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# China's energy, environment and policy perspective

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**Abstract:** This paper discusses the specific features of the energy in China, and addresses those key challenges in China is that the co-exist of (1) higher total energy production and lower per capita level; (2) lower per capita energy resources level with unrational energy consumption structure; (3) lower energy utilization efficiency and higher energy conservation potential; and (4) unequal distribution of energy resources. It reviews the key environmental problems related to the feature of energy production and consumption. Based on the analysis, the author furthers addresses the policy and actions needed.

**Key words:** energy; energy production; energy consumption; environment; policy

With the huge population and rapid economic growth, China became the world's second larger consumer of energy. Coal dominates the primary energy used, followed by oil, primary electricity and natural gas. What strategies and policies adopted by China therefore will not only have implications to its domestic economy and environment, but also is a concern of international society.

## 1 Major issues for China's energy facing the new century

As a nation in developing with large amount of population, China has the urban population less than 30% of total. Although China has been enjoying high economic growth rate, with annual GDP growth of over 10% during 1981—1996, the overall national economic efficiency and benefit is still in question compared with developed countries. As moving to the process of industrialization, China is facing challenges different in some degrees with other countries, both developing and developed. The problems being addressed below are the typical context for the energy-economy-environment relationship in China.

### 1.1 Higher total energy production and consumption v.s lower per capita level

China now is the second larger producer and consumer of energy in the world. However, the energy consumption per capita was only 0.8 tons (TCE) in 1996, about 1/8 of that of US, and 1/4 of the European countries. The domestic energy consumption in rural areas mainly depends on biomass. By the end of 1997, about 60 million of the residents in rural areas had no access to electricity. Table 1 shows China in the world context both economy and energy.

### 1.2 Lower per capita energy resources level v.s. unrational energy consumption structure

China riches of coal resources, with proven reserves of 1000 billion tons, developable water resources of 387 million kWh with annual electricity of 192 million kWh, which is as the largest in the world. China has also large amount of oil and natural gas reserves, and is the fifth largest producer of oil in the world. However, taking account of the population, the per capita coal reserves is only half of the world average, and 1/10 of the world average for recoverable oil reserves. Although China riches of the water resources and renewable resources, they can not be the substitutes of coal due to the higher explore cost.

Coal plays most important role in energy consumption in China, even by year 2010, it will still account for about 70% of total (Table 2, Fig.1). The industry of course consumes most of the energy. The energy consumed by sectors is shown in Table 3.

**Table 1 China in a world context 1995**

Country	GDP, Billion 1987 USD	Population, million	GDP per capita, 1987 USD	Energy consump- tion, Quadril- lion Btu	Carbon emission, million Mt	Energy/GDP ratio thousand Btu/\$ 1987	Percent of house- holds with electricity, 1994
Argentina	129.1	34.8	3709	2.5	34.5	19.4	90% *
Brazil	332.6	155.8	2135	6.8	67.0	20.4	91% *
China	532.9	1211.7	439	35.7	807.5	67.0	80%
Russia * *	246.9	148.1	1677	26.8	428.7	108.5	N.A.
India	378.6	935.7	405	10.5	213.2	27.7	88%
Indonesia	129.4	193.8	668	3.1	52.2	24.0	39%
Mexico	155.3	94.9	1636	5.6	92.6	36.1	95%
Poland	66.0	38.6	1710	3.8	84.0	57.8	N.A.
South Africa	90.2	41.2	2189	5.5	135.1	61.0	44%
South Korea	252.1	44.9	5615	6.3	102.0	25.0	100%
Turkey	116.5	61.6	1891	2.5	43.0	21.4	N.A.
United States	5452.5	263.4	20700	88.3	1415.1	16.2	100%
World total	21282.3	5724.4	3718	362.2	6063.1	17.0	N.A.

Note: \* urban population only; \* \* for all of the Former Soviet Union; Sources: US EPA 1997

**Table 2 Energy Consumption in China, %**

	1988	1990	1992	1994	2010
Coal	76.1	76.0	74.2	75.0	69.7
Oil, natural gas	19.1	19.0	21.0	19.3	26.2
Hydro power	4.7	5.0	4.8	5.7	4.1

Source: Zhang, 1997

**Table 3 Energy consumption by sectors, 1990, %**

	Total energy consumed	Oil	Natural gas	Coal	Electri- city
Agriculture, forest, fishery, water power	4.9	0.0		2.0	6.9
Industry	68.5	99.1	78.8	76.8	78.2
Construction	1.2	0.5	7.0	0.4	1.0
Transportation and communication	4.6	0.4	1.2	2.0	1.7
Commercial and services	1.3	0.0		1.0	1.2

