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Supply and Demand of Natural Gas in China and Its Prospects

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The coal-dominated primary energy consumption structure has triggered a series of environmental problems such as air pollution, smog and climate warming. To solve these problems, China has no way but to accelerate the transformation of energy consumption and optimize the energy structure. Natural gas, the cleanest, low-carbon and efficient fossil energy, plays a very important role in the energy structure in developed countries. On the other hand, the consumption of natural gas in China only accounted for 5.8% of the primary energy consumption in 2015, representing a huge gap compared with the world average of 24.1%. Before a major breakthrough is made in the renewable energy technology, significantly increasing the proportion of natural gas in the primary energy consumption structure will become an important means helping China transition to a low-carbon energy structure. To this end, China has set a natural gas consumption target of 360 billion m3 for 2020.
Recently, the global natural gas market has encountered excessive supply and weak price. It is generally predicted by international research institutions that this situation will continue for several years, which will create a great external environment for the widespread use of natural gas in China and the accomplishment of the “13th Five-Year Plan” and mid- and long-term targets for natural gas development. China should utilize the favourable circumstance in the market and take the opportunity of low oil prices to create a new impetus for the development of natural gas consumption.

1. Introduction

For a long time, the primary energy consumption structure in China has been dominated by coal and supplemented by petroleum, with natural gas consumption only accounting for a small part. Since the 1990s, a number of large-scale cross-regional pipeline projects have been implemented, such as the Shaanxi-Beijing pipeline, the Sebei-Xining-Lanzhou pipeline, the Ya-Gang pipeline and the first West-East Gas Transmission Pipeline, along with the development of the Tarim and Changqing oil and gas fields (Aven and Vinnem, 2005; Aven et al., 2007). The completion of Shaanxi-Beijing pipeline project in 1997 has kicked off the long-distance gas pipeline construction in China (Zhang et al., 2009). In 2000, the construction of the First West-East Gas Transmission Pipeline project started, making the large-scale transportation of natural gas from the west to the east possible and laying the foundation for China's transition from the startup period to the development period in terms of natural gas. At present, more than 7×10^4km of natural gas pipelines have been built in China, with a gas transportation capacity of 2800×10^8m^3/a or so. The transportation landscape that “transmits gas from the west to the east” and “brings gas from offshore” has initially formed, with the Sebei-Xining-Lanzhou system, the Shaanxi-Beijing system, the West-East Gas Transmission System and the Sichuan-East Gas Transmission System as the main framework, and a complete regional pipeline network built in Sichuan, Chongqing, the Yangtze River Delta and the Beijing-Tianjin-Hebei region. In the early development of the natural gas industry, proven resources were relatively limited and infrastructures such as pipelines were backward, so natural gas only played a very small part in the energy structure; with the exploration being further carried out, the resources and consumption rapidly increased, pushing the natural gas industry into the important development period. At this stage, infrastructures, market structure and consumer demands were rapidly developing, and the proportion of natural gas also increased very fast in the energy structure. Having

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experienced the thriving development, natural gas consumption gradually stabilized, and a relatively mature natural gas market was formed, taking up a certain proportion in the energy structure.
In 2016, the total energy consumption in China amounted to 4.36 billion tons of standard coal, of which, the consumption of coal, oil and natural gas accounted for 62.0%, 18.3% and 6.2%, respectively. In this year, the apparent consumption of natural gas amounted to 205.8 billion m^3, an increase of 6.6% over 2015. However, in terms of the regional distribution, the consumption of natural gas in China is mainly concentrated in the Bohai Rim, the Yangtze River Delta and the southeast coastal areas. These three regions consumed 101.9 billion m^3 of natural gas in 2016, accounting for 50% of the total consumption. Therefore, the consumption of natural gas is not balanced in China (Yusuf et al., 2014; Zhang and Huang, 2015).
At present, China is in the natural gas development stage, where the consumption of natural gas is increasing year by year. However, the growth has been slowing down significantly in recent years and the natural gas consumption has also taken up only a small proportion in the primary energy consumption. It is put forward in the *"13th Five-Year Plan" for Energy Development* that by 2020, the natural gas consumption will have reached 360 billion m^3, and that its proportion in the primary energy consumption will have reached 10%. At present, there is still a great gap between the actual development of the natural gas industry and our expectation. In order to maintain the rapid and sustainable growth of natural gas consumption, the guiding role of the government should be further enhanced (Bernardo et al., 2018; Opaluch et al., 2005; Sharma, 2010).

