Study on the Natural Gas Consumption and its Change Prediction

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Abstract. The global total natural gas consumption has risen to 3.67 trillion cubic meters in 2017 according to BP statistics. It is predicted that natural gas will be “the first one” in all primary energy before 2040. The global natural gas demand is expected to reach 4.9 trillion cubic meters respectively in 2040, accounting for 26.9% in the total primary energy consumption. The natural gas consumption analysis shows that the total consumption in the top twelve natural gas consumption countries accounts for 64.5% of the global. The natural gas consumption in America and Russia exceeded one third of the world in 2015. The gas consumption in BRICS (Brazil, Russia, India, and China and South Africa) has risen dramatically since 1980s. After 1990s, the consumption in the Asia-Pacific region has been on the rise, and the cumulative increment took the first place from 1975 to 2015. The Asia-Pacific region is expected to be the new global consumption center after Europe and America. From the point of per capita consumption, North America, the Middle East and former Soviet Union with rich natural gas resources have exceeded to 2 tons of oil equivalent, nevertheless, the less-developed regions such as Asia-Africa-Latin America are below 0.5 ton of oil equivalent. The gas natural consumption in none-OECD countries exceeded that of OECD in 2007, and the gap has increased year by year. However, the per capita consumption of natural gas in OECD is 5.2 times of Non-OECD. The consumption pattern is mainly influenced by economy development, if natural gas production pattern by resource endowment.

1. Introduction
The total global natural gas consumption is 3.67 trillion cubic meters in 2017 according to BP statistics. Natural gas presents a steady growth not only in the total consumption, but also a rising proportion in the consumption structure of primary energy. It is predicted natural gas will become “the first one” among the primary energy consumption before 2040 [1-2]. It has great significance to have a detailed analysis on its current consumption and future prediction.

2. Countries
According to the data released by BP [3], The top twelve countries in natural gas consumption are the United States, Russia, China, Iran, Japan, Canada, Saudi Arabia, Germany, Mexico, UK, United Arab Emirates and Italy, whose total consumption accounts for 64.5% of the global consumption. America and Russia are two biggest consumption countries, 778 billion and 391.5 billion cubic meters, accounting for
22.4% and 11.3% respectively of the global. The natural gas consumption in the two countries is more than one third of the world [3]. According to the natural gas consumption and proportion from 1985 to 2015, these countries are traditional main natural gas consumption countries, but the proportion of consumption shows the declining tendency.

However the consumption per capita in different vary greatly. The natural gas consumption is concentrated in the region with abundant natural gas resources such as North America, the Middle East and the former Soviet Union, and their consumption per capita is over two tons of oil equivalent. Then, the consumption per capita in Europe, the Asia-Pacific region (mainly in Australia and a few countries in Southeast Asia) and some countries in Central and South America is 1 to 2 tons of oil equivalent. The consumption per capita in most underdeveloped regions such as Asia, Africa and Latin America is the lowest, which is below 0.5 ton of oil equivalent.

3. Continents
The natural gas consumption in six continents, Europe (including Russia), North America, Central and South America, the Middle East, Africa, the Asia-Pacific is on the rise overall from 1965 to 2015 (Fig. 1). Up to now, in addition to the natural gas consumption in Europe has peaked in 2008 (1.0335 trillion cubic meters), the consumption in other continents has all peaked in 2015. The natural gas consumption in Europe reaches 655.9 billion cubic meters in 1981, which exceeds North America. The consumptions in Africa, the Middle East, the Asia-Pacific, Central and South America, Europe and North America have been risen by 135.3, 131.5, 119.8, 12.3, 6.4 and 2.1 times respectively from 1965 to 2015; the annual growth rates are 10.5%, 10.4%, 10.3%, 5.3%, 3.9% and 1.5% respectively; the increment is 134.5, 486.5, 695.3, 160.1, 847.5 and 499.8 billion cubic meters respectively. With the completion of the industrialization in the United States and Europe, economic growth has slowed down as well as the demand for natural gas. But the consumption amount is still large. The average annual consumption in Europe and North America from 1965 to 2015 is 17 times and 15 times as large as that in Africa respectively, which is “A lean camel is still bigger than a horse”. After 1990s, the economy in the Asia-Pacific region has developed rapidly, and the demand for natural gas have been on the rise. The cumulative increment occupies the second in the world from 1965 to 1974 and exceeds Europe to take the first place from 1975 to 2015. The Asia-Pacific region is expected to be the next center of global natural gas consumption after Europe and America.

