Investment Demand Analysis of Provincial Power Grid under the Background of Transmission and Distribution Price Reform[1]

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Abstract: The measurement of power grid investment is faced with many problems, such as many influencing factors, coupling among factors and complex and changeable social environment of power grid. At present, there is still a lack of comprehensive and practical systematic measurement methods. In the measurement and calculation of power grid investment demand, a single index and measurement method cannot cater to the changeable and different power grids. Therefore, it is necessary to "adapt measures to local conditions" and "vary from network to network", and study the quantitative calculation method of power grid investment demand under different classification, which fits the differentiated individual demand for investment of power grids.

Key words: Investment demand; Transmission-distribution price; Load rate

1. Introduction

As power grid planning and construction of the first, grid company should not only by raising funds through various channels, ensure the smooth progress of power grid investment, must also needs to make effective prediction for grid investment, so as to make overall arrangements, capital investment and use, to reduce the use of funds, improve the ability of resist investment risk, improve the operating and financial conditions.

Reference [1] designed the power grid economic index analysis system, the establishment of the system for investment benefit evaluation, power grid planning, investment management and other work have played an important role in support. Reference [2] presents a forecasting model of power grid investment demand based on cointegration theory and error correction model. Based on the long-run equilibrium model, a short-run adjustment model is constructed through the error correction model to improve the short-run prediction accuracy. Literature [3] from the investment, operation and equipment service life, the respect such as carbon micro analysis of the regional power grid investment influence on power grid enterprise, based on the demand side response is established on the basis of micro grid cost-benefit model, analyzed the micro power grid planning of equality and inequality constraints, and connecting

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with the actual, proves the validity and rationality of the model. In reference [4], according to the relationship between grid investment demand and grid development stage, the adaptive bell-shaped curve with environmental factors is first proposed to describe the grid investment demand. In reference [5], three economic evaluation methods of power grid investment are reviewed and compared. Reference [6] constructs the evaluation index and method of power grid input-output efficiency, and calculates the economic, environmental and social efficiency of power grid input-output respectively. References [7-8] put forward a real option investment decision model for evaluating urban power grid projects, which improved the technical and economic evaluation method of urban power grid planning projects. Based on the characteristics of power grid investment, the real option method was introduced, and the general steps of the real option method in power grid investment were given. Reference [9] proposes a coordinated approach to deal with microgrid investment and planning issues that increase PV potential. The results prove that such collaboration is beneficial for increasing the value of microgrid investments while improving the quality of service of the system, and should be considered in future regulatory frameworks. In reference [10] the relationship between grid investment demand and GDP, population size, social electricity consumption, installed capacity and company-based peak load was analyzed by taking the panel data of 23 provincial-level power grid investment in China from 2004 to 2016 as samples. Based on the analysis, China's grid investment in 2020 was predicted under different scenarios. Literature [11] studies the long-term impact of the proposed demand-side plan and its impact on the annual peak load forecast, which is important for strategic network planning, and proposes a set of specific demand-side measures aimed at reducing the annual peak load.

Overall, foreign demand for power grid investment research is advanced, studies of power industry and infrastructure investment is huge, the percentage is high, our country in the new electricity change after the method research of grid accurate investment is not much, mostly focused on investment evaluation, thus requiring accurate investment and investment demand for grid coordination optimization is studied

2. Provincial power grid investment demand measurement index system

According to the operation and development characteristics of provincial power grid, Nine characteristic indicators of provincial power grid investment demand are extracted, including per capita electricity consumption, per capita substation capacity of 220kV and above, weighted average length of UHV lines, load capacity ratio of 220kV, proportion of outgoing calls, proportion of 220kV smart substation, comprehensive line loss rate, unit grid investment increase load, and power supply reliability rate. The meaning and solution formula of each index in the provincial power grid investment demand measurement index system are as follows[12]:

2.1 The size of the dimension

Per capita electricity consumption (KWH): The average electricity consumption of the whole society for each person in a year. This index can reflect the level of economic development

and people's living standard of a region to a certain extent, which belongs to the economic index.

$$P_C = \frac{T_C}{R_P} \tag{1}$$

P_C refer to per capita household electricity consumption; Tc refer to Total annual electricity consumption in a certain area; R_p Resident population of the district. Per capita transformation capacity (kVA) :The provincial power grid mainly considers the transformer capacity of 220kV and above, which refers to the total transformer capacity of 220kV and above in a certain area to the average individual in a year. The comparison between the per capita transformation capacity and the per capita electricity consumption can reflect the reserve situation of the power grid capacity in this region to a certain extent.

