



## Comparative Study on Chinese and Foreign Natural Gas Consumption

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### Abstract

Energy consumption in china mainly relies on coal and oil, however, burning coal, oil and other fossil fuel will cause a certain degree of environmental pollution inevitably, thus natural gas be used actively as a supplementary energy all over the world is a certain trend in the future. At present, developed countries use and consume natural gas are relatively mature than others, and in this paper, we use comparative study methods, qualitative and quantitative analysis of natural gas consumption between China and abroad, compared analysis of the status quo and Problems of natural gas consumption, we give some suggestions to promote the consumption of natural gas tend to more rationalize.

**Keywords:** Natural gas consumption, Comparative analysis, Qualitative and quantitative analysis

### 1. The importance of natural gas in China's energy structure

#### 1.1 The development trends of the global energy Structure

To date, the earth's energy is still based on coal and oil, however, due to the large number of coal and oil consumption trigger of the environmental issue has been aroused extensive attention around the world. burning oil or coal will emit a large amount of greenhouse gas, which has become a pollution--- One of the main culprits for the environment pollution, emissions of acid gas will further lead to the generation of acid rain, nitrogen oxides and hydrocarbons by the strong ultraviolet radiation resulting the secondary pollution --- photochemical smog, in addition, coal and oil post-combustion-generated floating dust has become one of the pollution Sources. A series of environmental pollution problems forced people to find a relatively clean alternative energy. Many developed countries today, including some major developing countries are trying to change this single energy structure and attempt through burn cleaner energy to reduce atmospheric pollution.

According to reports, the main reason for China's air pollution is fuels of power plants, industrial, commercial and vehicle exhaust emissions. So to solve the contradictions between the fuel Combustion and environmental development, it is bound to vigorously develop clean energy. However, the technology of the new energy in the word such as solar energy, wind energy, tidal energy and so on are not mature enough, have not open to a wide range of promotion, thus the relatively cleaner natural gas has become the key choice for the over-time.

Nature gas is Colorless and tasteless whose principal ingredient is methane, usually with a certain content of ethane, propane and small amount of nitrogen, sulfur. The products of nature gas combustion are mainly carbon dioxide and water, compared with other fossil fuels is a relatively clean energy. Nature gas distributes widely in the world, especially in China, the natural gas industry has just begun to enter the development stage, and it is an ideal alternative energy.

#### 1.2 An important strategic energy in the future

This problem has been studied previously (Ranbing Liu, 2008, p.28 )As of the end of 2007, the world's remaining proven recoverable natural gas reserves are 175 trillion cubic meters, the Middle East and Eurasia region are the richest areas of natural gas, the natural gas reserves accounting for the world's total of 75.8%, only the natural gas reserves in Russia, Iran and Qatar 3 States accounted for the world's total of 55.8 % .

According to industry expert estimates (Junwu Chen,2000,p.22)With the depleting of coal and oil resources, natural gas will replace oil or coal become the first energy in the world, thus greatly develop of natural gas could be weakening the relatively single China's energy structure and the relative shortage of energy reserves. Natural gas is one of the cleanest energy in fossil fuels, which mainly use as fuels for power plants directly, industrial furnaces and civilian, a small amount use as chemical raw materials (manufacture and synthetic ammonia, methanol, formaldehyde, acetic acid, etc.). The next century, when oil prices rose because of insufficient resources, widen the price gap with natural gas, natural gas converted to oil-- "gas oil change" (GTL) technology will be spread widely.

### *1.3 huge resources of natural gas ensure China's energy consumption*

It is reported on line that([http://www.sinopecnews.com.cn/shnews/content/2009-03/20/content\\_618259.htm](http://www.sinopecnews.com.cn/shnews/content/2009-03/20/content_618259.htm)) the development of natural gas has great potential, recoverable reserves of natural gas has reached 22.03 trillion cubic meters. As of the end of 2007, China's natural gas proven recoverable reserves are 3.61 trillion cubic meters, the level of resources proved only 16.39%, which is lower than the level of proven oil resources in 36.18%, natural gas exploration is still in the early stages of exploration, the proven reserves show rapid growth momentum.

