

## Study on the Development of Shale gas and its Countermeasures in China

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### Abstract

**This paper briefly describes the basic concept of shale gas, and analyzes its generated characteristics, shale gas accumulation characteristics increases the difficulty of exploitation, thereby mining technology is extremely important. Based on the investigation of the mining situation of domestic and international shale gas, the necessity of development of shale gas industry in China is analyzed. Finally several constructive suggestions are put forward based on the development of shale gas in our country, and a valuable exploration is provided in order to speed up the development of shale gas in China.**

### Keywords

**Shale gas; Current situation of the development; The development countermeasures.**

### 1. The Concept and Characteristics of Shale gas

Shale gas: It refers to the unconventional natural gas that is concentrated in rich organic matter in the mud shale and interlayer and adsorption or Free State as the main form of existence, it is a kind of clean and effective energy resources.

The production of shale gas has its unique characteristics, at the same time, the life of exploitation and production cycle is longer in development. Most of the shale gas fields have wide distribution, large thickness, as well as the common gas <sup>[1]</sup>, which allows shale gas wells to be produced at a constant and steady rate. Compared with conventional gas reservoir, the development of shale gas reservoir has the characteristics of poor reservoir physical property, low porosity and low permeability, high air resistance, low recovery ratio and long mining time. The reservoir of shale gas reservoirs in China is different from other countries, gas reservoir buried deeper, therefore, China's shale gas exploration and development should be adapted to local conditions, and China's specific geological conditions are needed to consider when mining. Shale gas field production cycle is long, the mining life can be up to 30-50 years, or even longer.

The above characteristics of shale gas reservoir development will increase the difficulty of mining, while the technology will have a very high demand. Low yield problem caused by lower recovery ratio of shale gas will affect people's enthusiasm for it. To this end, in order to obtain a higher return on business, you need to speed up the drilling speed, improve the production capacity of a single well, and extend the duration of the mining to reduce the cost of production.

### 2. Research on development status at home and abroad

#### 2.1 Development status of shale gas in China

China shale gas resource potential is huge, including marine shale gas resources as the main force. The four major shale gas producing areas were Preliminarily formed: Sinopec's Fuling shale gas field, two gas producing areas of PetroChina's Changning and Weiyuan, as well as the extension of the oil

group in the Ordos Basin shale gas producing areas and shale gas producing area of Ordos Basin of Shaanxi Yanchang Petroleum. Development of technology and basically achieve localization, through commercial development of shale gas in Sichuan basin and Ordos Basin, as well as the exploration and development of shale gas in Henan, Inner Mongolia and other places, at present, China has initially mastered a series of exploration and development technologies of shale gas from the earth physics to fracturing test gas, and the integration technology of shale gas exploration and development project is formed. With the development of shale gas exploration and development, China shale gas pipeline construction and the project of comprehensive utilization has been implemented timely, and the vertical integration of exploration and development, network construction and comprehensive utilization has been achieved. For the area that pipeline construction is difficult and is not conducive to commercial development, the local consumption of shale gas comprehensive utilization project will has more obvious advantages. And the policies and standards related to shale gas are gradually improved, In order to encourage, accelerate, standardize and guide the development of shale gas industry<sup>[2]</sup>, China's national energy board, the Ministry of finance, the national development and Reform Commission and local government agencies at all levels have introduced a variety of policies and standards, covering the resource management in the shale gas industry, financial incentives, market and price, infrastructure, technical research and foreign cooperation and other aspects. The standard system of shale oil and gas resource evaluation and exploration and development is gradually improved. The development of shale gas in China is shown in table 2-1:

Table 2-1 shale gas development time

Critical factor	In 2011	In 2012	In 2013	In 2014	In 2015
Prospecting	—	—	—	proving recoverable amount 510bcm	—
Exploitation	Successful fracturing of the first shale gas well	6 wells in succession	—	—	Rapid increase in production capacity
Well drilling	PetroChina has completed the first well	With the bidding, exploration progress and technical progress, the number of drilling wells increased	—	—	Rapid increase in drilling
Technical progress	—	Technical reserve stage	Cooperative learning phase	—	Technology maturity stage
Mining policy	—	As an independent mineral	Improve taxation, subsidies, and scientific and technological support	—	—
Mining right management	First bidding	Second bidding	Tender mechanism mature	—	—
Natural gas price reform	—	Guangxi, Guangdong pilot unified station price	—	Although the price adjustment cycle is short, the scope of the pilot has expanded	—

