Research on China's Electricity Demand in 2017 and 2018

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Abstract. Based on the bottom-up modeling approach, this paper establishes a electricity demand forecasting model covering primary industry, secondary industry, tertiary industry, residential consumption and key sub-industries by using the method of sectoral analysis. The forecasting model can provide a scientific measure for determining the trend of China's electricity demand in 2017 and 2018. The forecast results show that China's economy will grow steadily in 2017, GDP growth rate is estimated to be about 6.8%, and total electricity demand is estimated to be 6354 TWh with a growth rate of 6.3%. The contribution rates of three industries and residential electricity demand will be 2.3%, 55.7%, 22.7% and 19.3%. In 2018, China's economy will remain stable with an estimated GDP growth rate of 6.7%, total electricity demand will be 6674 TWh with a growth rate of 5.0%. The contribution rates of the three industries and residential electricity demand will be 2.6%, 57.6%, 22.8% and 17.0% respectively.

1. Introduction

In 2017, benefited from the supply-side structural reform and the steady recovery of global economy, China's economy in the first three quarters has maintained a steady and sound growth. China's total electricity demand growth rate was 6.9%, reaching a new high speed in the same period of the past 4 years. And what is the growth rate of China's electricity demand in 2017 and 2018? This is a hot issue of wide concern of the society.

Based on the bottom-up modeling approach, the paper establishes a forecasting model of China's electricity demand by using the sectoral analysis method. According to the characteristics of China's electricity consumption in the first three quarters of 2017, the paper considers the development of macro-economy, key industries and the trend of temperature, and utilizes the model to predict China's electricity demand in 2017 and 2018.

2. Research on the forecasting model of China's electricity demand

The main methods of electricity demand forecasting are trend extrapolation, regression analysis [1], gray prediction [2], neural network prediction [3], [4], combined forecasting [5], [6] , [7]. Each of these methods has advantage and disadvantage. However, the common weakness is that the relations between industry development and electricity demand are not well established and the forecast results are not well explained.

This paper will utilize the sectoral analysis method to establish a forecasting model of China's electricity demand, and forecast the electricity demand of the primary industry, secondary industry, tertiary industry and residents, and then get the total electricity demand of the whole country. Among them, the electricity demands of the primary industry and the tertiary industry are mainly based on the

unit consumption of output model [8] to predict. Residential electricity demand is mainly based on the trend extrapolation model to predict. The electricity demand of the secondary industry is greatly affected by the development of energy intensive industries. Therefore, the forecast for electricity demand of the secondary industry is mainly based on the prediction of the electricity demands of energy intensive industries such as ferrous metals industry, nonferrous metals industry, building materials industry and chemical industry. The electricity demands of the four energy intensive industries are mainly based on the unit consumption of output model to predict. Except the electricity demand of energy intensive industries, the demands of non-energy intensive industries in the secondary industry are mainly based on the unit consumption of output model to predict. China's electricity demand forecast method is shown as Figure 1.
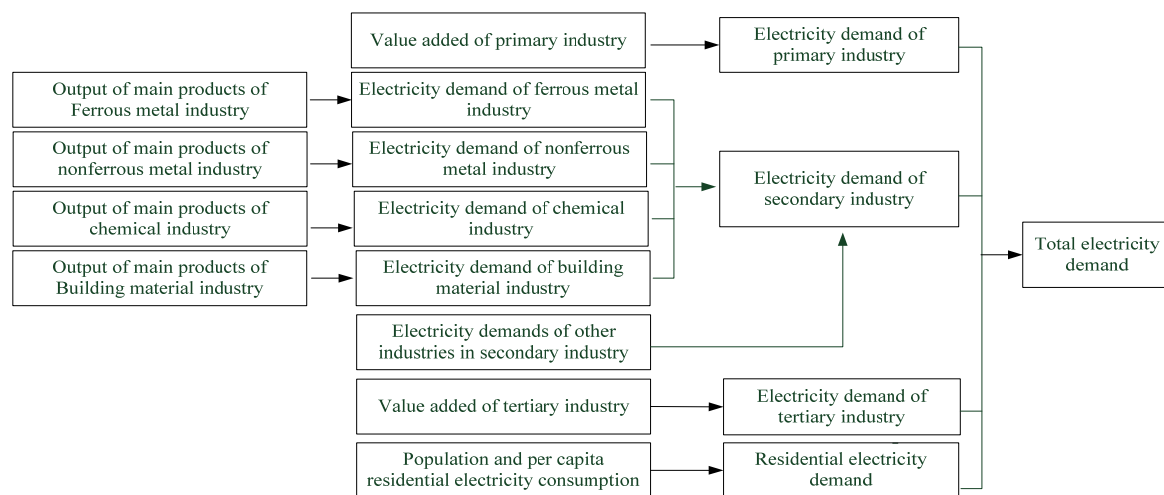

Figure 1. China's electricity demand forecast method.

