Analysis on the Characteristics of China's Power Consumption Growth in the Past 40 Years After Reform and Opening Up

Shan-shan WU¹,* and Qi WANG²

¹State Grid Energy Research Institute, Beijing, China
²North China Electric Power University, Baoding, China

*Corresponding author

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Abstract. Over the past 40 years of reform and opening up, China's economic and social development has achieved world-renowned achievements, and its economic aggregate has leapt to the second place in the world. Power consumption has grown rapidly, and the total power consumption has jumped to the top in the world, which has beneficially supported the rapid development of the economy and society. Reviewing the growth trajectory of power consumption in the past 40 years after reform and opening up is of great significance for grasping the characteristics of China's power consumption growth and scientifically judging the future growth trend of power demand.

Total Electricity Consumption in Society

The scale of power consumption has gone through a glorious growth stage from small to large. In 1978, the national grid coverage rate was less than half and the total electricity consumption in the whole society was only 249.8 billion kWh. With the quick development of the economy and the obvious improvement of people's living standards, China's power consumption scale has continuously hit a new high. After a long 18 years, China's total electricity consumption finally broke through 1 trillion kWh in 1996. Then power consumption entered a period of rapid growth, and the total electricity consumption of the whole society increased from 1 trillion kWh to 2 trillion kWh by only taking 8 years. In the following nine years, every three years went up one step, achieving breakthroughs of 3 trillion, 4 trillion, and 5 trillion kWh in 2007, 2010, and 2013 respectively. In 2010, China's total electricity consumption ranked first in the world. With the arrival of the “new normal” stage of the economy, the pace of electricity consumption growth in China has slowed slightly. But it has broken through 6 trillion kWh in just 4 years and reached 6.4 trillion kWh in 2017, an increase of more than 24 times compared with the initial period of reform and opening up and more than the entire consumed-electricity of America or Europe [1].

The annual increase in power consumption has achieved a “century leap” from tens of billions to hundreds of billions. Before 2000, the average annual growth was only about 45 billion kWh. After 2000, with China's accession to the World Trade Organization, the troika coordinated efforts to promote China's economy to enter a period of rapid growth. The average annual growth of electricity consumption in the whole society is close to 300 billion kWh, which is more than the total electricity consumption in 1978 and equivalent to an additional “UK” electricity consumption per year.

Electricity consumption has always maintained a growth trend, and the growth rate has generally shown an inverted V-shaped trend. From 1978 to 2000, the average annual growth rate of electricity consumption in China was 7.9%. In 1998, affected by the Asian financial crisis, China’s economic growth slowed down, and the growth rate of electricity consumption reached a low level of 2.8% since the reform and opening up [2]. Then the economy recovered quickly and broke double digits in 2000, reaching 11.4%. From 2000 to 2008, driven by the rapid growth of investment and exports, the average annual growth rate of electricity consumption was 12.5% with the highest point of growth of 15.5% in 2004. Subsequently, influenced by the global financial crisis and the transformation of
economic development mode and adjustment of industrial structure, the growth rate of electricity consumption experienced a shift period. From 2008 to 2017, the average annual growth rate of electricity consumption in China was 7.0%.

Figure 1. China’s total electricity consumption has been on the rise since 1978.

Power Consumption Structure

The power consumption structure is continuously optimized and presents significant phase characteristics. In 1986, China's three industries and residents' electricity consumption structure was 5.6:82.2:6.9:5.2. In the 1990s, the proportion of electricity consumption in the secondary industry declined. With the improvement of living standards and consumption levels, the tertiary industry and residents' electricity consumption grew sharply, and the corresponding ratio gradually increased [3]. The proportion of electricity used in the primary industry declined steadily. In 2000, China's electricity structure evolved to 4.0:72.7:10.9:12.4. After entering the new century, the heavy industrialization of China's economic development have become increasingly prominent. The secondary industry's electricity consumption has grown rapidly with the rising ratio of electricity consumption. The proportion of the primary industry has declined rapidly, and the corresponding part of tertiary industry and residential electricity consumption has changed slightly. By 2007, China's electricity consumption structure was 2.7:76.5:9.8:11.1, and the ratio of electricity used in the secondary industry reached a stage high. After 2008, with the continuous advancement of industrial structure and technological progress, the ratio of electricity used in the secondary industry continued to decline, and the proportion of the tertiary industry and residents' daily electricity consumption continued to increase.

The proportion of industrial electricity has shown an S-shaped trend with the industrialization process in China. From 1978 to 2000, China was in the early stage of industrialization. Light industry, food, textile and other industries had an absolutely advantage, and manual labor and labor-intensive industries dominated. At the same time, the service industry has just started with a high electricity consumption growth rate, leading to a rapid improvement in people's living standards and a significant increase in the ratio of household electricity consumption. The ratio of electricity used in the industrial secondary industry continued to decline, but it was still higher than 71%. From 2001 to 2008, China was in the middle stage of industrialization. Light industry has been replaced by heavy industry that become the main driving force for industrial growth [4]. The rapid growth of steel, aluminum, cement, chemical and other industries has led to rapid growth in industrial electricity consumption, resulting in a rebound in the ratio of industrial electricity. However, as the service industry and residential electricity consumption still maintain quick growth, the proportion of industrial electricity consumption has been limited, about 75%. Since 2009, China has entered the late stage of industrialization. The mode of relying on high investment and heavy chemical industry is unsustainable. Some industrial industries have a significant excess capacity, and industrial economic...
growth has entered a downward cycle. The ratio of electricity consumption has shown a rapid decline, reaching a minimum of 69% in 40 years.

