

Analysis on the trend and characteristics of electricity consumption growth in Shaoxing

Dai Gaoqi^{1,a}, Lin Haifeng², Zhang Yongjian² and Xia Liyu¹

¹State Grid Energy Research Institute Co., Ltd. Beijing, China

²State Grid Zhejiang Electric Power Company Shaoxing Power Supply Company, Shaoxing, China

Abstract. This article studies the current situation and development trend of electricity consumption in Shaoxing from the perspectives of electricity consumption in the whole society, industrial electricity consumption, and urban and rural residents' daily life electricity consumption. Compared with the average electricity consumption of the whole country, Zhejiang Province and various regions, we analyze power consumption trends and structural characteristics of Shaoxing.

1 Analysis on Electricity consumption of Shaoxing

Shaoxing is a prefecture-level city under the jurisdiction of Zhejiang Province. It is located in the north-central part of Zhejiang Province and on the south bank of Hangzhou Bay. It is a cultural and eco-tourism city with characteristics of southern water towns, an important city in the Yangtze River Delta city cluster, and a core city in the Greater Bay Area around Hangzhou Bay. Since the 1980s and 1990s, Shaoxing's economic development has continued to leap forward, and the electricity consumption of the whole society in Shaoxing has shown an increasing trend year by year. From 2010 to 2019, the electricity consumption of the whole society in Shaoxing increased from 29.6 billion kWh to 46.2 billion kWh. The average annual growth rate of electricity consumption was 5.07%, and the lowest point was 0.36% in 2015.

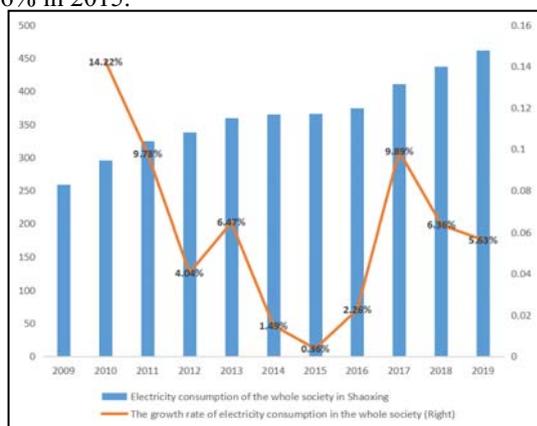


Figure 1. Electricity consumption and growth rate changes of the whole society in Shaoxing (unit: 100 million kWh).

In recent years, with the agglomeration and development of new energy, medicine, technology and other industries in Shaoxing, both industrial and domestic electricity demand has grown rapidly.

Shaoxing's industrial electricity consumption accounts for more than 77% of the total social electricity consumption. In addition to negative growth in 2015 and 2016, industrial electricity consumption has continued to rise, from 24.527 billion kWh in 2010 to 35.63 billion kWh in 2019.

With the improvement of residents' income conditions and the acceleration of urbanization, residents have higher and higher requirements for the quality of life, and more and more household appliances have begun to enter the homes of ordinary people. With the widespread use of household appliances, the electricity consumption of urban and rural residents will also rise steadily nearly doubled, from 2.483 billion kWh in 2010 to 4.866 billion kWh in 2019.

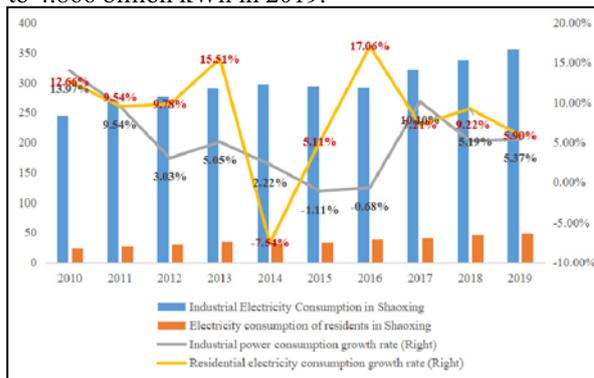


Figure 2. Electricity consumption and growth rate changes in industry and electricity consumption of urban and rural residents in Shaoxing (unit: 100 million kWh).