Abundant reserves of natural gas resources have laid a solid foundation to ease the tension of domestic energy supply. Neighboring countries such as Russia, Kazakhstan, Indonesia, and Myanmar have rich natural gas resources; those could supply China a large scale of natural gas through trading. In recent years, scientists have discovered a large number of Natural Gas Hydrate not only in china, but also around the world. According to expert estimates, the volume of Natural Gas Hydrate resources could meet the needs of humanity more than 1000 years. The reserves and distribution area of Natural Gas Hydrate are so large. It is an invaluable and prized energy for human beings in the future. Natural gas will substitute for oil and coal as the world's best choice in the future.

## **2. Develop and take advantage of natural gas resources**

### *2.1 Current Situation of natural gas Consumption*

From 2000 to 2008, natural gas consumption was rapid growth. In 2000 the national natural gas consumption is 24.5 billion cubic meters, in 2008 to reach 72 billion cubic meters. China's total consumption is ranked number one in the world, but the per capita consumption in China is much fewer than some developed countries', which is equivalent to 1/3 of per capita consumption of developed countries.

### *2.2 The basic situation of the natural gas consumption industry*

Natural gas is relatively clean energy and could used in a variety of products. natural gas is also an important chemical raw materials, their chemical products are ammonia, urea, methanol, formaldehyde and ethylene, synthetic ammonia production in the world, about 80 percent use natural gas as raw material, 70 % of methanol production use natural gas as raw materials, natural gas can also be used in power generation, is widely used in civil and commercial gas stove, water heater and so on.

China begin to focus on large-scale use of natural gas as fuel for vehicles, most of our bus and taxi will be expected replaced by clean energy vehicles. The Chinese Petroleum Kunlun Mountains Oil & Natural Gas Company has just been set up, which involved in the use of natural gas vehicle business, the whole country to proceed immediately to lay out the compressed natural gas vehicle business. The next annual sales will be more than 100 million cubic meters of natural gas.

## **3. The basic characteristics of the world's major countries use of natural gas resources**

Gengliang Chen listed the table of natural gas consumption structure all over the world in 1998 (Gengliang Chen, 2002, p.232).

Inset Table 1 here

In 2006, world natural gas consumption was 105.5 trillion cubic feet. Consumption in Russian was 16.6 trillion cubic feet, consumption in the United States was 21.7 trillion cubic feet, natural gas consumption in Russia and the United States was over 36% of the world's total consumption. In the current the distribution and use of natural gas in Russia, the United States and Europe are relatively reasonable in the world. The objects of study in this article are Russia, the United States, Europe and China, in order to comparative analysis then finds out the gap between the use of China's energy consumption and other countries in the world.

### *3.1 Russia*

Russia's natural gas production in 2007 to 607.4 billion cubic feet equal to the world's total output of 20.66%, while its domestic consumption was only 438.8 billion cubic feet. Each year, the volume of exports of natural gas is about 200 billion cubic feet to establish Russia to become the world position as a major power, before that, Russia's main natural gas supply for European through gas pipelines. Today, there are some changes in the political situation between Russia

and neighboring countries, Russia wants to cooperate with China to build another natural gas pipeline extend to China's eastern coastal in order to weaken Ukraine controls of natural gas transmission.

### 3.2 United States

U.S. natural gas consumption in 2007 the largest sector ---- the industrial sector consumed 6.6 trillion cubic feet, the use of the electricity sector reached to 6.8 trillion cubic feet, in 2007 natural gas consumption of civil was 4.7 trillion cubic feet. Natural gas consumption of commercial sector was 3.0 trillion cubic feet.

Natural gas industry journal (Zhong Wang,1999, p.98) reported that United States natural gas for power generation has grown gradually from nothing, which now accounts for not only 14.3% of the total consumption of natural gas but also 9%of the total generating capacity (the structure of power generation in United States: coal-fired electricity accounts for 52%, 21% nuclear power, hydroelectric power accounted for 10% , oil and renewable energy power generation accounted for 9%, natural gas accounts for 9%) .

### 3.3 Europe

Natural gas is not only used in heating the city, fuel for taxis, but also many industrial enterprises are switching to natural gas fuel. Europe is not rich in energy due to the geographical conditions, but the European countries attach great importance to environmental protection, and it is precisely because of such a strong sense of environmental protection, environmental protection has become an enormous role to develop technology of production. There is no doubt that the future of our society is facing one of the greatest problems is how to use of renewable energy. The European universities and research institutions have set up new energy and energy and environmental research institutes, in the cross-connect partners in the field of applied basic research to study new energy and renewable energy, practical research and development, including solar, biomass, geothermal energy, energy rate of energy utilization and new energy.

