The development situation analysis and outlook of the Chinese shale gas industry

Guanglin Pi, Xiucheng Dong*, Jie Guo

School of Business Administration, China University of Petroleum (Beijing), No.18 Fuxue Road, Changping, Beijing and 102249, China

Abstract

Influenced by the shale gas revolution in the U.S and outstanding contradiction between natural gas supply and demand on the domestic market, China gives top priority to shale gas development and utilization. Remarkable progress has been made in shale gas exploitation, technology and international cooperation since 2009. However, shale gas industry in China still faces many daunting problems such as imperfect mining right exit mechanism, environmental risk, immature technology, etc. Based on the successful experience of the U.S. shale gas development and lessons from China’s sluggish growth of coalbed methane gas, countermeasures proposed in this paper are summarized as follows: making overall planning for shale gas development, perfecting mining right exit mechanism and solving the overlapping mineral rights issue, promoting technology research, strengthening environmental regulation of shale gas, and promoting the construction of shale gas supporting infrastructure.

© 2015 The Authors. Published by Elsevier Ltd.

Keywords: Shale gas industry; Development situation; Outlook.

1. Introduction

The 21st century witnesses a global economic boom, along with the rising energy consumption. Oil-and-natural gas production capacity, however, is of sluggish growth. In consequence, shale gas is gaining increasing attention worldwide. To increase the supply of unconventional gas and perfect energy production mix, China has paid much attention to the exploration and development of shale gas since 2005 [1]. In 2010, the first shale gas well Wei-201 went into operation, which served as a prelude to China’s shale gas development. In recent years, the Chinese government has issued numerous policies to promote a sound development of shale gas in a proper and organized fashion. To help scholars get a full
picture of Chinese shale gas development, this paper systematically analyzes the current situation of China’s shale gas industry and discusses the outlook of the shale gas sector.

2. Development situation of the Chinese shale gas industry

The book named *Survey of National Shale Gas Resource Potential Evaluation* published by the Geological Publishing House in 2012 reveals that Chinese shale gas geological resource potential and technically recoverable resource reach 134.42 and 25.08 trillion cubic meters (excluding Qinghai and Tibetan), respectively. Table 1 shows the distribution of shale gas geological resource potential and technically recoverable resource in China [2].

**Table 1. Distribution of shale gas geological resource potential and recoverable resource potential in China**

<table>
<thead>
<tr>
<th>Area</th>
<th>Geological resources (Trillions of cubic meters)</th>
<th>Percentage (%)</th>
<th>Technically recoverable resources (Trillions of cubic meters)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Yangtze and Dian-Qian-Gui</td>
<td>62.56</td>
<td>46.54</td>
<td>9.94</td>
<td>36.92</td>
</tr>
<tr>
<td>North and Northeast China</td>
<td>26.79</td>
<td>19.93</td>
<td>6.7</td>
<td>26.70</td>
</tr>
<tr>
<td>Mid-lower Yangtze and Southeast</td>
<td>25.16</td>
<td>18.72</td>
<td>4.64</td>
<td>18.49</td>
</tr>
<tr>
<td>Northwest China</td>
<td>19.9</td>
<td>14.81</td>
<td>3.81</td>
<td>15.19</td>
</tr>
<tr>
<td>Total</td>
<td>134.42</td>
<td>100</td>
<td>25.08</td>
<td>100</td>
</tr>
</tbody>
</table>

China focused on tracking surveys on the U.S. shale gas development before 2005. China has begun to conduct preliminary research on domestic shale gas exploration since 2005. At present, China’s shale gas achieves considerable progress. In line with the Ministry of Land and Resources (MLR), China’s shale gas production totaled 1.3 billion cubic meters (bcm) in 2014 [3]. Many national oil enterprises (PetroChina, Sinopec, Yanchang Petroleum, etc.) and non-oil-gas companies (China Huadian corporation, Huaneng Group, Shenhua Group, etc.) in China have involved in shale gas industry in recent years. Compared with other Chinese companies, Sinopec invests more capital in shale gas industry and achieves greater achievements in shale gas exploration and development. In July 2014, the MLR verified proven reserves of nearly 107 billion cubic meters in Fuling shale gas field, signaling the official launch of the commercial development of China’s first large shale gas field. As of December 2014, accumulated shale gas production from Fuling field of Sinopec reached 1.13 bcm [4], demonstrating that most of China’s shale gas production comes from Sinopec Group. Sinopec also announced that Fuling will establish 5 bcm of annual production capability in 2015 and 10 bcm of annual production capability in 2017.

