

Tracking the Low-carbon Transition Performance of Chinese Listed Power Generation Companies under China's Carbon Neutrality Target

1. Main findings and conclusions

(1) In the "Low-Carbon Transition Performance Evaluation of the 13th Five -Year Plan", listed thermal power companies held by the Top Five power generation groups perform better than those controlled by local power generation groups. The energy structure of the power companies with a lower ranking is mainly composed of 100% thermal power. During the 13th Five-Year Plan period, of the top 10 companies in terms of transition performance, except for Guangzhou Development Group Incorporated, Shenergy Company Limited, and Fujian Funeng Co., Ltd, all others were owned by the state, of which six were controlled by the top five power generation groups. As the main forces of power generation companies, the top five power generation groups have tremendous assets and robust financial strength, which is an obvious advantage in terms of scale effect compared to smaller ones. In terms of regional distribution, most of the locally held listed companies in the top 10 are located in economically developed provinces and cities such as Shanghai and Guangzhou (Figure 1-1).

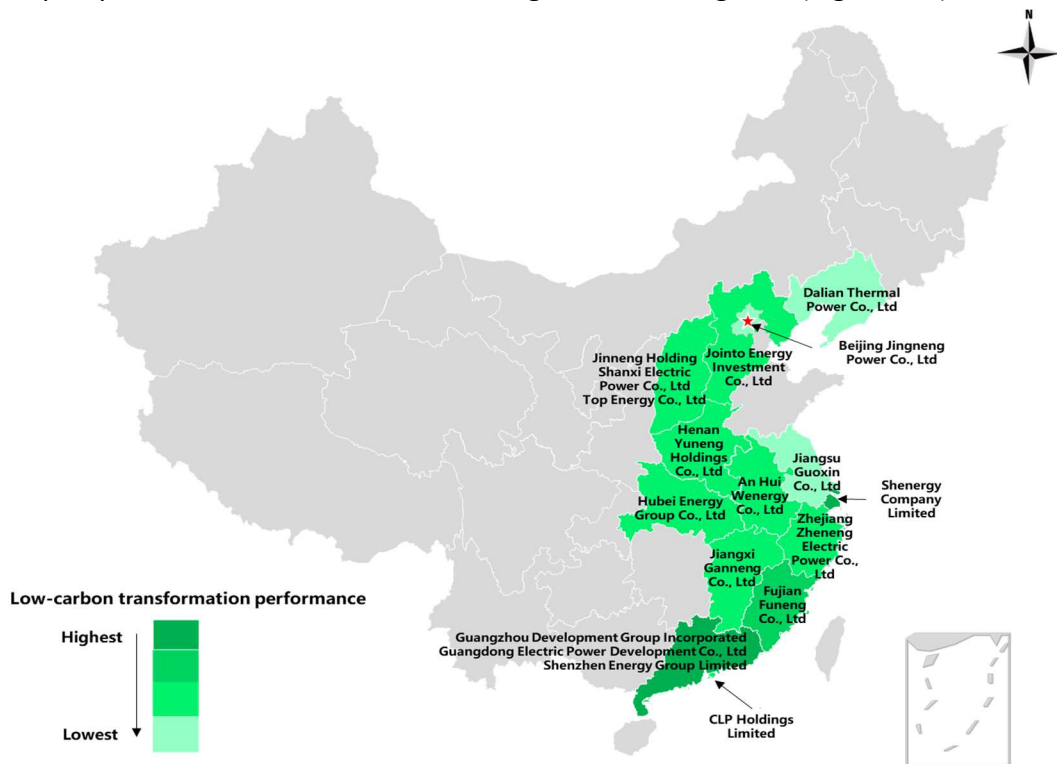


Figure 1-1 Regional distribution and comprehensive performance of locally held listed companies

(2) The low-carbon transition pathway of listed thermal power companies is not unique. Different companies should integrate their existing strengths to carry out differentiated transition pathways. Relying on the State Power Investment Corporation Limited and focusing on the development of new and comprehensive energy, China Power International Development Limited implements a diversified transition strategy. GD Power Development Co., Ltd. undertakes the high-quality thermal power assets of National Energy Investment Group Co., Ltd., vigorously develops high-efficiency thermal power with advanced technology retrofits, and implements a market focus strategy. It should be noted that the long-term transition performance of these two pathways is deserving further observation. Although the transition pathways are quite different, the two companies ranked middle and high in low-carbon transition performance during the "13th Five-Year Plan" period, and their comprehensive profitability performance was also high. In the final year of the "13th Five-Year Plan" in 2020, the return on equity of China Power International Development Limited and GD Power Development Co., Ltd. reached 6.30% and 7.16% respectively.

2. Typical case studies

(1) Jilin Electric: Positive transition and forge ahead with determination

Jilin Electric is ranked No. 1 in the low-carbon transition performance evaluation ranking, and its performance in each dimension is shown in Figure 2-1. Jilin Electric has performed well in financial support, transition progress and governance. During the "13th Five-Year Plan" period, it has completed the transition from a thermal power listed company to a comprehensive energy supplier. Driven by its new energy business, Jilin Electric has been very dynamic in the market, and has been maintaining the momentum of rapid growth in profits since it turned from a loss to a profit in 2018. Now Jilin Electric has put forward the "second transition" strategic goal, when most thermal power companies are still studying the transition strategy, Jilin Electric has been in the development of clean energy upgrading. Long-term strategic vision is not only reflected in the transition of Jilin Electric 's early start, but also in the strength of Jilin Electric 's low-carbon commitment and implementation, which makes Jilin Electric in the forefront position of the list in governance.

