CHAPTER 9

China's Electricity Market Reform in the Post-COVID Era

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Introduction

The CPC Central Committee and the State Council released official Regulation document "Opinions on the further reform of electric power system" (No. 9 document), as well as ten other supporting documents on March 15, 2015. It marks an official start of a new round of power system reform in China. The main idea of the reform can be summarized as "market liberalization, organization independence and system improvement." In specific, its goals include smooth transition to electricity price liberalization, except transmission and distribution price; liberalization of electricity distribution and selling businesses by allowing involvement of

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social capital; gradual deregulation of electricity generation and consumption plans except for regulatory power use and public welfare power use; promote independence of trading institutions and standardize their operation; continuously conduct in-depth research on the development of regional power grid and power transmission and distribution system that is suitable for China's conditions; further strengthen the government supervision; further improve the overall planning of electric power; and further strengthen the safe and efficient operation and reliable supply of electric power. Since the No. 9 document set the target paths, China's electricity market reform has followed the institutional reform framework of "opening two ends and controlling the middle" and has some major achievements.

In terms of power transmission and distribution price reform, it has established a relatively complete price policy system of electricity transmission and distribution, covering inter-provincial and inter-regional special projects, provincial power grids, and incremental distribution networks. The price reforms for electricity transmission and distribution and for regional power grids that covering power grids over all provinces (except Tibet) have been fully completed, and the electricity transmission prices of inter-provincial and inter-regional special projects have been successively approved one after another. Supervision and examination of power transmission and distribution price have been carried out for two rounds, ensured the electricity price mechanism to run smoothly.

In terms of power market establishment, the power market system has taken shape. New power market system with "medium- and long-term trading market + spot trading market + ancillary service market" has been initially established. China's power market reform started with the direct transaction between power users and power generation enterprises, constantly enriched the transaction modes, and the power market scale is gradually expanding year by year.

The medium- and long-term trading of electric power now is basically at mature stage, and all pilot areas of electric power spot market have entered the stage of trial operation. Some provinces and districts have also carried out the development of ancillary service market. With all these efforts, the power market reform has covered all provinces, formed a trading system that covers annual, monthly and weekly trading, as well as spot trading in day-ahead market and real-time market. In addition, the transactions cover electric energy, ancillary services, renewable energy consumption weight, and so on.

In terms of the development of trading institutions, two national-level power trading centers were established in Beijing and Guangzhou at the beginning of the reform. Later on, with the deepening of the reform, 33 provincial power trading centers were successively established. Some significant improvements in the trading platform standardization were seen as the equity proportion of centralized power grid enterprises in each trading center gradually decreased, forming a relatively independent market trading platform.

In terms of power distribution and sales market, power trading is fully open. By the end of 2019, there are about 4000 power sales companies in China, indicating a competitive market has been formed. Social investment access has been opened in power incremental distribution network, and more than 400 pilot projects (in five batches) of power incremental distribution reform have been launched to attract social capital, realizing the diversification of investors.

Results

Impact of COVID-19 on China's Power Market Construction

China's economy has shown strong resilience when facing the epidemic shock. China became the only major economy with positive economic growth around the world in 2020. Its economic performance showed a "V" curve, with lowest point in the beginning of 2020, and improved quarter by quarter gradually till up to normal level. By the end of the year, China's total economic output achieved more than one hundred trillion RMB, with an increase in GDP by 2.3%.