In recent years, the Chinese government has issued numerous policies (fiscal policy, science and technology policy, land policy, etc.) to develop shale gas industry. In December 2011, the MLR approved shale gas as an “independent mineral.” In November 2012, the Ministry of Finance and National Energy Administration (NEA) issued Notice on Introduction of Subsidy Policy for Development and Utilization of Shale Gas, which stipulates that shale gas mining companies will receive a subsidy of 0.4 yuan per cubic meter for 2012-2015. In October 2013, the NEA issued Policy for Shale Gas Industry, which proposes systematic industrial policies, mainly including industry regulation, demonstration area construction, marketing and transportation, and environmental protection. The Action Plans for Energy Development Strategy (2014-2020) released by the State council in October 2014 proposes that China should focus on the development of shale gas in the next few years.

After several years of independent research, China has mastered many exploration and development technologies of shale gas including assessment method for shale gas resource, method of seismic data
acquisition & processing, drilling fluid design, reservoir identification & prediction, horizontal drilling and staged fracturing technology, fracture detection and evaluation technology, etc. China also has comparatively mature technology in manufacturing of drill, fracturing truck group, downhole tools, and so on [5]. For example, batches of drilling equipment produced by Sichuan Honghua Petroleum Equipment Corporation have been exported to the U.S for shale gas development. In March 2014, Yantai Jereh Oil field Service Group produced the first world fracturing truck equipped with turbine engine of 4500 horsepower. The debut of this fracturing truck allows China to be the third country that possesses turbine fracturing equipment after the U.S. and Russia.

3. Outlook of the Chinese shale gas industry

Based on the analysis above, we can know that China has abundant shale gas resources and Chinese major state-owned oil and gas companies make certain breakthrough in exploration, exploitation and technology. Under the current progress, however, China will not be able to accomplish the government goal for shale gas output of 6.5 bcm by 2015. It is also difficult to meet China’s 2020 target of 30 bcm. The possible reason is that China’s shale gas industry still encounters many daunting problems (overlapping mineral rights issue, lack of regulatory system, immature technology, environment risk, inadequate infrastructure). The extent to which the Chinese government solves these problems will determine the prospects of China’s shale gas sector.

3.1. Overlapping mineral rights issue and imperfect mining right exit mechanism

Up to now, 77% of China’s shale gas favorable blocks and 80% of resources potential overlap with the existing oil-and-gas blocks of state-owned companies such as Sinopec Group and CNPC [6]. According to the Notice on Strengthening the Exploration, Exploitation, Supervision and Administration of Shale Gas Resource issued by MLR on November 22th 2012, state-owned oil companies would be granted to preferentially conduct shale gas exploration and exploitation in the existing oil-and-gas blocks [7]. Taking into account economic benefits, those enterprises target tight gas as a top priority of unconventional gas resources to be exploited instead of shale gas and their investment in shale gas exploration is limited. In consequence, most of shale gas blocks in the existing oil-and-gas areas remain unexploited, which deeply hinder shale gas progress in China. Furthermore, due to the imperfect mining right exit mechanism, bidding blocks provided by the MLR are mainly located in blank areas outside the present oil-and-gas blocks. And those bidding blocks, in general, bear poor basic conditions, geographic position and resource condition [8]. At the beginning of shale gas exploration, selecting poor quality blocks for bidding will dent and shake the confidence of investors and undermine the long-term progress of shale gas industry. How to complete mining right exit mechanism and settle the problem of overlapping mineral rights represents the major challenge facing China’s shale gas development.

3.2. Lack of regulatory system

The lack of regulatory system displays an important obstacle to China’s shale gas development. China’s supervision on oil and gas industry without specialized laws, regulations and national standards, relies heavily on the self-discipline of the enterprises. What’s more, there’s no independent and centralized regulatory institution in China to supervise conventional and unconventional natural gas development. Regulatory functions of shale gas are dispersed into different government departments without coordination. Furthermore, inadequate supervisory personnel also contribute to the imperfect
supervision mechanism. At present, the total number of supervisory staff including those of NEA and MLR is less than 100, much lower than that of the U.S. shale gas industry [9].

