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Overall review of the overcapacity situation of China's thermal power industry: Status quo, policy analysis and suggestions

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ABSTRACT

China's thermal power industry has gone through the phases of rapid development in the last decade. But the excessive enthusiasm of thermal power investment is making this industry overcapacity. The unbalanced demand-supply relationship in electric power market greatly affects the economic benefit of most thermal power plants. In this paper, we give an overall review of the overcapacity situation of China's thermal power industry, which is supported by latest data. Then, policy orientation and its effect is discussed. It can be found out that policies on the respect of construction scale control, renewable power integration, feed-in tariff reduction and environmental protection were considered as the main solution to relieve the over capacity situation. Finally, we propose three suggestions for the future development of China's thermal industry.

1. Current situation of China's thermal power industry

1.1. Overall situation

From the perspectives of installed capacity, power generation, scheduling characteristic and economical efficiency, thermal power has been undoubtedly playing a fundamental role in China's electric power system for decades. In recent years, the high-speed growth of thermal power investment and construction, which has been stood in sharp contrast to the weakening electric power demand growth, has led thermal power industry to an overcapacity situation. In 2015, the completed investment in fixed asset of China's thermal power was 139.6 billion yuan, with year-on-year growth of 22%. The new added thermal power capacity was 63.68 GW which was the highest annual level since 2010 [1]. By the end of the year 2015, China's thermal power installed capacity reached up to 990 GW, with the annual growth of 7.8%, which is much higher than the growth-speed of electric power demand (only 0.5%) [2]. Specific data of thermal power capacity in recent six years can be seen in Table 1, Figs. 1 and 2 [3–7].

We believe there are two reasons for the sharp contrast between high growth thermal power investment and weak electric power demand growth. The first reason is the devolution of approval right of thermal power project. Before the year 2014, it was China's central government to decide whether, when and where to build a thermal power plant [8]. A thermal power plant can be built only when the project gets the approval of National Energy Administration (NEA), the central government authority of energy and electric power industry. In 2014, the approval right was handed over to local governments [9]. Thus each provincial government got the right on thermal power planning in the scope of its authority. For local governments, the investment of thermal power plants was conducive to the growth of local GDP, which make it easy for the examination and approval of most thermal power projects. In 2015, 95 thermal power projects got approved by local governments. The total approved capacity of the 95 plants was 113.47 GW [10], and these capacity will be put into operation within the future three years after construction.

The second reason is the low price of coal. For the past few years, China's domestic coal price has been dramatically reduced and kept in a low level [11]. In Fig. 3, Bohai-Rim Steam-Coal Price Index (BSPI) was chosen to illustrate the price curve of domestic thermal coal. As can be seen in the abscissa, sixty days was chosen to illustrate the tendency of coal price in the last five years. Each day can be considered as a typical day representing each month, and the exact dates were also labeled in the abscissa. The coal prices in the typical days is practical values because the sixty values on the curve are obtained from the Bohai-Rim Steam-Coal Price Index (BSPI). The formation of the curve was drawn by connecting the sixty practical values. So the values between the practical values on the curve can be considered as coal price estimations. Actually, the problem discussed here is about the time scale we prefer in the figure. Choosing typical days in each month here is a reasonable time scale as it can not only illustrate a quite long history time (5 years) but also reflect the detail changes in each time unit (one months). The low fuel cost made thermal power industry gain much profit and thus attracted huge investment enthusiasm. Even

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Table 1
Specific data of China's thermal power investment and capacity in recent 6 years.

Year	Completed investment (billion yuan)	Increasing rate of investment (%)	Total capacity (GW)	New added capacity (GW)	Increasing rate of new added capacity (%)
2010	144.16	−7.3%	706.63	62.72	−7.8%
2011	115.43	−20.2%	765.45	58.86	−6.2%
2012	99.85	−12.3%	819.17	50.65	−13.9%
2013	92.16	−7.8%	862.38	34.50	−31.9%
2014	117.41	24.3%	915.69	48.29	32.3%
2015	139.62	22.0%	990.21	63.68	34.7%

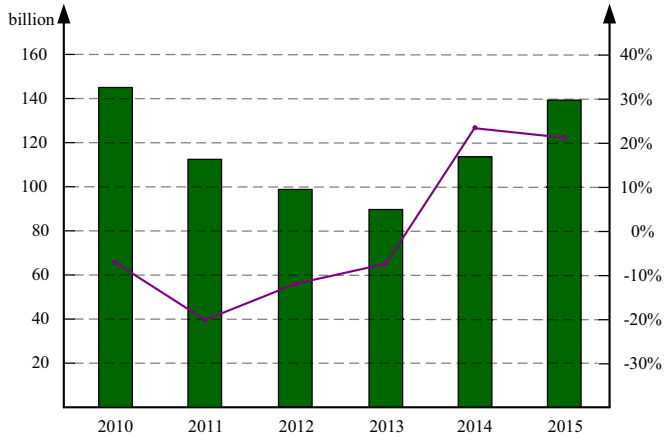

Fig. 1. Completed investment in fixed asset of China's thermal power in recent 6 years.

