

Research Paper

Natural gas utilization in China: Development trends and prospects

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ABSTRACT

It has been an important objective in China's energy development strategy to accelerate the promotion of natural gas utilization, cultivate main sources of natural gas, and increase the proportion of natural gas consumption. Based on the analysis of the development of natural gas utilization in China over the past 3 decades by means of classified and comparative research, this paper reveals the shift in the development pattern of China's natural gas utilization structure from the domination of industrial gas and chemical gas to a relative balance among industrial fuel, urban gas, and power generation gas. Sustained and steadily growing natural gas is an important basis for the rapid growth of natural gas utilization. Maintaining moderate growth in the natural gas transmission and distribution network is an important guarantee for the rapid growth of natural gas utilization. The slowdown in the world's economic growth has not caused any significant adverse impact on the rapid growth in China's electricity generation gas. The natural gas utilization policy has no effect on the adjustment of industrial fuel gas any longer. Industrial fuels and chemical gas are greatly subject to natural gas prices. Based on China's energy consumption targets for 2020 and 2030, this paper estimates the gas consumption of major gas areas and their development position, namely, more development space for industrial fuels, still rapid growth in urban gas but hardly major breakthroughs in gas proportion, rapid growth in power generation gas and a more prominent role in peak shaving, sustained high growth in transportation gas and challenges from new energy and low oil prices, and a significant decline but still a large scale in chemical gas.

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0. Introduction

History is an indication of the future. In order to effectively control air pollution and actively address climate change, China has accelerated the promotion of natural gas utilization, cultivated main sources of natural gas, and further increased the proportion of natural gas consumption. This has been an important objective in China's energy development strategy. China has ushered in a new era in the use of natural gas. Based on an analysis of the current situation of natural gas utilization in China and a clear understanding of the trends and laws of development of natural gas utilization, making targeted efforts in promoting natural gas utilization is, therefore, of great practical significance to the achievement of the strategic goals of energy development.

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1. Current situation of natural gas utilization in China

Impacted by natural gas resources, natural gas pipelines, natural gas markets and other factors, the China's natural gas consumption is mainly based on local and nearby resources before 1996 (Yongwu, 2004). With the completion of the third Shaanxi-Beijing Gas Pipeline in 1997 and the operation of West-East Gas Pipeline I in 2004, natural gas has been gradually transported for a long distance from the resource area to the central market, ushering in a new era of natural gas utilization. Depending on gas utilization characteristics of different users, natural gas users are mainly from the following six areas: urban gas (such as resident cooking, domestic gas and centralized heating), industrial fuels (industrial projects fueled by natural gas), gas for power generation (such as distributed gas energy, natural gas peaking power stations or cogeneration), chemical gas (such as hydrogen production from natural gas), gas for transportation (such as public transport, freight logistics and ship transportation fueled by natural gas), and gas for other purposes (National Development and Reform Commission, 2012).

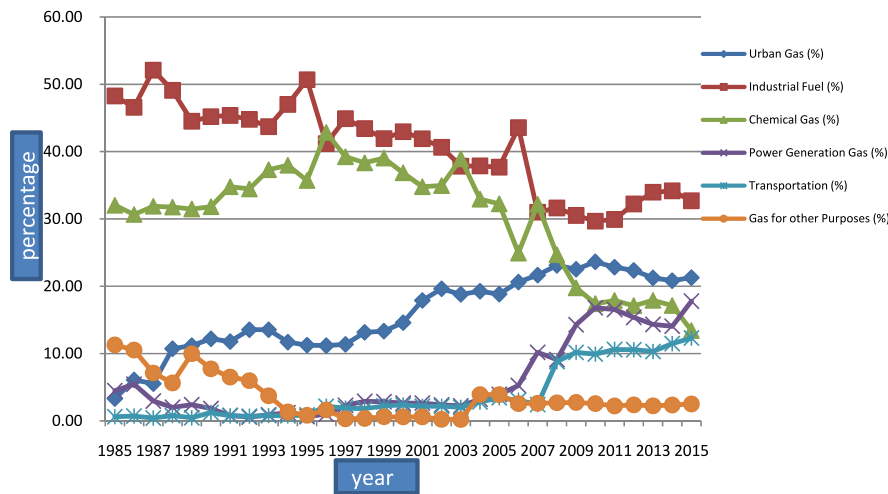


Fig. 1. Structural distribution of natural gas utilization in 1985–2015 (National Bureau of Statistics of the People's Republic of China, 1997–2017).