2 Trend analysis of electricity consumption in various districts of Shaoxing

Shaoxing has three districts, one county and two cities, namely Yuecheng District, Keqiao District, Shangyu District, Xinchang County, Shengzhou City, and Zhuji

^a Corresponding author: daigaoqi007@163.com

City. Electricity consumption in various regions is closely related to the distribution of industries and population. Keqiao District is an important part of the construction of a large city in Shaoxing. The electricity consumption of the whole society in Keqiao District is far ahead of other regions. The electricity consumption of the whole society in 2019 It is 16.565 billion kWh, accounting for 35.83% of the total electricity consumption of Shaoxing. The second is Zhuji City. In 2019, the electricity consumption of the whole society was 9.473 billion kwh, accounting for 20.49% of the total electricity consumption of Shaoxing.

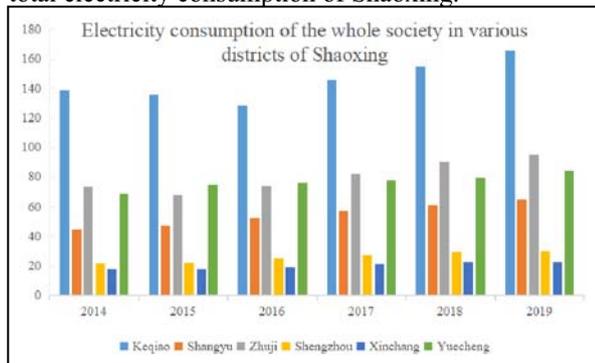


Figure 3. Changes in electricity consumption in the whole society in various districts of Shaoxing (unit: 100 million kWh).

Keqiao District's industrial electricity consumption is also much higher than other regions. In 2019, its industrial electricity consumption was 14.279 billion kwh, accounting for 40.08% of Shaoxing's total industrial electricity consumption. The second is Zhuji City. In 2019, Zhuji City's industrial electricity consumption was 7.151 billion kwh, accounting for 20.07% of Shaoxing's total industrial electricity consumption.

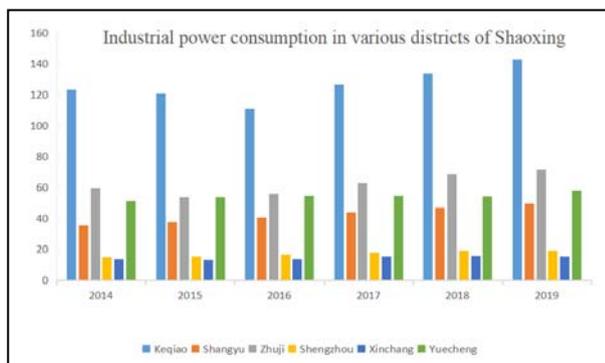


Figure 4. Changes in industrial power consumption in various districts of Shaoxing (unit: 100 million kWh).

The electricity consumption of residents in various districts of Shaoxing has been on the rise. Among them, the electricity consumption of residents in Zhuji City accounts for the highest proportion. In 2019, the electricity consumption of residents in Zhuji City was 1.193 billion kWh, accounting for 24.52 of the total electricity consumption of Shaoxing residents. %. The second is Yuecheng District, which is the administrative center of Shaoxing. In 2019, residents' electricity consumption was 1.026 billion kWh, accounting for 21.08% of the total electricity consumption of Shaoxing.

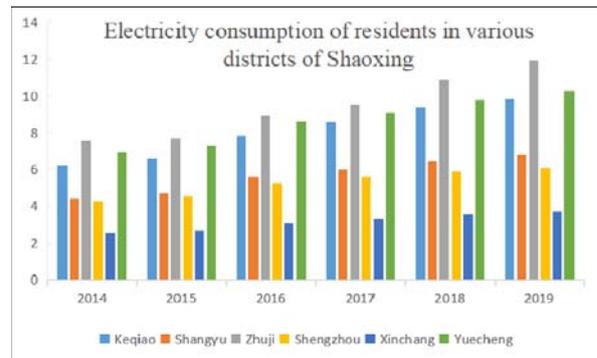


Figure 5. Changes in residential electricity consumption in various districts of Shaoxing (unit: 100 million kWh).