$$P_{trans} = \frac{T_{trans}}{R_P} \tag{2}$$

P_{trans} refer to Per capita transformation capacity; T_{trans} refer to Total transformer capacity in a certain area; R_p refer to Total regional population. Weighted average length of UHV lines (km/line) :The weighted average length of transmission lines over 330kV and below 1000kV in a certain area. It can reflect the equipment level and technology level of the region, which belongs to the power grid index.

$$UHV = \frac{Trans_{330\,kv-1000\,kv}}{N_{line}} \tag{3}$$

2.2 Technological dimension

Capacity-load ratio: The ratio of the total substation capacity of 220kV to the maximum network load of 220kV in a certain area. It can reflect the power supply capacity and capacity of the power grid. It is an economic and technical index, which is crucial in the planning and design of the power grid[13].

$$C_{ratio} = \frac{C_{total}}{L_{net}} \tag{4}$$

Percentage of out-of-area calls (%): This indicator reflects the accumulated exchanged electricity between provincial power grid and other power grids during the statistical period (the input is positive, the output is negative, and the balance between supply and demand is 0.This indicator can be used to understand the region's electricity consumption and production.

$$\eta_{out} = \frac{E_{ex}}{E_{total}} \tag{5}$$

220kV smart substation proportion (%): The proportion of smart substations among all 220kV substations in a certain area. It represents the intelligence degree of the power grid in the

region, which can reflect the development level of the region to a certain extent.In general, the power quality will be improved in areas with a high proportion of smart substations[14].

$$\eta_{smart} = \frac{N_{smart}}{N_{total}} \quad (6)$$

η_{smart} refer to Total number of 220kV smart substations in the region; N_{total} refer to Total 220kV substations.

2.3 Quality effect dimension

Comprehensive line loss rate (%) :refers to the percentage of total electricity loss in a certain area in a certain period of time to the total electricity supply. Its size can reflect the management level and technical level of the power supply enterprises in the region, which belongs to the economic index[15].

$$R_{loss} = \frac{E_{loss}}{E_{total}} \quad (7)$$

Additional load per unit grid investment (kVA): the ratio of the difference between the maximum annual power supply load at the end of the investment period and the maximum annual power supply load at the beginning of the investment period and the power grid investment in the planning period in a certain region[5].It is an economic index and can reflect the economic benefits brought by power grid investment.

3 Analysis of economic development in Z province

3.1 Analysis by synthesis

According to the National Bureau of Statistics, The GDP of the Zprovince was 6,461.3 billion yuan, an increase of 3.6 percent over the previous year at comparable prices. By industry, the value added of the primary industry was 216.9 billion yuan, up 1.3 percent; The added value of the secondary industry was 2,641.3 billion yuan, up 3.1%; The added value of the tertiary industry was 3,603.1 billion yuan, up 4.1 percent. The value added structure of the three industries is 3.3:40.9:55.8. According to the system of unified calculation and data release of gross regional product, the calculation of gross regional product includes two steps: preliminary calculation and final verification. According to the final verification, the current GDP of Zprovince in 2019 was 6,246.2 billion yuan, an increase of 6.8% over the previous year calculated at comparable prices, and the value added structure of the three industries was 3.3∶42.1∶54.6. Figure 1 shows the GDP and growth rate of Zprovince from 2015 to 2020.

