Study on the Path and Strategy of Carbon Control in China

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***Abstract*-China's carbon control path and strategy is heading in the direction of the new evolution. Carbon control path should be based on all-round development of economic model, which is the coupling of social economic metabolism and ecological economic metabolism. Carbon control is whole process management from source of carbon emission to carbon collection. China's carbon control strategy should pay equal emphasis on carbon emission reduction and increasing remit. Carbon recycling technology and CCS technology is core technology for the future development of China. There is a huge potential in terms of emissions .China should seize the opportunity to research and carry out carbon recycling and CCS technology in a planned and staged way, consummate new measures of carbon recycling industry regulations.**

Keyword: carbon control; carbon sinks; carbon emission; CCS technology choice

I. INTRODUCTION

Since the 1980s, China has formed the carbon control strategy which the main content is the improvement of energy efficiency, the adjustment of industrial structure and the optimization of energy structure, the core is the reduction of carbon emissions guiding the reduction of carbon consumption. As it's known to all, the development path depends on the position in the vertical division of labor in the international industry, China's carbon emissions reduction is relative, in the past 30 years, the energy

consumption quantity of ten thousands yuan GDP and the total amount of carbon emission continued to decline, but the efficiency was difficult to offset the expansion of economic scale, the total amount of energy consumption and carbon emissions are still on the rise. Exploring new carbon control path and strategy is critical.

II. THE HISTORICAL CONTRIBUTION AND FUTURE POTENTIAL OF CHINA'S CARBON CONTROL

China has always been a responsible big country in the carbon control. In the recent 30 years, China's 11times growth of GDP was supported by less than 3.5 times growth of energy consumption. What's more, China's energy efficiency isn't that low as the media widely publicized: which is seventh of Japan, quarter of the United States, and even 2 times lower than the world average. On the one hand, China's economic system mainly relies on the real economy, which significantly underestimate the energy intensity based on total GDP commuted rate method. If converted from the real purchasing power of GDP perspective energy efficiency, China's energy consumption level closes to the world average, currently close to U.S. level, and even higher than Canada and South Korea level (Referring to Table Ⅰ).

Compared with the process of industrialization of developed countries over the same period, China's energy efficiency is of high efficient, which depends on China used the advantage of backwardness, to learn and absorb the development experiences from developed countries and enhance the development quality in the process of industrialization.

TABLE Ⅰ. CHINA'S ENERGY EFFICIENCY COMPARED WITH THE WORLD（2002-2006）

Unit: tons of standard coal / million dollars

	Rate method based on 2000 prices					Purchasing power parity based on 2000 prices				
	2000	2002	2004	2005	2006	2002	2003	2004	2005	2006
World	3.8	3.7	4.4	4.4	4.3	2.5	2.6	3.0	2.9	2.8
China(Main-land)	10.2	8.7	10.7	10.6	10.4	2.1	2.1	2.8	2.8	2.7
India	5.7	7.1	11.9	11.2	10.8	1.3	1.3	2.3	2.1	2.1
Brazil	5.2	3.9	4.8	4.7	4.7	1.8	1.8	2.5	2.5	2.4
Russia	32.3	28.7	26.0	24.1	23.1	7.2	6.9	6.6	6.1	5.9
America	3.2	3.1	3.0	2.9	2.8	3.1	3.1	3.0	2.9	2.8
Japan	1.5	1.5	1.4	1.4	1.4	2.1	2.1	2.1	2.0	2.0
Germany	2.6	2.5	2.6	2.5	2.5	2.2	2.4	2.3	2.3	2.2
France	2.2	2.2	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Britain	2.6	2.3	2.3	2.2	2.2	2.0	2.0	1.9	1.9	1.8
Canada	5.3	5.1	5.1	5.0	4.8	4.2	4.2	4.2	4.1	4.0
Korea	4.9	4.9	4.7	4.5	4.3	3.3	3.3	3.2	3.0	2.9

Energy consumption data from The IEA (2008)

On the other hand, as the world's processing and manufacturing workshop, a considerable portion of energy consumption come from China, primarily through merchandise trade switch to hidden forms of energy to support the production and consumption of the rest of the world.