3 Comparative analysis of electricity consumption levels in various cities in Zhejiang

Shaoxing connects with Ningbo City in the east, Taizhou City and Jinhua City in the south, and Hangzhou City in the west. In 2019, Shaoxing's gross product (GDP) was 578.1 billion yuan, an increase of 7.2% over the previous year at comparable prices. The province has an average of 0.4%, ranking fifth in the province and 37 in the country. From the perspective of the total electricity consumption of the whole society in the past three years, Shaoxing ranks fourth in the province after Hangzhou, Ningbo and Jiaxing.

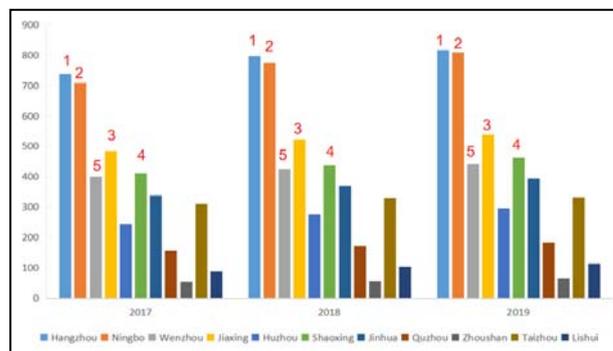


Figure 6. Comparative analysis of electricity consumption in the whole society of various cities in Zhejiang Province (unit: 100 million kWh).

Shaoxing's private economy is active, and the local economy is characterized by its textile industry and related industrial chains. In terms of industrial electricity consumption in the past three years, it ranks 4th in the province after Hangzhou, Ningbo and Jiaxing.

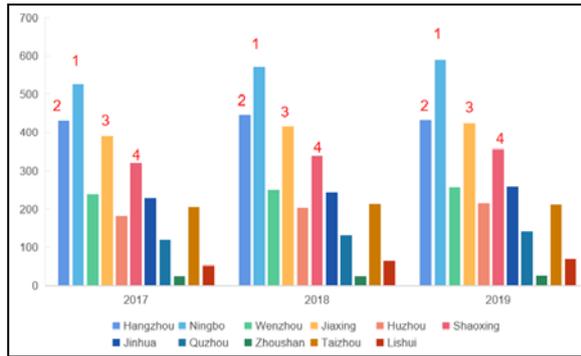


Figure 7. Comparative analysis of industrial electricity consumption in various cities in Zhejiang Province (unit: 100 million kWh).

The city has an area of 8,279 square kilometers. At the end of 2019, Shaoxing has a permanent population of 5.057 million and an urbanization rate of 68.4%. It is a small and medium-sized city as a whole. Judging from the electricity consumption of residents in various cities in Zhejiang Province in the past three years, it ranks 6th in the province after Hangzhou, Wenzhou, Ningbo, Taizhou, and Jinhua. Residents' electricity demand needs to be further tapped.

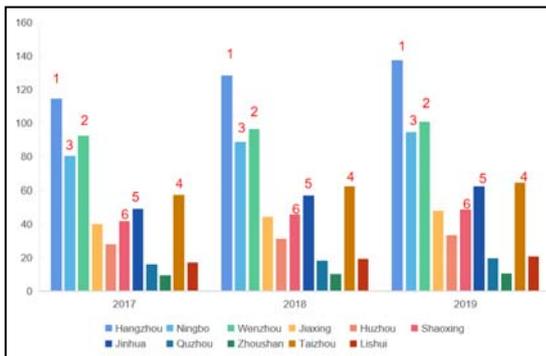


Figure 8. Comparative analysis of residential electricity consumption in various cities in Zhejiang Province (unit: 100 million kWh).

