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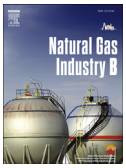

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Research article

Prospects of and challenges to natural gas industry development in China

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Abstract

An unprecedented breakthrough has been made over the past decades in natural gas industry, which helps improve energy mix and promote the low-carbon economy in China. With such abundant hydrocarbon resources, China owns two intensive oil and gas producing blocks in the Ordos Basin and Xinjiang province and two other concentrated gas producing blocks in Sichuan and Western South Sea. In addition, arterial gas lines have been connected as a gas grid all over China and natural gas market has become more and more mature and expanded. Thus, a natural gas industry system has come into being. However, with natural gas unevenly scattering all across China, the remnant resources mainly are distributed in the stratigraphic strata, deep strata in superimposed basins or in mature exploration zones, foreland basin thrust belts, marine gas fields, and so on. In reality, the future gas exploration should focus on such domains as the weathered crust karst reservoirs or carbonate and stratigraphic traps, deep clastic gas layers, and unconventional oil and gas plays. Achievements have been made in marine shale gas exploration, CBM gas steady development, and other unconventional natural gas resources. From the perspective of exploration potential, more giant oil and gas fields will be possibly discovered in deep strata or deep sea water, and stratigraphic hydrocarbon reservoirs and tight oil and gas reservoirs will also be the exploration focus. With the increase of exploration depth and degree, the overall oil and gas exploration cost will be significantly rising in general. New discoveries or reserves increase in natural gas exploration will highly depend upon research theory and technology progress, and such development technologies as 3D seismic survey, horizontal drilling and fracturing treatment will be more highlighted. Through enhancing the cost in natural gas exploration and development and strengthening the research of core technologies, natural gas industry will keep the trend of rapid growth in near future in China.

Keywords: China; Natural gas; Resource distribution; Residual resources; Deep sea water; Tight oil and gas reservoir

With the rapid development of world economy and continuously increasing population and energy consumption, the emission of greenhouse gas and a variety of harmful substances has surged sharply, leading to a deteriorated living environment for human beings. Faced with these challenges, clean and high-calorific-value natural gas energy has drawn more and more attention, and developing the natural gas industry has become the best option for the world to improve the environment and promote sustainable development of economy.

1. The status quo and development trend of global natural gas industry

1.1. The status quo of global natural gas industry development

Currently, oil and natural gas are among the most important primary energy sources and enjoy an important standing in the structure of global energy consumption. According to statistics, the global primary energy consumption was 124.8×10^8 t oil equivalent in 2012, an increase of 1.8% compared with that in 2011. The structure of energy consumption reveals that, the fossil energy sources including oil, natural gas and coal are still the most dominant in the world. Oil consumption accounts

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for 33% of global primary energy consumption, natural gas 24%, and coal 30%. The data is sourced from *BP Statistical Review of World Energy 2013*.

In 2012, the total primary energy consumption in China was 27.35 × 10^8 t oil equivalent, with coal, oil and natural gas being the main components. According to statistics, coal consumption was 18.73 × 10^8 t oil equivalent, accounting for about 68%; the oil consumption was 4.84 × 10^8 t, accounting for 18%; and natural gas consumption was 1438 × 10^8 m^3 (about 1.30 × 10^8 t oil equivalent), accounting for 4.8%. The total consumption of these three kinds of fossil fuels accounts for approximately 91% of the total consumption of primary energy sources in China. But as viewed from their respective consumption, coal is still the main component in energy consumed in China, while the proportion of natural gas in primary energy consumed in China is not high, with a big gap from the average proportion (24%) of the world natural gas consumption.

The global natural gas output is basically equal to the consumption. In 2012, the global natural gas output was 3.36 × 10^{12} m^3 and consumption was 3.31 × 10^{12} m^3. At present, natural gas output is quite uneven throughout the world. In 2012, the total gas output of top 10 countries in the world, including the United States, Russia, Iran, Qatar, Canada, Norway, China, Saudi Arabia, Algeria and Indonesia, reached 2.23 × 10^{12} m^3, accounting for about 66.4% of the global total. China reported a gas output of 1072 × 10^8 m^3 in 2012, ranking the 7th in the world.

