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A Research on Sustainability Evaluation and Low-carbon Economy in China

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Abstract. This article discusses the challenges of sustainable energy in China, identifies some major paths for the sustainable development of energy, and establishes a sustainability evaluation system for sustainable energy policies in four aspects, including the integrity of the energy decision-making, energy supply security, the sustainability of energy consumption, and the energy technology and education. To formulate China's sustainable energy policy, we need to start from two angles: energy security supply, economic competitiveness, environmental sustainability, and coordinate the relationship; Secondly, speeding up the development of coal based low carbon economy, improving energy market mechanism and increasing green energy consumption are the policy choices to promote sustainable energy development in China.

1. Introduction

With the acceleration of the process of economic globalization and the deepening of reform and opening up, China's economic total has increased significantly. However, in the new normal economic background, Chinese economy is from the scale speed of extensive growth to the quality and efficiency of intensive growth from investment driven to innovation driven factors, accelerate structural adjustment, transfer mode, promote industrial upgrading has become the main theme of economic development, expand the total demand at the same time, to production, to the inventory, to leverage, reduce costs, make a short board, improve the economic development efficiency has become the key to the development of regional economy in the new period. The energy rich area is dominated by energy economy, and the high input and high energy consumption pattern is the main area for improving economic efficiency.¹

2. Problems facing the sustainable development of energy

2.1 *The contradiction between supply and demand is increasingly sharp*

In recent years, with the rapid development of China's economy, the total amount of energy consumption has increased rapidly from 570Mtce in 1978 to 2460Mtce in 2006. Thus, China's energy consumption growth experienced three periods: the first period is from 1978 to 1996, which has reached a steady growth stage. The annual growth rate of energy consumption was basically maintained at 5% to 6%; The second period is from 1997 to 2000, which has reached a negative growth stage. Shi Dan believes that opening to the outside world plays a significant role in improving



energy efficiency. The adjustment of industrial structure and industrial internal structure has increased the energy input and output rate, and the improvement of energy efficiency by economic restructuring is an important factor in the negative growth of energy consumption at this stage; The third period is from 2001 till present, which has reached a rapid growth stage. The growth rate of energy consumption in China is maintained at the level of more than 9%, the growth rate of China's total energy consumption in 2003 and 2004 was once more than 15%. According to IEA, China's energy demand in 2030 will double at least on the basis of the present.

Among the main sources of energy, coal accounts for the largest share of the energy, about more than 60%. The proportion of energy consumption structure in 1990 was increasing. In 2030, it will come to 62.8: 21.2: 5.2: 1.8: 2.3: 5.9: 0.9. We can see the coal share rises firstly and then drops. The demand for oil and gas is growing rapidly, and the proportion of the total amount of energy demand is expanding, from 14.8% in 1990 to 26.4% in 2030; Although hydropower, nuclear power and other renewable energy have been promoted rapidly on the basis of previous ones, the proportion of primary energy demand is still small due to its small base. Meanwhile, although biomass energy has increased over the past year, the proportion of energy consumption is decreasing. As a whole, in the future, China's energy demand will show a trend of diversified development, but fossil energy, especially coal dominated single energy structure, will not be fundamentally changed in a long time.

Table 1 Constitution of primary energy demand under the reference scenario in China (%)

	2005	2015	2030	2005-2015	2005-2030
Coal	62.8	65.6	62.8	5.5	3.2
Petroleum	18.8	19.0	21.2	5.2	3.7
Natural gas	2.4	3.8	5.2	10.0	6.4
Nuclear power	0.8	1.1	1.8	8.8	6.5
Hydropower	2.0	2.2	2.3	6.1	3.8
Biomass	13.0	7.9	5.9	-0.1	0.0
Other renewable energy sources	0.2	0.4	0.9	14.4	9.9
Mtoe	1742	2851	3819	5.1	3.2

Source: According to "World Energy Outlook".

Since 1980, the production of heavy industrial products, represented by steel, cement and chemical fertilizer, has been growing rapidly. The proportion of China's total products of the same kind in the world increased from 8.2%, 9% and 17% to 31.2%, 46.6% and 43% respectively. Over the past six years since 1996, there has been a turning point in China's industrial development. No matter in terms of output value, investment and profit growth, the proportion of heavy industry has surpassed that of light industry, and there has been a trend of re industrialization. The promotion of domestic consumption structure, industrial transfer in developed countries, and the urbanization of China and the construction of new rural areas have been promoted by many factors. Since 2002, a new round of economic growth cycle has shown an increasingly significant feature of heavy industry. The proportion of heavy industry to industrial added value has increased year by year, and has increased by more than 60%. In 2004, it has reached 67.59%. By the first half of 2006, the proportion of heavy industry was close to 70%. The rework of rework means that more energy will be needed in the future to support economic growth.

Table 2 The importance of China's heavy industry in the world (%)

	1980	1995	2000	2005
Iron and steel production	8.2	13.0	15.5	31.2
Cement production	9.0	33.6	37.4	46.6
Chemical fertilizer production	17.0	27.0	29.0	43.0

Source: IEA secretariat calculations based on database of IMF, CEIC, ADB, IISI and WTO (WEO)

Since the first half of 2007, China has become a net importer of coal. Subsequently, the scale of China's raw coal trade deficit is expanding, and the dependence degree of raw coal imports is also increasing. IEA forecasts that China's net imports of coal are expected to be 130 million ton by 2030.