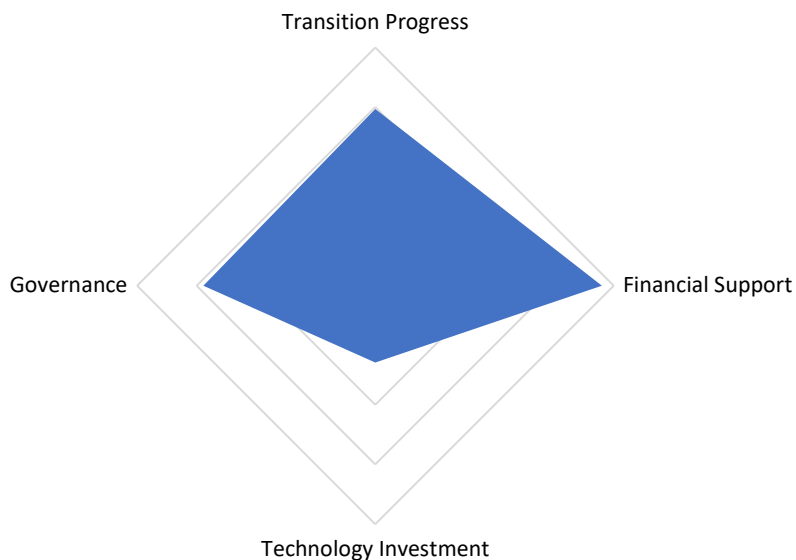


Figure 2-1 Radar chart of the low-carbon transition performance evaluation score of Jilin Electric

Timely low-carbon transition and layout of new business. Jilin Electric grasped the development time, developed the new business represented by comprehensive energy service, and started to layout the new energy business outside the province from 2012. During the "13th Five-Year Plan" period, Jilin Electric intensifies the transition and development, and by the end of 2020, the new energy accounted for 63.85%, as shown in Figure 2-2. The total profit of the new energy sector in 2020 reached 14 times that of 2015, as shown in Figure 2-3, the project location involves 30 provinces and municipalities across the country, and in recent years, with its excellent performance in the new energy sector, it has continuously entered the "Global Top 500 New Energy Enterprises".

Actively cooperate and enter new fields. In the "14th Five-Year Plan" for the development of science and technology, Jilin Electric proposed four main industries of new energy, comprehensive smart energy, hydrogen energy, energy storage, charging and replacement. In 2021, it signed the "Strategic Cooperation Framework Agreement" with Dupu (Suzhou) New Energy Technology Co., Ltd., and invested in the establishment of Shanghai Jidian Jiling New Energy Co., Ltd. in 2022, actively exploring the "green electricity off grid" business model, effectively using the company's own clean energy advantages, accelerating energy conversion, and cultivating new profit growth points.

Optimize existing thermal power and implement cost management. Despite the excellent and innovative achievements in the field of new energy, the thermal power project is still a problem that Jilin Electric needs to face. Jilin Electric disposed of inefficient thermal power assets, continued to optimize the installed capacity structure, and combined with the situation of the coal market in the northeast region, strengthened the staggered coal storage, greatly reducing the cost of raw materials,

and took multiple measures to make the loss of thermal power segment significantly reduced.

