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Energy Development Status and Developing Focus of Varied Regions in China

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Abstract: As a vast territory, China's energy resource endowments vary significantly by region. However, promoting a regional energy revolution based on local conditions is an effective way to end the bottlenecks that restrict China's energy development. Therefore, this study analyzes the current energy development situation from the aspects of energy production, consumption, and distribution, and investigates the differences in energy consumption intensity and the driving force for energy consumption growth in the core regions (i.e., the Beijing–Tianjin–Hebei region, Yangtze River Delta, Pearl River Delta, old industrial bases, Central China, energy-rich areas, and Southwest China). Based on these results, the medium- and long-term energy development trends and strategic focuses of these regions through 2035 are analyzed. The findings revealed that the Beijing–Tianjin–Hebei region should focus on the coordinated development of energy, economy, and the environment. An energy system with regional linkage should be formed and optimized in the Yangtze River Delta. The Pearl River Delta should strive to build a clean energy production, storage, and transportation base. Economic transformation should be promoted in the old industrial bases via value increment and the diversification of energy resources. Central China should establish an integrated energy hub, while the energy-rich areas should attempt to become green and sustainable energy security bases. Finally, clean energy consumption should be promoted in Southwest China. To coordinate energy development in several regions, China must consider the significant differences in local conditions, promote social development and ecological protection with the regional energy revolution, and encourage regional energy cooperation.

Keywords: regional energy development; energy intensity; energy transition; logarithmic mean divisia index (LMDI)

1 Introduction

Energy is an important material basis for economic and social development and is a prerequisite for improving living standards. Currently, China is the largest energy producer and consumer in the world. In 2019, China's total primary energy consumption reached 4.86×10^9 tce, accounting for 24.3% of the total global energy consumption [1]. However, China is facing a series of energy related challenges, including increasing constraints on energy resources, prominent ecological problems, and increased stress on energy structure adjustments, energy efficiency improvements, and energy security guarantees. Thus, there is an urgent need to promote a revolution in energy production and consumption.

Because of its vastness, the energy resource endowments of different regions in China vary significantly. Thus, the comprehensive advancement of the energy revolution should be based on local conditions and integrated with specific regional development statuses and strategies. Therefore, this study analyzes the current energy development situation, and examines

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the developing trends and energy transition focuses through 2035 in the core regions (i.e., the Beijing–Tianjin–Hebei region, Yangtze River Delta, Pearl River Delta, old industrial bases, Central China, energy-rich regions, and Southwest China). Based on these findings, countermeasures and suggestions are proposed.

The Beijing–Tianjin–Hebei region, which comprises two municipalities (Beijing and Tianjin) and the Hebei Province, is the political and cultural center of China. Meanwhile, as China's economic center, the Yangtze River Delta includes the Shanghai Municipality, Jiangsu, Zhejiang, and Anhui provinces. Located in the central and southern parts of the Guangdong Province, the Pearl River Delta, which is at the forefront of China's reform and opening-up, comprises nine cities: Guangzhou, Foshan, Zhaoqing, Shenzhen, Dongguan, Huizhou, Zhuhai, Zhongshan, and Jiangmen. Note that in this study, the Pearl River Delta refers to the entire Guangdong Province because of the availability of data. The old industrial bases, including three northeastern provinces and the Shanxi Province, were China's important industrial and energy supply bases. Central China comprises four neighboring provinces: Henan, Hubei, Hunan, and Jiangxi (according to the Strategy for the Rise of Central China, Central China includes six provinces: Henan, Hubei, Hunan, Jiangxi, Anhui, and Shanxi. However, to avoid the repetition of data statistics and analysis, this study lists the Anhui Province in the Yangtze River Delta and the Shanxi Province in the old industrial bases. Therefore, in this study, Central China only includes the Henan, Hubei, Hunan, and Jiangxi provinces). The resource-based economy features are prominent in the energy-rich regions, which are mainly composed of the Xinjiang Uygur Autonomous Region, Inner Mongolia Autonomous Region, Shaanxi Province, and Ningxia Hui Autonomous Region, which is where the energy "Golden Triangle" region (Ningdong, Ningxia; Ordos, Inner Mongolia; Yulin, Shaanxi) is located. Clean resources, such as hydropower, wind power, and natural gas, are rich in the Southwest China region, which includes four provinces: Sichuan, Chongqing, Yunnan, and Guizhou (the Tibet Autonomous Region is not involved in this study because of a lack of energy data).