The proportion of natural gas in diffident continents from 1965 to 2015 (Fig. 2) is more complicated. The proportion in North America has declined, which is from 72.7% in 1965 to 27.8% in 2015. The proportion in Europe has increased first and then decreased, which is 45.2% in 1981, exceeding the 43.1%
of North America. The proportion in other four continents keep increasing. However, the proportion in the Asia-Pacific region is from 0.9% in 1965 to 20.2% in 2015, Central and South America from 2.2% to 5.0%, the Middle East from 0.6% to 14.1%, and Africa from 0.2% to 3.9%. In 1973, the proportion in the Asia-Pacific region exceeds Central and South America, and the gap is enlarging. These data also implied that the development in the Asia-Pacific region is faster than the rest three continents, and its economic strength has been significantly improved. Therefore, there are closely positive correlations between natural gas consumption and economic development.

![Figure 2. Proportion of Natural Gas Consumption in Different Continents from 1965 to 2015 (Data sources: [3])](image)

The natural gas consumption and proportion in different continents in 2015 are shown in Table 1. Among them, the natural gas consumption in Europe (including Russia) is the largest, which reaches 1.0035 trillion cubic meters, accounting for 28.9% of the total. The North America is 963.6 billion cubic meters, accounting for 27.8%, ranking the second. The Asia-Pacific region is 678.6 billion cubic meters, accounting for 20.2%, ranking the third. The Middle East is 490.2 billion cubic meters, accounting for 14.1%, ranking the fourth. The Central and South America is 174.8 billion cubic meters, accounting for 5.0%, ranking the fifth. The Africa is 135.5 billion cubic meters, accounting for 3.9%, ranking the last. Obviously, Europe and North America are two centers of global natural gas consumption, and the total consumption in these two centers accounts for 56.7% of the global.

![Table 1 The Gas Consumption (100 million cubic meters) and Corresponding Proportion (%) in Six continents in 2015(Data sources: [3])](table)

|                | Europe | North America | Asia Pacific | Middle East | Central-South America | Africa | Total  |
|----------------|--------|---------------|--------------|-------------|-----------------------|--------|-------|
| Consumption    | 10035  | 9636          | 6786         | 4902        | 1686                  | 1233   | 33476 |
| Proportion     | 28.9   | 27.8          | 20.2         | 14.1        | 5.0                   | 3.9    | 100.0 |

From the viewpoint of per capita consumption, the natural gas consumption is concentrated in the region with abundant natural gas resources such as North America, the Middle East and the former Soviet Union, and their consumption per capita is over two tons of oil equivalent. Then, the consumption per capita in Europe, the Asia-Pacific region (mainly in Australia and a few countries in Southeast Asia) and some countries in Central and South America is 1 to 2 tons of oil equivalent. The consumption per capita in most underdeveloped regions such as Asia, Africa and Latin America is the lowest, which is below 0.5 ton of oil equivalent.
4. Developed and Developing Countries
According to the region divided from the degree of economic development, natural gas consumption in both OECD countries and none-OECD countries are on the rise. The former was from 500 billion cubic meters in 1965 to 1.62 trillion cubic meters in 2015, which has increased 3.25 times with the annual growth rate of 2.5%. The latter was from 150 billion cubic meters in 1965 to 1.86 trillion cubic meters in 2015, which has increased 12.1 times with the annual growth rate of 5.3%. Obviously, the increase of natural gas consumption in OECD is much less than that of in none-OECD. The none-OECD exceeded OECD in consumption in the year of 2007, and the gap has an increasing tendency year by year (Fig. 4). In recent years, the main reason for small increase of OECD natural gas consumption is that European Union, the main part of OECD, has a depressing consumption, even a negative growth.