3. Analysis for the electricity consumption in the first three quarters of 2017

The total electricity consumption continued to grow rapidly, from January to September, the total electricity consumption was 4688.8 TWh, with a growth rate of 6.9%, and the growth rate was 2.4 percentage points higher than that in the same period of the previous year. The growth rate hit a new high since the same period of 2014. In terms of quarters, the growth rates in the first, second and third quarters of 2017 were 6.9%, 5.8% and 7.8% respectively. In the first and second quarters, the growth rates were respectively increased by 3.7 and 3.7 percentage points as compared with that in the same period of previous year. The growth rate in the third quarter was roughly the same as that in the same period of previous year.

The growth rate of electricity consumption of the secondary industry significantly increased. From January to September, the electricity consumption of the secondary industry increased by 6.0%, the growth rate was 4.1 percentages points higher than that in the same period of previous year and the contribution rate reached 61.0%, which was the main driving force for the growth of total electricity consumption. In terms of quarters, electricity consumption growth rates in the first three quarters were 7.6%, 4.8% and 5.8% respectively, increasing by 7.4, 4.0 and 1.2 percentage points respectively over the same period of previous year.

The electricity consumption of the tertiary industry maintained a rapid growth with a slight decrease in growth rate as compared with that in the same period of previous year. From January to September, the electricity consumption of the tertiary industry increased by 10.5%, the growth rate was 1.0 percentage point slower than that in the same period of previous year. In terms of quarters, electricity consumption grew by 7.8%, 11.0% and 12.5% respectively in three quarters. In the first and third quarters, the growth rates decreased by 3.2 and 2.8 percentage points as compared with that in the same period of previous year respectively, and the growth rate in the second quarter increased by 3.6 percentage points as compared with that in the same period of previous year. Influenced by temperature, the drop in electricity consumption growth rate in the first quarter was mainly due to the

warm winter in 2017, the drop in the electricity consumption growth rate in the third quarter was mainly due to the hot summer in 2016, which led to a higher contrast base.

Residential electricity consumption growth was slower than expected, the growth rate decreased significantly over the same period of previous year. From January to September, residential electricity consumption increased by 7.5%, the growth rate was 4.0 percentage points slower than that in the same period of previous year. In terms of quarter, electricity consumption growth rates in the three quarters were 2.8%, 6.6% and 12.3% respectively. The growth rates in the first and third quarters decreased by 8.0 and 6.0 percentage points over the same periods of previous year respectively, and the growth rate in the second quarter increased by 2.6 percentage points over the same period of previous year. Similar to the tertiary industry, the residential electricity consumption growth was mainly affected by temperature.

The electricity consumption of the four energy intensive industries all showed positive growth. The growth of ferrous metals and nonferrous metals industries rebounded sharply, reflecting the obvious recovery of production in the traditional industries. From January to September, the total electricity consumption of the four energy intensive industries was 1342.6 TWh, with a growth rate of 4.6% over the same period of previous year, and the growth rate was 6.5 percentage points higher than that in the same period of previous year, accounting for 28.6% of the total electricity consumption. In terms of three quarters, electricity consumption of the four energy intensive industries increased by 9.4%, 3.6% and 2.4% respectively, with the growth rates increasing by 15.2, 4.7 and 1.6 percentage points over the same period of previous year respectively.

The rapid growth of electricity consumption of the high-end manufacturing and producer services showed that the supporting role of the new economic momentum had been strengthened. From January to September, the electricity consumption of the transportation, electrical, electronic equipment manufacturing industry increased by 10.3%, the electricity consumption of the transportation services increased by 14.2% (among which, the growth rates of urban public transport and electrified railway electricity consumption were 25.9% and 14.5% respectively), the electricity consumption of computer services and software industry increased by 30.3%.