2 Analysis of the current status of regional energy development

Based on statistical and comparative analyses of energy production, consumption, flow direction, and related data in different regions, the energy consumption intensity and its driving force are thoroughly investigated. Further, the characteristics and differences of energy development are analyzed to lay a foundation for energy transformation in each region.

2.1 Analysis of current status of energy production and consumption

This study used *China's Energy Statistical Yearbook 2018* [2] as a data source, and focused on analyzing the primary energy production and end-user energy consumption in each region, as shown in Fig. 1. Note that to ensure the rationality of the data comparison and analysis, all types of secondary energy (e.g., electricity and heat) were converted into primary energy according to the calculation method of coal consumption for power generation during data processing.

Regarding primary energy production, significant differences were observed among the different regions. Specifically, the energy-rich regions and old industrial bases had enormous coal production, accounting for 82% of the total coal production of the seven regions. Moreover, non-fossil energy production in Southwest China was dominant, accounting for approximately 49% of the total non-fossil energy production in the seven regions. Oil production in the seven regions was mainly concentrated in the energy-rich regions, old industrial bases, and Beijing–Tianjin–Hebei region, while natural gas production was concentrated in the energy-rich regions and Southwest China. Note that the energy-rich regions dominated in energy production.

The end-user energy consumption in the Yangtze River Delta was dominant at approximately 7.5×10^8 tce. Specifically, electricity occupied a large portion of the end-user energy consumption structure of each region, especially in the Pearl River Delta, where electricity accounted for 48%. Meanwhile, coal comprised a large proportion of the end-user energy consumption structure in many regions, especially in the Beijing–Tianjin–Hebei region, old industrial bases, and Central China, wherein coal accounted for more than 30%. The proportion of petroleum in the energy consumption structure varied greatly among different regions, accounting for approximately 29% in the Pearl River Delta region and less than 10% in the energy-rich regions. Natural gas accounted for approximately 10% of the total energy consumption in each region. Further, the thermal energy was significantly high in the north and low in the south.

According to the comparison between the total primary energy production and the total end-user energy consumption, the seven regions can be divided into three categories. The first is the energy transfer-out regions, which includes the energy-rich region and old industrial bases, of which the energy self-sufficiency rates (the ratio of the total primary energy production to the total end-user energy consumption) are approximately 310% and 130%, respectively. The second is basically self-sufficient

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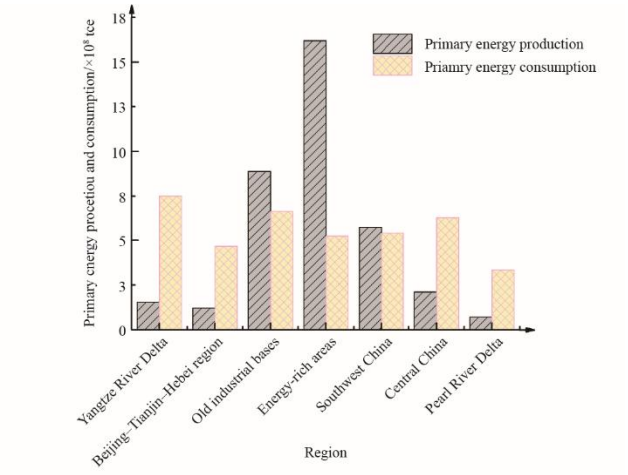
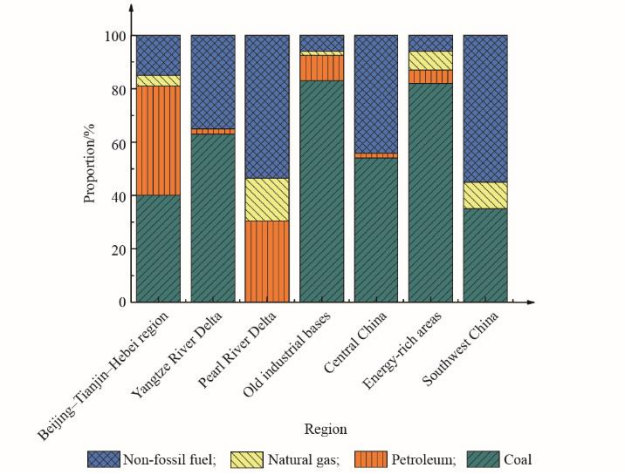
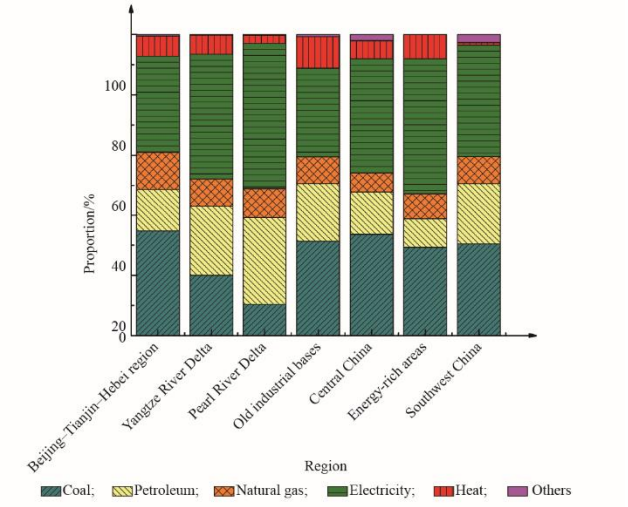
regions, including Southwest China, wherein the energy self-sufficiency rate is close to 100%. The third category is energy transfer-in regions, such as the Yangtze River Delta, Pearl River Delta, Beijing–Tianjin–Hebei region, and Central China, whose energy self-sufficiency rates are lower than 35%, and that of the Yangtze River Delta is only 21%.