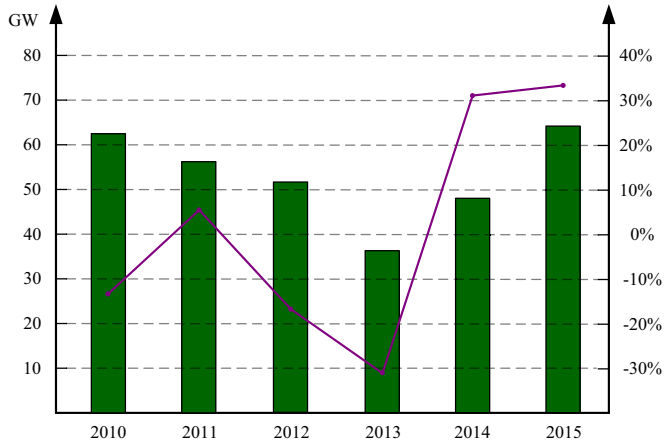

Fig. 2. New added thermal power installed capacity of China in recent 6 years.

though China's government has reduced the feed-in tariff of thermal power for many times (the total reduction was 0.072 yuan/kWh) [12], the return on equity (ROE) of thermal power industry still was up to 20% in 2015 as the coal price declined even more during the same time. This ROE level is much higher than the level of China's hydropower and wind power.

The overcapacity situation of thermal power can be directly reflected by the index of utilization hour. In 2015, China's utilization hour of thermal power plants was 4329 h, which was marked as the lowest level since the year 1969 [13]. Undoubtedly, the power generation also suffered a great decrease. In 2015, China's thermal power generation was 4097 TW h, decreasing 1.82% compared with last year. The utilization hour and generation of China's thermal power industry in recent years can be separately seen in Figs. 4 and 5.

Except for the low electric power demand and overwhelmed installed thermal power capacity, the increasing ratio of non-fossil energy power in electric system also aggravated the big slump of thermal power utilization hour and generation. Non-fossil energy power, like wind and solar, not only occupied a certain amount of power generation, but also made many thermal power plants undertake the task of deep peak load regulation. For instance, thermal power plants in some regions with abundant wind power resources, like northeast and northwest of China, generally kept operating with very low power capacity during the time with strong wind, and some plants often adjusted its power output up and down in very short time in order to cooperate with the output of wind power. Technically, this kind of system operation is negative to the economy efficiency of thermal power plants. So it is not difficult to realize that the more proportion the non-fossil energy power accounts, the worse the utilization hour and power generation of thermal power appear.

1.2. Distribution

The distribution of added thermal power capacity among provinces was quite unbalanced. 17 provinces' new added thermal power capacity was over 1 GW. Among them, five provinces, including Henan (6.60 GW), Anhui (6.32 GW), Xinjiang (5.49 GW), Zhejiang (5.24 GW) and Shanxi (5.17 GW), put more than 5 GW thermal power capacity into operation [14]. The amount of added thermal power capacity in this five provinces accounted for 45% of the total. In some other provinces, the growth of thermal power capacity was quite slow. The added thermal power capacity in Tianjin, Liaoning, Guangxi, Yunnan and Tibet was less than 0.02 GW. The distribution of thermal power added capacity in China can be seen in Fig. 6.

By the end of the year 2015, the cumulative thermal power capacity of 7 provinces, including Jiangsu (83.80 GW), Shandong (76.10 GW), Guangdong (74.78 GW), Inner Mongolia (72.68 GW), Zhejiang (62.30 GW), Henan (62.13 GW) and Shanxi (59.40 GW), was over 50 GW, while the cumulative thermal power capacity in Beijing, Hainan, Qinghai and Tibet was less than 10 GW [14]. It is observed that thermal power capacity is mainly concentrated either in the region of abundant coal resources or in the region with large electric power demand.

The distribution of capacity under construction should also be noticed as it can directly indicate each province status in planning of construction. As can be seen in Table 2, China's total thermal power capacity under construction is up to 250.28 GW currently [2]. That means the total thermal power capacity will be up to 1240 GW by the end of 2020 even there is no more thermal power capacity to be planned by the government. There are 11 provinces with thermal power capacity under construction over 10 GW, among which Guangdong, Shanxi, Shaanxi facing the situation of thermal power capacity under construction over 20 GW.

In terms of China's thermal power generation, the distribution in each province is also quite different. In 2015, the top six provinces in the rank of thermal power generation were Shandong, Jiangsu, Inner Mongolia, Guangdong, Henan, Shanxi, which were basically consistent with the rank of thermal power capacity. The distribution of China's thermal power generation and its growth rate can be seen in Fig. 7. In this figure, it is easy to find out that only eight provinces' thermal generation were with positive growth rate, which also proved the overcapacity situation.

As the economy development is going through a restructuring process, China's electric power demand is decreasing dramatically. China's total electric power consumption in 2015 was 5550 TW h. The increasing rate of total electric power consumption in 2015 was 0.5%, making a record low level in recent 40 years [2]. On the exact contrary development direction, thermal power capacity was enjoying a large growth. The reason of this overcapacity situation is because the coal price has been in a quite low level for long time, which made the profit