power	12.07% / 7.47%	13 / 6.5
	Solar photovoltaics	4.04% / 2.57%	12 / 6
3. Ancillary service reserve (MW)	Regulation reserve	800	1000
	Real-time reserve	1000	1100
	Supplemental reserve	1000	1100
4. Number of electrical and mechanical accidents (Times / year)		10	16
5. Equivalent Unavailability Factor (EUF) of coal-fired power plants (Total hours of equivalent tube rupture outage)		0.27% (23.5 hours / unit / year)	Under 1.35% (under 118 hours / unit / year)
6. Average time for transmission system equipment failure (Hours / year)		0.29	1.44
7. The ratio (%) of power recovery outages for downstream automated feeders (within five minutes)		45%	35%
8. Capacity of energy storage systems (MW)		57	102
9. AMI smart meter infrastructure (cumulative number of households)		1,501,531 households	2 million households
10. AMI user power use data available online for inquiry (hours)		6 hours ago	5 hours ago
11. Participation in demand response scheme (GW)		2.68 GW	2.6 GW
12. Bandwidth improvement of backbone / regional fiber optics system (Gbps)		Completed 215 sets of backbone (10G) routers	100Gbps backbone network optimization
13. Introduction of IDS information security protection		Completed performance evaluation of intrusion detection system in 3 domains	Promote experimental sites (8 domains)

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

103-2 103-3

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

There are more than 500,000 electric vehicles in Taiwan. Giving these vehicles the capacity to transmit electricity back to the grid when needed for emergency dispatching, would essentially allow Taiwan's electric vehicles to act as an emergency energy storage system. This would provide a tremendous boost to the transition. Taipower and electric scooter maker and battery swapping system provider Gogoro have officially announced the new technology concept is possible and will offer bidirectional charging through Gogoro's battery swapping stations.

On October 26, 2021, Taipower held a Taipower X Gogoro Battery Exchange Station Vehicle-to-Grid (hereinafter referred as V2G) Technology Presentation, where then-Taipower Chairman Wei-Fuu Yang, and Gogoro Founder, Chairman and CEO Horace Luke witnessed the world's first battery exchange station for electric scooters with V2G abilities. In addition to demonstrating a bi-directional charging and discharging function, Taipower also debuted its self-developed energy management system (EMS).

In response to the continuous growth of domestic electricity demand, Taipower has developed multiple sources of electricity. But the Company has also thought beyond the existing mindset of simply building power plants by integrating smart grids and energy storage systems to strengthen demand management. Taiwan has experienced a substantial growth in electric vehicles. Statistics from the Ministry of Transportation and Communications indicate that the number of registered electric vehicles had reach nearly 530,000 by the end of September 2021. In addition to providing the electricity required for driving, Taipower has further validated the V2G technology by utilizing the battery storage characteristics of the vehicles, allowing electric vehicles to become energy storage.

In 2019, Taipower started a "Research on Electric Carriers, Charging and Exchange Stations to Provide Auxiliary Services to the Grid" project using the Shulin Site of the Taiwan Power Research Institute as a development base. Last year, Taipower completed its verification by transmitting the electricity from vehicles to the grid and an automatic frequency modulation ancillary service function. By the end of 2021, the Company had launched two V2G electric vehicle smart charging demonstration sites.

Meanwhile, Taipower also worked with Gogoro to build the world's first electric scooter V2G battery exchange station. In the future, apart from meeting the demand from electric scooters, battery exchange stations are expected to transform into decentralized energy storage stations throughout the country, thus playing the role of "virtual power plants" to help strengthen grid stability and create smart cities.