## 2.2 Development status of shale gas in foreign countries

Successful exploitation of shale gas makes the United States rank the first largest gas producing country in the world. In the 2000-2010 decade, shale gas dry gas production in the U.S. increased from 11 billion cubic meters to 137 billion 800 million cubic meters; The United States shale gas wells increased from 28 thousand in 2000 to more than 40 thousand in 2008; the proportion of shale gas in natural gas consumption in the U.S. also jumped from 1% in 2000 to the current 30%. Shale gas development has greatly improved the pattern of U.S. natural gas supply and energy security situation, its share of U.S. natural gas production increased from 1.6% in 1996 to about 23% in 2010<sup>[3]</sup>, and the United States becomes the world's largest producer of natural gas and resource state overtaking Russia in 2009. With the progress of technology and the continued increase in proven reserves, the future development of shale gas will enter the explosive growth period, which drives the production of natural gas in the United States to enter the "golden age".

Canada is the second country after the United States to achieve commercial exploitation of shale gas, in 2009, its production has reached 7.2 billion cubic meters. Currently the world has more than 30 countries to develop the work of shale gas exploration and development, but the development of shale gas in the country outside North America is still in the primary stage. In the next ten years, shale gas production will still be limited to North America, since then, the mainland will generally establish the production base of shale gas and unconventional oil and gas, and it will gradually become an integral part of the global production of hydrocarbons.

Technical recoverable resources volume of shale gas in European can be relatively low, but widely distributed and mainly concentrated in Poland, France, Norway, Ukraine and Sweden and other countries. The shale gas recoverable resources in Poland for is the most in Europe, it is expected in the next 10-15 years that Poland can provide 20 billion -30 billion cubic meters of natural gas per year. In addition, Germany, the United Kingdom, Spain and other countries have begun to carry out shale gas research and tentative development, some enterprises have started commercial exploration and development. But in France, the related mining activities has been temporarily stopped because of concerning about the greater negative impact that exploitation of shale gas will bring on water management. On the whole, Due to the lack of large oil service industry in Europe, dense population, more political constraints, and there is a more stringent environmental requirements, it is still far from achieving large-scale commercial development of shale gas in Europe.

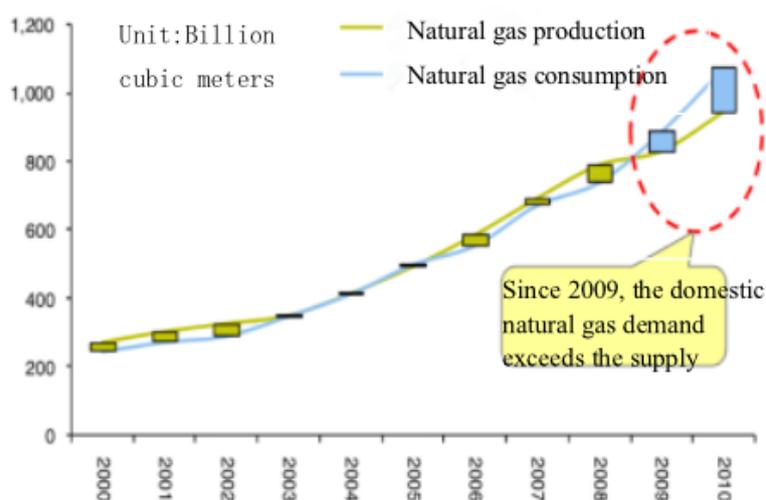


Figure 3.1 natural gas demand in short supply

## 3. The necessity of the development of shale gas industry in China

Energy shortage has become a stumbling block to the rapid development of society and economy in the long term, Since China entered into the period of rapid economic development. In view of the

rapid growth of the energy needs of China's industrial and agricultural production and the people's living and consumption, the increase of domestic energy supply gap, as shown in Figure 3.1, and the increasing dependence on energy imports, from the strategic point of view of national energy security, it should be as soon as possible to find alternative energy sources to avoid the potential energy crisis. In 2014, the new strategic thinking of the development of China's energy security was clearly put forward in the energy conference by Xi Jinping<sup>[4]</sup>, that is "the four revolution and cooperation", which further illustrates the importance of energy security issues, and also marks China's entry into the new era of energy production and consumption revolution.