(a) Comparison of regional total energy production and consumption quantities



(b) Comparison of regional primary energy production structures



(c) Comparison of regional end-user energy consumption structures

Fig. 1. Comparison of regional energy production and consumption in 2017.

2.2 Analysis of current status of energy flow direction

For convenience of comparison, the amount of primary energy was used as the measurement standard, and energy varieties were combined. Further, to eliminate the influence of energy varieties on the energy transfer-in/transfer-out (import/export) of various regions, the data were processed to form a graph of net energy import and net energy transfer-in/transfer-out for each region in 2017 (as shown in Fig. 2).

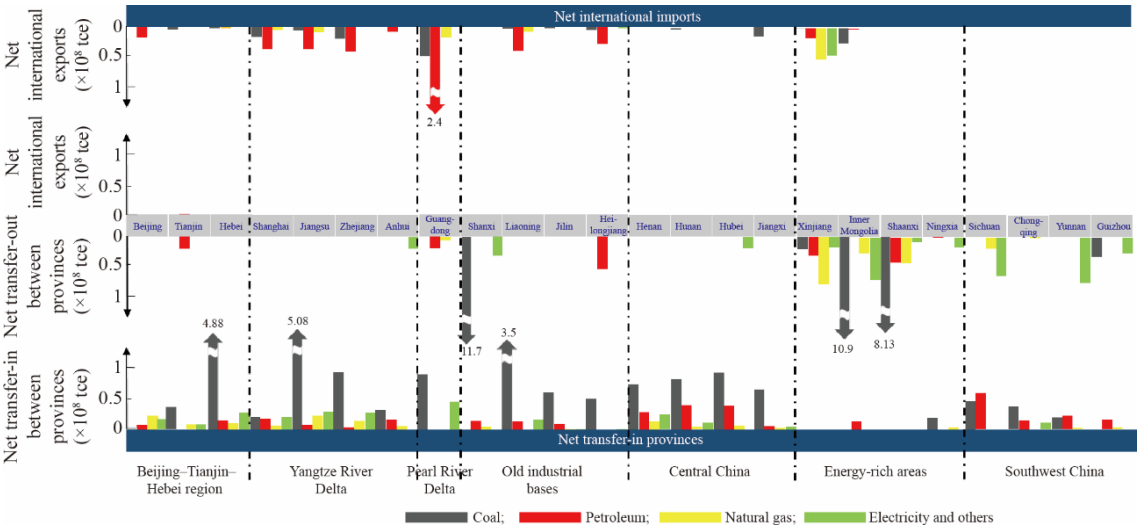


Fig. 2. Regional situations of net energy import and transfer-in/transfer-out in 2017.

