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A DEEP DIVE IN TO CARBON TECHNOLOGY DEVELOPMENT

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ABSTRACT

China must follow an occasional carbon pathway, within which technology plays a key role in the future economy and social development. The results show that there are lots of potential and opportunities for China to maneuver towards a coffee-carbon society when given enhanced and accelerated applications and expansions of key low-carbon technologies. Strong policy and measure support from all sectors in China are needed to attain this goal.

KEYWORDS: Climate change; scenario; low carbon; technology

INTRODUCTION

Climate change, a worldwide issue exerting heavy influences on the entire world, has been attracting more and more attention thanks to its key role in sustainable development. The international community including developing countries is making unremitting efforts during this field, among these efforts, greenhouse emission (GHG) emissions mitigation is crucial, within the sense to comprehend a coffee carbon development model and construct a sustainable development roadmap. Low carbon development not only becomes a social-economic development pathway for China's future but also facilitates China's economic restructuring and accelerates the expansion of industries with low energy consumption and high added value. As found out, China will follow the strategic plan of enlarging the domestic demand and promoting economic process, cultivate vote a replacement economic process point featured by low carbon, and speed up the event of industry, construction, and transportation with the characteristics of low carbon. to create progress in low carbon development, more efforts shall be made to mitigate GHG emissions to line up ways to scale back GHG emissions under current social, economic, technological, and resource conditions.

This work will undergo pressures and face challenges, but also will provide incentives and opportunities for people. It is often achieved only through the implementation of every kind of policy and measures comprehensively (Fig. 1). Though it's not in line with national conditions to cut back emissions on large scale, the mixture of energy, agriculture, and land-use policies can cause the slowdown of rocketing energy demand and GHG emissions, and might gradually complete the transformation of domestic economic development pattern. Still, within the mid of industrialization, China consumes an oversized number of energy resources emitting pollutants and GHG while developing fast. The remarkable feature at this stage is that the coexistence of advanced and backward technologies

with the latter prevailing under the background of rapid expansion of economic scope. On the one hand, China has the advantage to eliminate out-of-date technologies and employing international advanced technologies. On the opposite hand, it faces investment impulses in low-cost but backward in pursuit of scale expansion, which can result in a "lock-in" of obsolete technologies and can make the promotion of energy efficiency in China very difficult. Therefore, in both the short term and therefore the future, the prevailing of low carbon technologies is that the key to pushing GHG emission mitigation. By stipulating feasible energy and environmental policies yet as technological development strategies, China can ex- intensively transforms its economy into an occasional carbon type. Relevant domestic studies show that if appropriate policies are implemented, many advanced low-carbon technologies have huge market potential and may gain popularity by 2020. Furthermore, they'll contribute to the fast economic development of China and therefore the strong promotion of energy conservation and environmental protection, a win-win result. Analyzes the varied technology portfolios under the various emission scenarios, and presents a key low carbon technology development roadmap for China.

1. STUDY METHOD

While analyzing technique combinations and technology roadmaps, researcher's reception and abroad usually adopt the scenario analysis methodology. They consider diversified factors including social-economic development, energy resources, energy technologies, environmental restrictions, and consumption behavior, analyze different scenarios of energy and GHG emissions in future's China, Based on the above method, the paper adopts the Integrated Policy Assessment Model of China (IPAC) and uses the quantitative chemical analysis method to check emission scenarios. Three sub-models of IPAC are mainly employed, namely IPAC-CGE, IPAC- Emission, and IPAC-AIM [Hu and Jiang, 2001; Hu et al., 1996]. The connection among the three models may be viewed