Except the EU, China is the only country who clearly stated the targets of emissions reduction. From the early 2006 to the end of the first half of 2009, China had shut down 7467 small thermal power units with a total capacity of 54.07 million kilowatts. By preliminary estimates , the closed mall thermal power units could help to reduce carbon dioxide emissions by 124 million tons per year.

China has made outstanding contributions to increase the forest carbon sinks of the global and Asian. During 1990 - 2005 years, China had increased its forests by 6.1 million hectares through tree planting campaign、forest ecological construction. While the global forest area

during the same period had a net reduction of 125.3 million hectares. At present, China's annual forest carbon sink is about 900 million tons, estimated by the growth volume of forest stock per cubic meter can absorb an average of 1.83 tons carbon dioxide, which is equivalent the size of the carbon emissions from combustion of China's Petroleum.

In the next 30-50 years, the carbon emission reduction potential and carbon remit increasing potential are very impressive.

Through the adjustment of industrial structure、energy structure optimization and energy efficiency management, the Chinese per ten-thousand yuan GDP energy consumption efficiency has obvious decline space measured no matter by the rate method or the purchasing power, it is estimated that the former is more than 70%,while the latter is more than 30%.In other words, the Chinese unit GDP carbon emission intensity is expected to be reduced to 30%-70%, which is a conservative estimate under the premise of carbon emission reduction potential without the breakthrough of technology and alternative energy.

Though further forest construction、restoration and conservation projects, in the next 30-50 years, the forest carbon sink function is expected to double to about 2 billion tons (carbon dioxide).

In addition, China also has 1.45 trillion tons geological carbon sinks. Major basin depositional systems are often a dozen layers or even dozens of layers, has the natural advantages of a good geological storage of carbon dioxide. The kind of basin contains Songliao basin, Bohai Bay Basin, Ordos Basin, Sichuan Basin, the Junggar Basin, Tarim, Bohai Basin and so on. Studies have shown that China's carbon dioxide geological storage only is up to 1.45 trillion tons (Hendrikds, 2004). which can meet China's 500-1000-year carbon stock demand.

III. THE ENTIRE PROCESS FROM SOURCE TO SINK OF CHINA'S CARBON CONTROL STRATEGY

At present, China's strategy of carbon control is evolving towards a new direction. Carbon control should be based on all-round development of economic model, which is the coupling of social economic metabolism and ecological economic metabolism. It is the whole process of management of carbon emissions from the source to the sink. Compared with the original carbon emissions as the core control strategy, the new carbon emission control mode emphasis on the carbon reduction, re-use and recycling.

Among them, the reduction means the reduction of carbon emissions, which consist of the relative reduction (the decrease in the scale of unit GDP carbon emissions) and absolute reduction (the decrease in the carbonscale).China's economic development stage decided the next 20 years, and the relative reduction of carbon emissions is China's development goal.

After 30-50 years technology accumulation, indirect use will gradually replace the direct use, the carbon would become an important source of energy and raw materials. Recycling has many forms, which can be summarized as carbon capture and carbon storage. CCS technology means to capture the carbon dioxide produced by industrial processes、fuel combustion and other means, and transport to specific locations, sealed, so that it can not escape back to the atmosphere in long-term. The CCS technology begun in the 1960s, the initial purpose had nothing to do with the carbon reduction, but used in the field of oil and gas development to increase oil and gas acquisition. With the people's attention to the issue of global warming caused by greenhouse gas emissions , CCS technology gradually leaps to the eyes of scientists and entrepreneurs, some scholars even claimed that CCS technology was the only way to achieve a safe usage of the fossil fuels.