From 1965 to 2015, the proportion of natural gas consumption in OECD and none-OECD presents some kinds of “scissors-shaped”, and the gap is narrowing. The proportion of natural gas consumption in OECD has declined, which is from 76.4% in 1965 to 46.5% in 2015, and the proportion in none-OECD countries has climbed to 53.5% in 2015 from 23.6% in 1965. Nevertheless, the gap is widening again in the early 1990s (The US created a “new economy” era because of their robust economic development) (Fig.3). However, from the consumption per capita, the natural gas consumption per capita in OECD is 1160 cubic meters in 2015, the consumption per capita in none-OECD is only 220 cubic meters.

![Figure 3. The Consumption of Natural Gas Consumption in OECD and None-OECD from 1965 to 2015 (Data sources:[3])](image-url)

If the world is divided into three groups, OECD (representing developed countries or economics), the BRICs (representing emerging economics) and other countries (except for OECD countries and the BRICs). The natural gas consumption in these three groups is on the rise overall from 1965 to 2015. But
the proportion of OECD countries has declined, the proportion of BRICs and other countries has increased continually shown in Figure 4.

![Figure 4](image)

**Figure 4.** The Natural Gas Consumption in OECD, BRICs and Other Countries from 1965 to 2015 (Data sources:[3])

5. Future Prediction

The global demand for natural gas will continue to grow till the year of 2040. According to the reference scenario, the global natural gas demand is expected to reach 3.9 trillion cubic meters and 4.5 trillion cubic meters and 4.9 trillion cubic meters respectively in the year of 2020, 2030 and 2040, accounting for 24.9%, 25.7% and 26.9% in the total primary energy consumption accordingly (Fig. 5). The annual growth rate of natural gas consumption is 3.3%, which ranks the first among the three fossil fuels. Over the next 30 years, global gas consumption will reach 126 trillion cubic meters, 2 times as much as the accumulative amount in the past 30 years.

Global natural gas consumption per capita in 2015 was 486.6 cubic meters. As predicted, the global consumption per capita will keep growing till 2040. Under the reference scenario, global consumption per capita will be 507 cubic meters in 2020, 541 cubic meters in 2030, and 552 cubic meters in 2040.

![Figure 5](image)

**Figure 5.** Global Natural Gas Consumption from 2015 to 2040
6. Conclusion
It is predicted that natural gas will be “the first one” in all primary energy before 2040. The global natural gas demand is expected to reach 4.9 trillion cubic meters respectively in 2040, accounting for 26.9% in the total primary energy consumption. The natural gas consumption in Asia-Pacific region is increasing rapidly, which is expected to be the new global natural gas consumption center after Europe and America. The total consumption of the top twelve natural gas consumption countries accounts for 64.5% of the global. The natural gas consumption in America and Russia exceeded one third of the world in 2015. The gas consumption in BRICS (Brazil, Russia, India, and China and South Africa) has risen dramatically since 1980s. The consumption pattern is mainly influenced by economy development, if natural gas production pattern by resource endowment [4-5]. Natural gas industry has more characterized by high integration over the upstream, midstream and downstream industries, which can be more obviously restricted by the economic development (Zhou et al., 2009).

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References
[1] Scott Montgomery. Trans. Song Yang, Jiang Wenbo. The Trend of Global Energy. Beijing: China Machine Press. 2012
[2] Tong Xiaoguang. The Significance and Possibility of Fully Boosting the Proportion of Natural Gas in the Energy Mix. Natural Gas Industry 2010,(10)
[3] British Petroleum Company. 2016. BP statistical review of world energy 2015[R]. London: British Petroleum Company
[4] Zhang Kang. The Geographic Peripheral Oil and Gas between China and the Rest of the World. Beijing: Geological Publishing House. 2009
[5] Zhou Yuezhong, Li Ting. The Study of the Influence Factors on Consumption of Natural Gas. Market Modernization, 2008,(10): 187-188
[6] Zhou Zhibin, Zhou Yipei. The Foundation, Prospect and Strategy of Coordinated Development on the Industry Chain of China’s Natural Gas. Natural Gas Industry, 2009, (29)