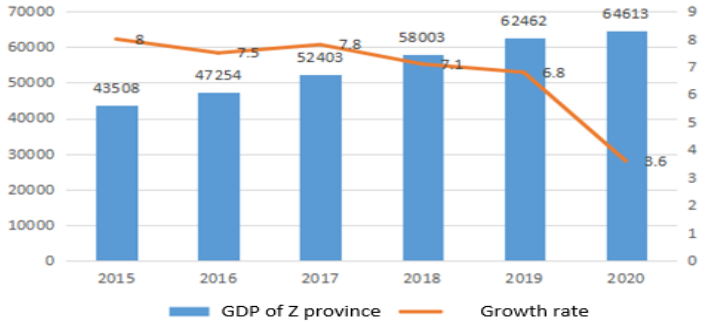

Figure 1 GDP and growth rate of Z province from 2015 to 2020

3.2 Industry and Construction

In 2020, the annual average capacity utilization rate of industrial enterprises above designated size in Z province was 79.1%, and it recovered to 82.7% in the fourth quarter, 1.4 percentage points higher than that of the previous year. Among industries above designated size, the added value of energy-intensive industries increased by 3.8 percent, accounting for 33.2 percent at comparable prices, or 0.6 percentage points lower. For industries above designated size, the cost per 100 yuan of operating revenue was 82.86 yuan, down 0.71 yuan over the previous year, and the debt-to-asset ratio was 54.6 percent, down 0.6 percentage points. The debt-asset ratio of the service sector above designated size was 55.6%. Investment in high-tech industries, ecological and environmental protection urban renewal, water conservancy facilities and transportation grew by 7.4 percent, 2.0 percent and 6.1 percent, respectively. Investment in industrial technical upgrading grew by 2.6 percent. The added value of the "three new" economies, mainly characterized by new industries, new forms of business and new models, accounted for 27.0% of GDP in the whole year. The added value of core industries of the digital economy reached 702 billion yuan, up 13.0 percent over the previous year at comparable prices. Among industries above designated size, the added value of digital economy core industries, health products, energy conservation and environmental protection, culture, high-end equipment and fashion manufacturing grew by 16.8 percent, 14.3 percent, 8.7 percent, 7.9 percent, 7.9 percent and 4.9 percent, respectively. The added value of high-tech, new and high technology, equipment manufacturing and strategic emerging industries increased by 15.6 percent, 9.7 percent, 10.8 percent and 10.2 percent, respectively. The artificial intelligence industry grew 16.6 percent. Among strategic emerging industries, the added value of new-generation information technology, new energy, biology and new materials industries increased by 21.0%, 14.8%, 11.5% and 5.2%, respectively. Detailed results are shown in Table 1.

Table 1 Added value and growth rate of sub-industries above designated size in Z province in 2020

Industry	Value added（one hundred million yuan）	Increase over the previous year（%）
Industrial added value above designated size	16715	5.4
High technology industry	2606	15.6

High and new technology industry	9961	9.7
Equipment manufacturing industry	7381	10.8
Strategic emerging industry	5525	10.2
Manufacturing is the core industry of the digital economy	2430	16.8
Energy saving and environmental protection manufacturing	2027	8.7
Health products manufacturing	839	14.3
Fashion Manufacturing Industry	1466	4.9
High-end equipment manufacturing	4231	7.9
Cultural manufacturing industry	771	7.9

The annual added value of industrial enterprises above designated size was 1,671.5 billion yuan, an increase of 5.4% over the previous year. Among them, the growth of state-owned and state-controlled enterprises was 3.8 percent, and that of private enterprises was 4.0 percent. The growth of foreign-invested enterprises was 5.7 percent, and that of Hong Kong, Macao and Taiwan businesses was 4.8 percent. Value added of the 17 traditional manufacturing sectors rose 2.3 percent[6].The output value of industrial sales above designated size was 7,333.6 billion yuan, up 1.8%, of which the value of export delivery was 1,212.8 billion yuan, up 0.5%.The output rate of new products in industries above designated size was 39.0 percent, 1.3 percentage points higher than the previous year. Among the 11 new products listed in the national "three new" statistics, the output of new energy vehicles (77.7%), carbon fiber and composite materials (58.7%), optical fiber (50.8%), industrial robots (43.6%), solar cells (39.3%), integrated circuits (21.2%) and other rapid growth.

3.3 The tertiary industry

In 2020, the growth rate of added value of the tertiary industry in Z Province was 0.5 percentage points higher than GDP, driving 2.1 percentage points of GDP growth, and the growth contribution rate reached 59.4%.The added value of real estate, wholesale and retail trade, transportation, storage and postal services grew by 5.1 percent, 2.0 percent and 0.6 percent, respectively, up by 6.3, 15.5 and 15.8 percentage points over the previous quarter; The value added of the lodging and catering industry fell by 9.1 percent, 21.0 percentage points narrower than the previous quarter. According to preliminary figures, the operating revenue of the service industry above designated size increased by 10.8%, 4.8 percentage points higher than that of the first half of the year. Among them, the revenue of information transmission, software and information technology services, and scientific research and technology services grew by 16.3 percent and 22.7 percent respectively, 5.5 and 11.9 percentage points faster than that of services above designated size. Since the second half of the year, the epidemic prevention and control situation in China has stabilized, and the fear of the epidemic has gradually subsided. The tourism industry has recovered to nearly 80% of that of the previous year, and the catering industry has recovered to 90%.In 2020, the number of tourists made 570 million trips, up 78.5 percent from the previous year, and the total tourism revenue reached 827.5 billion yuan, up 75.8 percent. Food and beverage income achieved positive growth from August to December, the cumulative decline gradually narrowed, from

the first quarter of -42.3% narrowed to the whole year of -8.4%. Table 2 shows the operating income of major industries of service enterprises above designated size in 2020.