4 Comparative analysis of electricity consumption level and growth rate of Shaoxing

Compared with the electricity consumption and growth rate of the whole country and Zhejiang Province, the change trend is relatively similar. In addition to the 8.98% growth rate of electricity consumption in Zhejiang Province in 2016, which was significantly higher than the 2.25% in Shaoxing and 4.94% in the country, the growth rate of electricity consumption in Shaoxing over the years showed a high degree of synergy with the country and Zhejiang Province. Excluding 2016 Influenced by the annual electricity growth rate, the correlation coefficient between Shaoxing's electricity consumption growth rate and Zhejiang's electricity consumption growth rate is 0.958, and the correlation coefficient with the national electricity consumption growth rate is 0.897. The electricity growth trend is closer to that of Zhejiang Province.

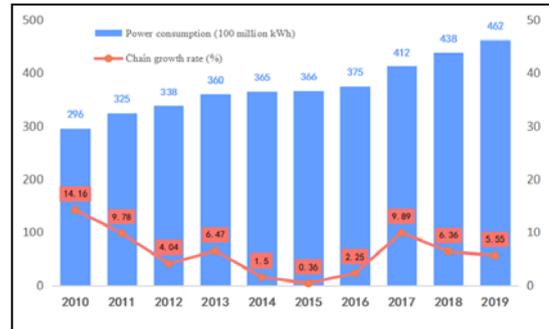


Figure 9. Electricity Consumption and Growth Rate of the Whole Society in Shaoxing

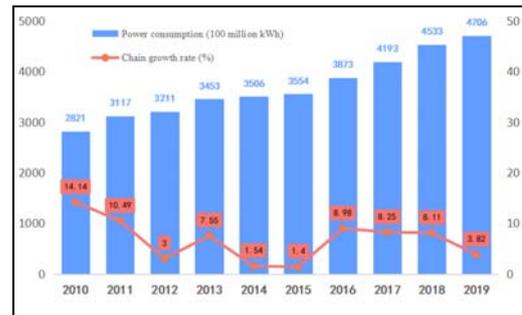


Figure 10. Electricity Consumption and Growth Rate in Zhejiang Province



Figure 11. National electricity consumption and growth rate

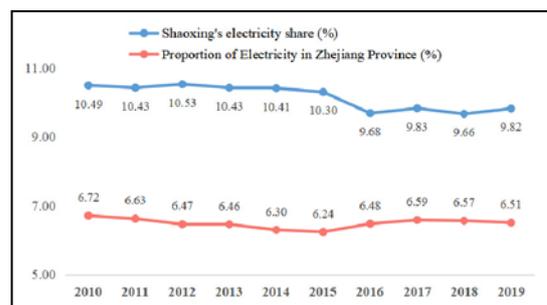


Figure 12. Proportion of electricity consumption in the whole society

Over the years, the proportion of electricity consumption in Shaoxing in Zhejiang Province has fluctuated around 10.0%, and the proportion of electricity consumption in Zhejiang Province in the national electricity consumption has fluctuated around 6.5%. Before 2016, the proportion of electricity consumption in Shaoxing and Zhejiang Province had fluctuated. The proportion of electricity consumption has shown a declining trend, but after 2016, the proportion of electricity consumption in Zhejiang Province has a

slight upward trend, while the proportion of electricity consumption in Shaoxing continues to drop below 10%, and the growth of electricity consumption in Shaoxing slightly lags behind The provincial average.

5 Comparative analysis of industrial electricity consumption structure

In terms of industrial structure, Shaoxing, under the correct leadership of the Zhejiang Provincial Party Committee and Government, has focused on cultivating industrial development, speeding up project construction, and forming two leading industries dominated by modern service industries and manufacturing. In terms of electricity consumption structure, Shaoxing's secondary industry accounts for the largest proportion of electricity consumption. Over the years, the proportion of secondary industry electricity consumption has exceeded 78%, which is about 7 percentage points higher than Zhejiang Province and about 9 percentage points higher than the national level. Industrial power consumption accounts for the smallest proportion, while tertiary industry power consumption and residential power consumption account for the middle.

