

4.1 Smart Grid General Planning

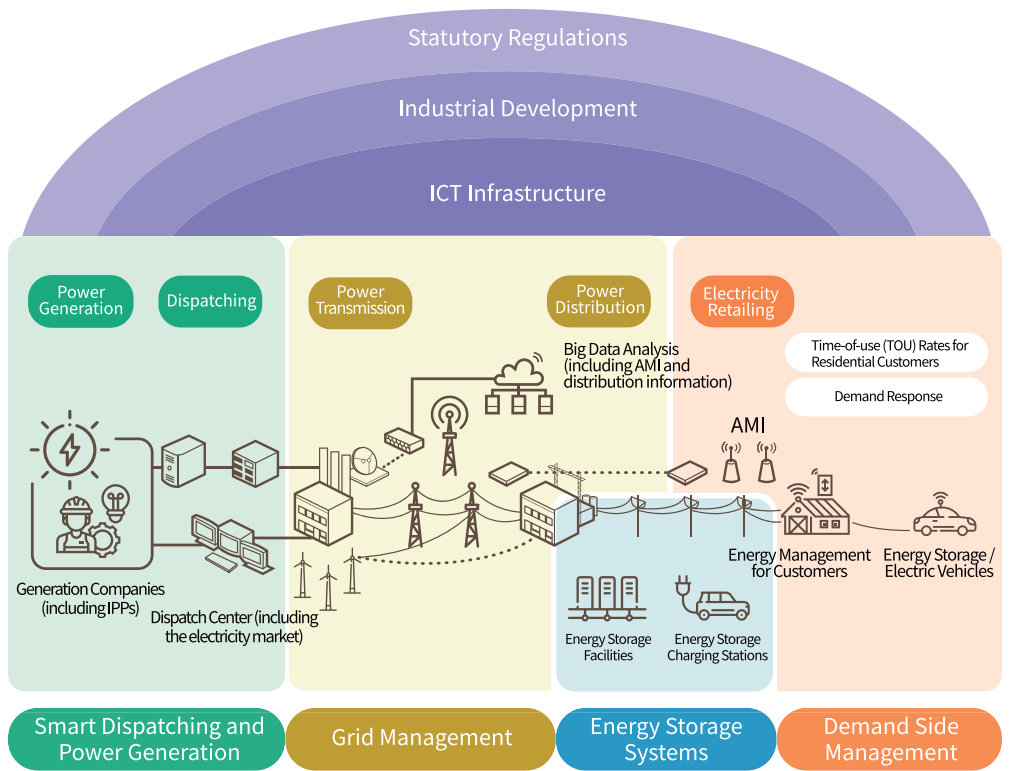
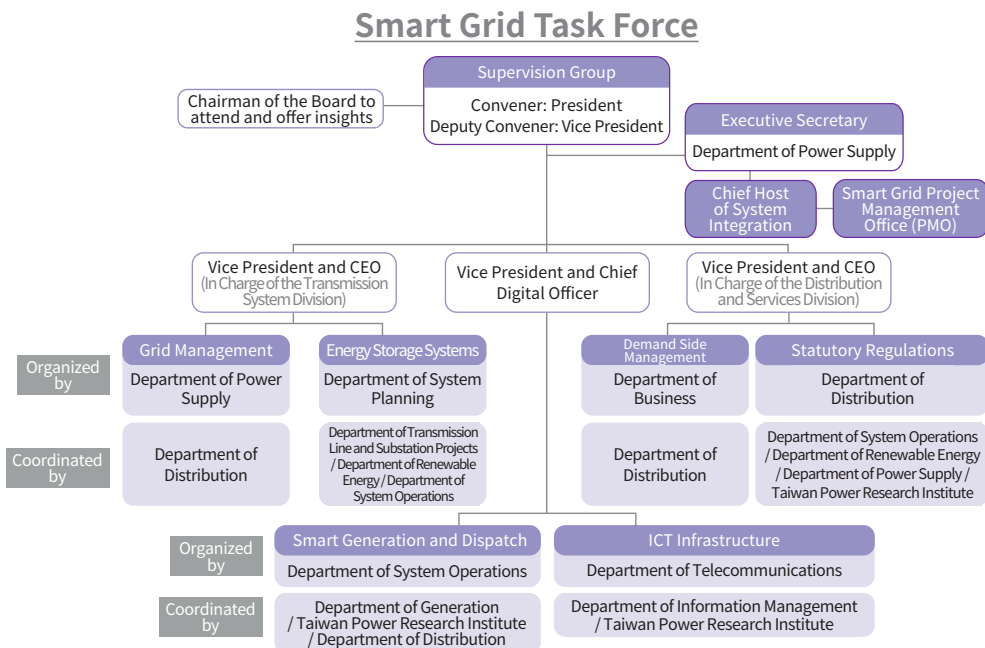
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Smart grids are vital to driving energy transition, leading industrial transformation and new economic development. Taipower is proactively reducing the impact of renewable energy generation's intermittency, enhancing grid resilience, and strengthening and consolidating power transmission and distribution systems. Additionally, the Company is committed to improving disaster prevention and troubleshooting capabilities while increasing the system's supply and demand performance, incorporating load management methods and enhancing user participation opportunities through 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 connections, (2) strengthening the resilience of existing grids to enhance power supply quality in the face of extreme climate, 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 in these areas to strengthen its energy management and grid resilience.