Table 2 Operating Revenue of main industries of Service enterprises above designated size in Z Province in 2020

Industry	Operating revenue (100 million yuan)	Year-on-year increase (%)
Transportation, warehousing and postal services	4560	8.5
Information transmission, software and information technology services	10043	16.3
Real estate (except real estate development and management)	701	0.8
Leasing and business services	3264	3.3
Scientific research and technical services	1841	22.7
Water conservancy, environment and public facilities management	295	-11.4
Residential service, repair and other services	247	0.0
Education	90	0.2
Health and social work	265	0.3
Culture, sports and entertainment	329	-19.0

4 Analysis of electricity consumption and load characteristics in Z Province

4.1 Analysis of electricity consumption in Z Province

From 2015 to 2020, the electricity consumption of the whole society in Z Province continued to grow, among which the tertiary industry and the domestic electricity consumption of urban and rural residents grew rapidly. With the further upgrading of the industrial structure in Z Province, the electricity consumption of the whole society and the distribution of electricity consumption of various industries will have great changes.Figure 2 shows the electricity consumption and changes of the three industries in Z Province from 2015 to 2020.

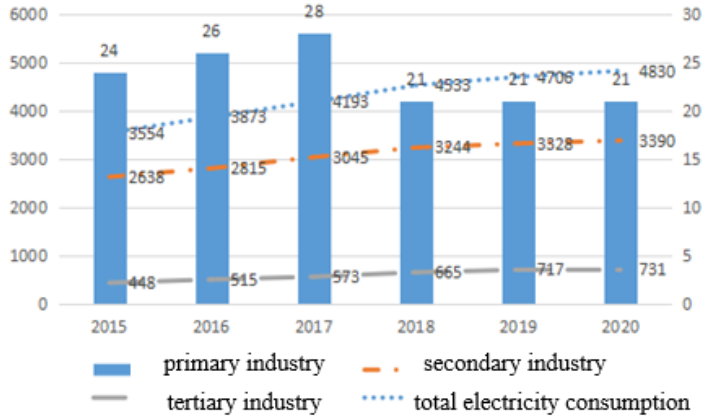

Figure 2 Electricity consumption of the three industries from 2015 to 2020

From 2015 to 2020, the electricity consumption of the whole society in Z Province increased year by year, and the growth rate was fast from 2015 to 2018, with an annual increase of 8%. Affected by the epidemic and other factors, the growth rate slowed down after 2019, and the electricity consumption of the whole society in 2020 increased by 2.63% compared with that in 2019.

First industrial electricity consumption accounted for more than the minimum in the third industry, nearly three years in a 2.1 billion kwh, the stability of the annual electricity consumption as well as the retrofit project of Z Province smoothly, greatly improves the quality of power supply, the provincial key village power supply reliability is 99.931%, average annual outage time of 6 hours, far above the national average of rural power grid.

The average annual electricity consumption of the secondary industry accounts for 70%-74% of the total social electricity consumption, and the proportion is decreasing year by year. From 2016 to 2020, the growth rate of the average annual electricity consumption of the secondary industry decreased year by year, and the growth rate in 2020 was only 1.86% higher than that in 2019.The main reason for the decrease in the growth rate of electricity consumption in the secondary industry is the decrease in the increase of electricity consumption in light and heavy industries due to the impact of the epidemic and import and export trade.

The average annual electricity consumption of the tertiary industry accounts for 12.6%-15.1% of the total social electricity consumption. The tertiary industry was the most affected by the pandemic, and its electricity consumption growth decreased significantly in the past two years, from 16.1 percent in 2018 to 1.95 percent in 2020.

4.2 Load characteristics analysis of Z Province

In order to ensure the reliability of power supply, the investment of power grid often needs to meet the needs of maximum load. By analyzing the load characteristics of Z Province, we can get the index of the maximum load growth rate and the change of the average annual load rate in Z Province, which can be used as the basis of the analysis of investment demand.

(1) Annual maximum load

Load values at 24 hours on the maximum load day of Z power grid from 2015 to 2021 were selected for analysis, as shown in Table 3.