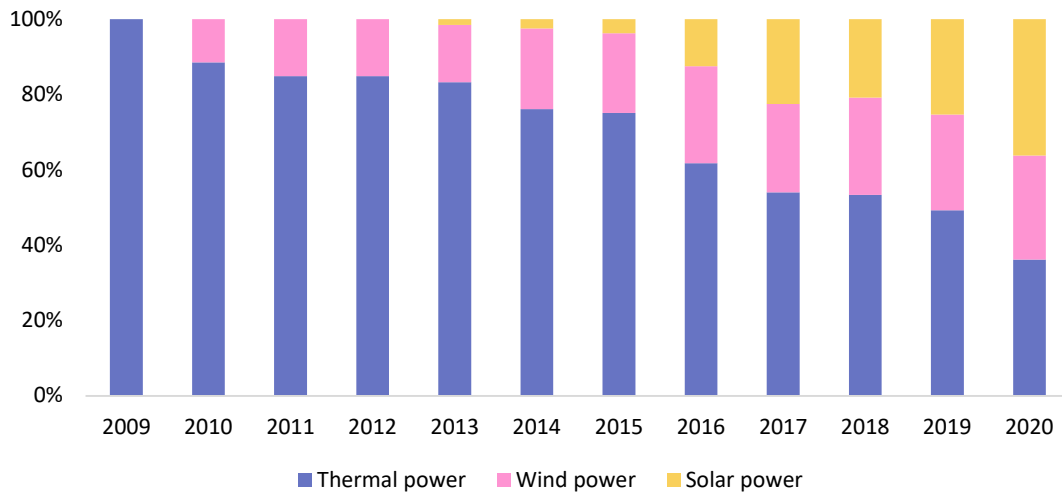


Figure 2-2 Changes in the energy structure of Jilin Electric

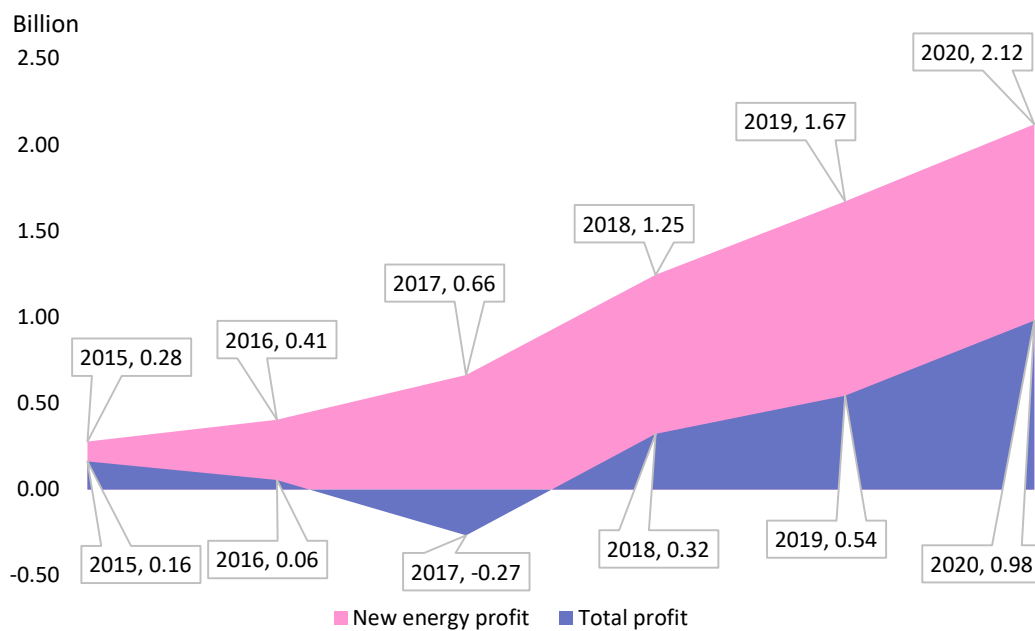


Figure 2-3 Changes in the profit of Jilin Electric

(2) China Power: Diversified integration, harmonization and innovation

China Power ranks 9th in the low-carbon transition performance evaluation ranking, and its performance in all dimensions is shown in Figure 2-4, with excellent performance in terms of transition progress and governance. With the goal of building an innovative, internationalized and comprehensive energy modern state-owned enterprise with outstanding core competitiveness, China Power has positioned itself to become the core subsidiary of the Group's conventional energy business, the ultimate platform for the integration of conventional energy business and assets, and a leader in scientific and technological innovation and institutional innovation. During

the “13th Five-Year Plan” period, China Power fully utilized its technological and resource advantages to vigorously develop new energy such as wind power and solar power, seized the first opportunity in the new energy market and the development of integrated intelligent energy, laid out the new business, explored the technological application of hydrogen energy, energy storage and distributed energy, and implemented a diversified development strategy with the goal of becoming an advanced integrated energy service provider, so as to promote the transition of the energy structure and intelligence.

During the "13th Five-Year Plan" period, China Power focused on the development of new energy, integrated the concept of energy internet, coordinated the development of integrated intelligent energy, explored new growth poles of the company's profits, and drove the company's low-carbon transition with the "three new" industries, which has new vitality in the market.

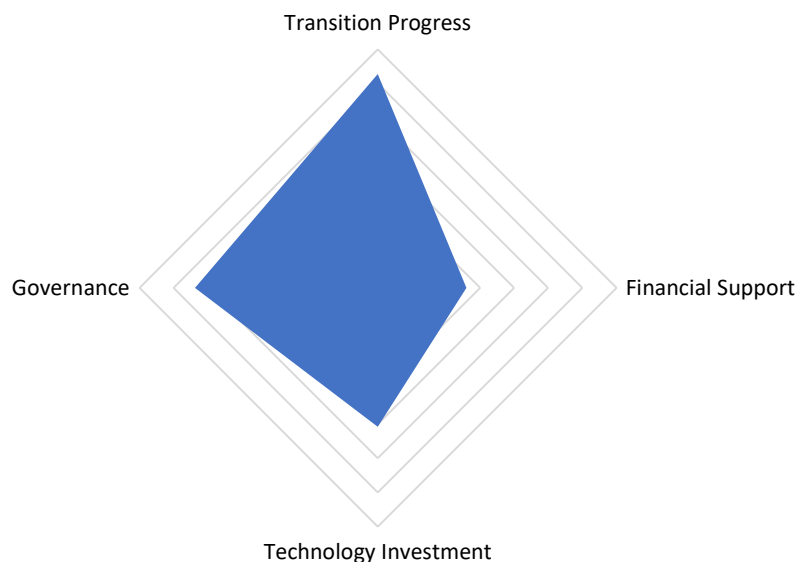


Figure 2-4 Radar chart of the low-carbon transition performance evaluation score of China Power

Deploy clean energy, develop large-scale and efficient thermal power, and promote the transition progress. China Power utilized its own technical and resource advantages, and arranged new energy sources such as wind power and solar power according to local conditions to increase the proportion of renewable energy sources.