4. Forecasting of Electricity Demand in 2017 and 2018

4.1. The Main Assumption
GDP: The GDP growth rate in the first three quarters of 2017 was 6.9%, in the fourth quarter, GDP growth rate is expected to be 6.7%, the annual GDP growth rate will be 6.8%. The global economy is recovering steadily; China's economic growth will remain stable in 2018. China's GDP growth rate will be about 6.7% in 2018, and the growth rates of value added of primary industry, secondary industry and tertiary industry will be 3.7%, 6.1% and 7.8% respectively.
The development of ferrous metal industry: The steel is expected to be in the demand platform period in the nearly two years. As the base continues increasing, the absolute amount will be still huge. It is estimated that the crude steel output in China will increase by 4.8% and 0.3% respectively in 2017 and 2018.

The development of non-ferrous metal industry: It is estimated that the growth of electrolytic aluminum production will still be positive but the growth rate will continue to narrow, which will be 4.5% and 3.9% respectively in 2017 and 2018.

The development of chemical industry: It is estimated that the output of caustic soda will increase by 4.5%, 4.0% respectively, the output of calcium carbide will increase by 4.1%, 3.5% respectively, the growth rate of chemical fertilizers will be -6.3% 3.0% in 2017 and 2018.

The development of building materials industry: With the structural reform of the supply-side and the development of emerging building materials in recent years, the output growth of cement is expected to decrease by 0.8% and 1.0% respectively in 2017 and 2018.

The temperature: The summer was very hot and the cooling load had been fully released in 2016 and 2017. It is estimated that the summer temperature are unlikely to continue high and the cooling load growth will slow down significantly in 2018.

4.2. Forecasting of Electricity Demand in 2017

In the fourth quarter, the growth rate of electricity demand will decrease slightly compared with the third quarter, which will be influenced by the winter pollution control in Beijing, Tianjin and Hebei province, environmental supervision and the gradual increase in the electricity demand base. The total electricity demand in the fourth quarter is expected to increase by 4.8%. It is estimated that the total electricity demand will be 6354 TWh in 2017, with a growth rate of 6.3%, and the growth rate will increase by 1.4 percentage points over that in 2016. The electricity demand of the primary industry will increase by 8.6%, and the growth rate will be 3.6 percentage points higher than that in 2016. The electricity demand of the secondary industry will increase by 5.3%, the growth rate will be 2.4 percentage points higher than that in 2016. The electricity demand of the tertiary industry will increase by 10.2%, and the growth rate will be 1.0 percentage point slower than that in 2016. The residential electricity demand will increase by 7.3%, and the growth rate will be 3.5 percentage points slower than that in 2016. The contribution rates of the three industries and residential electricity demand will be 2.3%, 55.7%, 22.7% and 19.3% respectively. The forecast results are shown as table 1.

In terms of sub-industries, it is estimated that the electricity demand of the four energy intensive industries will be 1859.4 TWh in 2017, with an increase by 3.9%. The growth rate of chemical industry electricity demand will be 4.0%, the growth rate of building materials industry electricity demand will be 3.2%, the growth rate of ferrous metals industry electricity demand will be 1.0%, and the growth rate of non-ferrous metal industry electricity demand will be 6.9%.

Table 1. The forecast results of electricity demand in 2017 and 2018.

Sector	2017		2018	
	Demand (TWh)	Growth rate (%)	Demand (TWh)	Growth rate (%)
Total	6354.0	6.3	6673.8	5.0
The primary industry	118.6	8.6	126.9	7.0
The secondary industry	4490.9	5.4	4675.1	4.1
Energy intensive industry	1859.3	3.9	1899.3	2.1
Chemical industry	454.1	4.0	466.1	2.6
Building materials industry	329.1	3.2	331.2	0.6
Ferrous metal industry	493.0	1.0	495.5	0.5
Non-ferrous metals industry	583.1	6.9	606.5	4.0
Non energy intensive industry	2631.6	6.4	2775.8	5.5
The tertiary Industry	878.4	10.2	951.2	8.3
Residential electricity	866.1	7.3	920.6	6.3

4.3. Forecasting of Electricity Demand in 2018

Considering economic and temperature factors, the growth rate of electricity demand in 2018 will be slower than that in 2017 and it is estimated that the total electricity demand of the whole country will increase by 5.0% to 6673.8 TWh. The growth rate of electricity demand in the primary industry will be about 7.0%, decreasing slightly as compared with 2017. The electricity demand of the secondary industry will be affected by the weaker price-driven effect on the supply side. In addition, the higher contrast base in 2017 will lead to a slowdown in growth rate. The growth rate of electricity demand of the secondary industry will be about 4.1%. Because of the high temperature in 2016 and 2017, the air conditioning load had been fully released, the growth rate of the tertiary industry and residential electricity demand will decline, which are expected to be about 8.3% and 6.3% respectively. The contribution rates of the three industries and residential electricity demand will be 2.6%, 57.6%, 22.8% and 17.0% respectively. The forecast results are shown as table 1.