Table 3 Maximum daily hourly load of Z Province from 2015 to 2021

Time	2015	2016	2017	2018	2019	2020	2021
0:00	4750.2	5605.9	6165.4	6102.72	5684.6	6155.0	6975.4
1:00	4513.8	5361.2	5900.5	5797.81	5445.0	5791.5	6630.4
2:00	4330.8	5121.4	5636.6	5560.92	5208.3	5498.1	6371.3
3:00	4178.6	4954.5	5423.9	5341.90	5028.4	5293.8	6181.1
4:00	4032.5	4770.5	5225.2	5192.78	4901.0	5107.2	6020.0
5:00	3950.6	4671.8	5102.8	5131.39	4803.2	5010.9	6006.8
6:00	4118.3	4732.7	5179.5	5245.83	4899.5	5123.7	6197.8
7:00	4588.9	5031.1	5478.2	5666.71	5309.6	5458.3	6704.0
8:00	5209.9	5779.9	6291.2	6647.86	6294.1	6297.0	7785.6
9:00	5894.9	6365.2	6935.6	7373.24	7140.2	6729.7	8568.2
10:00	6067.7	6721.0	7328.0	7787.80	7594.7	6988.6	8923.5
11:00	5941.9	6687.2	7242.2	7692.69	7546.7	6701.2	8709.2
12:00	5835.8	6553.5	7063.6	7478.30	7408.8	6204.9	8258.3
13:00	6146.1	6896.6	7435.1	7835.04	7733.5	6600.7	8761.9
14:00	6219.1	6921.1	7502.7	7806.99	7669.4	6650.7	8854.0
15:00	6131.6	6797.2	7387.4	7453.69	7531.6	6525.8	8794.0
16:00	6002.6	6586.5	7251.6	7102.56	7349.7	6439.2	8682.2
17:00	5613.1	6124.9	6858.3	6586.98	6816.6	6081.8	8225.2
18:00	5080.3	5577.3	6310.0	6044.68	6264.2	5644.1	7641.0
19:00	5020.0	5485.8	6196.5	6008.91	6203.4	5569.7	7537.8
20:00	5325.8	5795.5	6562.6	6179.15	6479.0	5589.4	7603.2
21:00	5449.8	5927.6	6768.2	6193.49	6526.2	5519.1	7502.3
22:00	5534.0	6009.8	6758.5	6194.35	6432.9	5645.8	7387.3
23:00	5408.4	5888.1	6532.1	5954.54	5919.1	5362.1	7099.8
Maximum grid load	6219.1	6921.1	7502.7	7835.0	7733.5	6988.6	8923.5

According to the data in the above table, the maximum load occurrence time in Z Province from 2015 to 2021 has moved from 14:00 in 2015 to 10:00 in 2021, which is mainly guided by the price policies such as peak-valley TOU price in Z Province, and some users have changed the electricity consumption time. From the perspective of the maximum load growth, except in 2019 and 2020 when the epidemic was more affected, the maximum load continued to increase, and the maximum load growth in 2021 was nearly 20 million kW higher than that in 2020. Load curve at 24 hours of maximum load day is shown in Figure 3.

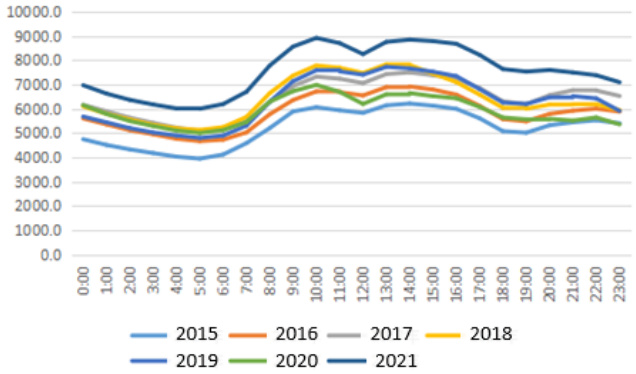

Figure 3 Daily load curve of maximum load from 2015 to 2021

From 2015 to 2021, the maximum load of the whole society increased year by year from 62.9 million kW to 98.8 million kW, with an average growth rate of 7.84% higher than the average growth rate of the whole society's electricity consumption of 6.35%.The maximum social load and its growth rate are shown in Figure 4.

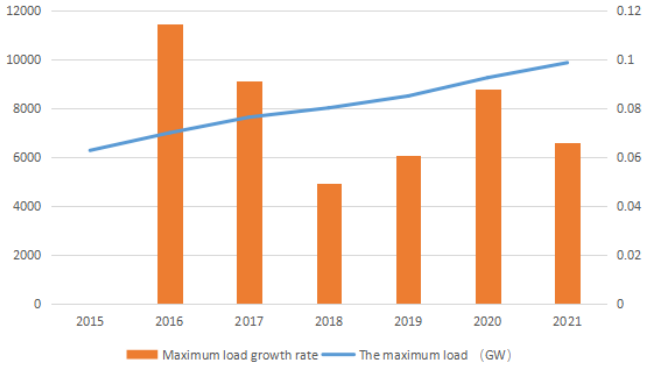

Figure 4 Daily load curve of maximum load from 2015 to 2021

(2) Load rate

Load rate refers to the percentage ratio of the average load to the maximum load during the statistical period (day, month, year).The load rate can reflect the stability of regional electricity consumption. The higher the load rate, the smaller the difference between the average power load and the maximum load, and the higher the utilization rate of power equipment. The change of load rate in Z Province from 2015 to 2021 is shown in the figure 5.