There are significant differences in the distribution of energy transfer-in/transfer-out among the regions. From the perspective of energy transfer-out, the amount of various energies in the energy-rich regions dominated that in other regions, making a great contribution to the guarantee of domestic energy supply. The old industrial bases in Northeast China also participated in energy transfer-out, and the amount of Shanxi's coal transfer-out and Heilongjiang's oil transfer-out were both large, which matches the energy reserve advantages of the two provinces. Further, electricity transfer-out was significant in Southeast China as it contains abundant hydropower resources.

Regarding coal flow direction, the coal transfer-in to energy-starved but economically developed regions (such as the Beijing–Tianjin–Hebei region and Yangtze River Delta) was distinct. Specifically, the old industrial bases and Central China both received over 2.5×10^8 tce of energy, suggesting that the industry development levels of Northeast China and Central China have significantly improved. Further, the amount of coal transfer-in was considerable in Southeast China, reaching 1.0×10^8 tce. Regarding the flow direction of non-coal energy varieties, Central and Southeast China had a large amount of oil transfer-in, both exceeding 1.0×10^8 tce. Conversely, the amount of electricity and other non-fossil energy transfer-in occupied the second most used energy of the total energy consumption in the Beijing–Tianjin–Hebei region and Yangtze River Delta, indicating that West China contributed more to the electricity supply of these urban agglomerations, which is consistent with the national energy strategy of the West–East Power Transmission project.

2.3 Analysis of energy consumption intensity and driving force

As shown in Fig. 3, different industrial structures cause significant differences in energy consumption intensity (energy consumption per gross domestic product (GDP)) among different regions. The energy consumption intensities of the energy-rich regions and old industrial bases were significantly higher than the national average. In Shanxi and the energy-rich regions, this was mainly because of the large proportion of energy-intensive industries, whereas for the three provinces in Northeast China, this was primarily the result of the low industrial added value caused by backward technological innovation. Southeast China, the Beijing–Tianjin–Hebei region, and Central China had energy consumption intensities that were close to the national average, but they must further develop high value-added industries. Meanwhile, the Yangtze River Delta and Pearl River Delta had the lowest energy consumption intensities, suggesting that they should consider the advantages of advanced manufacturing and service industries in the future to make industrial structure adjustments.

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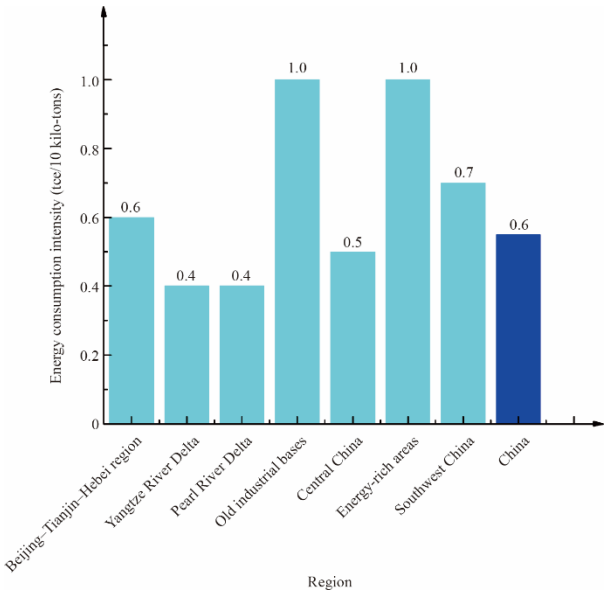

Fig. 3. National and major regional energy consumption intensities (the standard of primary energy quantity in 2017).

The logarithmic mean divisia index was used to analyze the driving force of energy consumption growth [3]. This method meticulously reflects the impact of attribute changes in economic sectors regarding energy consumption. Fig. 4 shows the decomposition results for each region, wherein the length of each bar reflects the contribution of each factor to the energy consumption growth, and a negative value represents a reduction in energy consumption caused by this factor.