The epidemic hit China's economy most badly in the first quarter: GDP growth rate dropped fast and turned negative in the first quarter, with 6.8% lower compared with one year earlier. GDP then grew steadily in following three quarters. Impacts of the epidemic on each industry show certain diversity. Different from other industries that suffered negative economic growth, export volumes of manufacturing industry rose during the period of relapse of the epidemic in other countries, as there were increases in net exports of goods and services that led to a 0.7% increase in GDP. However, as the main engine of economic growth, China's national consumptions in 2020 were at negative growth rate, with reduction of 3.9% in the total retail sales of consumer goods compared

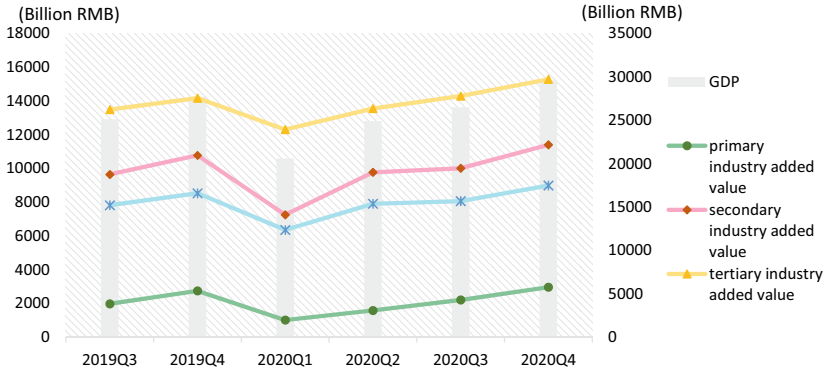

Fig. 9.1 Quarter GDP and added value of industries in 2019–2020 (*Source* National Bureau of Statistics (NBS), 2020)

with the previous year. The annual consumption expenditure reduction led to a 0.5 percentage drop in GDP (Fig. 9.1).

Impacts of COVID-19 on Power Supply and Demand in China

National power supply and demand drops in the first season of 2020, which is basically consistent with the economic trend. The total social electricity consumption is 7.51 trillion kwh, with a year-on-year growth of 3.1%. The growth rate of social electricity consumption was—6.5, 3.9, 5.8, and 8.1% in each quarter, which also showed a "V" curve. While looking from industries, the power consumption of the primary industry, secondary industry, and tertiary industry were 85.9 billion kwh, 5.12 trillion kwh, 1.21 trillion kwh, respectively. Year-on-year growth rates of the three industrial sectors are 10.2, 2.5, 1.9%, respectively. Industrial power consumption in the first quarter dropped significantly, and then higher goods and services consumption potential brought a mild increase of power consumption in the second quarter. With full control of the epidemic and recovery of import and export trade afterward, the electricity consumption of the tertiary and the manufacturing industry began to rebound. However, an unexpected extreme weather in winter of 2020 caused power consumption increased significantly in the whole society. The power demand pressure from both society and industries in the third

and fourth quarters resulted in power shortage in some provinces and cities (Figs. 9.2 and 9.3).

The epidemic crisis highlights the structural contradiction between various types of power supply and peak shaving. In recent years, the new energy installation and grid-connected power generation are constantly increasing, but the hours of coal-fired power generation are decreasing. Insufficient power supply leads to risks of peak shaving, and the epidemic situation further exacerbates those issues. The epidemic situation depressed the power consumption in a short period of time, caused

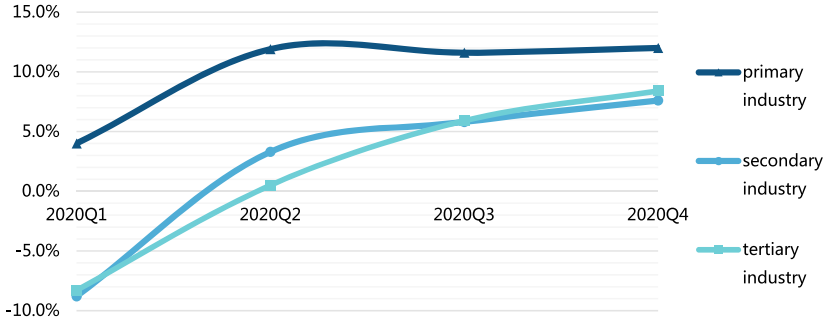

Fig. 9.2 The quarter growth rates of industrial power consumption in 2020 (*Source* NBS, 2020)