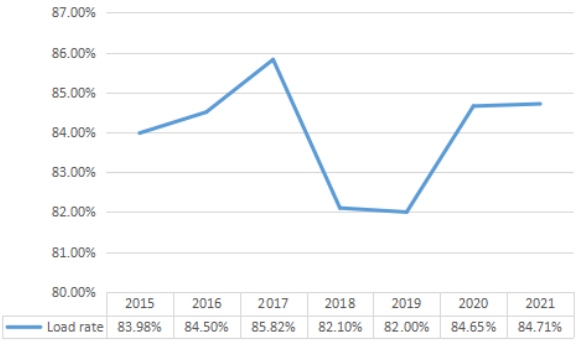

Figure 5 Load rate in Z Province, 2015-2021

The average load rate of Z Province in the past six years was 83.97%, which was lower than that in 2017 due to economic impact in the past two years. With the proposal of the national "double carbon" goal, a large number of new energy units connected to the grid require the power grid to increase the investment in intelligent transmission and distribution facilities, and the new investment is difficult to recover from the transmission and distribution price under the condition of the existing load rate.

4.3 Load characteristics analysis of Z Province by industry

The load data of a typical daily sub-industry in Z Province are selected to determine the main influencing factors of maximum load and the trend of load change in Z Province in the future, and the main investment direction and investment demand are judged according to the maximum load and the trend of load growth.

(1) Load characteristics of the primary industry

The primary industry's electricity consumption is mainly concentrated in agricultural electricity consumption. Z's primary industry's electricity consumption accounts for 0.6%-0.7% of the whole society's electricity consumption. From the perspective of Z's industrial structure, the province's GDP in 2021 is 7,351.6 billion yuan, the output value of the primary industry is 220.9 billion yuan, and the agricultural output value accounts for about 3%.Figure 6 shows the typical daily 24-hour load curve of Z primary industry.

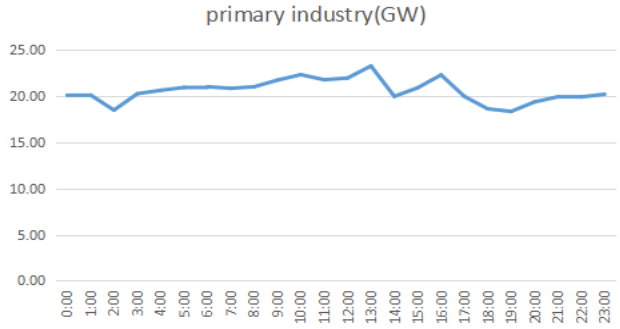

Figure 6 Typical daily load curve of the primary industry

From the perspective of 24 hours of a typical day of the primary industry in Z Province, the load at each time point is relatively stable, with an average load of 205,900 kW and a maximum peak-valley difference of 49,300 kW. With the completion of the rural power grid transformation project in Z Province, the investment in the electricity sales end of the primary industry is relatively stable.

(2) Load characteristics of the secondary industry

The economic added value of the secondary industry in Z Province in 2021 was 3,118.9 billion yuan, accounting for about 42.4% of the provincial GDP. According to the 24 hour load value of a typical day, the load at each hour of the secondary industry accounts for 62% - 79% of the provincial load.

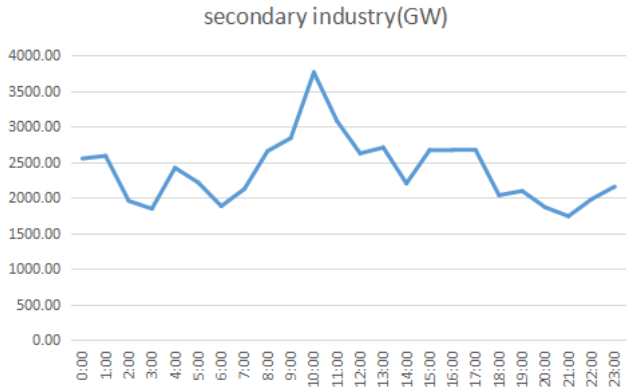

Figure 7 Typical daily load curve of the secondary industry

Figure 7 reflects the typical daily maximum load and minimum load of the secondary industry in Z Province are 37,624,400 kW and 17,418,300 kW, respectively. The load at each time point has great fluctuation, and the maximum peak-valley difference is 20.2061 million kW. The high load and volatility of the secondary industry put forward higher requirements on the stability of the power system. With the proposal of the "double carbon" target and the increase of the proportion of contracted electricity quantity, the investment of the power grid in intelligent transmission and distribution equipment will be further increased to ensure the reliability of power supply.