Source: Yan, 1994

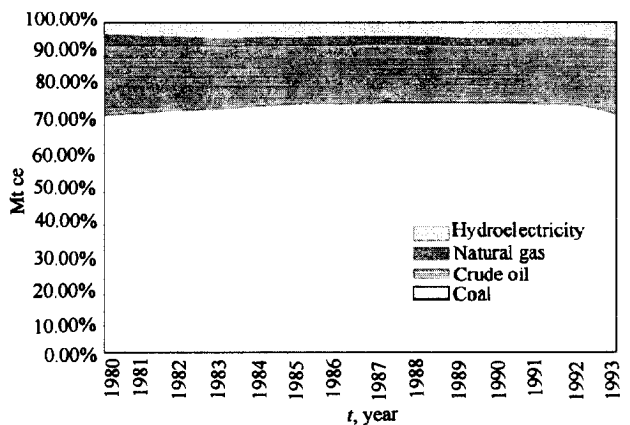


Fig. 1 Primary energy consumption, 1980—1993 (source: Lawrence Berkeley National Laboratory, 1996)

Such energy structure not only results in lower efficiency of energy utilization, but also imposes huge pressure on environment and transportation. In addition, due to the changes of demand structure and requirement of environmental quality, the shortage of high quality energy supply is the major challenges in China.

**1.3 Lower energy utilization efficiency v.s higher energy conservation potential**

The basic situation in China is that the co-exists of modern industry with advanced technology and traditional industry with lower technology level; economic developed regions with undeveloped and poor regions. Due to the large proportion of energy intensive manufactures and large number of small and medium enterprises, the energy consumption structure mainly rely on coal. Together with low equipment used, the energy consumption in China is characterized as higher energy consumption intensive, lower energy utilization efficiency. In 1995, the energy efficiency in China was only 34%, which equals to the level of 80's of that in developed country. The energy consumption level for main industrial products was 30%—100% higher than that of developed countries. The total energy conservation potential in China was estimated about 300 to 400 million tons (TCE), which is about 1/4 to 1/3 of the current energy consumption (Li, 1998).

**1.4 Unequal distribution of energy resources**

The major coal reserves are in the north, southwest and northwest. These three regions



only 2% of total. Although China riches of natural gas resources, the production of natural gas in 1996 was less than 20 billion m<sup>3</sup>, with a ratio of reserve and exploration of 100:1. China is proposing to increase the proportion of natural gas supply to 4% of total by year 2010.

**Renewable energy:** Renewable energy has become/is becoming a major sources of rural energy in China. The development and promotion of renewable energy technology played a central role to solve the shortage of energy supply in rural and remote areas. Currently, the rural areas consumes 300 million TCE of new and renewable energy, accounts for 20% of the total energy consumed in China, and 47% of total energy consumed in rural area. It was projected that the consumption of renewable energy will increase to 390 million TCE by year 2010. The priority area for renewable energy development and consumption is wind, solar, biomass, geothermy, and small hydropower.

### 3 Energy v.s environment in China

China's energy structure relying on coal. Such a structure has important implications to the environment in China. It was estimated by some experts that the loss caused by air pollution and water pollution accounts for 3%—8% of the GNP (World Bank, 1997). The environmental problems related to the coal in China can be summarized as following:

#### 3.1 Quality of coal is in question

The ash contents of coal have the proportion of 27%, and sulphur contents of 1.1%—1.2% at an average. Table 4 shows the sulphur contents of coal in China, in which, the coal with sulphur contents over 1.5% accounts for over 20% of the total coal.

**Table 4 Distribution of sulphur contents of coal in China**

	Lowest carbon coal	Lower carbon coal	Medium carbon coal	Medium sulphur coal	High sulphur coal	Highest sulphur coal
Sulphur contents	0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-3.0	3.0
Percent in total coal consumed	42.13	21.97	15.04	10.30	3.00	7.56

#### 3.2 Lower proportion of coal being washed

In 1995, only 20% of the coal in use was washed, and mainly as the input for coking and chemical production.

#### 3.3 Lower pollution treatment level

The pollution treatment level in the electricity generating process as well as the coal burning process is pretty low. Although the dust precipitation efficient rate reached at 96% for coal fired electricity generation in 1995, the desulphurization and other pollution control measures are still in the demonstration process.

The above three features of coal consumption in China determine that the air pollution in China is mainly come from coal burning. The major air pollutants are soot, SO<sub>2</sub> and NO<sub>x</sub>. The emission of these three pollutants from coal burning accounts for 90% of the total air pollutant emission.