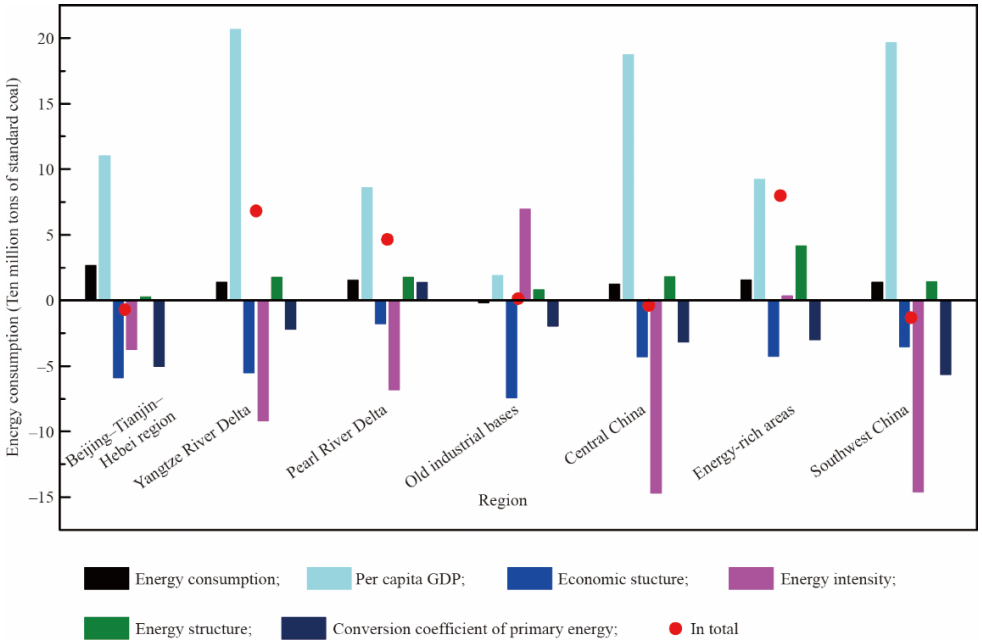

Fig. 4. Decomposition results of energy consumption growth based on the standard of primary energy quantity for each regional economic sector from 2011 to 2017.

In general, the growth of per capita GDP is the most important factor driving the growth of energy consumption in all regional economic sectors (three industries), while adjusting the industrial structure and reducing energy intensity play major roles in restraining the growth of energy consumption in economic sectors. From 2011 to 2017, energy consumption in the economic sectors decreased in the Beijing–Tianjin–Hebei region, Central China, and Southeast China. In the Beijing–Tianjin–

Hebei region, this decline was mainly the result of adjusting the economic structure (the proportion of three industries) and improving energy conversion efficiency (represented by the primary energy conversion coefficient). Conversely, in Central and Southeast China, the decrease was primarily caused by a significant decline in energy intensity. Meanwhile, energy consumption in the energy-rich regions, Yangtze River Delta, Pearl River Delta, and old industrial bases significantly increased. Specifically, the rapid growth of energy consumption in the old industrial bases was caused by an increase in energy intensity; the significantly rising demand for energy in the energy-rich region, Yangtze River Delta, and Pearl River Delta was because of the rapid development of the economy, which significantly exceeded the impact of other factors. In addition, the adjustment of the energy structure, specifically the increase in the end-user electricity consumption proportion, drove the increase in energy consumption.

3 Analysis of the focus of regional energy medium- and long-term development strategies

3.1 Beijing-Tianjin-Hebei region must promote the coordinated development of energy, economy, and the environment

The Beijing–Tianjin–Hebei region is one of the most important urban agglomerations in China, as it has the largest economic scale and greatest vitality in northern China. In 2019, the gross regional product of the Beijing–Tianjin–Hebei region was approximately 8.46×10^{12} CNY, accounting for 8.5% of the national GDP [5]. However, a large disparity exists in the level of economic development within the Beijing–Tianjin–Hebei region. For instance, Beijing has entered a post-industrial development stage, Tianjin has basically completed its industrialization, and Hebei remained in the middle stage of industrialization. As of late, the rapid development of the social economy has brought the Beijing–Tianjin–Hebei region continuous total energy demand growth, which has intensified its external dependence on regional energy supply. Thus, the Beijing–Tianjin–Hebei region presents a tight energy situation.

To a large extent, the Beijing–Tianjin–Hebei region can be considered the epitome of China's economic and social development. Nevertheless, while this region has made achievements in coordinated development, it also faces specialized problems regarding the prominent contraction of resources and the environment. In addition, the Beijing–Tianjin–Hebei region faces severe challenges including air pollution, water shortage, water pollution, and the excessive exploitation of water resources, of which eco-environmental pollution has the characteristics of regional transport.