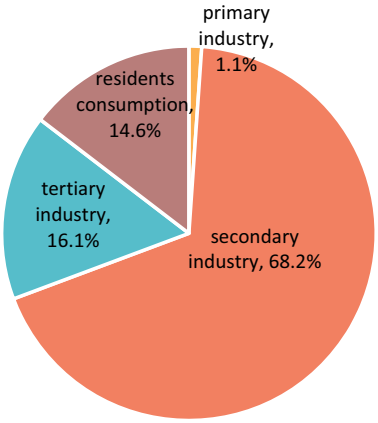

Fig. 9.3 Proportions of industrial power consumption for urban and rural residents (*Source* NBS, 2020)

reductions of incomes of power generation enterprises. As responses to the operation pressure, some power sources withdrew and some peak shaving resources were cut off, which inevitably lead to the structural power shortage when resumption of work and production started and power load rapid rose.

For the power grid, the repeated changes of power load caused by the epidemic raise the operation risks. Industrial power load normally has stable demand curve, and a shock in industrial power load is more difficult to recover, which causes declines in basic load demand of the entire power grid. Thus, the peak shaving pressure in electricity troughs will be extremely prominent, even causing risks of power failure due to grid overload.

The epidemic will also bring uncertainty to market transactions. On the one hand, the uncertainty of power supply and demand caused by the epidemic has increased the uncertainty of market participants' trading scenarios. Local market transactions are still proceeding as usual while demand is shrinking, which squeezed some power supply and power sales enterprises out of the trading market, and further compressed the trading space. On the other hand, epidemic prevention and control not only reduces the circulation efficiency of energy resources, but also restrains the power demand scale. At the same time, the shortage of upstream energy supply has an adverse impact on power production and supply, and the contradiction between quantity and price stipulated in the transaction contract may increase. Due to involvement of multiple players in the transaction, it is difficult to execute the negotiated volume and prices initially signed in contracts before the epidemic, or the long-term contracts were sometimes given up due to short-term low prices in spot market. Those chaos in transaction market led to conflicts and affect the equity relationship between the two sides of the power transaction as well as between the upstream and downstream of the power industry. In addition, it is sometimes difficult to forecast and arrange production plans for power generation enterprises and power grid, which affect smooth development of medium- and long-term transactions if there were a concentrated release of production and consumption demand and a rebound of power demand.

Discussion

Problems and Challenges in China's Electricity Market Reform

The design of electricity market trading system is not well prepared for huge risks. Pandemic caused factories to shut down, people to live in isolation, and services to stagnate. The power demand of the whole society continues to be depressed. As a result, the long-term association contracts signed before epidemic were facing certain difficulties in delivery, assessment, and settlement, which also lead to the vast majority of users and power sales companies facing greater risk of power deviation. In principle, large users and power sales enterprises need to pay the corresponding deviation assessment fines in this situation. However, because there is no advance plan to deal with such crisis, local governments have stepped up with patch policy in the short period of time to cope with this issue.

The power marketization reform is not thorough enough, as the market centralized trading is not coordinating well with real market supply and demand. It is counterintuitive to see that power trading prices remained stable when relationship between power supply and demand undergone dramatic changes in epidemic situation. Theoretically, prices are more sensitive to shorter contract length, and thus can reflect the real balance between supply and demand with more accuracy. However, during the epidemic period, the centralized trading market did not show close relationship among price, demand and supply. Therefore, it reflects that the existing power market system and market design is not efficient, let alone its role of guiding prices to balance power supply and demand.

The ancillary service market such as frequency modulation and peak shaving needs to be improved. At the later stage of the epidemic, many extreme events in China and other countries have sounded an alarm for the development of domestic power market. In China, with the economic recovery and the cold weather during the winter time of 2020–2021, the power consumption rose rapidly, giving huge pressure to the existing insufficient power supply. Some provincial power grids once approached their load limits. Hunan, Jiangxi, Zhejiang, Inner Mongolia, and other regions switched off and limited power in succession. The existing power system has shown lack of effective capacity, especially when considering that China has planned to connect it with a large number of new energy grid in the future. It demands to establish the corresponding capacity compensation mechanism, and speed up the construction of

ancillary service market such as frequency modulation, peak shaving, energy storage, and reserve.