In terms of sub-industries, it is estimated that the electricity demand of the four energy intensive industries will reach 1899.3 TWh in 2018 with a decrease by 1.8 percentage points compared with that in 2017. The growth rate of chemical industry electricity demand will be 2.6%, the growth rate of building materials industry electricity demand will be 0.6%, the growth rate of ferrous metals industry

electricity demand will be 0.5%, and the growth rate of non-ferrous metal industry electricity demand will be 4.0%.

5. Conclusion

China is in a crucial period of supply-side structural reform, the trend of electricity demand is volatile and the difficulty of accurate forecasting is increasing significantly. In the paper, the sectoral analysis method is utilized to establish China's electricity demand forecasting model covering primary industry, secondary industry, tertiary industry, residential consumption and key sub-industries, which will provide a scientific measure for the research on the trend of the electricity demand in 2017 and 2018.

In 2017, China's GDP growth rate is forecasted to be 6.8%, with an increase of 0.1 percentage point compared with that in 2016; the total electricity demand is forecasted to be 6354 TWh, growing by 6.3%, with an increase of 1.4 percentage points compared with that in 2016. The contribution rates of the three industries and residential electricity demand will be 2.3%, 55.7%, 22.7% and 19.3% respectively

In 2018, global economy will continue to recover and the domestic supply-side structural reform will continue. The tertiary industry will grow rapidly and support the stable development of the economy. The GDP growth is expected to be 6.7%. Considering the factors such as a slight slowdown in the economic growth and the higher temperature in the previous years, the growth rate of total electricity demand will be slower in 2018. The total electricity demand will increase by 5.0% to 6673.8 TWh. The contribution rates of the three industries and residential electricity demand will be 2.6%, 57.6%, 22.8% and 17.0% respectively.

Acknowledgments

References

[1]   Mao Lifan, Jiang Yuechun, Yao Jiangang, et al. Medium and long term load forecasting based on orthogonal signal correction and partial least-squares regression. Proceedings of the CSEE, 2009, 29(16), pp. 82-88.

[2]   WANG Dapeng, WANG Bingwen. Medium- and Long-Term Load Forecasting Based on Variable Weights Buffer Grey Model. Power System Technology, 2013, 37(01), pp. 167-171.

[3]   ZHANG Jianmei, ZHOU Buxiang, LIN Nan, et al. Prediction of Mid-long Term Load Based on Gray Elman Neural Networks. Proceedings of the CSU-EPSA, 2013, 25(04), pp. 145-149.

[4]   LI Chunxiang, NIU Dongxiao, MENG Limin. A Comprehensive Model for Long- and Medium-Term Load Forecasting Based on Analytic Hierarchy Process and Radial Basis Function Neural Network . Power System Technology, 2009, 33(02), pp. 99-104.

[5]   ZHOU Quan, REN Haijun, LI Jian, et al. Variable Weight Combination Method for Mid-long Term Power Load Forecasting Based on Hierarchical Structure. Proceedings of the CSEE, 2010, 30(16), pp. 47-52.

[6]   MAO Li-fan, YAO Jian-gang, JIN Yong-shun, et al. Theoretical Study of Combination Model for Medium and Long Term Load Forecasting. Proceedings of the CSEE, 2010, 30(16), pp.47-52.

[7]   TAN Zhongfu, ZHANG Jinliang, WU Liangqi, et al. A Model Integrating Econometric Approach With System Dynamics for Long-Term Load Forecasting. Power System Technology, 2011, 35(01), pp. 186-190.

[8]   TAN Xiandong, HAN Xinyang, FENG Yi, et al. China's Power Supply and Demand Review in 2014 and Prediction in 2015. Electric Power, 2015, 48(4), pp.1-5.