3.3. Immature technology

Researches of major shale gas techniques in China have just started and a fully-developed system for shale gas exploration and development technologies has not yet been formed. With regard to exploration, techniques such as seismic identification for shale gas, output prediction and well location deployment are still in the infant stage. As for drilling and well completion, drilling period is long with high cost due to the inadequacy of reservoir protection design, drilling fluid design, logging while drilling technology and geosteering technology. As for staged fracturing techniques, reservoir evaluation, design of staged fracturing and fracture monitoring techniques are mainly controlled by foreign companies. Shale gas exploration and exploitation technologies have been fully developed in the United States. However, technologies abroad are not always suitable for China’s geological conditions for the reason that there are many differences in geological and surface conditions between the U.S. and China. In view of this, China may enhance its own shale gas industry with reference to experience and technologies of U.S., but the U.S. model of shale gas development cannot be fully copied.

3.4. Potential environmental risk

The U.S. practice shows that water pollution, CO$_2$ and methane emissions, geological hazards, surface ecological damage, and other environmental problems may occur in the process of shale gas exploration and development [10]. In comparison with the United States, China’s geological conditions and surface conditions of shale gas are generally complex. Therefore, the shale gas exploitation activities are likely to bring a greater threat to China’s ecological environment.

3.5. Inadequate infrastructure

The U.S. already had an extensive network of pipelines to transport natural gas to market before shale gas became a major gas resource [11]. At present China’s natural gas pipeline network is poor, and the total mileage of pipeline just reaches 80000 kilometers by the end of 2014 [12]. In addition, shale gas resource rich regions in China are mostly concentrated in the central and western mountainous area according to the “Survey and Assessment of National Shale Gas Resource”, which makes it hard and expensive to construct pipelines, transport shale gas and expand downstream market.

4. Conclusions and policy implications

In recent years, the Chinese government has paid much attention to exploration and development of shale gas, to ease the outstanding contradiction between natural gas supply and demand. Many development plans and industry polices have been carried out and progress has been made in shale gas exploitation with the participation of both national oil companies and non-oil-gas enterprises. However, to achieve further development of shale gas, China still encounters many serious problems: overlapping mineral rights issue and imperfect mining right exit mechanism, lack of regulatory system, immature technologies, potential environmental risks, and inadequate infrastructure. The findings of this paper have many important policy implications as follows:
First, China’s government should make overall planning for shale gas development, scientifically formulate shale gas strategic positioning, development pattern and supporting policies, and promote the sound and rapid development of China's shale gas exploration and exploitation [13].

Second, it is critical to perfect mining right exit mechanism and solve the overlapping mineral rights issue. To begin with, stop the continuation of oil-gas mining rights of favorable shale gas blocks which are outside of the oil and gas proven and controlled reserves distribution areas. Next, reinforce the mining right exit mechanism and deal with the problem of overlapping mineral rights according to law. The MLR should be authorized to reclaim blocks which are below the required exploration standard and those reclaimed blocks can call for new tenders. Finally, dramatically raise the standard of minimum exploration investment and reconfirm whether state-owned oil companies reach the new standard.

Third, China should strengthen the independent research of shale gas key technology, actively introduce and digest advanced techniques from the United States, and form a technique system of exploration and development matching Chinese geological conditions [14].

Fourth, it is important to establish shale gas regulatory system with emphasis on environmental protection. The Chinese government should introduce a series of environmental standards and strengthen environmental supervision of shale gas. Meanwhile, the government should develop targeted environmental monitoring tools and techniques, enhance environmental protection and social responsibility consciousness of shale gas companies, and achieve sustainable development of shale gas industry.

Finally, it is important to promote the construction of shale gas supporting infrastructure, especially natural gas pipeline network. The Chinese government should further perfect the Measures for Regulation of Fair and Open Access to Oil and Gas Pipeline Networks which was issued by the NEA in February 2014, to strengthen supervision of opening natural gas pipelines network.

5. Copyright

Authors keep full copyright over papers published in Energy Procedia

Acknowledgements

This research was financially supported by the National Natural Science Foundation of China (Grant NO. 71273277) and the Philosophy and Social Science Major Issue Research Project (Grant NO. 11JZD048).

References


**Biography**

Dong Xiucheng is a Professor in the School of Business Administration of China University of Petroleum. His research areas are energy strategy and energy economics. He is well-known as one of “The Most Active Expert and Scholar in Modern China” and has been an advisor for many governmental decisions.