2.2 Fast rising energy prices

In recent years, the price of international crude oil, natural gas and coal has been rising vigorously. The energy price represented by crude oil has risen from an average of 28.89 US dollars per barrel in 2003 to 70.93 US dollars per barrel in 2007, with an average annual growth rate of 19.7%. The European Union, represented by natural gas, climbed from 4.40/MBtu in 2003 to \$8.93 in 2007, up to 103%. According to the benchmark price, northwest Europe Central American Appalachian coal spot prices index, Japan and Japan coke import CIF average CIF value of imports of coal boiler. In the last 5 years, the global coal price has increased from \$39.3/t in 2003 to \$74 in 2007, up to 88.3%, up to 88.3%. In 2008, crude oil prices once exceeded \$140/barrel, although the recent decline in crude oil prices remained at about \$100/barrel. The rapid rising of energy price is a concentrated expression of the increasingly sharp contradiction between the energy supply and demand.

2.3 Increasing pressure on environmental protection

With the rapid growth of total energy consumption, CO₂ emissions are increasing, and environmental pressure in China is gradually increasing. China's total energy consumption in 1990 was 1000Mtce, and the total amount of CO₂ emissions was about 220 million ton, the total amount of carbon emitted by coal consumption is 200 million t. The total amount of energy consumption rose to 5200Mtce in 2025, the total amount of emissions will reach 8.2 billion ton, coal consumption is about 0.6 billion ton of carbon. Although the proportion of carbon emissions from coal consumption to total CO₂ emissions has been decreasing since 2002, according to the prediction of reference scenarios, the ratio still remains above 70% by 2025. According to the World Bank's 2007 data, 20 of the 30 most polluted cities in the world are in China. With the increasing consumption of coal, China has become the largest SO₂ emitter in the world, the second largest CO₂ emission country in the US. The cost of early death and disease caused by air pollution has accounted for 1.2% to 3.2% of GDP in 2003. In the regular scenario, the health damage cost of air pollution is expected to rise, which will be equivalent to 13% of China's GDP by 2020.

3. Path selection of energy sustainable development

"Sustainable development" in its essence, is to co-ordinate the harmonious development of man and nature, dealing with economic construction, population growth and utilization of resources, ecological environment protection, promote the whole society on the development of production, affluent life and a good ecological environment. Specific to the sustainable development of energy demand, energy supply security, economic competitiveness and environmental sustainability of the three overall, the supply of energy security is the core content of sustainable energy development; economic competitiveness for sustainable energy to provide effective protection; environmental sustainability is the basic premise of sustainable energy.

Energy security is the core of sustainable energy. Zhang Lei believes that the national energy

security concept is composed of two organic parts i.e. the security and stability of energy supply of energy use, the stability of energy supply is to meet the energy supply stability of national survival and development of the normal demand, energy security refers to the energy consumption and use should not pose any threat the survival and development environment of human beings. To be sure, Mr. Zhang described the concept of broad energy security as a collection of energy supply stability, economic security and environmental friendliness. Because the contradiction between energy supply and demand is the direct cause of the energy crisis, this article only defines the definition of energy security as the guarantee degree of energy supply for energy demand in a certain geographical and time range from a narrow sense.

Economic competitiveness provides a strong guarantee for sustainable energy. The promotion of economic competitiveness can provide a strong guarantee for sustainable energy from two aspects of supply and demand. From the supply of economic competitiveness is conducive to the improvement of the overall economic strength and improve the scientific and technological progress, so as to provide more capital and technology, research and development to mobilize more social resources into alternative energy, clean energy and energy-saving technology, from the perspective of strengthening supply capacity to ensure the sustainable development of energy. From the demand, the promotion of economic competitiveness will certainly promote the transformation and upgrading of industrial structure, the improvement of energy use efficiency and the decline of energy intensity. The promotion of economic competitiveness can guarantee the sustainable utilization of energy from the two aspects of "open source" and "throttle".

Environmental sustainability is the basic prerequisite for sustainable energy. Environment is the foundation of human survival and development, provide material resources and play the role of waste disposal. Environmental Sustainability provides material assurance and environmental support for the realization of sustainable energy, which is the basic prerequisite for the sustainable development of energy.

To formulate China's sustainable energy policy, we need to start from the perspective of energy security, economic competitiveness and environmental sustainability. We fully understand the relationship between the three mechanisms based on the understanding of the relationship between the three, and promote the common development of the three.

4. Ways of resolution

4.1 Measures taken by the government.

Renewable energy already has unprecedented development opportunities. The government must attach great importance to the development of renewable energy. Strengthen policy guidance and expand investment channels. We need to develop technologies that are conducive to the development of renewable energy. We will reduce the cost of renewable energy development and expand the scale of development through subsidies, subsidies, taxation and land incentives. We should increase fiscal input and effective tax and price policies to support renewable energy development.

The combination of low-carbon economy and economic development mode transformation. In order to adapt to modern economic structure change, our country need to make a series of adaptive adjustment of the pattern of economic development: from the extensive, as inputs to the essential characteristics of traditional growth mode, to intensive, increasing the service efficiency of elements as the essential characteristics of modern growth pattern change; From the high consumption of traditional industrialization mode to the low consumption of modern industrial model.

4.2 Suggestions on the development of low-carbon economy in Chinese enterprises.

It is necessary to establish a low carbon consciousness enterprise, and to realize that the low-carbon economy is a new growth point of economy. As an industrial revolution, low-carbon economy will help economic development. Second, we should fully recognize the urgency of developing a low-carbon economy. If we establish a low-carbon concept, the development of low-carbon economy

as a top priority will bring huge business opportunities and benefits to enterprises.

On the other hand, enterprises should increase research and development, increase investment in low-carbon technologies, and improve their ability to innovate in low-carbon technologies. If enterprises can seek technological breakthroughs in green consumption technology and ecological recovery technology, they will increase resource productivity and energy efficiency more. At the same time, it should also selectively introduce, absorb and re-innovate the forms of foreign advanced low-carbon technologies. Enterprises should continuously improve the innovation ability of enterprises' low carbon technology, thus improving the core competitiveness of enterprises.

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