2. Status of natural gas supply in China

In 2015, driven by consumption and price, the natural gas supply in China increased from 42.1 billion m^3 in 2005 to 196 billion m^3. Since domestic gas production could not meet the growing demand, China's import dependence increased from 0% in 2005 to 31%. In the total supply, the domestic production of natural gas was 134.6 billion m^3, accounting for 69%, including 108.9 billion m^3 of domestic conventional onshore gas, 12.8 billion m^3 of domestic conventional offshore gas and 12.9 billion m^3 of domestic unconventional onshore gas; the volume of the imported pipeline gas was 33.4 billion m^3, accounting for 17%; and that of the imported LNG was 27.4 billion m^3 (1.97 million tons), accounting for 14% (Figure 1).

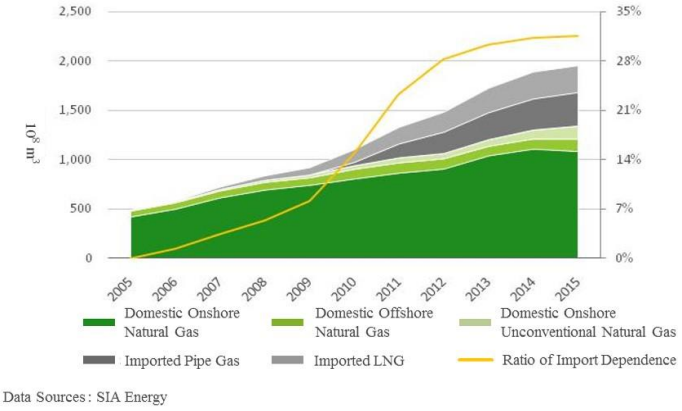

Figure 1: Natural gas supply structure in China during 2005-2015

With the slowdown in the growth of medium and long term consumption, the growth rate of natural gas supply in China also decreased, and the increment mainly relied on imports. According to a prediction made by SIA, by 2020, the supply of domestic gas, imported pipeline gas and imported LNG in China will have amounted to 163.7, 42.9 and 63.9 billion m^3, respectively, with an import dependence of 37% (Figure 2).
On the global scale, due to the sluggish economic recovery and the rapid development of renewable energy, the decreasing growth rate of natural gas consumption has broken the balance of the supply and demand pattern and resulted in a slumping price. In 2015, the supply prices of LPG and LNG dropped more than 50% from the highest level. Analysts generally believe that the easing pattern of natural gas supply will last three to five years. Asia, as an important buyer in the global natural gas trading market, will have more bargaining power and influence in this more accommodative market environment. This has created a great external environment for China to use its international resources to ensure the supply of natural gas.

