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# 5.1 Smart Electricity Services

## 5.1.1 Demand Side Management Measures  `3-3` `203-2`

In recent years, demand for electricity in Taiwan has been growing. Coupled with the difficulty of setting up new power generation units and climatic anomalies, this has led to an increasingly tight supply of electricity. According to Article 47, paragraph 4 of the Electricity Act, the Electricity Retailing Enterprise shall draft an annual incentive program that encourages and assists users to save electricity. The plan will be submitted to the electricity industry regulatory authority for review.

## Demand-Based Bidding ▶▶

"Demand-Based bidding" refers to the practice of allowing users to sell back the electricity they save to Taipower during periods of high system load. Users bid their desired price, and Taipower determines the winning bidder based on the lowest bid. If the winning bidder successfully reduces their electricity consumption during the designated period, they are eligible for a reduction in their electricity bill. This measure empowers users by allowing them to set their own price, stimulating their potential for reducing electricity usage. It helps improve the system load profile, thereby delaying the need for new power generation facilities and reducing the risk of potential power shortages. In the future, Taipower plans to provide more real-time power consumption information through smart meters, and to refine demand response scheme designs. For example, the Company will coordinate the increasing number of renewable energy grid-connections to adjust periods for users to suppress power consumption. This will provide more flexible resources for the power system. Taipower will also be reviewing and piloting a variety of demand response plans.



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## Time-of-Use Rates ▶▶

The Time-of-Use (TOU) rates set different electricity prices for peak and off-peak periods. This reflects the power supply costs in different periods and guides users to reduce or shift peak power consumption to off-peak periods. Taipower has now used TOU rates for more than 40 years since they were first employed in 1979. At present, there are a total of 14 TOU rates for all kinds of customers. Among them, TOU rates have been fully applied to high-voltage users since 1989, while low-voltage users are free to choose to participate or not.

| Power Consumption Category | Total Customers (Households) | TOU Customers (Households) | Ratio (%) |
|---|---|---|---|
| Meter-rated lighting for non-businesses | 13,373,135 | 63,472 | 0.47 |
| Meter-rated lighting for businesses | 1,040,266 | 127,306 | 12.24 |
| Low-voltage electricity | 306,781 | 38,049 | 12.40 |
| High-voltage electricity | 24,854 | 24,854 | 100.00 |
| Ultra-high-voltage electricity | 673 | 673 | 100.00 |
| Total | 14,745,709 | 254,354 | 1.72[Note] |

Note: If only potential customers (i.e., those using >700 kWh per month for residential and >1100 kWh per month for small stores) are considered, time tariff accounts for about 15% of the total number of customers.

Note: With the exception of contracted light and contracted power (which are billed on a capacity basis without seasonality), the rest of the electricity tariff is applied seasonally. The proportion of users is 99%

## Description of Electricity Type

In line with the deployment and application of smart meters, Taipower introduced Residential and Commercial Simple Time-of-Use (TOU) Pricing in 2016. In May 2021, the Company further launched Standard Three-Tiered TOU Pricing for Lighting and Three-Tiered TOU Pricing for Low-Voltage Electricity to provide users with multiple options. In May 2022, Taipower introduced Electric Vehicle Charging and Swapping Facility Pricing to cater to the growing demand for electric vehicles. Together, these pricing plans offer users a diverse range of choices.

Additionally, with the increasing generation of renewable energy, there have been changes in peak and off-peak hours within the power system. To accommodate this, Taipower has adjusted the peak and off-peak periods for time-of-use pricing. These were officially implemented in 2023.

