Available online at www.sciencedirect.com

ScienceDirect

Natural Gas Industry B 2 (2015) 473–480

www.elsevier.com/locate/ngib

Research article

China's natural gas exploration and development strategies under the new normal

Lu Jialiang, Zhao Suping*

Langfang Branch, PetroChina Research Institute of Petroleum Exploration & Development, Langfang, Hebei 065007, China

Received 14 November 2015; accepted 8 December 2015
Available online 25 May 2016

Abstract

China's natural gas industry has experienced a great leap-forward development in the past decade. Since the second half of 2014, however, international oil price has dropped sharply and global oil and gas markets have been sluggish. In China, economy growth rate slows down and resource environments tend to be more restricted. And energy production and consumption revolution speed up, and the development of natural gas industry experience profound changes internally and externally. Through review on the achievements in recent high-speed development and analysis on the future development of China's natural gas industry, it is believed that the growth rates of China's natural gas output and consumption will slow down and the supply and demand fundamentals present loose states. Low-permeability tight, deep–extra deep and unconventional reservoirs will be the principal targets of natural gas exploration and development and the tendency of resource deterioration is inevitable. The pressure to the decrease of gas price rises due to the sustained recession of oil price and the sharp decrease of alternative energy price. The normal means to increase benefits is to control investment strictly and reduce cost greatly. As for the new normal, five suggestions are proposed for natural gas exploration and development in China. Firstly, reinforce exploration continuously by guaranteeing work load and investment at the required level, and tamp the development basis. Secondly, pay much attention to early development evaluation, give prominence to plan implementation design and control productivity construction rhythm. Thirdly, pay attention to the top-level design of mature gas field development and adjustment, with fine description and management as the priority, and improve overall development level. Fourthly, strengthen the researches on exploration and development technologies, with the simplification and practicability of technologies as the focus, and reduce the cost effectively. And fifthly, summarize high-speed development experience of natural gas industry, pay attention to the demonstration and design of key indicators, and strengthen the study on progressive planning.

Keywords: China; Low oil price; New normal; Natural gas; Output; Consumption; Supply and demand fundamentals; Resource deterioration; Exploration and development; Suggestions

At the end of 2004, the West-to-East Gas Pipeline Project was completed and officially put into operation, marking the fast development period of China's natural gas industry. In the past decade (2004–2014, the same hereinafter), China's natural gas industry has experienced a great leap-forward development and has obtained a series of achievements in the fields of exploration and development, pipeline transportation support, and consumption and utilization. A relatively complete industrial framework is basically established. China's natural gas industry contributes greatly to the energy structure optimization and energy conservation and emission reduction in China. After ten years' fast development, China is now one of the major natural gas producers and consumers in the world, and the effect of China's natural gas markets on global natural gas market and their integration degree increase remarkably. Since the second half of 2014, however, global oil market has experienced profound change. International oil price has dropped sharply and now still stays at the low level, and global

* Corresponding author.
E-mail address: zhaosp69@petrochina.com.cn (Zhao SP.).
Peer review under responsibility of Sichuan Petroleum Administration.

http://dx.doi.org/10.1016/j.ngib.2015.12.001

oil and gas markets have been sluggish. In China, economy growth rate slows down and resource environments tend to be more restricted. With the speeding up of energy production and consumption revolution, natural gas industry is experiencing profound changes internally and externally. Both challenges and opportunities exist. In this paper, the future development situations of natural gas industry is analyzed and studied after the experience concluded through ten years' fast development of China's natural gas industry is reviewed and summarized. Then, natural gas exploration and development strategies are proposed so as to grasp the opportunities under the new normal, adjust development concepts in time and ensure fast and healthy development of natural gas industry in China in the long term.

