Flexible Resources Help to Meet Summer Peak Demand:

Suzhou's practice of energy storage and virtual power plants[1]

Abstract: As an economically strong city, Suzhou is among the cities with the highest electricity consumption in China, and it faces enormous pressure in meeting power demands during summer peak period as a result. Suzhou has been promoting the local development of energy storage, virtual power plants (VPPs), and power market reforms. During the summer peak of 2024, the city met electricity demand without adding new coal-fired power capacity or imposing power rationing. Energy storage and VPPs, as new-quality flexible resources, have played a significant role in ensuring electric power security and increasing the share of renewable energy. This model serves as an example and reference for energy transition in other regions with high electricity demand.

Keywords: Energy storage; virtual power plants; power market reform; energy transition

[1] Case provided: Policy Research Project Group of the "Global Climate Governance and Green Inclusive Transformation" Special Topic of the International Cooperation Council

I. Background

As one of China's leading economic powerhouses, Suzhou had in 2024 a permanent population of approximately 12.987 million, a GDP of CNY 2.67 trillion, and an annual electricity consumption of 186.33 terawatt hours (TWh)—among the highest energy consumption in the country[2]. In 2024, the city experienced an extended period of extreme summer heat, pushing the peak electricity load across the grid to 32.505 gigawatts (GW), an increase of approximately 2.5 GW or 7.1% compared to the corresponding period in 2023, causing an unprecedented pressure on the power system during the summer peak. This led Suzhou to enhance the resilience of the power grid and its ability to cope with extreme loads by deploying energy storage systems and operating VPPs. As a result, the city was able to meet the summer electricity demand effectively and ensure the safe and stable supply of electricity without adding new coal-fired power capacity or imposing power rationing.

II. Key Measures

(1) Large-scale Deployment of Grid-Side Energy Storage to

[2] The data on permanent population, GDP, and annual electricity consumption are sourced from the *2024 Suzhou Statistical Bulletin on National Economic and Social Development*. https://tjj.suzhou.gov.cn/sztjj/tjgb/202504/c77512c90a144784beba4870a6b5cc0d.shtml

Strengthen Power Supply Resilience and Efficiency

The implementation of energy storage projects has significantly enhanced Suzhou's peak shaving capabilities. As of July 2025, Suzhou had connected a cluster of energy storage power stations to the grid with a total installed capacity of 540 megawatts (MW) and a 2-hour charge/discharge duration, encompassing nine facilities in total. During the summer peak season, these power stations operated under a model of free charging and orderly discharging, effectively alleviating the supply pressure caused by extreme heat and high load.

Energy storage has delivered remarkable economic benefits as a substitute for coal-fired power in peak shaving. Energy storage generates revenue primarily through peak-shaving compensation and capacity leasing fees. The full life cycle levelized cost of electricity (LCOE) for grid-side energy storage in Suzhou is approximately RMB 0.37/kWh (about USD 0.051/kWh), lower than the RMB 0.48/kWh (USD0.07/kWh) cost of coal-fired peak shaving[3]. At the macro level, the energy storage industry serves as a new driver of economic growth. As of 2024, nearly 100 registered companies in

[3] The full-lifecycle levelized cost of electricity (LCOE) for grid-side energy storage is calculated based on a 100 MW/200 MWh energy storage system. The cost of coal-fired peak shaving is estimated using the average market electricity prices in recent years combined with the allocated capacity price in Jiangsu Province for 2024.

Suzhou had been engaged in the energy storage sector[4]. By 2026, Suzhou expects to grow its new energy storage-related industry revenue to over RMB 120 billion (USD 12.7 billion) and cultivate or attract 10 next-generation energy storage enterprises with an annual output value exceeding RMB 4 billion[5] (USD 0.56 billion).

Replacing coal-fired peak shaving with energy storage can also yield substantial carbon reduction benefits. Based on the average CO_2 emission factor of Jiangsu's electricity system, the CO_2 emissions per kWh from grid-side storage are approximately 0.1099 kg lower than those from coal-fired peak-shaving units (using the 2023 average coal consumption for power generation as a benchmark). In light of Suzhou's current deployment of approximately 540 MW of storage capacity, the city can reduce CO_2 emissions by an estimated 37,981 tons annually compared to coal-fired power units[6].