The proportion of electricity used by the tertiary industry and residents’ lives has shown an N-shape trend, and residents’ electricity consumption is more resilient. From 1978 to 2000, the proportion of electricity consumption in the tertiary industry continued to rise sharply, basically increasing by 1 percentage point every 3 to 4 years, and reaching 11% by 2000. From 2001 to 2008, affected by the substitution effect of the quick development of heavy industry, the proportion of electricity consumption in the tertiary industry did not rise and fell into the “bottleneck period”. After 2009, the tertiary industry's electricity consumption once again ushered in a rapid development period, increasing by 1 percentage point every three years. By 2017, the ratio of electricity consumption reached a historical high of 14%. The proportion of household electricity consumption is similar to that of the tertiary industry, but its characteristics are more prominent. During the period from 1978 to 2000, the proportion of household electricity consumption increased faster than that of the tertiary industry; from 2001 to 2008, the residential electricity consumption showed a “more resilient” aspect, and the proportion of decline in power was smaller than that of the tertiary industry; After 2009, the ratio of household electricity consumption has once again entered the upward cycle, but the increase rate is obviously less than that of the tertiary industry [5].

![Figure 2. Changes in the electricity consumption structure of the whole society since 1985.](image)

![Figure 3. China's per capita electricity consumption, per capita living electricity consumption and their growth since 1986.](image)

**Per Capita Electricity Level**

The per capita electricity consumption is close to the global average, but the growth rate is not as fast as that of the whole society. In 1978, China’s per capita electricity consumption was only 260 kWh, and it was not until 2000 that it exceeded 1,000 kWh. After 6 years, it entered the 2000 kWh phase. In the next six years, the per capita electricity consumption increased by 1000 kWh every three years, and finally became a “4000 kWh club” in 2014. In 2017, the per capita electricity consumption reached 4,538 kWh, which is 18 times that of 1978, close to the global average. During the period from 1978 to 2000, the average annual growth rate of electricity consumption per capita was about 6.6%, which was 1.4 percentage points slower than that of the whole society. From 2001 to 2011, per capita electricity consumption ushered in the “golden period”. During this period, China’s economy and electricity consumption showed rapid growth, while population growth slowed down significantly. The average annual growth rate of electricity consumption per capita was as high as 11.5%. After that, entering the bottleneck of growth, the average annual growth rate of electricity consumption per capita was only 4.5% from 2011 to 2017.

The per capita living power consumption exceeded 600 kWh, and its growth rate was significantly faster than the per capita electricity consumption. With the rapid increase in the popularity of basic
household appliances such as TVs and washing machines, per capita living electricity consumption in 1997 exceeded 100 kWh. In the following eight years, the popularity of household appliances such as computers, air conditioners, and hair dryers, the residential electricity consumption continued to maintain a high growth rate which exceeded 200 kWh in 2005. After that, with the continuous increase in the usage rate of existing electrical appliances and the popularization of new generation household appliances such as water dispensers and air purifiers, the per capita living electricity consumption in China has reached a new level every three years. It reached 307 kWh, 417 kWh, 506 kWh and 626 kWh in 2008, 2011, 2014 and 2017 respectively, which growth rate is more than twice of electricity consumption per capita [6].

**Subdivided Industry Electricity**

The internal structure of industrial electricity is continuously optimized, and the conversion of old and new kinetic energy is obvious. In the early stage of industrialization (1978~2000), light industry was the leading force of the economy, and four high energy-consuming industries (including chemical raw materials and chemical manufacturing, non-metallic mineral products, ferrous metal smelting and rolling processing, non-ferrous metal smelting and rolling processing) and equipment manufacturing industries (including metal products, general and special equipment manufacturing, transportation/electrical/electronic equipment manufacturing) have an basically equivalent annual growth rate of electricity consumption, at 7.3% and 6.6% respectively, which growth rate is slower than that of the whole society. The heavy industrialization under development are increasingly prominent. The annual growth rate of electricity consumption in the four high-energy industries and equipment manufacturing industries has increased significantly compared with the previous stage, with growth rates of 15.2% and 16.9% respectively. As China enters the late stage of industrialization (from 2009 to the present), especially after the economic “new normal”, due to the acceleration of economic restructuring and the continuous transformation and upgrading of industry, the growth rate of electricity consumption in high energy-consuming industries is gradually decreasing. Its average growth rate is only 5.8%, which is lower than the initial stage of industrialization. However, the equipment manufacturing industry still maintains a high level of growth, with an average annual growth rate of 9.4%, which has become a new driving force for the growth of electricity consumption in the secondary industry after the "new normal".

![Figure 4. Conversion of new and old kinetic energy within the industry since 1987.](image)

The production service industry and the life service industry are coordinated and developed. In 2005-2017, the electricity consumption of the production service industry increased from 72.7 billion kWh to 237.2 billion kWh, and the life service industry increased from 146.8 billion kWh to 541.2 billion kWh, both of which maintained quick growth. They rose by 2.3 times and 2.7 times respectively, far higher than the increase in electricity consumption compared by the whole society
(1.5 times). From the point of view of the difference in electricity consumption growth rate, before 2014, the growth rate of electricity consumption for living services was generally faster than that for productive service electricity. Since 2015, the growth rate of electricity consumption in the production service industry has clearly surpassed the life service industry, which reflects the adjustment of China's industrial structure into a new stage and the improving ability of the service industry to support industrial production.

![Figure 5. Electricity consumption and growth for production service industry and life service industry since 2005.](image)

This year marks the 40th anniversary of reform and opening up, and it is also the beginning of the spirit of the 19th National Congress. Under this new historical coordinate, China's power consumption situation will continue to be characterized by the late stage of industrialization. The total power consumption continues to grow, and industry structure carries on being optimized, and the per capita power consumption level will reach and exceed the global average. Finally, at a new starting point, better quality power consumption will support the economy to achieve high quality development.

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