By the end of 2021, wind power and solar power each accounted for 27.96% and 35.25% of the installed capacity of clean energy sources, as shown in Figure 2-5. At the same time, it also explored "energy +" multi-energy complementary projects, combined existing energy projects to strengthen cooperation with other industries, developed high-efficiency thermal power with large capacity and high parameters, and accelerated the improvement of its peak shaving capacity through flexible modification and other technologies.

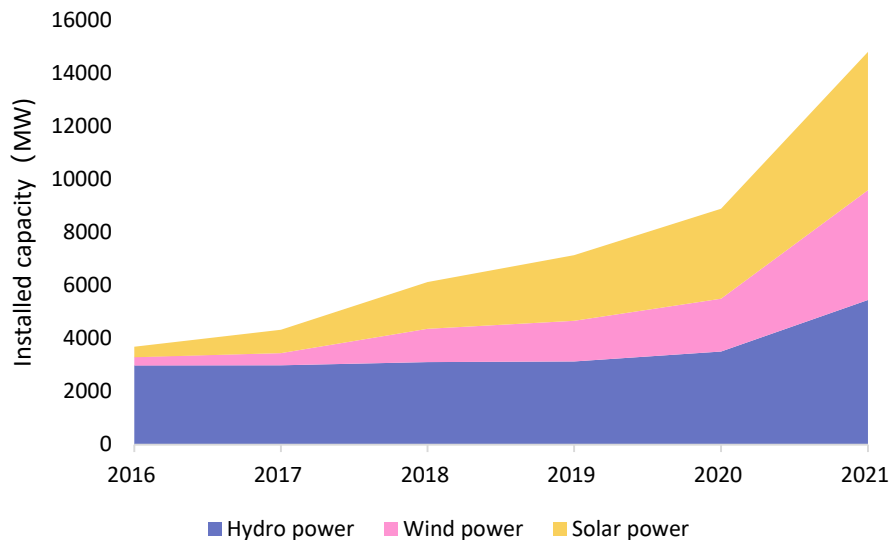


Figure 2-5 Installed capacity of clean energy in China power

Strengthen information disclosure, develop new business models and enhance governance. China Power has established a regularized information disclosure mechanism to enhance the transparency of corporate operations, and the information disclosure is relatively complete, providing a good governance for low-carbon transition. In addition, China Power has earlier set its sights on the "three new" industries, implemented the diversified development strategy, vigorously promoted and developed the integrated energy business, and its integrated energy development has achieved remarkable results, and played an important leading role in the listed thermal power companies.

(3) Guodian Power: Focus on thermal power, professional leadership

The results of Guodian Power in the evaluation dimensions of low-carbon transition performance are shown in Figures 2-6, with higher scores in governance and transition progress, and all four evaluation dimensions are above the average of the listed thermal power companies in the evaluation sample. Guodian Power has taken advantage of its strong power assets, focused on the power industry chain, and built a world-class power company with global competitiveness. During the "13th Five-Year Plan" period, Guodian Power gave full play to its advantages in thermal power assets, actively promoted the development of large-scale and high-efficiency thermal power generation, and drove the transition of thermal power units through technological innovation to realize comprehensive ultra-low emissions, energy saving and consumption reduction. At the same time, Guodian Power relied on the supportive and regulating capacity of conventional energy sources, such as thermal power and hydropower, and effectively integrate new energy sources for the development of new energy sources, so as to provide safe, stable, clean and low-carbon power products. During the "14th Five-Year Plan" period, the company is strategically positioned as "the

leader in conventional power energy transition, the main force in new energy development, and the leader in the construction of world-class enterprises", focusing on new energy and accelerating low-carbon transition. The company will further improve its low-carbon transition by developing into a specialized energy supplier.

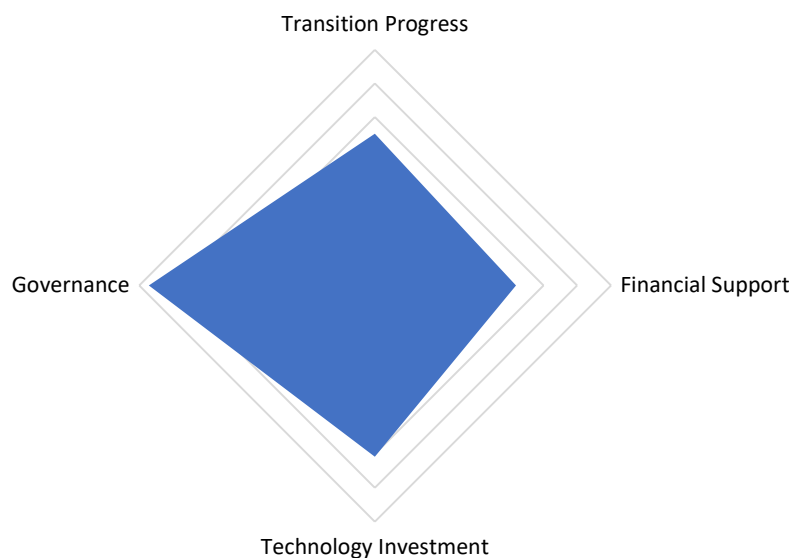


Figure 2-6 Radar chart of the low-carbon transition evaluation score of Guodian Power