## **4. Countermeasures and Suggestions of shale gas exploration in China**

### **4.1 To strengthen the strategic planning of shale gas**

The exploration and development of shale gas in China should be based on the national strategic height, so that shale gas industry can become an important way to change the mode of economic growth and ensure the security of energy security. Simultaneously, a series of support policies conducive to the development of shale gas industry need to be developed and implemented, the strategic position of shale gas development also need to be protected. And the formulation of development measures of local governments should attach to the central government's policy, so the advantages of shale gas resources in various regions should be considered from whole country. those areas with rich resources should be focused on and developed, and the policy support of capital, talent, taxation should be given, and the relevant laws and regulations should be established to protect the implementation of the policy, the area with the advantage of resource endowment and the government should be guided to pay attention to the development and development of shale gas. And then shale gas development concept can be conducted to the various regional enterprises through the local government's strategic planning and layout of shale gas, the fiscal revenue, technological innovation, industrial support and other policies that are conducive to the development of shale gas should be launched.

### **4.2 To improve relevant system of Shale gas development**

Firstly, the mining rights management system of shale gas should be established. Shale gas will be established as an independent mineral that is different from the conventional natural gas and special shale gas block registration system should be established. Learning the United States experience, the mining right management system that improve the enthusiasm of the local government and enterprises should be established combined with China's national conditions. Shale gas blocks registration takes measures of the registration of new minerals, mining rights transfer adopt the form of competition. Those who fail to meet the requirements of the investment or the output of the mine is not up to the standard within the prescribed time period, are forced withdrawal. Secondly, the support policy of finance and taxation should be made. The establishment of the tax system of shale gas can draw lessons from the conventional energy sources, coal bed gas and foreign policy support measures, and our country's finance and tax policies should be developed according to the national conditions. In addition to the basically reducing income tax, VAT and other tax policies, the cost of the exploration and mining can be reduced for shale gas mining right people, those equipments which can not be produced by domestic technology can be exempted from customs duties. The implementation of these policies can reduce the cost of enterprises to encourage enterprises to invest in equipment.

### **4.3 Making full use of the role of private enterprise**

The market access should be properly liberalized in the early stage of the development of the industry, the diversification of investment subjects should be increased, the role of private enterprises should be fully played, the research and development of technology must be supported and encouraged, cultivation of specialized service system is supposed to proceed in a planned way. At the same time, the market access standards should be scientifically formulated. As long as qualified development domain, such as small and medium-sized enterprises and private capital should be encouraged. In view of this, China should attach importance to the role of different market players, the preferential

policies of private enterprise access must be formulated, on the basis of fully taking into account the differences between state-owned enterprises and private enterprises, the support policies for state-owned enterprises and private enterprises are supposed to be differently treated.

#### **4.4 Strengthening the construction of pipeline network and related infrastructure**

The ultimate goal of shale gas development is the use, infrastructure will be the key to the use of shale gas. Firstly, for the development zone that the natural gas pipeline network is more perfect, the transmission pipeline can be directly constructed, and natural gas pipeline network can be used to enter the shale gas. Secondly, for the Shale gas area far from the natural gas pipeline network, the fair access mechanism for shale gas pipeline network can be established, establishing their own pipe network in local governments and enterprises should be encouraged. Thirdly, the external transmission pipeline equipment should be constructed in real time according to the development situation of shale gas field <sup>[5]</sup>. The experience of the United States can be learned from, the competition should be open, and market supervision must be strengthened. In the pipe network facilities construction, market competition mechanism should be given full play to allow more small and medium enterprises to enter, the construction right of shale gas area can be obtained through bidding, the withdrawal of investment can be charged through the pipe network rent.

#### **4.5 Improving the development of technology to reduce production costs**

The biggest problem in Shale gas exploitation is the gas is adsorbed closely in the rocks which is difficult to be produced, so the single well gas output is low, and gas cost cannot be quickly recovered, which results in high cost of natural gas units. To achieve large-scale commercial exploitation, not only drilling gas recovery but also reducing the cost of production to achieve a higher rate of return are very critical. Continuous progress of technology is the key of promoting the decline in the cost of shale gas in the United States and achieving large-scale commercial exploitation from the American Experiences.

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