| Supply Voltage | Category | | Scope of Application | Example of Application |
|---|---|---|---|---|
| Low voltage | Contracted light and electricity | | Lights, small appliances, and alarms for outdoor public facilities | Public street lights, alarms |
| | Meter-rated lighting | Electricity for non-businesses | The total capacity of electricity used for residential purposes or for lights, small appliances, and electric power in non-productive premises other than residences is less than 100 kw | Residences |
| | | Electricity for businesses | | Small-sized stores |
| | Low-voltage electricity | | For lights, small appliances, and electric power in production or non-production premises with a contracted capacity of more than 1kw but less than 100kw. In cases where the power supply is 380V with no technical difficulties, the capacity can be expanded to 499 kw | Medium-sized organizations, schools, supermarkets, medium-sized shopping malls, small and medium-sized factories, electric vehicle charging and swapping facilities |
| High voltage and above | High-voltage electricity | | For lights, small appliances, and electric power in production or non-production premises with a contracted capacity of more than 100kw | Large-sized factories, organizations, schools, banks, department stores, and electric vehicle charging and swapping facilities |
| | Ultra-high voltage electricity | | | Mega factories, MRT systems, airports |

## Demand Side Management Measures

Taipower focuses on demand-side management, with demand response and energy conservation as its two main driving directions. The goal is to create an energy-saving atmosphere, promote demand response, and encourage energy-saving practices among the general population. By generating a collective drive for energy conservation, the aim is to reduce peak loads and promote energy efficiency as a nationwide movement. This will drive changes in societal behavior, and encourage the active participation of the entire population in energy conservation and in carbon reduction efforts.

**RULES**
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| | Measure | Description | Applicable customers | Results |
|---|---|---|---|---|
| **TOU Rates** | Use of TOU rates since 1979 | Reflects the cost of electricity during different periods. Encourages off-peak electricity use to reduce energy consumption during peak hours. | Optional for meter-rated lighting and low-voltage customers; applicable to all high-voltage customers | The cumulatively suppressed peak load reached 4.16GWh in 2022 |
| | Launched Simplified Residential / Commercial TOU rates in 2016 | Provides more diverse rates for residential/commercial customers. Price signals are used to guide users to reduce electricity consumption during peak hours, thereby achieving the goal of reducing peak load. | Residential, small shops and low-voltage customers | |
| | Added new three-stage TOU rates for standard type and low-voltage meter-rated lighting in 2021 | | | |
| **Demand Response Load Management Measures** | Implemented Air Conditioner Duty Cycling Load Control Measures in 1991 (Ended on December 31, 2022) | Central air-conditioning systems are paused for 15 minutes in every 60 minutes of operation. Packaged air conditioning systems are paused for eight minutes with 22 minutes of operation to suppress peak loads. | Non-productive customers (e.g., office buildings, schools) | The 2022 peak load day (July 22) exceeded the low peak load by 1.15 GW |
| | Implemented Power Consumption Reduction Measures in 1987 | Provides reduced rates as incentives to encourage customers to reduce electricity consumption during peak hours or to shift to off-peak hours, to reduce system peak loads. | Either (super) high-voltage customers with more than 100 kW of dedicated capacity as specified in their contracts (could include factories and educational institutions or schools) | |
| | Implemented Demand-Based Bidding Measures in 2015 | Through user-defined feedback pricing, more autonomy is given to customers to reach their power-consumption mitigation potential and improve system loads. This reduces the demand for new power development and minimizes the risk of power shortages | Users that are frequently above high-voltage use levels | |
| | Implemented new Demand-Based Bidding Measures – a Joint Solution - in 2017 | Allows customers to apply for Demand-Based Bidding in groups | Users that are frequently above high-voltage use levels | |
| | Implemented emergency response measures and pact-guarantees in 2021 | In line with load reduction in cases of emergency, the system improved demand-side resilience | Users that are frequently above high-voltage use levels | |
| | Implemented flexible nighttime reductions from 2022 | Offers flexible suppression options for different hours during nighttime peak periods to encourage users to reduce power consumption. | Users that are frequently above high-voltage use levels | |
| | Power-Saving Service Team | Monthly visits to high-voltage users. Teams use high-voltage AMI data analysis and simple equipment diagnostic questionnaires (air-conditioning equipment, motors, lighting equipment, etc.) that help users grasp power consumption, inventory power saving potential, and promote Demand Response Measures to maintain a stable power supply. | Users that are frequently above high-voltage use levels | Taipower's Power-Saving Service Team visited 4,456 users in 2022, with an estimated power saving potential of 103.24GWh |
| | Community Energy Saving Campaigns | Provides free power-saving advocacy services for communities and associations. Taipower uses assemblies to promote power-saving, share energy-saving related knowledge and experiences. The Company advocates proper power-saving techniques, the use of high-efficiency energy-saving products (e.g., LED lighting), and provides electricity improvement recommendations for public facilities. | Local communities and associations | A total of 1,502 seminars were organized in 2022, with approximately 200,000 participants |