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4 https://bg.qianzhan.com/trends/detail/506/250126-4457d3cc.html

5 The *High-quality Development Plan for the New Energy Storage Industry in Suzhou (2024–2030)*.

6 The carbon reduction potential of grid-side energy storage is estimated using CO_2 emission factor of Jiangsu Province's average power system, while the CO_2 emissions from coal-fired peak shaving are calculated based on the average coal consumption for power generation in 2023. With approximately 540,000 kW of installed storage capacity currently deployed in Suzhou, and assuming 320 dispatch cycles per year with two hours of discharge per cycle, the use of energy storage in place of coal-fired units is estimated to reduce CO_2 emissions by about 37,981 tons annually.

Figure 1 50 MW/100 MWh grid-side energy storage project of Suzhou Shengneng

Credit: Energy Foundation China.

(2) Unlocking the Potential of VPPs to Build a Demand-Side Regulating Network

Tapping into the potential of VPPs is essential to meeting rising electricity load. By the end of 2024, Suzhou's load-side flexible resources had an estimated regulation potential of approximately 4.5488 GW in total, encompassing energy storage, air conditioning, electric vehicle charging and discharging, data centres, and various industrial sectors[7].

Suzhou has also established the largest **VPP for EV charging and battery swapping** among prefecture-level cities in China[8]. Through technological innovation, 68 battery swapping stations have been integrated into a new-type electricity load management system,

[7] State Grid (Suzhou) Urban Energy Research Institute, *Development Pathway for Virtual Power Plants in Suzhou During the 15th Five-Year Plan Period*, 2025.

[8] The People's Government of Suzhou Municipality, *Suzhou Completes Construction of the Largest Battery-swapping Virtual Power Plant*, 2025. https://www.suzhou.gov.cn/szsrmzf/szyw/202503/a60985e397184d0c9fbfb424db962de1.shtml

delivering a combined regulation capacity of 20 MW. Each individual station can adjust charging power within 1 minute and with over 90% accuracy and high controllability. While ensuring a seamless battery swapping experience, such stations can enable efficient allocation of power resources. According to data from the Suzhou Municipal Bureau of Industry and Information Technology, the city had 574,200 new energy vehicles (NEVs) in 2024. Based on an equivalence model of orderly EV charging and discharging and behaviour aggregation, Suzhou's charging infrastructure offers an adjustable capacity of approximately 475.1 MW.

(3) Deepening Electricity Market Reform to Create Space for the Development of a New Power System

The position of new power system market participants has been clearly defined. The Jiangsu Development and Reform Commission and the Jiangsu Energy Regulatory Office recently issued the *Notice on Carrying Out Power Market Transactions in 2025*, which explicitly states that new entities, such as VPPs and independent energy storage operators, are eligible to participate in market transactions[9].

[9] Jiangsu Provincial People's Government, *Jiangsu Clarifies Market Participation Eligibility for New Power System Entities*, 2025.
https://www.jiangsu.gov.cn/art/2025/1/14/art_90848_11470299.html

VPPs are encouraged to participate in the market. The National Development and Reform Commission and the National Energy Administration issued *Guiding Opinions on Accelerating the Development of Virtual Power Plants*, which calls for continuously diversifying business models for VPPs and enabling them to participate fairly in various power markets or demand response mechanisms based on their core functions and to earn corresponding revenues. The policy also encourages VPPs to engage in business innovation and offer comprehensive energy services, such as energy conservation, energy data analysis, energy solutions design, and carbon trading-related services, thereby expanding revenue streams.