Guodian Power's assets are distributed in 28 provinces, municipalities and autonomous regions across the country, mainly concentrated in the eastern coastal areas, large coal power bases and outward power transmission corridors. Combining the competitive advantages of different regions, Guodian Power promotes the layout of wind power and solar power projects of "base-type, field station-type and distributed type". Relying on the supportive and regulating capacity of conventional power supply, Guodian Power has obvious advantages in developing new energy sources by utilizing resources such as peak shifting and corridors in different parts of the country. Guodian Power's thermal power assets are all focused on in Inner Mongolia, Ningxia, Zhejiang, Yunnan and other regions, in addition to using the coal power supply and peak shaving capacity of thermal power units in the above regions, it can also use the advantages of existing transmission channels to implement the development strategy of "thermal power + new energy + peak shaving".

Increase technological investment and promote energy technology upgrading to facilitate low-carbon transition. With the goal of building a six-type green coal-fired power station of "safety, efficiency, environmental protection, low carbon, flexibility and wisdom", Guodian Power vigorously implements the optimization and upgrading of the thermal power industry, implements multi-dimensional technical transition such as boiler comprehensive upgrading and transformation, steam turbine flow transformation, energy-saving upgrading and transformation, and efficient central heating supply for existing thermal power units, and continues to carry out multi-

dimensional economic indicators benchmarking between plants and values of thermal power units to improve the operating efficiency of units, and the company's main economic and technical indicators are in the forefront of comparable enterprises.

Clean up impaired assets, increase power business revenue, and strengthen financial support. As shown in Figure 2-7, Guodian Power gives full play to its own power asset advantages, uses the existing conventional power supply to give new energy development a first-mover advantage, explores the integrated development model of coal power and new energy, and realizes a first-class professional energy supplier.

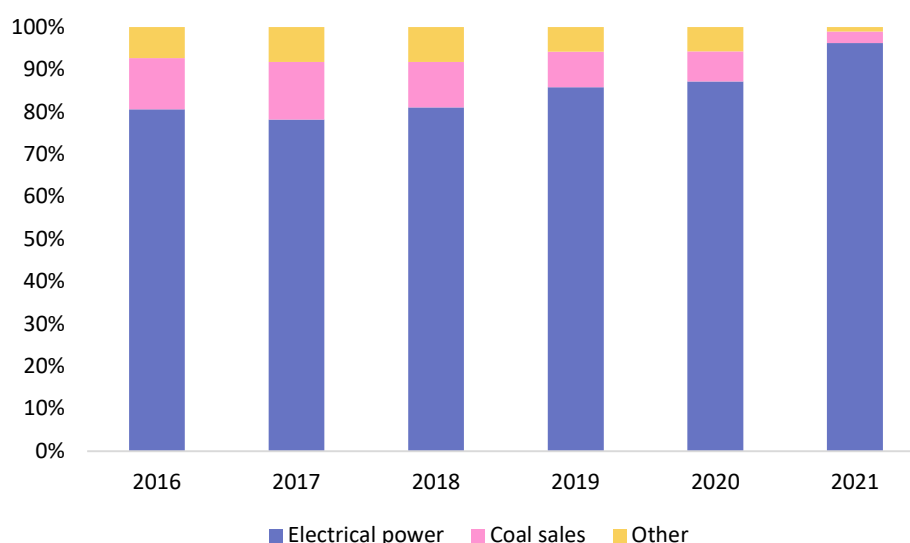


Figure 2-7 Changes in revenue of Guodian power business

(4) Guangzhou Development Group: Combining industry and finance to help development

Guangzhou Development Group ranked 3rd in the low-carbon transition performance evaluation ranking, and its performance in various dimensions is shown in Figure 2-8, among which the performance in technology investment and transition progress is outstanding. Guangzhou Development Group is one of the important local integrated energy enterprises in Guangdong Province, serving the Guangdong-Hong Kong-Macao Greater Bay Area and expanding outward to South China, North China, East China, Central China, Southwest China and other regions, and is mainly engaged in the integrated energy business focusing on thermal power, city gas, new energy and energy logistics. The company's thermal power plants are concentrated in the power load center of the Guangdong-Hong Kong-Macao Greater Bay Area and are one of the large-scale power generation enterprises in South China. Guangzhou Development Group's new installed capacity is all for wind power and solar power projects in "13th Five-Year Plan". In the early stage of "13th Five-Year Plan", new energy projects were invested and constructed with new development, with a cumulative installed capacity

of 94 MW, new energy projects were fully rolled out, distributed solar power projects were started one after another, and the energy structure changes were shown in Figure 2-9. Guangzhou Development adheres to the "two-wheel drive" of independent construction and mergers and acquisitions, promotes the development of solar power, wind power, charging piles and other projects, and gradually forms a scale effect, and the scale of the new energy industry has entered a period of rapid development.