# 5.1.2 Power Saving Performance

In order to encourage energy conservation in practice, Taipower has employed power-saving incentives since July 2008. The Company continues to introduce new measures to maintain customer motivation and prompt additional power-saving over the long term. In order to increase user interaction and the effectiveness of voluntary power saving, a registration mechanism was introduced in 2018. Customers who sign up through the website, customer service hotline, or at a service counter will receive a reward of $0.6 per kWh of electricity saved, with a minimum bonus of $84 per period (2 months). The same year, a Power-Saving Reward Points mobile application was launched. This allows users to collect points by participating in various energy-saving puzzle activities on the app. Points may be redeemed for prizes or used to participate in sweepstakes. The goal is to promote power-saving among the public and to create a power-saving culture and habits. Taipower will continue to organize power-saving promotional activities that convey power-saving concepts through innovative and amusing approaches.

## Power Savings Reward Performance in 2022

| Year | Amount of saved electricity (Billions of kWh) | Reward amount for saving electricity (NT$100 million) | Carbon dioxide emission reduction (10,000 metric tons) | Equivalent number of Daan Forest Parks (for CO2 absorption capacity) in one year |
|---|---|---|---|---|
| 2020 | 1.19 | 10.3 | 61 | 1,558 |
| 2021 | 1.49 | 11.9 | 76 | 1,948 |
| 2022 | 2.31 | 17.0 | 117 | 3,016 |

Note:
1. Calculated based on the 2021 electricity emission coefficient of 0.509 kg $CO_2$e/kWh announced by the Bureau of Energy, Ministry of Economic Affairs in November 2022 and the 2020 Energy Bureau report on Daan Forest Park's absorption of 389 metric tons of $CO_2$ each year.
2. The performance of power-saving rewards is derived from the statistical data of customers who have logged in and completed power-saving reward activities (4.22 million customers in 2020, 4.34 million customers in 2021, and 4.32 million customers in 2022).
3. The calculation of electricity consumption reduction for the current year is based on the previous year, which is also the base year.

# 5.1.3 Digital Transformation

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Taipower has formulated a clear development blueprint for digital transformation, focusing on four key areas: platform construction, data governance, talent cultivation, and innovative applications. By the end of 2021, two major infrastructure projects – the island-wide fiber-optic communication system and the big data platform – had been completed, establishing a solid foundation for Taipower's future digital transformation. Taipower will continue to dedicate effort to driving digital transformation. Through top-down strategic planning and bottom-up innovation inspirations, it aims to stimulate innovative reforms within different units. A consensus among Taipower employees on promoting digital transformation has been consolidated. Taipower aspires to become a driving force in the energy technology industry as Taiwan's power sector moves towards liberalization.

## The Construction of a Smart Grid ▶▶

After the proportional increase in renewable energy generation, there has been a significant system load discrepancy due to the integration of intermittent renewable energy into the grid. The success of this integration requires a more flexible grid and the ability to stabilize the power supply quality through flexible scheduling. Taipower utilizes advanced technologies such as 5G, AI, IoT, and blockchain to integrate distributed energy resources while pursuing power system optimization. Through the digital integration of power resources, Taipower aims to create a digital energy internet with a smart grid at its core.

Taipower's smart grid is developing in three stages. The first is Smart Grid 1.0 and focused on infrastructure development. The second, Smart Grid 2.0, emphasizes practical operational models, and will ultimately lead the third stage, or Smart Grid 3.0, when the energy market opens up and the efficient integration of energy is achieved thereby enabling widespread applications. Currently, Taiwan is in the second stage of smart grid implementation, which emphasizes ensuring the stable operation of the power system, enhancing power supply quality, and encouraging user participation in energy conservation.