In addition to the problems occurred during the epidemic, there are some inherent problems in China's power market reform. Those deep-seated contradictions have not been solved, which restrict the market-oriented reform in future.

The electricity price mechanism needs to be improved. In particular, we need better price approvement methods and refined economic analytical tools for monopoly market. There is still room for structural adjustment of power transmission and distribution price. Problems related to cross subsidy have not been properly solved. The cost dredging mechanism of various generating units still needs to be further clarified, and the power transmission mechanism has not taken full effects.

The power market system is not perfect, and the market structure needs to be optimized. The construction of electric power market is still in the primary stage, and the trading barriers among provinces are serious. The efficiency of electric resource allocation in power market cross regions and provinces is not high. In terms of power generation and supply, the state-owned capital still occupies the dominant position, thus the market structure is not diversified enough. Meanwhile, monopoly and collusion still exist in power market transaction processes in some regions, which affects normal operation of the power market.

The power regulatory system lags behind the reform practice. On the one hand, the regulatory system still needs to be improved. The boundary between the government and the market is not clear enough, with existing administrative barriers in the market. For those administrative functions that are delegated from government to the market, there are administrative intervention and unclear supervision responsibility problems. On the other hand, the revision of relevant regulations seriously lags behind the electricity reform process, and the failure of legislation establishment created lots of problems. In addition, the examination system of fair competition that is related to the practice of power market has not been established.

Domestic and international pattern has undergone profound adjustments due to the epidemic, and the reform faces more complicated situations.

Internationally, energy security is facing new challenges, which continue to squeeze the price of power supply chain, thus affecting the power market development. At present, the global political and economic

pattern is undergoing deep adjustment, the instability and uncertainty of the external environment are increasing significantly, the trend of anti-globalization is intensifying, the supply chain cycle of global industrial chain is blocked, geopolitical risks are rising, and the international energy supply and demand chain has changed significantly. All of those challenges have affected the stability of domestic energy supply and may cause damages to the power market when extreme events occur.

China's economic development has entered a new stage, the process of clean energy and low-carbon transformation have accelerated, and the structure of power supply and demand has changed. In particular, China has promised the world to reach the peak of carbon by 2030, to achieve carbon neutrality by 2060, and accelerate the development of clean and low-carbon energy. This promise means that significant changes will take place in China's power supply structure and power consumption in the future. New energy resources represented by wind power and photovoltaic power on the supply side will become the main power sources of energy increment, and more clean energy sources will be connected to the power system. On the demand side, electric energy substitution will be promoted, and power consumption may increase rapidly, which requires the establishment of an appropriate power market system and an improvement of existing trading system.

Progress of Power Market Reform in Post-COVID Era

COVID-19 has caused some negative impacts on the reform of the electricity market. Aiming to solve the inherent problems in China's power market and the new problems exposed in the development and trading processes of the power market reform, the central government issued several documents in 2020 to promote the reform to be more extensive and complete.

An official regulation document—"Implementation opinions on promoting the independent and standardized operation of power trading institutions" (Implementation Opinions)—was issued in the beginning of 2020. It directly specified quantitative shareholding ratios and work schedule, and put forwarded detailed requirements for the independent operation of power trading institutions. The Implementation Opinions clearly requires trading institutions to operate independently in terms of "human resources, financial management and material resources," and introduces third-party supervision with specific requirements. This

indicates that the power marketization reform entered into the "actual implementation period" from the "transition period." It is no longer limited to the pilot areas, but has effectively promoted the implementation and completion of the market mechanism. In the first half of 2020, the shareholding ratios of power grid enterprises in two regional trading institutions in Beijing and Guangzhou and all other provincial trading institutions all drop to less than 80%. The shareholding ratio of power grid enterprises continuously dropped to less than 50% by the end of 2020.