There is a resource basis for further development of global natural gas industry. According to an appraisal by the United States Geological Survey (USGS) on conventional oil and/gas resources of the world, the global remaining technically-recoverable resources of conventional oil (including natural gas liquid) are 2550 × 10^8 t, and the global remaining technically-recoverable resources of conventional natural gas are 462 × 10^{12} m^3. According to the definition given by USGS, the remaining technically-recoverable resources include remaining recoverable reserves, to-be-discovered technically-recoverable resources to be identified, and reserve increment growth.

The world is abundant with unconventional gas resources, and in the future the exploration and development potential will be huge. According to the appraisal by USGS, the global remaining technically-recoverable resources of unconventional gas (coalbed gas, tight gas and shale gas) are 328 × 10^{12} m^3 (Fig. 1), and those in the Asia–Pacific region account for 39.5%.

Energy demand has become the focus of attention all over the world. In recent years, a number of institutions and organizations have been carrying out energy development trend forecast, and the most representative forecast was made by International Energy Agency (IEA). According to the forecast made by IEA, as impacted by the active control on energy demand and the strict energy policies enforced in various countries, the total demand for primary energy throughout the world will reach up to 172 × 10^8 t oil equivalent by 2035, with an annual growth rate of 1.2%. Fossil energy sources (oil, natural gas and coal) will remain dominant and account for about 75% in total energy consumption; renewable energy will gradually catch up and a proportion of about 25% in total energy consumption is anticipated. According to the prediction results by IEA, the global natural gas output will be ramped up to 3.94 × 10^{12} m^3 in 2020 and 4.96 × 10^{12} m^3 in 2035.

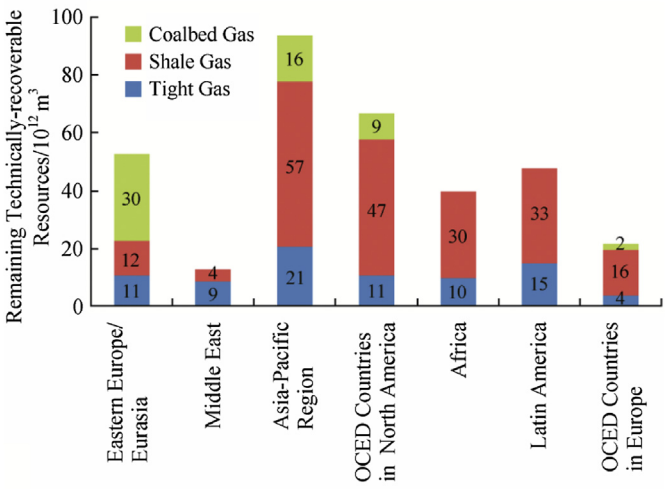

Fig. 1. Global distribution of remaining technically-recoverable unconventional natural gas resources. Notes: The data is sourced from USGS (2012); OECD refers to the Organization for Economic Co-operation and Development.

1.2. The development trend of global natural gas industry

An analysis on global gas market and transportation situations of natural gas throughout the world reveals that the following five trends will appear in natural gas industry development.

1.2.1. The global natural gas consumption will continue to grow rapidly and continuously, with the Asia–Pacific region enjoying the highest growth rate

According to the statistics of BP, in 2012, natural gas consumption of OECD (Organization for Economic Co-operation and Development) countries was 1.59 × 10^{12} m^3, an increase of 2.5% compared with that in 2011, constituting 47.92% of the global total. Natural gas consumption in non-OECD countries was 1.73 × 10^{12} m^3, an increase of 2.0% compared with that in 2011, constituting 52.08% in the global total. With respect to natural gas consumption in different regions, except for Europe and Eurasia with consumption decrease, the consumption in all other regions has been on the rise steadily. In particular, the Asia–Pacific region saw a rapid rise of the proportion of natural gas consumption in the global total, from 12.5% in 2001 to 18.86% in 2012, recording the fastest growth rate in the world (Table 1).