Taipower also utilizes AI and big data analytics to perform predictive maintenance and renewable energy generation forecasting. For thermal power units, preventive maintenance applications have already been implemented to achieve operational optimization and cost savings. For wind and solar photovoltaic energy, correlation predictive models can be established between power generation and sunlight data, providing a forecast for wind and solar power generation over the next 48 hours. This information assists with system dispatching and unit generation scheduling.

# Strengthening Communication Infrastructure ▶▶

To support Taipower's digital transformation and leverage digital innovation technologies that drive smart operations, Taipower is actively enhancing its communication infrastructure by constructing an Ultra-High-Speed IP Fiber-optic Communication System to meet the communication and transmission bandwidth requirements for future applications such as the smart grid, 5G, AI, and IoT. The system will also enhance the reliability of the communication system. The core network construction for Phase 1 was completed on November 20, 2020, and the construction of Phase 2 for the relay backbone network was completed on December 10, 2021. The construction of Phase 3 for the access network was reported for inspection on December 5, 2022, and the Company is currently working diligently on the inspection and acceptance of the Phase 3 access network. Work has also begun on the construction of the Phase 4 synchronous clock source system.

To ensure a stable power grid and a reliable power supply, Taipower actively strengthened the communication systems at power plants, ultra-high-voltage substations, primary substations, secondary substations, distribution substations, and service centers in 2022. This includes laying 100 kilometers of optical cables, setting up 42 sets of fiber-optic communication systems, providing 720 communication circuits, installing 590 access routers for protection relay, dispatching line and feeder automation systems, and facilitating the operation, monitoring, protection, load balancing, and other related operations of the entire power grid.

In response to the waves of 5G, AI, and IoT technology development, Taipower will continue to establish relevant 5G application services. These include implementing vertical applications in the power field and deploying wireless communication for power terminal devices. Taipower will continuously review and plan for the optimal deployment to improve operational efficiency and effectively utilize power usage.

# An Introduction to 5G Service Applications ▶▶

Taipower has identified a number of projects that can utilize 5G technology to offer application services. In collaboration with the Kaohsiung Asian New Bay Area 5G AIoT Innovation Park project, the a 5G AIoT Promotion Office was established at the Southern Power Plant in 2021 to conduct verification of power applications related to 5G AIoT. In January 2022, a 5G AIoT Promotion Team was formed internally, and through brainstorming and identifying actual needs within various units a Real-time Collaboration System for Switchyards in Southern Power Plants was proposed. The system aims to enhance operational safety and logistics collaboration using 5G AIoT technology.

On June 28, 2022, a matchmaking briefing was held, with the participation and guidance of the Ministry of Economic Affairs' Asia Silicon Valley 5G AIoT Project Office and the Kaohsiung City Government. The Real-time Collaboration System for Switchyards in Southern Power Plants project was launched. It subsequently underwent public review in January 2023 and was opened to bidding from February 2 to 13, 2023. The initiative aims to facilitate the implementation of 5G AIoT technology and establish its vertical application in the power industry.

# Mobile App Development ▶▶

Taipower has combined mobile digital technology with AMI smart meter big data applications to launch the Taiwan Power App, which provides functions such as electricity bill inquiry and payment, service applications, electricity management, visualized electricity consumption charts, power outage reporting, and more. This app aims to make electricity usage more convenient for the public. Taipower has also introduced a Power Instant App that allows users to earn points by participating in energy-saving and educational activities. These points can be redeemed for prizes or entry into lucky draws. The app serves to promote key concepts in energy conservation among the public and to foster a culture of habitually saving electricity.

Furthermore, to promote intelligent occupational safety and health, Taipower has developed a Smart Occupational Safety Management App. The main features of the app include reporting work starts/finishes, clocking in/location tracking, and message notifications. It enables the more effective management of contractors by allowing for real-time monitoring of their personnel, activities, timing, locations, and products. This encourages contractors to be self-aware and comply with occupational safety regulations, leading to the more effective management of contractors.

To enhance the efficiency of employee work, communication, and data sharing, Taipower has also implemented a Taipower Cloud Drive (iCloud) App. The app provides a platform for employees and subcontractors to exchange data within and outside the network while ensuring security and convenience.

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