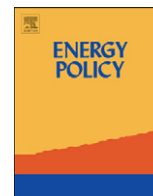




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Communication

China's natural gas: Resources, production and its impacts

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HIGHLIGHTS

- ▶ We show that available gas resources are overestimated by China's authorities.
- ▶ We forecast China's future gas production under different resource scenarios.
- ▶ This paper shows that China's gas production will not meet the soaring demand.
- ▶ The gap between supply and demand will continue to increase rapidly in future.
- ▶ China's gas security will meet a severe challenge because of this increasing gap.

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ABSTRACT

In order to achieve energy consumption targets, and subsequently reduce carbon emissions, China is working on energy strategies and policies aimed at actively increasing the consumption of natural gas—the lowest carbon energy of the fossil fuels, and to enhance the proportion of gas in total primary energy consumption. To do this, it is a necessary prerequisite that China must have access to adequate gas resources and production to meet demand. This paper shows that the availability of domestic gas resources are overestimated by China's authorities due to differences in classification and definitions of gas resources/reserves between China and those accepted internationally. Based on official gas resource figures, China's gas production remains low with respect to the projected demand, and will only be 164.6 bcm in 2020, far lower than the 375 bcm of forecast demand. The gap between gas production and demand will reach 210.4 bcm by 2020. Existing plans for the importation of gas and the development of unconventional gas will not close this gap in the next 10 years, and this situation will therefore present a severe challenge to China's gas security, achievement of targets in improving energy consumption structure and reducing carbon emissions.

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1. Introduction

In China, high-carbon energy resources, such as coal and oil, dominate, and accounted for 88.07% (coal: 70.45%; oil: 17.62%) of Chinese primary energy consumption in 2010 (BP, 2011). Compared to these figures for high-carbon energy resources, the proportion of low-carbon energy resources, such as natural gas and non-fossil fuels, is only 11.93% (natural gas: 4.03%; non-fossil fuels: 7.89%). However, there is one important reason for us to believe that this structure of energy consumption will be unsustainable in future (Xue, 2008, 2009; Ju et al., 2010), and that is because China is facing tremendous pressure to reduce its carbon emissions due to the fact that it has become the largest carbon

dioxide emitting country in the world (BP, 2011). On November 26, 2009, the State Council announced that China would endeavor to lower its carbon dioxide emissions per unit of GDP by 40–45% by 2020 relative to the 2005 level (World Resources Institute (WRI), 2009). Therefore, in order to fulfill its commitment to reduce carbon emissions, a reasonable choice for China is to change the structure of its energy resources and increase the quantities of low-carbon energy resources, enhancing their proportion in total energy consumption.

One of the best low-carbon energy resources is natural gas. According to the official “12th Five-Year Plan”, Chinese natural gas consumption will reach 260 billion cubic meters (bcm) in 2015, and its proportion of total energy consumption will be 8.3% (Qu, 2011). Consumption of natural gas was only 109 bcm in 2010 (BP, 2011), implying an annual growth rate of 18.99% in the next five years. After 2015, gas consumption will continue to rise and reach more than 350 bcm by 2020, with a proportion of over 10%

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of total energy consumed (Liu et al., 2010; Li, 2010, 2011). Therefore, we can expect the Chinese government to take a number of measures to increase natural gas consumption in the future.

However, one important factor seems to be ignored by Chinese policy makers, and that is whether or not there are adequate gas resources to support its ambitious goal for gas consumption. Currently, most Chinese scholars claim that Chinese domestic gas production will continue to rise rapidly. However, their analysis does not consider limitations on gas resources (Qiu and Fang, 2005, 2009; Li et al., 2009; Qiu et al., 2011). Even if there is a gap between gas production and demand, scholars accept that China can import adequate foreign gas resources to meet demand (Qiu et al., 2011). This extremely optimistic opinion of China's gas supply may convey a misleading conclusion to Chinese policy makers, and furthermore, will result in flawed national natural gas strategies and policies. It is therefore very important that China carefully analyze its gas resources, so that a quantitative analysis on gas production potential can be achieved more accurately. This is the main purpose of this paper.

The structure of this paper is as follows. Section 2 reviews historical production and discovery of proved geological reserves of natural gas. Section 3 summarizes and discusses Chinese natural gas resources, and defines three analytic scenarios with different resources. Section 4 introduces the forecast models of discovery of proved gas geological reserves and production. In section 5, under different scenarios, we predict Chinese gas discovery and gas production by applying the models mentioned in Section 4. Then the forecast results are analyzed and discussed in Section 6. Section 7 summarizes the main lessons of this paper.