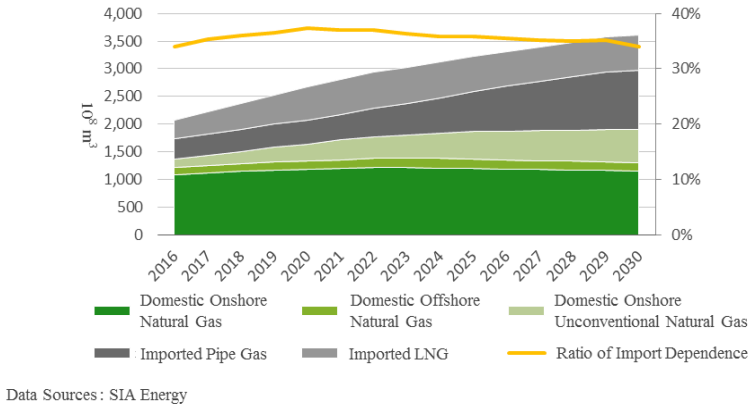

Figure 2: Prospects of natural gas supply in China during 2016-2030

3. Current Situation of Natural Gas Demand in China

Since the West-East Gas pipeline began to supply gas to the middle and lower reaches of the Yangtze River in 2004, the core natural gas demand zone has gradually shifted from the initial inland gas producing regions like Sichuan, Chongqing and Shaanxi to the economically developed regions such as the Beijing-Tianjin-Hebei region, the Yangtze River Delta and the Pearl River Delta. In the following ten years, thanks to the rapid economic development, the substantial increase of the supply capacity, the continuous improvement of storage and transportation facilities and the reform of the natural gas price mechanism, the natural gas industry had witnessed a rapid development (Bryant, 2003). In 2015, the apparent consumption of natural gas in China increased from 39.7 billion m^3 in 2004 to 194.7 billion m^3, with an average annual compound growth rate of 17%. From the perspective of consumption structure, the industrial natural gas consumption in 2015 was 89.8 billion m^3, accounting for 48% of the total consumption of natural gas, the consumptions of natural gas by power generation and district heating, transportation and residence were 31.1, 19.8 and 40.4 billion m^3 respectively, and the total consumption of natural gas for commercial use and the other sectors was 10.5 billion m^3 (Figure 3).

Figure 3: Natural Gas Consumption Structure in China during 2005-2015

Since 2014, the growth of natural gas consumption has reduced from a two-digit number in the previous decade to 9.6%, and further to 2.5% in 2015. There are two factors leading to the result:

First, the “new normal” in China's economy has affected the demand for natural gas downstream. Due to the slowdown of economic growth, traditional large gas-consumers such as steel, glass and ceramics industries faced difficulties in their own development, making their output decreased year by year and further leading to the decrease of gas consumption (Mearns and Yule, 2009).

Second, the poor gas price transmission has weakened the substituting capacity of natural gas. In recent years, the drops of global coal and crude oil prices have been rapidly transmitted to China, but the natural gas

price reduction has not benefited the end users due to the bundling of sales and transmission and the monopoly of domestic sales. Compared with alternative energy sources, the cost competitiveness of natural gas has declined, hindering its development (Finšgar and Jackson, 2014; Wälde, 2008).
Subject to the factors above, predictions foretell that the natural gas consumption during the "13th Five-Year Plan" period will maintain the slow growth, and the natural gas consumption in China will have amounted to about 270.8 billion m^3 by 2020 (Figure 4).

Figure 4: Prospects of natural gas consumption in China during 2016-2030

Forecasts have also been made by other domestic and foreign institutions. China Energy Research Society forecasted that the natural gas consumption in China would have reached about 290 billion m^3 by 2020, and the IEA forecasted the figure to be 320 billion m^3 by 2021. The above forecasts are far from the natural gas consumption target of 360 billion m^3 by 2020 proposed in the *National Plan on Climate Change (2014-2020)*. In order to achieve breakthroughs and maintain the rapid and sustainable growth of natural gas consumption, full play should be given to the guiding role of the government. A new impetus needs to be found in the market to achieve the national "13th Five-Year Plan" target (Diao et al., 2014; Kumar and Markeset, 2007; Lu, 2016).

4. Prospects of the Natural Gas Supply and Demand in China

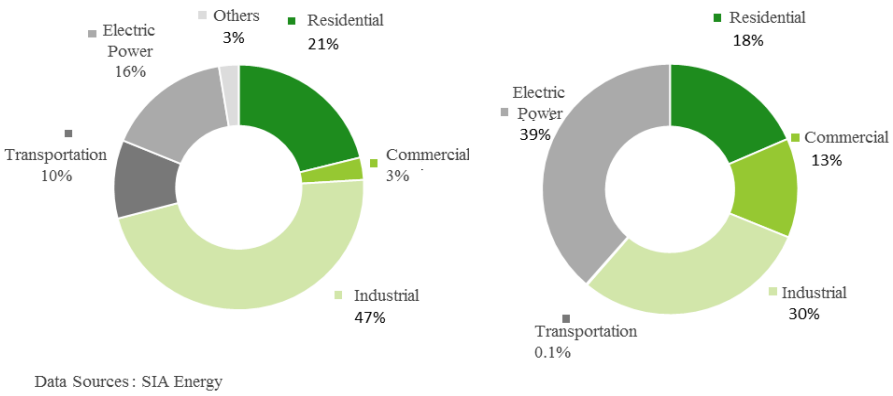

Figure 5: Natural gas consumption and structure in China (left) and the US (right) in 2015