1. Review on the fast development of natural gas industry in China

1.1. Continuous exploration breakthrough and reserves increasing at peak rate

Since 2004, great breakthrough of natural gas exploration has been realized in the areas of Kuche and Tazhong, the Tarim Basin, in tight sandstone gas reservoirs in the Ordos Basin, in the Upper Triassic Xujiahe Formation gas reservoirs, Puguang Gas Field, Yuanba Gas Field and Longwangmiao Formation gas reservoirs in central Sichuan Basin, and in Dongfang 13-2 in the Yinggehai Basin. Natural gas reserves have been increasing continuously, with yearly average proved gas in place over 6000×10^8 m^3, including recoverable reserves of 3600×10^8 m^3. The cumulative proved gas in place in the past decade is 6.34×10^{12} m^3, more than the sum of national cumulative proved reserves before. At the end of 2014, the national cumulative proved gas in place was 10.45×10^{12} m^3, including recoverable reserves 6.2×10^{12} m^3. With further exploration of coalbed methane (CBM), the accumulative proved CBM in place was 6266×10^8 m^3. As for shale gas exploration, great discovery has been obtained in the field of marine shale in the Sichuan Basin [1]. In 2014, the proved geologic reserves initially submitted by the Fuling Shale Gas Field was 1067×10^8 m^3. Based on the latest data, the total shale gas reserve in this basin by 15th October 2015 was 5400×10^8 m^3, including 3800×10^8 m^3 from Sinopec and 1600×10^8 m^3 from PetroChina. Ten years' reserves increasing at peak rate provides the firm basis for the fast increasing of natural gas output.

1.2. Moving into the queue of major gas producers based on the fast increasing of gas production

With the successive commissioning of long-distance natural gas pipelines (e.g. West-to-East Pipelines, Shaanjing (Shaanxi–Beijing) Gas Pipelines and Eastward Pipelines of Sichuan Gas), the bridges between the resources and the markets have been set up continuously. A number of large gas fields over 50×10^8 m^3 were developed and put into production successively, including Kela 2, Dina, Sulige, Yulin and Puguang gas fields, so natural gas production rose fast to 1296×10^8 m^3 in 2014 from 410×10^8 m^3 in 2004. Within ten years, the natural gas production was more than doubled, with yearly average rising rate of 12.2% and yearly production incremental of 88.6×10^8 m^3. Compared with other countries at fast development stage, China's production rising rate and incremental both ranked in top three (Table 1). The rank of China's natural gas production in the world jumped to the 6th in 2014 from the 17th in 2004.

1.3. Continuous technical innovation and integration impelling scale beneficial development of complex gas reservoirs

In order to solve the bottleneck issues that restricted the development of complex gas reservoirs, major scientific research projects have been set up, basic researches and on-site pilots have been carried out vigorously, and innovative and integrated technologies have been developed continuously in recent ten years. A lot of progress has been achieved in terms of fine description of heterogeneous reservoirs, staged fracturing stimulation of horizontal wells, fast drilling, safety development technologies of high-acidity gas reservoirs, and standardized design, digitalized construction and factory-like operation modes, based on which, complex gas reservoirs are developed efficiently in large scales, typically including Sulige low-permeability tight gas reservoirs, Kuche extra deep gas reservoirs, Tazhong fracture-pore carbonate gas reservoirs, Puguang high-sulfur gas reservoirs and Xushen volcanic gas reservoirs. With the continuous innovation and integration, the reserves of complex gas reservoirs, which account for 70% of total proved reserves, are developed and utilized effectively, and support strongly the fast ascending of natural gas production in China.

1.4. The basic completion of national main pipeline networks with the speeding up of transportation and distribution system construction

After the West-to-East Pipeline I was put into production at the end of 2004, the construction of China's long-distance

Table 1
Natural gas production rising rate and incremental of different countries at the fast development stage.

Country	Fast development stage	Yearly average production incremental/10^8 m^3	Yearly average production rising rate
U.S.A	1931–1967	123.00	6.1%
Canada	1987–2002	86.06	6.7%
Algeria	1994–1999	38.93	9.0%
Indonesia	1983–1996	34.57	9.1%
U.K.	1992–2000	71.13	9.8%
Malaysia	1984–2004	25.57	10.4%
Australia	1988–1994	21.17	10.6%
India	1985–2003	14.11	11.1%
Norway	1995–2004	69.70	12.2%
Egypt	1998–2004	24.33	14.0%
China	2004–2014	88.60	12.2%

Note: The basic data is derived from BP energy statistics (2015).