ADVANCES IN CLIMATE CHANGE RESEARCH

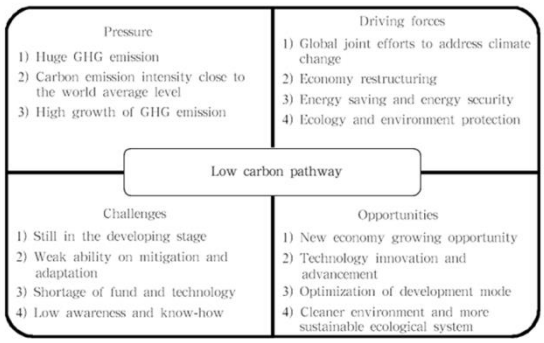

Figure 1 Four aspects of low carbon economy

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Further more, they'll contribute to the fast economic development of China and also the strong promotion of energy conservation and environmental protection, a win-win result. This paper, in consideration of things and driving forces behind future economic development, energy growth, and emissions, analyzes the varied technology portfolios under the various emission

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2. STUDY METHOD

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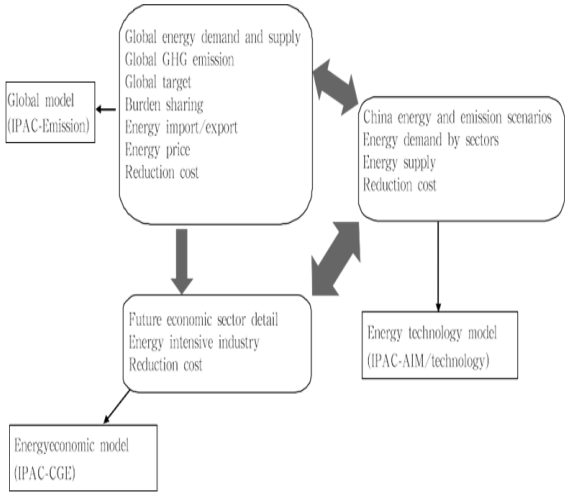

Figure 2 The model framework

The link among the three models is viewed in Figure 2.

The three sub-models are connected through soft connection (i.e., outputs) of 1 sub-model are used as input in another sub-model. Results of the three models are `adjusted and obtain feedback from other sub-model, and this setup will result in similar results coming from the three different models) to make sure accuracy and rationality. supported the population scenarios by the National Population and birth control Commission, a projection is formed that China's population will increase to the height value of 1.47 billion from 2030 to 2040 and reduce to 1.46 billion in 2050 [NPDSRPT, 2007]. consistent with the three-step development plan of China, it's predicted that the event level of China in 2050, i.e., the annual GDP increasing rate, is going to be about 6.4% from 2005 to 2050. Parameters for the economic structure changes are supported outputs from IPAC-CGE, i.e., the proportion of secondary industry and also the tertiary industry in macro-economic aggregates are going to be 45.5% and 50.2% respectively in 2030, and 36.4% and 61.2% respectively in 2050. Furthermore, with correlation analysis and therefore the judgments of industry experts, the yield changes of energy-consuming industrial products are shown in Figure 3.

The changes in construction and transportation in terms of volume of services are studied in the same way. Using yield and serve volume as major inputs to IPAC-AIM/technology mode, the model can produce low carbon technology compositions in various scenarios and so present an occasional carbon technology development roadmap for China.

SCENARIOS

To produce a coffee carbon development roadmap of China, this paper designs three scenarios that will be compared in terms of technology composition to form a technology development roadmap.

(1) Business as was common (BAU). It presumes that China will take measures substantially influencing global climate change like policies concerning energy conservation and developing renewable, but won't take extra efforts exclusive to fight global climate change.

(2) Low carbon (LC). It reflects that in consideration of domestic social, economic, and environmental demands, China will do national policies concerning global climate change, and can take some measures as intensifying technology advances, transforming economic development modes, and changing consumption methods. it's a scenario with low energy consumption and low emission which may be achieved through domestic endeavors.

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(3) Enhanced low carbon (ELC). It presumes that under the common prospect of world global climate change mitigation, China will make its due contribution to emission reduction. On the one hand, this scenario considers the advanced technology-enhanced across the world, the prices of major technologies dropping de- increasingly, and also the technology spreading increasingly from developed countries to developing counties. On the opposite hand, it takes into consideration that China as of 2030 will invest more in low carbon industries and technologies, boast several energy productions and use the most recent technologies (such as clean coal), which can help China substitute the highest rank of the globe in terms of technology development and application, and attain the recognition of carbon capture and storage (CCS) within the whole country. According to our research and analysis, this is often mainly caused by differences in technology development and applications.