Studies have shown that one universal feature indicating the gas consumption has developed to the mature stage is that natural gas consumption by power generation accounts for a high percentage in the total consumption of natural gas. For example, the above proportion was 61% in Japan in 2015 and 39% in the U.S. (the right one in Figure 5). On the other hand, the natural gas in China is mainly consumed by industries (47%) and residents (21%), and only 16% is consumed by power generation and district heating (the left one

in Figure 5). This indicates that there is still great room for the utilization of natural gas in power generation in China. As the cleanest fossil fuel, natural gas is of great importance to improving the proportion of clean power and reducing carbon emissions from the power generation. Therefore, natural gas for power generation should become an important impetus to promote natural gas consumption growth during the “13th Five-Year Plan” period (Kang, 2012; Lu, 2010).

Natural gas power generation has various advantages, such as low pollution and emission, quick start-up, easy peak regulation, short construction period, small area occupied and suitability for power supply in urban areas. These features make natural gas power generation reliable, efficient, clean, environmentally friendly and flexible, and turn it into a strong support for the development of clean energy, and also a powerful tool to deal with the intermittent and instable supply of renewable energy as well as improve the operation quality of the power grid (He et al., 2010).

However, the current high cost of natural gas leads to poor economy of this power generation mode. Take Hebei Province for example. A comparative analysis of the internal average costs of various power generation methods in this province in 2015 (Figure 6) shows that the comprehensive cost of coal-fired power generation has a significant advantage and has formed a barrier to the development of technologies and commercial investments involving other clean energy sources. Natural gas is only more cost-effective than terrestrial PV in terms of power generation, but considering the PV subsidies, natural gas is actually the most expensive power source. Therefore, in order to promote the consumption of natural gas in power generation, the terminal price must be reduced to increase its competitive advantage.

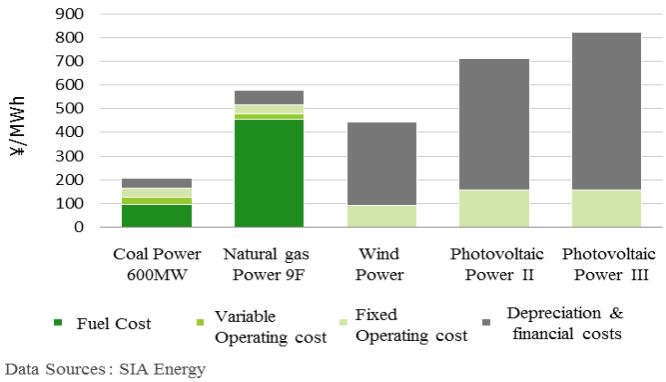

Figure 6: Costs of different power generation methods in Hebei Province in 2015

5. Conclusion

In 2016, the natural gas consumption in China was 208.7 billion m^3, accounting for only 6.2% of the primary energy consumption. At the same time, due to a series of problems such as unclear positioning, high price, insufficient gas storage capacity and large differences between peaks and valleys, the development of the natural gas industry is still less than satisfactory in this country. Therefore, China should take advantage of the current economic downturn and the weak natural gas demand, and seize the opportunity of the accommodative international natural gas supply market and slacking prices to maintain the rapid and sustainable growth of natural gas consumption. It should also give full play to the government’s guiding role, actively promote the consumption of natural gas, especially for power generation and make way for low-carbon industrial development to finally achieve the natural gas consumption growth target proposed in the “13th Five-Year Plan”.

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