**Table 5 Share of greenhouse gas emission in China 1990, %**

	Energy consumption	CH <sub>4</sub> of coal layer	Cement	Animals	Paddy	Others
Percentage	82	2	4	3	5	2

Source: China's Greenhouse Gas Emission Control and Strategies

than that of US (5.3 tons) and Japan (2.3 tons), the total emission was 59.6 billion tons of carbon, which accounts for 1/10 of the world total. It was estimated that CO<sub>2</sub> emitted by energy consumption accounted for 82% of the total greenhouse gas emission in China (Table 5).

The rapidly grow of demand on energy will exacerbate the degradation of environment. Take CO<sub>2</sub> as an example, although the per capita emission of CO<sub>2</sub> was 0.6 tons (carbon) in 1990, much less than that of US (5.3 tons) and Japan (2.3 tons), the total emission was 59.6 billion tons of carbon, which accounts for 1/10 of the world total. It was estimated that CO<sub>2</sub> emitted by energy consumption accounted for 82% of the total greenhouse gas emission in China (Table 5).

### 4 Policy strategy proposed

Under the context of globalization of world economy as well as the trends of global changes (especially the climate change), China has to deal with various challenges regarding energy production and consumption. The key issue is whether and how China to meet the demand on energy supply by further economic development, and at the same time to satisfy the environmental

requirement. Based on the understanding of China's situation, the following policies and strategies should be therefore taken into consideration.

#### **4.1 Integrated energy planning and management**

Environmental problems closely related to the social and economic activities, a better and integrated approach to take the environmental concern into the energy development is therefore critical. This policy set includes (1) to establish a set of integrated planning approach for energy, environment, and economy that should be suitable to China's situation. Such approaches should be promoted to energy management institutions at various level; (2) to enhance the energy management, to improve the energy supply structure to improve the proportion of cleaning energy and high quality energy, to develop and introduce technologies of energy production, distribution and consumption, which can reduce the total demand on energy; (3) to enhance the construction of energy infrastructure at rural area, to change the ecological system being degraded situation caused by heavily consume biomass.

#### **4.2 Improve energy efficiency and energy conservation**

As a developing country, it is hard to allocate tremendous amount of money to clean up the pollution. The win-win solution should be put as the first priority to manage environment. Experiences and theoretical studies showed already that improving energy efficiency and energy conservation would benefit both economy and environment. This policy sets covers: (1) to establish an energy conservation management system in China, to develop and improve the regulatory and policies. The first action needed it to remove unreasonable subsidies to energy; to use economic instruments to improve the process of energy conservation; (2) to develop industrial policies to improve the development of low energy consumption industries and enterprises, therefore to restructuring the industry; (3) to develop and promote advanced energy conservation technologies, which would be also supported by favorable tax and loans; (4) to improve the public awareness on energy conservation by education and training and communication programs.

#### **4.3 Promote clean coal technologies and coal exploration technologies with low and non pollution**

China has the commitment to Climate Change Framework Convention, therefore, this policy set should focus on both domestic and global environment. This policy set includes: (1) to develop necessary policies and regulations to promote such technologies; (2) to develop technologies needed in various areas; (3) to improve the proportion of conversion coal to secondary energy, such as electricity, heating, and coal gas; (4) to involve actively in the international cooperation regarding the climate change and other transborder pollution.

#### **4.5 Develop new energy and renewable energy**

As mentioned above, the energy structure of China mainly depends on fossil energy which is not a very sustainable way. Meanwhile, China has also considerable of renewable energy. Two major actions are needed: (1) to give priority for developing renewable energy and increase input on the development; (2) to introduce advanced and practical technologies to China to lower the cost of new and renewable energy.

## **References:**

- Lawrence Berkeley National Laboratory, 1996. China energy databook [Z]. LBL-32822 Rev. 3, UC-900.
- Li H X, 1998. Introduction of China's energy policy. Paper presented in China-Dueth Energy Workshop[C], Feb, 24 1998. Beijing.
- Working Group, 1996. China's greenhouse gas emission control and strategy [M]. Beijing: China's Environmental Sciences Press.
- Yan C L, 1994. China's energy development report [M]. Beijing: Economic Management Publishing House.
- Zhang K M, Hao J M, Ma Z *et al.*, 1997. Introduction to sustainable development [M]. Beijing: China's Environmental Sciences Press.
- Zhang L, Yang C H, 1998. China's Soft Science[J]. 3: 74-79.