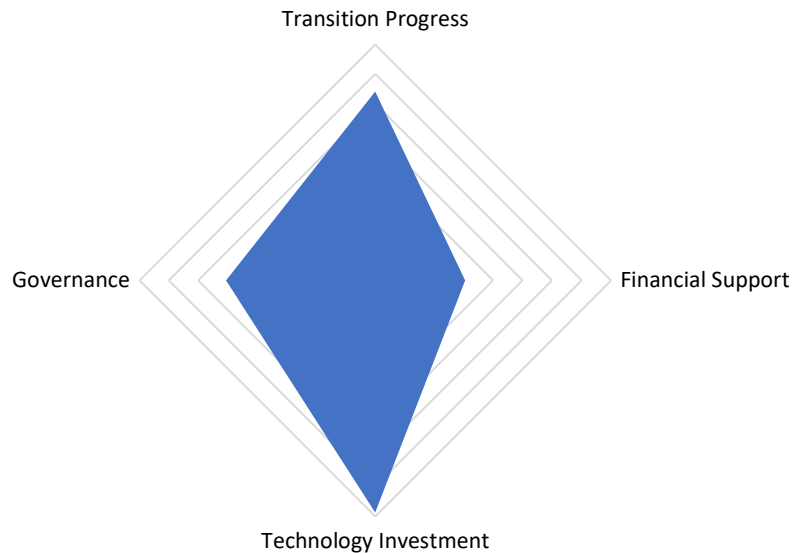


Figure 2-8 Radar chart of the low-carbon transition performance evaluation score of Guangzhou Development Group

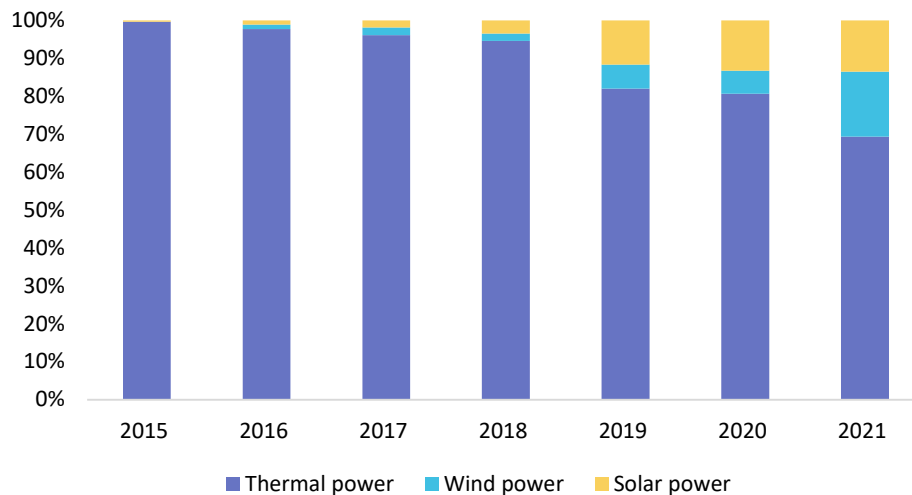


Figure 2-9 Changes in the energy structure of Guangzhou Development Group

Extend the business to hedge the risk of volatile energy sales. Guangzhou Development Group began to develop financial business since 2017, providing financial services such as fund aggregation management, settlement, credit and supply chain for the group, providing financial support for the development of the energy industry, realizing the integration of industry and finance, and achieving good development in financial support. In addition, the Guangzhou Electric Power Trading

Center was established in 2016, and the first electricity spot market in China was completed and started for trial operation in 2018. Guangzhou Development Group seized the opportunity of market-oriented reform, promoted the centralized operation mode of integrated electricity distribution and sales, actively participated in market bidding, and made every effort to fight for power generation rights, and its electricity sales are shown in Figure 2-10.