2. Historical production and proved geological reserves of natural gas

China's natural gas industry has developed rapidly since 1949. One development is the increase in the annual production of natural gas from 0.01 bcm in 1949 to 96.76 bcm in 2010. The year 2004 proved to be a turning point for China because, until 2004, China had no pipeline network to transport natural gas, a barrier to the growth of domestic gas production. In 2004, the first West–East Gas Pipeline—connecting gas resources in the West with the market in the East, was completed and put into trial operation. Thereafter, China's gas production rose rapidly with an average annual growth rate of 15.47% from 2004 to 2010 (Fig. 1).

The other major development for China's gas industry is the substantial increase in the annual discovery of proved geological reserves. Fig. 1 shows that proved geological reserves of natural gas has grown rapidly since 1990, and especially since 2000, with an average annual increase of 543.38 bcm from 2000 to 2010. One important reason for this rapid development is that Chinese petroleum exploration has shifted from oil-dominance to oil–gas of equal importance (Dai et al., 2008). By the end of 2010, the cumulative proved that geological reserves of natural gas had reached 8.015 trillion cubic meters (Tcm).

3. China's gas resource assessment

3.1. China's official gas resource assessment

There are 5 major national oil and gas resource assessments in China since the “Reform and Opening-up” of 1978. From Table 1, we can observe that China's known natural gas resources continue to increase, for example, prospective resources are 33 Tcm based on the first national oil and gas resource assessment (Zhou and Tang, 2004), however, according to the latest national oil and gas resource assessment, this has increased to 56 Tcm (Li et al., 2006). According to official reports, the reason for this apparent increase in gas resources is due to innovation in geological theory and progress in exploration technology. There were indeed many innovations and improvements to geological theory and exploration technologies during last decades, and we can see that data provided by the Chinese Academy of Engineering in 2004 (CAE) (2004) concurs with data provided by China's national oil companies in 2000 (Li et al., 2004). After a year, the third national oil and gas resource assessment shows increase in all types of natural gas resources, especially for geological resources and recoverable resources. These increases, however, are hard to explain.

3.2. China's scholars' gas resource assessment

The results of the 3rd national oil and gas resource assessment have been widely used by many scholars and institutions (Li et al., 2009; Dai et al., 2008; Zhao et al., 2008; Higashi, 2009). However, in their articles and reports it is very hard to clearly identify accurate quantities of Chinese gas resources. The main reason is that the classifications and definitions of the petroleum resources/reserves used by Chinese authorities are different to those applied internationally (Zhang, 2009). For example, between the “Guidelines for

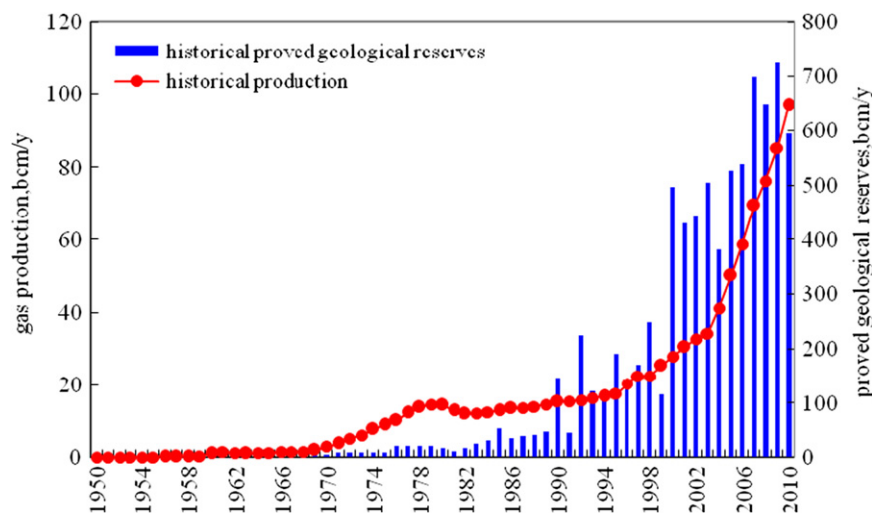


Fig. 1. Historical annual discovery of proved geological reserves and production of Chinese natural gas.

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