Therefore, ecological restoration and environmental improvement is one of the three fields that must be focused on advancing the coordinated development of the Beijing–Tianjin–Hebei region. To achieve this, it is necessary to solve the problem of pollutant emissions in the process of large amounts of coal consumption, especially bulk coal consumption, as well as oil and gas combustion in the region. Realizing the coordinated development of energy, economy, and the environment will be the top priority for the Beijing–Tianjin–Hebei region by 2035. At the same time, improving regional energy production and the consumption structure will promote the development of upstream and downstream of the industrial chain as well as related industries, creating new growth points for regional economic development, and helping the region form a high-grade, precision, and advanced industrial structure.

3.2 Yangtze River Delta must integrate and optimize the regional linkage energy system

Fossil energy consumption, especially coal consumption, accounts for a large proportion of the regional energy consumption structure in the Yangtze River Delta. In this region, the energy demand is large and highly dependent on input from outside the region. Further, its energy supply is facing great pressure, the energy infrastructure must be improved, and the level of specialization within the region is not high.

Currently, the development of energy integration in the Yangtze River Delta has made some achievements, but local administrative barriers remain, manifesting in the lack of collaboration in energy planning, construction, environmental protection, and other aspects. Thus, it is necessary to break through a series of institutional obstacles and transform the mode of regional energy development to better serve the public service sectors, such as the local haze governance and the construction of ecological civilization. To date, no energy authority has been established, and no unified regional energy planning and energy conservation and emission reduction targets have been formulated. Therefore, the relationship between the current energy management system and the requirements of energy marketization is becoming increasingly limited, indicating that the energy market must be further cultivated and improved.

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The specialization level of the energy industry is low in the Yangtze River Delta, and the overall linkage effect has not yet been fully exerted. With the convergence of an industrial structure, there is a high coincidence degree in new energy vehicles, energy conservation and environmental protection, new-generation energy information technology, new energy materials, high-end energy equipment, and other strategic emerging industries. Therefore, it is difficult to comprehensively achieve both industrial cooperation and a division of labor while forming good industrial chains and hierarchies. By 2035, the demonstration area in the Yangtze River Delta should be developed, the Yangtze River Delta Energy Integration Pilot Demonstration Area should be built, and the construction of a modern energy system should be promoted to realize the Internet Plus Smart Energy development strategy proposed by China. In particular, this region should focus on breaking down industry and provincial barriers to achieve interconnection, multi-functional coordination, and regional linkage.

3.3 Pearl River Delta must establish a clean energy production, storage, and transportation base by relying on the Belt and Road Initiative and the construction of the Guangdong–Hong Kong–Macao Greater Bay Area

The Pearl River Delta region is the pilot area of China's reform and opening-up, and thus acts as an important window for China's opening up. This region has large energy consumption, and mainly relies on fossil fuels either imported and transferred-in from within and outside the Guangdong Province, as well as crude oil primarily supplied by the South China Sea oil fields, imports, and transfer-in from other provinces. Further, the overall external dependence of electricity supply is high [6]. The Guangdong–Hong Kong–Macao Greater Bay Area is the fourth largest bay area in the world, following the New York and San Francisco bay areas in the United States and the Tokyo Bay Area of Japan, and is also the starting point of the "Belt and Road" Maritime Silk Road.

To advance the in-depth development of Belt and Road economic construction, it is necessary to rely on Hong Kong and Macao as free and open economies and Guangdong as a pioneer of reform and opening-up. Then, the Pearl River Delta can continue to further reform and open wider, remaining at the forefront of China in high-quality economic development, acting as a demonstrative leader, accelerating institutional innovation, serving as a pilot area, constructing modern economic systems to be better integrated into the global market system, and establishing the world's emerging industry, advanced manufacturing, and modern service industry base, thereby building a world-class urban agglomeration.

By 2035, the Pearl River Delta region should construct a clean energy production, storage, and transportation base. (1) The resource advantages of coastal clean energy could be used to develop offshore wind power. As meeting increased demand mainly relies on clean energy, clean energy should be promoted to become a major part of energy supply, and begin a new era of low-carbon energy supply. (2) The development opportunity of the Belt and Road initiative should be positively extended to deepen cross-border cooperation in the energy industry, implement energy opening and cooperation projects, expand energy supply channels and development space, extend the use of energy resources overseas, and build a national energy operation hub and regional energy operation center in southern China. (3) The advantages of the ports in the coastal areas of the east and west wings should be exploited. The new energy industrial bases in Shenzhen, Zhongshan, Foshan, and Dongguan should be used to promote the construction of a large backbone support power supply in the coastal areas of the east and west wings, encouraging the rationalization of an energy structure and ensuring energy input and output.