(3) Load characteristics of the tertiary industry

The economic added value of the tertiary industry in Z Province in 2021 was 4,011.8 billion yuan, accounting for about 54.6% of the provincial GDP. According to the 24 hour load value of a typical day, the load of the tertiary industry at each hour accounts for 20%-37% of the provincial load.

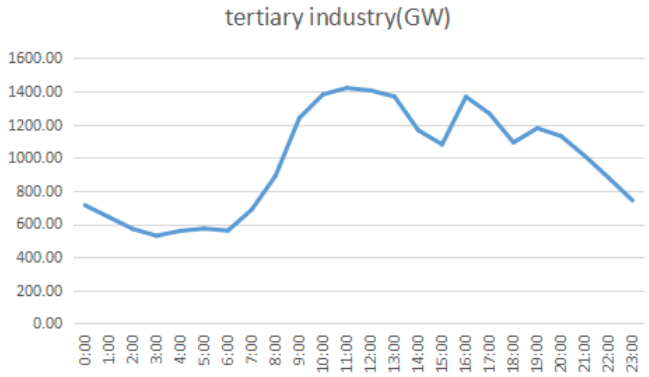

Figure 8 Typical daily load curve of the tertiary industry

Figure 8 reflects the typical daily maximum load of the tertiary industry in Z Province is 14.1953 million kW, and the minimum load is 52877 million kW. The load at each time point has great fluctuation, and the maximum peak-valley difference is 890.76 million kW. The characteristics of the tertiary industry, such as large load differences, obvious characteristics of load demand time points, and difficult load transfer, require the power grid to have strong peak regulating and peak power supply capacity.

5 Correlation analysis of electric power and economic development in Z Province

5.1 Correlation analysis between electricity and economy in Z Province

Electricity consumption is closely related to various indicators of regional economic development, and measuring the correlation between electricity consumption and economic indicators in Zhejiang Province is of great significance for the selection of Zhejiang power grid investment projects. Table 4 shows the values of relevant economic variables in Zhejiang Province.

Table 4 Economic index values of Zhejiang Province from 2007 to 2021

Year	Imports and exports (thousands of United States dollars)	Gross Industrial Output Value (100 million yuan)	Consumer price index	Retail Price Index	Production price index	GDP (100 million yuan)	Z Province tertiary industry added value (100 million yuan)	Z Province's secondary industry added value (100 million yuan)	Z Province's primary industry added value (100 million yuan)
2007	176,856,300.00	36073.93	104.20	103.80	102.40	2,189.40	8685.82	11514.16	1188.67
2008	211,109,300.00	40832.1	105.00	106.30	104.30	2,322.87	9691.01	12375.97	1243.41
2009	187,734,900.00	41035.29	98.50	98.80	94.90	2,471.44	10812.52	13302.28	1300.67

2010	253,500,000.00	51394.2	103.84	103.90	106.20	27,722.31	12063.82	14297.93	1360.56
2011	309,377,800.00	56406.06	105.38	105.51	105.00	32,318.85	14180.23	16555.58	1583.04
2012	312,402,800.00	59124.16	102.18	101.87	97.30	34,665.33	15681.13	17316.32	1667.88
2013	335,788,700.00	62980.29	102.30	100.98	98.16	37,756.58	17337.22	18446.65	1784.62
2014	355,147,449.00	67039.78	102.06	100.90	98.83	40,173.03	19221.51	19175.06	1777.18
2015	347,343,300.00	66,819.00	101.41	99.92	96.38	42,886.49	21341.91	19711.67	1832.91
2016	336,499,548.00	68,953.40	101.90	101.00	98.30	47,251.36	24091.57	21194.61	1965.18
2017	377,895,941.00	66,328.00	102.10	101.40	104.80	51,768.26	27602.26	22232.08	1933.92
2018	432,476,514.00	69,775.40	102.27	102.14	103.43	58,003.00	30724.3	23505.9	1967
2019	447,231,724.00	73,766.20	102.90	102.50	98.90	62,351.74	33688	26567	2097
2020	487,934,351.00	75,684.80	102.30	101.20	96.90	64,613.34	36031	26413	2169
2021	641,092,336.00	77,695.40	101.50	102.20	106.30	73,516.00	40118	31189	2209

The electricity consumption in Z Province and the above economic indicators were multivariate regression using Stata software to determine the impact of different economic indicators on electricity consumption, and the results were shown in Table 5.