Since the beginning of the 21st century, impacted by coal, fuel oil, electricity and other alternative energy sources, especially soaring natural gas prices, the share of industrial fuel gas in China's natural gas utilization mix has declined, but still at 30%, making industrial fuel gas the largest gas use area. Urban gas consumption has maintained rapid growth, with domestic gas consumption increasing 83 times between 1985 and 2015. Since 2016, urban gas has made up more than 20% of China's natural gas utilization mix, but still with a big gap with the largest gas use area. Power generation gas experienced robust growth after 2007, making it the third largest gas use area in China. Gas for transportation has grown slowly since 2008. Chemical gas has been on the decline. In the 30 years from 1985 to 2015, a new pattern for natural gas utilization in China was formed, which featured a shift from the domination of industrial gas and chemical gas to a relative balance among industrial fuel, urban gas, and power generation gas. (See Fig. 1)

2. Main influencing factors and development trends of natural gas utilization in China

Globally, natural gas is mainly used as urban gas, industrial fuels and fuels for power generation. Natural gas utilization is impacted by a great number of factors, including resource availability, natural gas infrastructure (Jun et al., 2011a), economic situation, development policies, and the price level (Guohua, 2011).

2.1. Natural gas supply

The downstream natural gas consumption market is fundamental to the development of the natural gas industry (Mingqing et al., 2001). An overview of changes in natural gas utilization in China over the past 3 decades until the operation of the third Shaanxi-Beijing gas pipeline and West-East Gas Pipeline reveals amazing discoveries. From 1985 to 2015, China's natural gas production increased by 8.12% on an average annual basis, while natural gas utilization increased by 9.43% on an average annual basis. Since China started natural gas import in 2006, breakthroughs in the increase in natural gas imports have been made, with China's external dependence of natural gas up from 1.03% to 31.63% (as shown in Fig. 2). Imported natural gas has played an increasingly important role in meeting growing demand for natural gas in China.

Before the first Shaanxi-Beijing Gas Pipeline was put into operation (1985–1996), the average annual growth rates of natural

gas utilization and natural gas production in China were low, but basically balanced, as shown in Fig. 3. After the first Shaanxi-Beijing Gas Pipeline was put into operation (1997–2003), without the support of imported natural gas, the average annual growth rate of natural gas utilization in China was 2 percentage points higher than that of natural gas production. Especially after West-East Gas Pipeline was put into production (2004–2015), in response to rapid growth in both natural gas consumption and natural gas production in China and in order to bridge the widening gap between natural gas production and natural gas demand, it was necessary to keep increasing natural gas imports, for natural gas production cannot meet growing need for natural gas any longer (as shown in Fig. 3). Maintaining a certain amount of natural gas production can help maintain and foster the natural gas market, while expanding natural gas utilization can in turn enhance natural gas production and lead to the continuous expansion of natural gas supply to meet rapidly growing demand for natural gas. The sustained and steady increase of natural gas resources is an important basis for the rapid development of natural gas utilization.

2.2. Natural gas transmission and distribution pipe network

Natural gas is a special commodity. The construction of its transmission and distribution pipe network is essential to its delivery and utilization by end users. Natural gas pipelines grew at an average annual rate of 7.16% in China from 1985 to 1996 (as shown in Fig. 4), while the figure was 10.51% from 1985 to 1996, both higher than the average annual growth rate of natural gas utilization of the same period. This shows that natural gas pipeline construction played a leading role in promoting the growth of natural gas consumption and pipeline construction has promoted growth in natural gas consumption. Since West-East Gas Pipeline I was put into operation (2004–2015), natural gas pipelines grew at an average annual rate of 12.47% in China, but still lower than that of natural gas utilization of the same period. This shows that the rapid growth of natural gas utilization depends to a certain extent on the construction of pipelines, but the rapid growth of natural gas utilization in turn demanded growth in natural gas pipelines. Maintaining moderate growth in natural gas transmission and distribution networks is an important guarantee for the rapid growth of natural gas utilization.

2.3. World economic situation

During the Asian financial crisis (1997–1999), except for gas for power generation, urban gas, industrial fuels, chemical gas and

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