3.4 Old industrial base must promote economic transformation with high energy value and diversification of energy

The old industrial base is an important energy base in China and a key region for implementing the strategies of western development and northeast revitalization in China. Northeast China has a large proportion of energy production and energy-intensive industries and a high proportion of fossil fuel consumption. While the coal industry has obvious advantages and the tertiary industry is booming in Shanxi, the industrial structure must be optimized.

The proportions of deep processing, fine processing, and the conversion rate of fossil fuels in the old industrial bases are low. Further, the added value and technological content of the products are inferior. Specifically, the industrial chain of coal and petroleum has not been sufficiently extended and contains significant defects, such as more primary products and fewer refined products. Because of the short industrial chain and low added value of products, the majority of products are in the upper reaches of the industrial chain and are mainly driven by markets outside of the province, leaving limited space for active regulation. By 2035, the old industrial bases need to: (1) greatly improve the deep processing capacity of coal and petroleum resources, extend the industrial chain, and improve the added value of products; (2) promote the diversified development of energy, including the construction of demonstrative projects for the comprehensive utilization of abandoned mining resources, the development of multi-energy complementary technology to promote clean energy consumption, the advancement of a wind

power heating industry to increase wind power consumption, and promote the large-scale development of biomass blend burning in coal-fired power plants to reduce carbon emissions; and (3) utilize investment activities, such as the construction of infrastructure in renewable energy projects, power grid connection, equipment installation, power station operation and management to drive the transformation and upgrading of traditional industries, promote the development of emerging industries, facilitate the development of the macro-economy, stimulate employment, and improve the ecological environment.

3.5 Central China must optimize the energy and industrial structure and build a comprehensive energy hub

Central China is in the second echelon of China's economic development and is an important channel for energy transportation and energy supply security. The distribution of energy resources in this region is extremely unbalanced, as it contains scarce coal resources but abundant water resources, making it an important hydropower industrial base. In recent years, energy consumption in Central China has grown, and there has been a general contraction between energy supply and demand. Economic development in Central China is dependent on the secondary industry without fundamental changes, and the development of the tertiary industry, especially in the modern service industry, lags behind severely. Further, this region has a high degree of dependence on external energy, and its energy structure has been dependent on fossil fuels for a long time. Therefore, it is urgent to accelerate adjustments to the regional energy and industrial economic structures in order to advance the Rise of Central China strategy.

The Rise of Central China is an important national economic development strategy that follows the opening-up of China's eastern coastal areas, China Western Development, and Revitalization of Northeast China. Regarding the overall strategy of China's regional development, Central China has obvious regional advantages and plays a key role in connecting the east and west parts of China. By 2035, Central China should strengthen the construction of infrastructure hubs in traffic, energy, and other fields in order to not only help the Yangtze River Delta and Pearl River Delta change the situation of tense national transportation and electricity supply but also play a larger role of support and linkage in the smooth implementation of China Western Development, the revitalization of the northeast old industrial base, and the eastern industrial transfer. In general, to promote the development of Central China, it is necessary to focus on establishing a comprehensive energy hub in Central China to make it the driver of the Rise of Central China strategy.

3.6 Energy-rich regions must establish a green and sustainable energy security base

Coal reserves in the energy-rich regions account for approximately 70% of the total coal reserves in China. Moreover, the area is also rich in oil, natural gas, and renewable resources [7]. These energy-rich regions are important bases for the West–East Coal Transport, West–East Gas Transmission, and West–East Power Transmission strategies in China, and act as an important cornerstone for China's energy security. Since the reform and opening-up, and the Great Western Development, energy-rich regions have developed rapidly, but the development mode is extensive and the resource-based economic development mode remains dominant [8]. Regarding regional development, homogeneous competition in the energy chemical industry is evident.