Table 5 Regression results of electricity and economic indicators in Z Province

Model		Coefficients are not standardized		Standardization coefficients	t	Significance
		B	Standard error	Beta		
	(Constant)	3589.472	21.597		166.204	.000
	Z:Imports and exports (thousands of United States dollars)	-57.260	138.628	-.062	-.413	.690
	Z:Gross Industrial Output Value (100 million yuan)	-72.109	208.243	-.078	-.346	.738
	Z：GDP (100 million yuan)	397.367	160.952	.428	2.469	.039
	Z Province tertiary industry added value (100 million yuan)	569.991	186.475	.613	3.057	.016
	Z Province's secondary industry added value (100 million yuan)	-74.513	303.839	-.080	-.245	.812
	Z Province's primary industry added value (100 million yuan)	174.591	217.603	.188	.802	.446

Since the GDP of Z Province has a certain correlation with the added value of the tertiary industry, some indicators are significantly lower, but GDP and electricity are significantly correlated, indicating that there is a quantitative relationship between electricity consumption and regional GDP in Z Province, and its standardization coefficient is 0.428.The added value of the tertiary industry has a higher coefficient of influence on electricity than GDP, and with the increase in the output value of the service industry in Z Province, the demand for electricity will increase to a certain extent, while the load of the tertiary industry has obvious

daytime and seasonal characteristics, and the power grid will increase the investment in electricity transmission capacity and the investment in the smooth operation of the power grid to balance the load.

5.2 Load and economic correlation analysis in Z Province

Compared with electricity consumption, the load characteristics have a greater impact on the safe operation of the power grid. In order to ensure the reliability and safety of electricity consumption, the power grid investment often has to meet the electricity demand at the time of the maximum load, and the investment in power transmission and distribution equipment will be higher than the electricity demand. Table 6 shows the regression results of load and economic indicators in Z Province.

Table 6 Regression results of load and economic indicators in Z Province

Model		Coefficients are not standardized		Standardization coefficients	t	Significance
		B	Standard error	Beta		
1	(Constant)	3720.479	1385.657		2.685	.044
	Z:Imports and exports (thousands of United States dollars)	-830.793	863.328	-.561	-.962	.380
	Z:Gross Industrial Output Value (100 million yuan)	-549.803	1312.878	-.261	-.419	.693
	Z：GDP (100 million yuan)	13459.769	7309.464	6.802	1.841	.125
	Z Province tertiary industry added value (100 million yuan)	-7103.524	4050.503	-5.141	-1.754	.140
	Z Province's secondary industry added value (100 million yuan)	-100.009	2015.489	-.068	-.050	.962
	Z Province's primary industry added value (100 million yuan)	211.397	1284.192	.124	.165	.876

In the relevant indicators affecting the load, the results of GDP and the added value of the tertiary industry are remarkable, from the perspective of the standardization coefficient, the GDP impact coefficient on the load is 6.802, and the added value of the tertiary industry is negatively correlated, and the standardization coefficient is -5.141. GDP has a much higher impact on the load than electricity, and on the other hand, part of the investment of the grid to meet the load demand will not be able to recover from the electricity.The negative correlation between the added value of the tertiary industry and the load shows that the increase in load unstable users has a negative impact on the overall load balance, and the power grid needs to increase investment for such users.

6 Conclusions

Based on the analysis of electricity growth and load characteristics in Z Province, this paper makes an empirical analysis of electricity consumption and maximum load and the main economic evaluation indicators of Z province. The results show that electricity consumption and maximum load demand have a significant positive correlation with economic growth, and the influence coefficient of economic change on maximum load is higher than that of electricity. It is difficult to ensure the safety and stability of the power supply at the point of maximum load when the investment demand of power grid enterprises is only based on the increase of electricity quantity. According to the historical power and load data for the next five years in Z province was related index prediction, on the basis of get expected capacity investment demand in Z province, the result shows that under the condition of the exclusion of systemic factors, Z power grid capacity investment demand is expected to increase year by year, annual new capacity of 20.9285 million kilowatts, an annual capacity of investment of 5.651 billion yuan.

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