With further standardization of medium- and long-term electricity trading market and spot market, the construction of a unified, open, and orderly competitive electricity market system is steadily advancing.

As the "experimental field" of China's power market system, the development of spot market is the most complex design of power system. It undertakes the function of price exploration, and also bears the responsibility of exposing and solving various problems. In March 2020, "The notice on continuous work on the settlement of spot power market pilot projects" clearly stated that the power selling companies and power users should agree time-sharing settlement rules with the power generation enterprises in the medium- and long-term contracts, and should not set up an unbalanced fund pool. Each settlement item should be recorded independently, with clear classification and guidance.

Since the end of June in 2019, eight provincial spot market pilot projects have been fully launched. As of May 2020, Shanxi, Gansu, Shandong, Fujian, and other provinces have completed the third settlement trial operation. Gansu Province has realized the first full monthly spot market settlement trial operation in April 2020.

The pace of medium- and long-term electricity trading has not yet been suspended due to epidemic. In July 2020, "The revised basic rules for medium and long term electricity trading" (The Basic Rules) was issued to improve the existing rules as a supplement, including improving the access and exit rules, the types and methods of electricity trading, and modifying key rules in the price mechanism, etc. Later on, a new notice[1] in 2021 added contents of "promoting signing contract in different time divisions" and "widening the price differences between peak and trough." Those changes are made to strengthen the coordination, promote an

[1] The notice on regulating median and long-term power trading contract in 2020.

effective connection between the medium- and long-term market and the spot market, and reasonably determine the delivery mode in the spot market and the trading curve of the medium- and long-term contract.

Two regional trading institutions in Beijing and Guangzhou and all provincial trading institutions have issued detailed rules for medium- and long-term trading. They have realized a transformation from direct trading between single power generation enterprises and electric power users to medium- and long-term power trading system with multiple power sources and standardized trading processes.

As an important part of the power market reform, power transmission and distribution price have long been concerned. The main task of power transmission and distribution price reform used to be "mechanism establishment." At present, it has turned to a new stage of "strong regulation," and the regulations are becoming more and tighter.

In 2020, on the basis of improving the pricing system and strict cost supervision, the National Development and Reform Commission approved the power transmission price of five regional power grids, formulated the power transmission and distribution price of provincial power grids in the second supervision period, and issued regional and provincial electricity price approvement documents. Those actions further improved China's power transmission and distribution price supervision system. So far, the regional and trans-regional power grid transmission price verification has been completed. The guidances on the power distribution price formulation of local power grid and incremental distribution network have also been issued.

In the next step, China will take the second round of power transmission and distribution price verification as an opportunity to straighten out the formation electricity price mechanism, gradually eliminate cross subsidies, and transform the "price difference" mode to the "favorable price" mode. China will continuously learn from marketization experiences of power price settlement, research in relevant measures to expand market peak-trough price difference, introduce capacity compensation mechanism, promote different types of power generation units to enter market, and make the price mechanism meet diversified requirements of spot market.

Since the 13th Five Year Plan, China has promoted 483 pilot projects of incremental distribution network. Some challenges of incremental distribution areas have been broken through, and the reform of pilot projects is steadily advancing. The State Grid Corporation of China clearly

proposes to support, participate in and promote the incremental distribution reform. China Southern Power Grid also said that it will actively and steadily carry out reforms with mixed competition transformation for businesses such as power incremental distribution and power sales. Southern Energy Regulatory Bureau issued power business licenses to 18 pilot project owners to accelerate the reform of power incremental distribution.

Similarly, the establishment of ancillary service market in each province is also in full swing, with diversified transaction varieties, diversified participants, and gradually expanding the scope of resource allocation. In December 2020, the southern-region ancillary service market for power supply frequency modulation started trial operation. The ancillary service market expanded the original hydropower plants in Guangdong and partial areas of Guangxi to all regions in Guangxi and Hainan. This is also the first regional power supply frequency modulation market to enter trial operation in China, marking that the innovative development of power ancillary service in the "14th five year plan" is unfolding.