By 2035, the development of energy-rich regions should draw support from its energy advantages by using the energy revolution as a starting point to promote the coordinated development of energy exploitation and utilization with the ecological environment and supporting the green and sustainable development of the regional economy and society. With the ecological environment carrying capacity as a constraint condition, it is necessary to focus on the revolution of energy supply, scientifically exploit energy resources, strengthen the integration of energy systems, and intensify coordination with energy input regions in order to improve the quality of energy output, and ultimately provide continued drive for the development of other regions in China. In addition, the quality of local energy utilization should be improved, and the added value of the energy industry should be increased to promote the steady advancement of the regional economy. Moreover, the environmental damage caused by energy utilization should be reduced, and it is necessary to turn passive efforts into active efforts to make the development of the energy industry actively feed back to the development of the ecological environment.

3.7 Southwest China must consume clean energy and share the benefits of development

Since the 12th Five-Year Plan period, Southwest China has actively exploited and utilized hydropower, mineral resources, and other resources, and the regional economy has shown steady and rapid growth [9]. While Southwest China is rich in hydropower resources, these resources are not sufficiently utilized.

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In the medium- and long-term, clean power production in Sichuan and Yunnan will continue to exceed the local power consumption capacity. However, hydropower, photovoltaic, and other resources in Sichuan still have room for development, meaning that the installed capacity of electricity will increase significantly in the future. Meanwhile, Yunnan is rich in hydropower, wind, and solar energy, and will continue to exploit hydropower resources in the near future and solar energy and wind power in the long term. Therefore, by 2035, Southwest China should promote the regional and national optimal allocation and consumption of clean energy resources by stages, drive the development of clean energy-related industries, advance the improvement of employment, taxation, poverty alleviation, infrastructure, and other aspects, and finally realize the shared development of economy and society.

4 Countermeasures and suggestions

4.1 Local condition must be considered because of differences in energy development among regions

Significant differences exist among various regions in terms of energy production, consumption, transfer-in, and transfer-out. Therefore, local conditions should be considered to precisely promote the coordinated regional development and energy revolution in different regions to achieve high-quality regional development. In particular, the Beijing–Tianjin–Hebei region, Yangtze River Delta, and Pearl River Delta should focus on mitigating energy consumption, adjusting the regional economic structure, and establishing a clean, low-carbon, safe, and efficient energy system. Meanwhile, Central China and the old industrial bases should focus on eliminating backward production capacities and realizing the development of industrial advanced manufacturing industry by adjusting the industrial structure and upgrading industrial technology. Finally, the energy-rich regions and Southwest China should aim for the coordinated development of energy supply and consumption, ensure energy supply to other regions, and strengthen the advancement of high value-added industries.

4.2 Promote regional economic and social development and ecological protection through energy revolution

Regional economic and social development, and ecological and environmental protection cannot be separated from energy support and coordinated development. However, the energy resource endowments of different regions vary significantly, altering the economic and social development and ecological and environmental situations. To promote the energy revolution, it is necessary to combine it with specific regional development strategies and create a feasible plan for regional economic and social development, as well as ecological and environmental protection. Thus, the Beijing–Tianjin–Hebei region, Yangtze River Delta, and Pearl River Delta should pay more attention to ecological and environmental protection during the process of energy transformation and development, and the old industrial bases and energy-rich regions should consider ecological and environmental protection while enhancing the role of energy exploitation and utilization in promoting energy. Moreover, Central and Southwest China need to focus on advancing economic development via energy development.

4.3 Promoting regional coordinated development to achieve inter-regional energy cooperation and win-win cooperation

Regional resource endowments, the current situation of the energy system, the current status and potential of economic and social development, and infrastructure construction should be combined with energy security, ecological environment, and social equity to promote inter-regional energy cooperation. In particular, we suggest strengthening the coordinated development of regional energy and promoting energy dispatch matching to realize the win-win cooperation among regions. Specifically, the Beijing–Tianjin–Hebei region and Yangtze River Delta should strengthen energy cooperation with other regions to ensure safe and stable energy supplies. The old industrial bases, energy-rich regions, and Southwest China should fully utilize their energy resource endowments and shoulder the responsibility of ensuring a secure energy supply in China. Further, the Pearl River Delta and Central China should make use of their favorable geographical advantages to build energy storage and transportation bases or integrated hubs. Through the regional energy revolution and inter-regional energy cooperation, China's energy revolution will be steadily promoted.

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