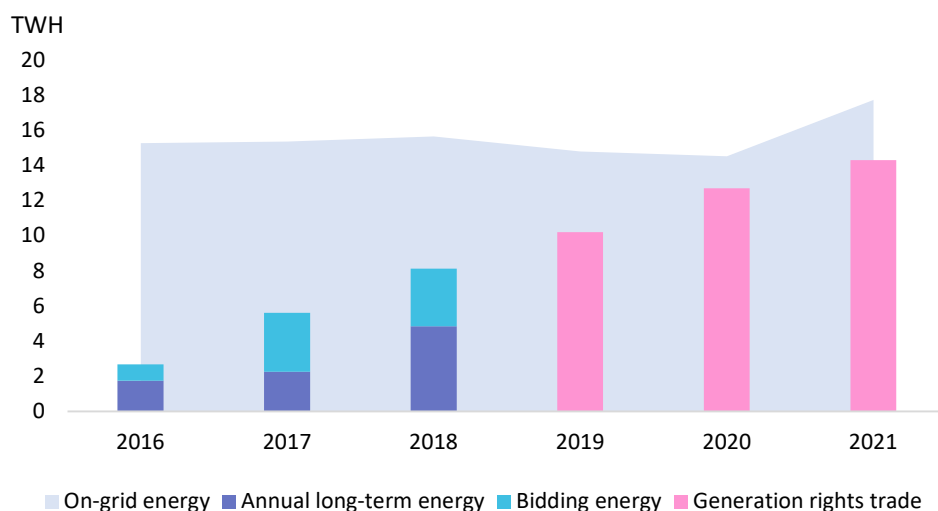


Figure 2-10 Changes in electricity sales in Guangzhou Development Group

Strengthen the transition of coal power assets, diversify the layout of business, and promote sustainable business development. On the one hand, Guangzhou Development Group actively optimizes coal power assets, rationally uses industrial water sources, mixes coal, carries out energy-saving transformation, wastewater discharge transformation, optimizes the hot start mode of gas turbines and other measures to effectively reduce energy consumption levels and coal-fired costs. On the other hand, Guangzhou Development Group is actively expanding its integrated energy business, promoting Guangzhou's first comprehensive energy project, the Guangzhou Financial City Start-up Area Integrated Energy Project, while accelerating the layout of new energy storage businesses, expanding smart electricity services, and making preparations for entering the national carbon market.

3. Management Implications for Listed Thermal Power Companies

(1) Pay special attention to the low-carbon transition plan and explore the low-carbon development model

Formulate a clear and effective low-carbon transition plan and step up strategic planning and ensure full delivery of the plan. In combination with the national low-carbon energy policy and its own development and positioning, the company should put forward specific implementation goals and action plans for the transition plan,

evaluate the operability of the plan, implement the target plans at different stages, and promote the smooth and effective transition of the company.

Optimize the existing thermal power and develop new energy in parallel. As much as possible based on their own conditions, companies should strengthen forward-looking research, in the direction of green and low-carbon development, to accelerate the transition from thermal power listed companies to new energy listed companies. They should drive their own business growth through new energy, develop new profit growth points, realize low-carbon and clean technology retrofits for thermal power and develop large-scale high-efficiency thermal power, so as to promote the effectiveness of the transition. They should take new energy development as a strategic priority development direction, to realize the transition and upgrading from a one-dimensional thermal power company to an efficient, clean, green, energy-saving new energy company.

Actively participate in carbon emissions trading and green power trading. The company should further understand carbon emission trading mechanisms, actively participate in carbon emission reduction activities, and promote the company's low-carbon transition with binding emission reductions. In addition, the participation of new energy in the electricity market has become an inevitable trend, and green power trading is also being carried out in an orderly manner. Through green power trading, thermal power companies can solve the lack of access to green power purchase in the short term, and can promote new energy development and energy transition of the company in the medium and long term.

(2) Increase investment in green transition and apply multiple innovation models

Promote the application of mature technologies and closely track cutting-edge technologies. Companies should increase investment in technology, promote the application of mature low-carbon energy technologies, continue to promote the expansion and upgrading of thermal power units, and implement heating retrofits and energy-saving and carbon reduction retrofits of in-service coal power units, so as to reduce coal consumption and carbon emission intensity and promote the transition of thermal power. At the same time, companies should closely track cutting-edge technologies, such as next-generation nuclear power technology, high-efficiency hydrogen production and storage technology, CCUS and emerging energy storage technologies in the R&D stage, which have a certain R&D foundation but are not yet very mature. Therefore, listed thermal power companies should promote the application of mature technologies and closely track cutting-edge technologies.

Develop comprehensive energy services and carry out incremental distribution network business. Companies should cultivate new modes of business such as source-grid-load-storage integration, incremental power distribution business and

comprehensive energy services. Accelerate investment in comprehensive energy services and source-grid-load-storage integration projects, diversified integration and development of new models. On the basis of the incremental distribution network, based on the distribution range of power users, and according to local conditions, they should build a comprehensive energy service system. They should extend the industrial chain: upstream they should carry out wind, solar, coal, gas and other combinations of forms of power supply; midstream they should guarantee industrial power, heating steam and summer refrigeration needs; and downstream they should guarantee customers' power use, carry out energy saving guarantee services, and overall form a deep integration of comprehensive energy services.

(3) Strengthen policy guarantee of the transition system and enhance the public disclosure of information

Establish the company's carbon asset management system and formulate optimization strategies. The company should formulate corresponding carbon asset management strategies around the overall strategic objectives, carry out tracking research well, timely grasp the policy trend of the national carbon market, improve the carbon asset management and trading platform, and carry out iterative optimization and adjustment. The company should establish a sound and robust carbon management system, actively participate in the national carbon market, and create a carbon business strategy map for the coordinated development of the entire industrial chain.

Use third-party inspection and verification to improve management capacity and continue to enhance information disclosure properly. In the market, timely, full and complete disclosure of information is not only the cornerstone for ensuring the normal operation of the market, reflecting the fairness of market operations, but also can play a role in safeguarding the reasonable interests of market players and the safety of fund settlement. The company should expand the extent and improve the quality of information disclosed in their corporate reports. Detailed disclosure of the company's future plans and actual progress should be made in public reports, especially public disclosure of relevant climate information, such as carbon emissions and carbon trading.