## 4. Comparative Study of natural gas utilization between China and foreign country

### 4.1 Consumption structure

Energy Information Administration (<http://www.eia.doe.gov/neic/infosheets/natgasconsumption.html>) reported that World wide consumption of natural gas is projected to increase by nearly 66 percent between 2005 and 2030. Among the end-use sectors, the industrial sector remains the largest consumer of natural gas worldwide, accounting for 44 percent of the total increase in demand for natural gas between 2005 and 2030. Natural gas also is expected to remain an important energy source in the electric power sector, particularly for new generating capacity. By the year 2030, total world consumption of natural gas is expected to be 158.0 Tcf.

The United States is the largest producer and consumer of natural gas. In this field of make use of natural gas, whether from a technical point of view or policies are relatively mature than china. After measured ,the United States in 2007 , the natural proportion of industrial consumption accounted for 28.7% of the energy consumption structure, the consumption is 220.561 billion cubic meters; civilian accounts for 20.5%, the consumption is 133.77 billion cubic meters; for commercial use of natural gas accounted for 13.1%, consumption is up to 85.178 billion cubic meters; for electricity accounted for 29.7%, consumption is 194.651 billion cubic meters; for motor fuel accounts for only 0.1%, and the consumption is 18.321 billion cubic meters, as well as pipelines fuel and consumption of oil and gas industry operations.

Insert Table 2 here

Currently, China's consumption of natural gas accounted for energy consumption's only 3.5%, far below the global average consumption level of 25%. As can be seen from Table 1 China's natural gas is mainly used in industry, which equal to national natural gas consumption's 63.1 % , China's natural gas consumption in the industrial sector the proportion is much higher than the United States, but this does not mean that we can produce more natural gas products. As a result of relying on foreign developed countries' advanced technology, the same volume of natural gas can produce more end products, while China is relatively backward because of technology; we have to consume more natural gas resources to produce the same amount of products. Chemical projects used of natural gas in 2007 amounted to 22.343 billion cubic meters, accounting for 43.8 percent of industrial consumption. Chemical industry projects, as well as gas-fired power plants and other industrial projects are rapid developing in recent years, increasing gas consumption. In the overall natural gas consumption structure of the word, chemical industry accounted for only 4.1 percent, while China's chemical industry in 2007, natural gas consumption is accounted for more than 30%, significantly higher than Normal level of the world.

The proportion of Natural gas consumption of business and the power industry is at a low level, which leads to a deeper reflection that sale natural gas in China is poor business mobility and still monopoly by China National Petroleum Corporation and China Petrochemical Corporation.

Comparatively speaking, China's natural gas for power generation is at a very low level. The amount use of natural gas for power generation in China was only 7078 million cubic meters, equal to 9,413,740 tons of standard coal, and

China's electric energy consumption for a total of 184,745,900 tons of standard coal, that is only 5% of the total generating capacity, however, which made up to roughly 20% in the word. Today China mainly relies on coal power generation, which will inevitably cause a certain degree of environmental pollution.

#### *4.2 The price*

*Insert Table 3 here*

The natural gas average realized price in china was just 3.15 dollars per thousand cubic feet in 2008. The natural gas average realized price was reach to 3.28 dollars per thousand cubic feet in 2009 March. From 2009-4-1 Civil natural gas price in Beijing up-regulate to 2.05 Yuan per cubic meter, equal to 8.4918 dollars per thousand cubic feet. Based on consideration of the utilization of Mining technology and production, domestic natural gas prices did not play a role in regulating natural gas supply and demand, China's low natural gas prices directly led to China's natural gas structure is irrational, the strategic status of natural gas has not been of great importance to the relevant departments.