In an embryonic control strategy of the entire process from source to sink, reduction and reuse is the core of the carbon source control. Through the carbon re-use, the carbon source and the emission source is no longer stay the same, more and more carbon source will no longer be a source of carbon emissions, the carbon dioxide produced will be raw materials transported to the new production processes in a way of industry digestion and resources coordination, and the carbon generation of Socio-economic metabolism is no longer equal to the carbon emissions. In addition to the improvement efficiency of energy use, carbon emissions reduction's connotation will be even richer. Carbon sink control is mainly aimed to increase the valuable carbon sink, which contains the ecological carbon sinks and non-ecological carbon sinks, but they are all called " carbon storage "in CSS technology. The main way of ecological carbon storage is to increase forest cover and raise the level of forest productivity. While the non-ecological carbon storage mainly contains the following three ways: the geological storage, ocean storage and solidified storage, among which, injecting the carbon dioxide to the failure or to be failure reservoirs is the most attractive option, so it's of the dual effect of reduction of carbon and increasing revenue of oil and gas. It is estimated that global carbon storage capacity is very attractive, by conservative estimation, the geological storage of carbon capacity is at least 1 trillion tons, and the Eco-storage of carbon capacity of the flux (only consider plant carbon storage) is nearly 2 trillion tons per year.

IV. THE PRIORITY SEQUENCE AND KEY TECHNOLOGY OF CARBON CONTROL IN CHINA

The advancement of both reduction carbon emission and increased sink are important characteristic and strategy of the China carbon control.

In the aspect of reducing emissions, in the next 20-30 years, energy efficiency management will be the core of the carbon reduction pathway, oil and gas safety is the guarantee, the biomass energy replacement will be an important direction. They should be push forward. The reasons are as follows:

(1) The energy consumption of fertilizer production accounts for 10 percent of China's total energy consumption, but agricultural fertilizer use efficiency is only about 30%; thermal power consumption of 50% of the country's coal production; cement production energy consumption accounts for about 5%, about 70 percent of its production consumed by the backward cement production process; iron and steel industry always shared the country's total energy consumption by 12% to 15%. These four industries, on the one hand, the overall efficiency of energy use is low, on the other hand the energy efficiency of advanced enterprises or installations had reached the international advanced level. In the coming 20-30 years, energy management and industrial optimization should be made in order to accepted by the society, and lower the cost and increase emission reduction benefits, also have good economical attraction.

(2) Carbon dioxide geological storage of related technologies had already existed in China's oil and gas exploration industry. Shengli Oilfield, Zhongyuan Oilfield, Jilin Oilfield, Daqing Oilfield had successfully used the carbon dioxide flooding EOR technology to enhance oil recovery. And the injection of flue gas improving recovery technology of China National Petroleum Corporation was named by《The World's Oil》as 2006 "World Oil Award" .In addition, China had also accumulated some experiences in the carbon dioxide drive CBM income. It was obvious that ensuring and improving oil and gas security of supply is one of the most economical carbon reduction pathway.

(3) China's biomass energy potential is about 100 million tons (diesel equivalent) without squeezing the food supply, but now is not utilized completely.

In the aspect of increasing carbon sinks, China should go both the ecological increased sink with non-ecological carbon sink, ecological increased sink have priority. The reasons are stated as follows:

(1) Increasing forest cover and improving the productivity of forests are of ecological security and increasing the dual role of carbon sinks, also has a good cost effective;

(2) At present, considering the non-ecological carbon sinks based on the CCS technology is still facing the challenges of lacking large-scale carbon storage experiences、high operating costs and lack of carbon storage management regulations. Fully fallen into the large-scale commercial operation track will take at least 30-50 years.

CCS technology is one of the core technologies of China's future development and its industry will become one of China's future core industries, while this will be seen at least 30-50 years later. As for the CCS, China's main task in the following 10-20 years is to carry out diversified technologies' R & D and pilot, and then to make the preliminary site selection; and in the following 10-20 years, attention should be focused on the establishment of the initial carbon transport network and demonstrating the site of carbon storage systematically, after that, another 10-20 years will be need to improve the commercial operation platform. Absolutely, the main task now is to improve or expand the environmental benefits of CCS technology in carbon reduction on the certain basis of the technical scope or efficiency, which mainly contains the CCS technology based on the geological storage used in the field of oil and gas exploration and coal field; the development and pilot of CCS technology based on oil and gas fields and coal-based power plant; the establishment of CCS Strategic Committee that responsible for developing the technology and applications of the CCS industry's regulation, planning and supervision, avoiding plagued by problems of applications first, and then the drawbacks of regulation.

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