Conclusions

Future Trends of China's Electricity Market Reform

To sum up, China's power market reform is facing more challenges due to existing contradictions in the current energy load distribution system and the structure of power system, the complexity of power system reform, as well as negative impacts brought by the epidemic situation and profound changes in the international political and economic pattern. In specific, those challenges mainly include the contradictions between trading marketization and traditional dispatching mechanism, between new technologies/new forms of industries (such as energy Internet) and the existing energy planning and distribution system, and between the new energy access and the current imperfect consumption mechanism. Therefore, in addition to the steady progress of current reforms, China's power market reform will focus on the following goals in the future.

China will continuously expand trading space and the proportion of market-oriented power trading. In regard to trading market scope, China will gradually break down the trading barriers among provinces, constantly improve the proportion of cross-regional and cross-provincial

power trading, and gradually integrate the inter-provincial and intra-provincial markets to form a national unified electricity market. In regard to power market system, China will accelerate the construction and improvement of spot market, gradually establish a complete market system that is designed for short-, medium-, and long-term power trading, and gradually set up ancillary service market, capacity market, power transmission right trading, and financial derivatives trading based on the demands of market development.

With the rapid development of new technologies and formats in the energy industry, the industry boundaries of energy supply are blurred. Cross-industry operation has become the norm, and distributed energy has become an important supplement to centralized energy supply. With the help of smart grid, Internet, energy storage, and other technologies, the end-users' various energy needs are met as power allocation optimization can be realized with deep interaction within the power grid. In terms of transaction subjects, diversified small and micro-market subjects (such as distributed energy, micro-grid, virtual power plant (VPP), energy storage, and interactive energy consumption) should be allowed with wide access. China should also gradually expand participation scale in power market transactions and explore a user-centered energy service mode. In terms of distribution development of power system, China should gradually carry out market-oriented transactions of distributed power generation and micro-grid; form a regional "self-sufficiency + surplus trading" transaction mode; explore the coordinated operation of power wholesale market and retail market for balancing users' demands.

Clean energy is an important measure to achieve the goal of carbon neutrality in China. In the power generation side, China will promote coal power generation to reach the peak point as early as possible, speed up the conversion of coal power to electric power. Meanwhile, in consideration of the distribution capability of energy resources and load within the country, China should optimize the timing of new energy development by integrating local resources, power grid conditions, and load levels, etc. China will also improve the clean energy development and management mechanism, gradually abolish the feed-in tariff approval mechanism of clean energy, gradually increase the proportion of clean energy on the power generation side and promote more participation of clean energy in market transactions. The market-oriented trading policy of wind power and photovoltaic power should be continuously improved, as well as supporting the linkage between the full guaranteed acquisition and the

free power market transaction till full participate of new energy sources in the market-oriented transactions.

Social attributes play important roles in power emergency during the epidemic, which is very different from natural disasters. It is necessary to strengthen emergency capacity when develop power market in the future, changing from "emergency oriented" to "risk management oriented." In terms of power market system design, China should promote inter-provincial and inter-regional ancillary service market; improve the supportive mechanism on the demand side of transactions. In regard to power grid operation, China will improve risk control capability; closely track the economic trend, power demand, and weather changes; reasonably arrange the operation mode of power grid; preassess the power supply capacity and operation safety of power grid under various circumstances and formulate corresponding solutions. On the power supply side, China should enhance the complementary flexibility of various types of power sources; speed up the construction of large-scale interaction system with "Source-Network-Load-Storage" (refer to power source, power network, power load, and power storage); carry out strategic guidance and centralized control of flexible power load; make full use of user side resources; resolve the short-term conflicts between power supply and demand; and improve the ability to withstand and recover from extreme situations such as catastrophic natural disasters and accidents.

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