Dispatch and settlement mechanisms are being optimized, and market-based incentives for energy storage are being refined. According to the *Notice on Several Measures to Accelerate the High-quality Development of New Energy Storage Projects in Jiangsu Province*, issued by the Jiangsu Development and Reform Commission in 2023[10], during peak summer and winter seasons (January, July, August, and December), energy storage systems are, in principle, required to be dispatched for at least 160 full-charge/discharge cycles or 320 discharge hours. Charging is free

[10] Jiangsu Development and Reform Commission, *Several Measures to Accelerate the High-quality Development of New Energy Storage Projects in Jiangsu Province*, 2023. https://fzggw.jiangsu.gov.cn/art/2023/8/3/art_51012_11064875.html

during these periods, while discharging is compensated at the provincial benchmark coal-fired power tariff (RMB 0.391/kWh, about USD 0.053/kWh), and systems are additionally supported by peak-hour compensation based on discharged electricity fed into the grid. However, peak-hour compensation will be phased out gradually year by year. Outside of the peak seasons, charging is priced at 60% of the benchmark coal-fired tariff, while discharging remains at the full benchmark coal-fired tariff. These measures have established a high-reward, market-driven incentive mechanism for energy storage and created a convenient, equitable, and well-regulated environment for capacity trading. With further refinements to these market-based policy mechanisms, energy storage operators will benefit from more stable revenue expectations, further highlighting the critical role of energy storage as part of the emerging power system.

III. Lessons and Insights

(1) The Integrated Model of Grid-Side Energy Storage and VPPs Can Simultaneously Meet the Green and Safety Needs During Peak Electricity Demand

China’s energy transition must achieve two core objectives: (a) meeting the growing electricity demand to ensure supply and security and (b) steadily increasing the share of renewable energy in the power system to advance green and low-carbon transition. Suzhou's success story during the summer peak demand period demonstrates the practical viability of a local government-driven model that integrates energy storage with VPPs. This approach has proven capable of ensuring electricity security during peak demand periods and facilitating the green transition without adding new coal-fired power capacity and imposing power rationing.

(2) Local Governments Should Take a Forward-Looking Approach to New Power Regulation Resources and Overcome Dependence on Traditional Supply Pathways

Local governments need to align with the energy transition trends, move beyond traditional reliance on coal-fired installed capacity for supply security, and integrate energy storage and VPPs into the broader urban planning for electricity security and green development. It is essential to conduct forward-looking assessments of peak load pressures in order to scale up the deployment and utilization of energy storage power stations and VPPs, particularly in regions facing acute peak demand stress, and to optimize the diversified source-grid-load-storage interaction mechanisms. Going forward, greater efforts are needed to tap into the regulation potential of electric vehicle charging and discharging, air conditioning systems, data centres, and industrial sectors such as electronics manufacturing, textiles, and steel. Together, these resources can play a vital role within the VPP framework.

(3) Optimizing Market-Based Mechanisms and Industrial Support Policies for the Power Sector

First, the capacity pricing mechanism should be improved to open up capacity market opportunities for energy storage and VPP participants. Through capacity compensation and trading mechanisms, these participants can help offset the costs of construction and operation, enhancing investment return expectations. **Second,** flexible peak-shaving incentive policies—such as differentiated peak-valley pricing, free charging, and peak-time discharging rewards—should be implemented to ensure stable, full life cycle returns for energy storage systems. **Third,** relevant market access and trading rules must be refined to clarify the participation status and settlement modes for new electricity resources, including VPPs, independent storage operators, and battery swapping stations. **Fourth,** local governments need to be encouraged to establish dedicated funds or provide low-interest loans to support the development of energy storage systems and VPP platforms while incorporating energy-use flexibility into government performance evaluations to ensure sustained policy policy. **Fifth,** clear policy signals should be sent through long-term industrial planning to attract investment in the energy storage sector, promoting technology application and industrial growth.

(4) Replication and Promotion: Supporting power supply security and transition in high-load regions

These measures collectively help to speed up the phase-out of coal-fired peak-shaving with energy storage and VPPs, enable a higher share of renewable energy on the grid, and support the orderly cessation of new coal power construction. Going forward, such a business model and success story can be extended to other high-load regions or areas facing pressure in power supply security in China, as well as to other countries—especially developing nations—to balance electricity demand growth, energy transition, and economic efficiency.