#### *4.3 Natural gas resources storage underground*

The world per capita consumption is 403 cubic meters natural gas / year, while China per capita consumption is only 25 cubic meters / year. Based on the China's large population, it is easy to estimate that the natural gas demand in China has great potential under the pushing of such a large energy demand; China's natural gas demand will continue to rise. U.S. natural gas inventories - based on the underground storage facilities on November 14 2008, in which working gas in storage was 348.8 billion cubic feet. Natural gas inventories are expected to be 5-year follow-up changes through the history of other years, as long as weather conditions remain close to normal. China National Petroleum Corporation has been building in the Dagang Oilfield in Tianjin, which is China's first large-scale natural gas storage for the accommodate imbalances in winter and summer consumption of natural gas in Beijing and Tianjin. However, underground gas storage project in China has not a large-scale implementation.

### **5. Proposed measures for Natural gas use in China**

#### *5.1 The increasing pressure of environmental protection, domestic energy consumption structure in urgent need of adjustment*

First of all, the natural gas proportion of primary energy consumption structure in China is on the low side .natural gas as an important strategy energy, can adjust the fragile energy structure of China's, for example every year the generating capacity restrict by the price of coal and the quantity of coal supply in Hunan, Shanghai and other regions, we can take full account of the way electric power generation change, in the case of a short supply situation of coal ,natural gas could used as alternative energy generation. The technology of Natural gas for power generation is currently basic maturity, but due to policy reasons, China's use of natural gas for power generation projects are not widely implemented, only a few prefectures achieve to combined heat and power projects.

Secondly, the industrial sector share of natural gas consumption is too large, the overall scarcity of resources in natural gas, this structure is not conducive to the development of other sectors, the country should adopts appropriate measures to encourage the development of technologies to further improve the utilization rate of natural gas.

#### *5.2 To raise domestic gas prices*

Domestic natural gas consumption demand continued to grow, year on year increase the supply gap. Natural gas energy as a scarce energy, its price should be determined by market supply and demand-driven, supported by national policies, but at present, China's natural gas pricing does not follow this principle, the low price of domestic natural gas leads to further exacerbate the contradictions between supply and demand, resulting in natural gas market position has not been fully exploited.

#### *5.3 To increase the proportion of city gas*

Urbanization is an inevitable trend of economic development in recent years the proportion of China's urban industrialization is growing so fast, urban pollution has become the densely polluted area. Focus on improvement and rectification of urban pollution is an important way to tackle the sources of pollution. China's industrialization should be increased the use level of natural gas in the main cities to reduce the coal-fired fuel and alleviate the situation of urban pollution, such as more vehicles use compressed natural gas, take the implementation of natural gas for power generation projects and so on.

#### *5.4 Natural gas resource reserves increased*

Strengthen China-Russia- Kazakhstan the three countries firmly of strategic relations in the energy field, and at the same time to strengthen cooperation with African countries in the field of energy on the basis of equality and mutual benefit. Further expand the scope of natural gas pipelines, the establishment of a nationwide network of natural gas and the introduction of the expansion of LNG projects.

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Table 1. Comparison of natural gas consumption structure all over the world in 1998

	raw material,%	power generation,%	civilian use,%	annual consumption×108m <sup>3</sup> /a
Latin American region	8.1	23.4	13.3	900
African Region	5.3	43.1	7.4	500
Middle-Eastern region	12.8	39.5	9.9	1400
South-East Asia Region	13.2	38.1	10.1	1100
North American Region	1.8	22.4	39.8	7200
Western Europe Region	3.8	23.0	43.0	4200
Soviet Union Region	1.4	33.8	21.9	5700
Japan	0.2	66.8	30.5	720
China	39.6	14.4	11.2	220

Table 2. The proportion of natural gas consumption between china and US

Unit: %

trade country	industry	civilian	commerce	generate electricity	automotive fuel
US.	28.7	20.5	13.1	29.7	0.1
China	63.1	19.2	5.1	<10.2	<2.4

Table 3. U.S. natural gas prices

Unite: dollars/MCF

year	wellhead price	City Gate Price	Residential Price	Commercial Price	Industrial Price	Electric Power Price
2003	4.88	5.85	9.63	8.4	5.89	5.57
2004	5.46	6.65	10.75	9.43	6.53	6.11
2005	7.33	8.67	12.7	11.34	8.56	8.47
2006	6.39	8.61	13.73	12	7.87	7.11
2007	6.37	8.12	13.06	11.32	7.68	7.31
2008	8.07	9.18	13.68	11.99	9.61	9.35

Data Source: EIA