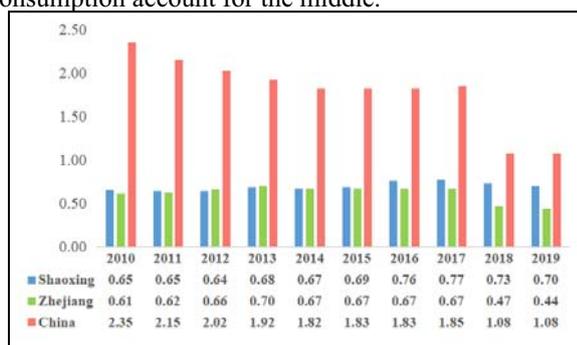


Figure 13. Proportion of electricity consumption in the first industry (%).

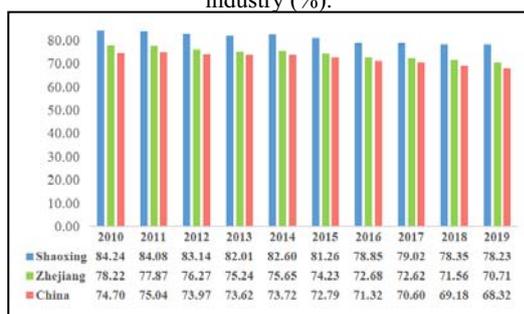


Figure 14. Proportion of electricity consumption in the second industry (%).

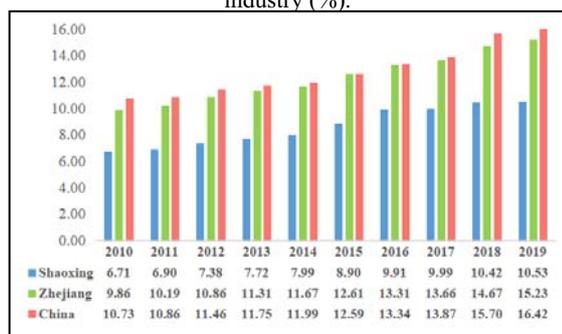


Figure 15. Proportion of electricity consumption in the third industry (%).

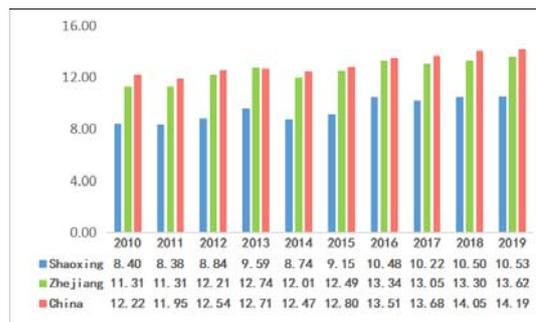


Figure 16. Proportion of the residents' electricity consumption (%).

Electricity consumption in agricultural production is mainly concentrated in water conservancy irrigation and primary processing of agricultural products. The characteristics of electricity consumption in agricultural production are relatively strong seasonality and relatively large fluctuations. From 2010 to 2019, the proportion of electricity consumed by the primary industry in Shaoxing increased from 0.65% to 0.70%, showing a slow increasing trend. The proportion of electricity consumed by the primary industry in Zhejiang Province decreased from 0.61% to 0.44%, first slowly After increasing and decreasing, the proportion of electricity consumption in the country's primary industry decreased from 2.35% to 1.08%, showing a decreasing trend. Although Shaoxing's agricultural electricity consumption accounts for a relatively low proportion of the total electricity consumption in the whole society, it accounts for a relatively high proportion compared with the change in the average electricity consumption of the primary industry in Zhejiang Province. The change trend is significantly different from that of the whole country and Zhejiang Province. As a large agricultural city, although this part of the demand accounts for a small proportion, it still deserves sufficient attention.