The Smart Grid General Planning Framework ▶▶

Key Strategic Areas (7 items)	Specific Practices (21 items)
Smart dispatching and power generation	<ul style="list-style-type: none"> Establish a renewable energy generation monitoring system Establish an energy trading platform Establish a big data damage monitoring system for the boiler tubes of coal-fired units Undertake ancillary service demand research
Grid management	<ul style="list-style-type: none"> Apply and promote transmission system data in planning, operations, and maintenance Apply and promote feeder automation system data
Energy storage systems	<ul style="list-style-type: none"> Construct an energy storage system at a Taipower site Establish an ancillary service procurement mechanism
Demand side management	<ul style="list-style-type: none"> Establish a low voltage Automated Meter Infrastructure (AMI) Apply AMI data Review electricity price structures and run trials on dynamic prices Review and run trials on various demand response schemes
ICT infrastructure	<ul style="list-style-type: none"> Enhance security of the smart grid information program Enact a smart grid data application plan Establish an upgrade plan for backbone/regional fiber optics communication systems Introduce an electrical IoT communication system to the plan
Industrial development	<ul style="list-style-type: none"> Expand product and system services (Industrial Development Bureau) Drive enterprises to participate in the electricity market (Industrial Development Bureau)
Statutory regulations	<ul style="list-style-type: none"> Review current electricity-related regulations (Bureau of Standards, Metrology and Inspection) Refine renewable generation system interconnection technology (Taipower) Develop national standards for smart grids and establish an equipment testing platform (Bureau of Standards, Metrology and Inspection)

Smart Grid Performance in 2022 ▶▶

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



Smart dispatching and power generation

The Company 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 introduced a Distribution-level Renewable Energy Advanced Management System (DREAMS). The real-time monitoring capacity of renewable energy (GW) reached 4.26 GW in 2022.



Grid management

Plan, operate, and maintain transmission system data, and consolidate information to strengthen the management of power transmission and distribution assets. In 2022, the average failure time of transmission system equipment was 0.373 hours/year.



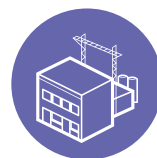
Energy storage system

The capacity of energy storage systems reached 150.8 MW.



Demand side management

Taipower is targeting potential power-saving users in its deployment of smart meters. By the end of 2022, a total of 2.108 million high-voltage AMIs had been installed.



ICT infrastructure

Completed the installation of 100 kilometers of optical cables, 42 optical fiber communication systems providing 720 communication circuits, and installed 590 sets of routers in 2022.



Smart Grid Performance and Target

Review Objectives	2022 Target		2022 Performance	2025 Target (Approved Version)
1. Real-time monitorable capacity of renewables (GW)	7 GW		4.26 GW (Wind power 1.52 GW; Solar photovoltaics 2.74 GW)	16.5 GW
2. Accuracy of renewable forecasts (Day-ahead / hour-ahead error rate %)	Wind power	13% / 6.5%	8.78% / 4.8%	10% / 5%
	Solar photovoltaics	12% / 6%	5.00% / 3.42%	10% / 5%
3. Ancillary service reserve (MW)	Regulation reserve	1,000 MW	1,000 MW	1,300 MW
	Real-time reserve	1,100 MW	1,149 MW	1,100 MW
	Supplemental reserve	1,100 MW	1,193 MW	1,100 MW
4. Number of electrical and mechanical accidents (Times / year)	16		8	15
5. Equivalent Unavailability Factor (EUF) of coal-fired power plants (Total hours of equivalent tube rupture outage)	Under 1.35% (Under 118 hours / unit / year)		0.09% (7.5 hours / unit / year)	1.2% (105 hours / unit / year)
6. Average time for transmission system equipment failure (Hours / year)	1.44		0.373	1.42
7. The ratio (%) of power recovery outages for downstream automated feeders (within five minutes)	35%		49%	70%
8. Capacity of energy storage systems (MW)	102 MW		150.8 MW	590 MW ^{Note}
9. AMI smart meter infrastructure (cumulative number of households)	2 million households		2.108 million households	3 million households (by 2024)
10. AMI user power use data available online for inquiry (hours)	Within five hours		Within five hours	Within four hours (Two hours for TOU customers)
11. Participation in demand response scheme (GW)	2.6 GW		2.77 GW	2.8 GW
12. Bandwidth improvement of backbone / regional fiber optics system (Gbps)	100Gbps backbone network optimization		<ul style="list-style-type: none"> ✓ Completed on-site installation of 590 sets of IP-MPLS system area network (10Gbps) routers. ✓ Completed the draft plan for the next-generation optical transport network (OTN) system. 	Regional 10Gbps (Complete in 2023)
13. Introduction of IDS information security protection	Promote experimental sites (8 domains)		Building completed on 8 domains	Complete all dispatch centers (32 domains)

Note: According to the "National Power Resource Supply and Demand Report for the Year 2022" published by the Bureau of Energy in July 2023, Taipower has set a target to install 1000MW of energy storage batteries by 2025.

The Smart Grid Index (SGI)

The Singapore Smart Grid Index (SGI) is an international assessment of smart grid development. It evaluates the progress of power companies in implementing smart grid initiatives based on seven main themes: customer empowerment and satisfaction, cybersecurity, renewable energy, integration of distributed energy resources, power reliability, data analysis and monitoring, and control. The research covers the Asia-Pacific region, Europe, and the Americas.

The report surveyed a total of 94 power companies from 39 countries worldwide. Enedis, a subsidiary of the French electricity holding group EDF, achieved the highest score of 98.2 and secured the top position. Taipower and UK Power Networks (UKPN) tied for second place with scores of 94.6. Taipower has consistently maintained its position on the list, outperforming other well-known Asian power companies from Japan and South Korea.

2022 BENCHMARKING RESULTS

Utility	Country/Market	Score
Enedis	FRA	98.2
TaiPower ★	TWN	94.6
UKPN	GBR	94.6
ConEd	USA	92.9
WPD	GBR	92.9
CitiPower	AUS	91.1
DEWA	ARE	89.3
SP Energy Networks	GAR	89.3
SDGE	USA	87.5
FPL	USA	85.7