4. Policy Implications for Government Supervision

(1) Optimize the top-level design of thermal power planning, and strengthen the policy guidance of the high-quality transition of thermal power

The government should formulate a medium and long-term plan for the transition of the thermal power industry as soon as possible. The government should clarify the direction of national and regional coal power development in the medium

and long term based on the functional attributes of coal power in the new electric power system, set up an early warning mechanism for coal power additions to reasonably control the scale of coal power additions, and guide the transition of thermal power listed companies based on the characteristics of the regional coal power positioning needs, so as to enhance the ability of enterprises to transition. At the same time, taking into account the challenges, potentials and carbon reduction difficulties faced by different companies, the government should carry out differentiated management in planning and flexibly set corresponding targets.

The government should further improve the industrial policies and supporting measures for coal power transition. On the one hand, the government should continue to implement national policies on eliminating backward coal power production capacity; reduce homogenized competition through asset transfer and merger and acquisition, coal and power restructuring, regional integration and other means of capital operation; and promote overall loss reduction, reduce liabilities, and alleviate operational difficulties. At the same time, government should focus on old and small units and subcritical units, and actively promote the implementation of coal power units to energy-saving, heating and flexibility retrofits. On the other hand, supporting measures under different transition paths should be improved, including personnel resettlement for life-extension emergency standby units, and technology development support for CCS and BECCS retrofits.

The government shall give preferential policies to the power generation companies that undertake the responsibility of ensuring power supply security. In order to meet the peak demand for economic and social development as well as the large-scale and high proportion of new energy development, under the premise of strict control of coal power projects, it may also be necessary to develop peaking units and support units in some areas in the near-term. However, continuing to operate or adding new coal power projects in the current market environment will further aggravate the lossmaking situation of listed thermal power companies. Therefore, the government should favor the policies of power generation companies that bear the social responsibility for security of supply, pay attention to the transition difficulties they face, and alleviate the operating pressure through policies such as tax breaks, capacity service compensation, and preferential loans.

(2) Actively promote the development of transition finance and help the company realize high-quality development model

The government shall define the path of transition technology and formulate the standards of transition finance for coal power. The government should focus on including the thermal power industry in the transition finance classification catalog. Based on the dynamic nature of the low-carbon transition, transition finance should

flexibly adjust the technical path on a regular basis, taking into account the actual emission reduction of the industry and changes in the overall environment, and the classification criteria should also be dynamically adjusted in line with the actual situation to ensure consistency with the realization of the transition path. The standards for defining transition finance should help market players to identify transition activities at a lower cost, and apply to transition enterprises, transition projects, related financial products and investment portfolios, and reflect the dynamic needs of the market, policies and technological development.

The government should design and implement incentive policies to improve the financing supporting transition activities. Many places in China have already launched green project banks and matching platforms for green projects and financial resources, and are using preferential policies such as carbon emission reduction support tools, interest subsidies, guarantees, certification subsidies and other incentives to provide incentives for the inclusion of banked and matched projects. In the future, eligible transition projects can also be included in the green project pool to provide similar incentives to enhance the fundability of transition enterprises and transition projects. Local governments could also launch exemplary transition projects and utilize local green or transition funds to provide financial support.

The government should effectively carry out dynamic evaluation and monitoring, and supervise the development of transition finance. In terms of supervision and evaluation, the establishment of a relevant evaluation system for financial institutions to carry out transition finance can be explored. Transition finance can draw on the policy system of green finance by first clarifying the basic supervisory principles in the top-level design guidance, and then formulating specific guidelines by the corresponding supervisory departments. For example, the target nodes of emission reduction should be set up for the thermal power industry, and dynamic evaluation and monitoring should be done according to the annual implementation of low-carbon transition and the use of transition finance tools by listed thermal power companies, so as to reduce the risk of "greenwashing" in high-carbon industries, and to support the power industry in successfully realizing low-carbon transition.

(3) Urge listed thermal power companies to disclose information related to green development and low-carbon transition

In combination with the transition finance instruments, mandatory information disclosure provisions should be adopted for transition activities and transition investment. Given that the core objective of transition finance is to reduce carbon emissions, consideration could be given to adopting a mandatory disclosure requirement for listed thermal power companies receiving transition finance, requiring them to disclose, at a minimum, their carbon emission intensity at each stage

of the transition period, thereby enhancing comparability. In accordance with the transition disclosure requirements of the G20 Transition Finance Framework, government should promote and urge listed thermal power companies to publicly disclose information related to green development and low-carbon transition.

The government should accelerate the research and establishment of information disclosure indicator systems, and implement the corresponding reward and punishment regulations. At present, the information disclosure content of listed companies is still relatively extensive, and the relevant regulatory authorities should take into account the characteristics of the thermal power industry and study the establishment of an indicator system for the thermal power industry to improve the comparability of information disclosure, including the disclosure of data on energy consumption, greenhouse gas emissions, transition plans and implementation, and the progress of emission reduction activities. Regulators can publish an overview of information disclosure by listed companies through authoritative platforms such as government websites, and give praise and rewards to listed companies that actively make public disclosures, guiding them to play the role of industry benchmarks, and warning companies that fail to disclose, so as to expand the main body of information disclosure in a gradual and orderly manner.