In recent years, through optimizing the environment and attracting investment, Shaoxing has successively introduced many large enterprises to settle in, which has greatly promoted the growth of regional electricity demand. Shaoxing, Zhejiang Province, and the country's secondary industry electricity consumption ratio decreased from 84.24%, 78.22%, 74.70% in 2010 to 78.23%, 70.71%, and 68.32% in 2019, all showing a decreasing trend. Shaoxing has the smallest decline, Zhejiang Province has the largest decline. The change trend of the electricity consumption of the secondary industry in Shaoxing is consistent with that of the whole country and Zhejiang Province, but the proportion of industrial electricity consumption is higher than the average level of the country and Zhejiang Province.

Shaoxing is a famous tourist city. The tourism industry will drive the development of catering, accommodation, commerce and other industries, and the electricity consumption of the tertiary industry will inevitably increase significantly. Shaoxing, Zhejiang Province, and the national tertiary industry accounted for electricity consumption increased from 6.71%, 9.86%, and 10.73% in 2010 to 10.53%, 15.23%, and 16.42% in 2019, all showing an increasing trend. Shaoxing has the

smallest increase and the country has the largest increase. The electricity consumption of the tertiary industry in Shaoxing has the same trend as the country and Zhejiang Province in terms of changes, but the proportion of electricity consumption is lower than the average level of the country and Zhejiang Province, indicating that Shaoxing's electricity demand for the tertiary industry still needs further exploration and improve.

The proportion of residential electricity consumption in Shaoxing, Zhejiang Province, and the whole country increased from 8.40%, 11.31%, and 12.22% in 2010 to 10.53%, 13.62%, and 14.19% in 2019, showing an increasing trend. Among them, Zhejiang Province has the largest increase and the country has the smallest increase. The change trend of residential electricity consumption in Shaoxing is consistent with that of the country and Zhejiang Province, but the proportion of electricity consumption is lower than the average level of the country and Zhejiang Province. It may be integrated with regional development, new district development, and business and living district construction. The resulting population migration is related.

6 Growth trends and characteristics of electricity consumption in major industrial sectors

Shaoxing's industrial electricity consumption accounts for more than 77% of the total electricity consumption of the whole society. We will further subdivide the electricity consumption structure of industrial industries, and study the electricity consumption characteristics of Shaoxing's main industries and Shaoxing Power Supply Company's support for electricity consumption in major industries.

Take the industrial power consumption structure of Shaoxing in 2018 as an example. Among them, the manufacturing industry accounts for 91.53%, the electric heating gas and water production and supply industries account for 8.06%, and the mining industry accounts for only 0.41%. The manufacturing industry consumes significantly more electricity than the other two industries, which is the main industry driving the growth of electricity consumption in Shaoxing.

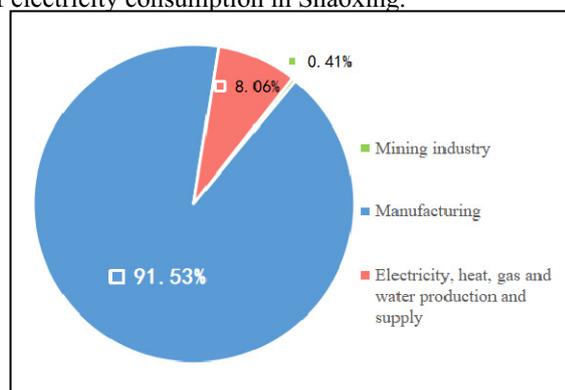


Figure 17. The industrial electricity consumption structure of Shaoxing in 2018.

In order to deepen the research on the electricity consumption characteristics of the pillar industries for

the growth of electricity consumption in Shaoxing, further subdivide the electricity consumption structure of the manufacturing industry. The manufacturing industry can be subdivided into 29 industries, with electricity consumption accounting for 44.604% of the textile industry, 8.364% of the chemical fiber manufacturing industry, and 7.602% of the chemical raw material and chemical products manufacturing industry, ranking the bottom three. The leading position is the instrument and meter manufacturing industry at 0.077%, the petroleum, coal and other fuel processing industry at 0.015%, and the tobacco product industry at 0.001%. It can be seen from the electricity consumption structure of the subdivided industries that the textile industry, chemical fiber manufacturing, chemical raw materials and chemical product manufacturing are the pillar industries of Shaoxing.

7 Conclusion

This article first analyzes the current situation and development trend of electricity consumption in Shaoxing. The electricity consumption of the whole society in Shaoxing is showing an increasing trend year by year. Its industrial electricity consumption accounts for more than 77% of the total electricity consumption of the society. The electricity consumption has also risen steadily. The electricity consumption of the whole society and industry in Keqiao District is much higher than that of other areas, and the electricity consumption of residents in Zhuji is the highest.

Through comparison with the average electricity consumption of the whole country, Zhejiang Province and various regions, it is found that in terms of the total electricity consumption of the whole society and industrial electricity consumption in the past three years, Shaoxing ranks behind Hangzhou, Ningbo, and Jiaxing. The province ranks fourth, and residents' electricity consumption ranks sixth in the province. Compared with the level and growth rate of electricity consumption in Shaoxing and the country and Zhejiang Province, the change trend is similar, but the growth of electricity consumption in Shaoxing is slightly behind the average level of the province.

In terms of electricity consumption structure, Shaoxing's secondary industry accounts for the largest proportion of electricity consumption. Over the years, the proportion of secondary industry electricity consumption has exceeded 78%, which is about 7 percentage points higher than that of Zhejiang Province and about 9 percentage points higher than that of the country. Industrial power consumption accounts for the smallest proportion, while tertiary industry power consumption and residential power consumption account for the middle. Among the industrial subdivisions of Shaoxing's electricity industry, the textile industry, chemical fiber manufacturing, and chemical The raw material and chemical product manufacturing industry accounts for the largest proportion and is the pillar power industry in Shaoxing.

In the "14th Five-Year" development stage, Shaoxing will focus on the development of "Ronghang Linking Ningbo with Shanghai", focusing on the integrated development of the Yangtze River Delta and the construction of the "Four Major" in Zhejiang Province, integrating into the regional integration process, and promoting concepts, systems, and rules. Standards and policies are in line with advanced cities, better accept the spillover effects of advanced cities, and accelerate the realization of the integration of Hangzhou and Shaoxing, Ningbo and Shaoxing, and fully integrate with Shanghai. The potential and space for power consumption growth is large.

References

1. J. Wang. Shaoxing: Serving high-quality economic development with environmental protection[J]. *Environmental Education*, **10**, 45-47, (2020)
2. W.W. Xu. Research on the high-quality development path of Shaoxing economy[J]. *Statistical Science and Practice*, **7**, 45-48, (2020).
3. W.Z.Wang. Research and application of optimization of power forecasting hybrid model algorithm for multi-source influencing factors[D]. Beijing University of Technology, (2019).
4. Y.B.Wang. Comprehensive forecasting method of monthly electricity consumption based on time series decomposition method and regression analysis method [D]. Shenyang Institute of Technology, (2019).
5. Y. Luo, Y. Zhang, J. R. Ren. Y.W.Zhu, Y.S.Yu, K.W. Li. Research on the Disparity of Residential Electricity Consumption in Various Regions of Zhejiang Province—A Thear Coefficient Perspective [A]. Zhejiang Electric Power Society 2018 Excellent Proceedings [C]. **6**, (2018).
6. L.F. Dong. Research on the market strategy of the electricity sales business of Shaoxing Power Supply Company under the background of electric power reform[D]. North China Electric Power University (Beijing), (2017).
7. Z. Zhang. Research on data-driven short- and medium-term power demand forecasting optimization learning method[D]. Hefei University of Technology, (2015).
8. H. Shao. Electricity must go first if the economy is to develop—the reform of the Shaoxing Electric Power Bureau in Zhejiang Province[J]. *Market Observation*, **11**, 36-37, (1997).