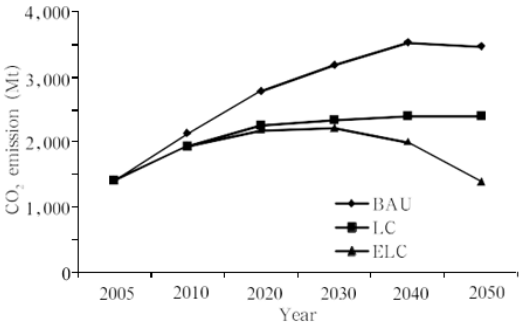

Figure 4 Energy-induced CO_2 emissions by 2050 in different scenarios

LOW CARBON TECHNOLOGY ROADMAP

The differences within the three scenarios above show that we've got future potential in low carbon development. However, to succeed in the potential, we'd like to implement various policies and measures to cut back the investment costs in low carbon technologies and to extend its market shares and application scope. This is often especially important for China because the failure of applying and spreading low carbon technologies as early as possible will cause the loss of opportunities for controlling and mitigating carbon emissions in the future. In general, because the market scope of low carbon technologies is enlarging, the investment and operation costs will gradually drop (this is additionally called learning effects of technologies),

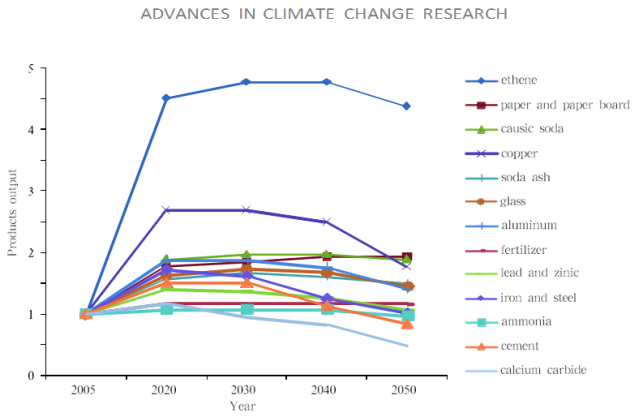

Figure 3 the trend of output of main industry products (output is 1 in 2005)

supported other relevant studies, we analyze several key cost learning curves (Fig. 5) and input the results into energy technology modes as important parameters in analyzing low carbon technology development roadmaps. Supported the above analysis, this paper selects 14 crucial low carbon technologies, compares them with the above scenarios, and produces the event roadmaps of these vital technologies under the targets of low carbon development (Fig. 6, NGCC refers to gas combined cycle). In Figure 6, the red arrow represents technologies within the sprouting stage, the brown arrow for technologies within the initial stage of promoting, green arrow for technologies within the marketing and recognition stage. After comparing the scenarios, we conclude that in contribution to the fulfillment of the LC scenario in China, the 14 technologies in numerous time periods will exert diversified effects. Before 2030, vital low carbon technologies within the power sector, industry sector, building sector, and transportation sector include off-shore alternative energy generation technologies, advanced industrial energy-use technologies, building-integrated solar thermal/ heating technologies, hybrid vehicles, etc. After 2030, there'll be other technologies exerting their due influences, among which CCS (including CCS within the power sector and energy end-use sectors)

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will make a significant contribution to the belief of ELC scenarios.

5 CONCLUSIONS AND SUGGESTIONS

A low carbon pathway in China implies that the country or local regions will make the most effective efforts to re- duce GHG emissions, and can keep the economy growing fast at relatively low reduction costs. Though China doesn't have the capacity and conditions to chop GHG emissions by an outsized margin, we can still abate the increased rate of GHG emissions and gradually transform to a coffee carbon mode by adopting an occasional carbon development model This paper shows that to fulfill future low carbon development targets, in both energy production and energy consumption, technologies make their due contributions. Low carbon technologies concerning energy consumption will play a more significant role before 2030, and after 2030 low carbon technologies concerning energy production will play a bigger role. At present, energy conservation technologies reducing carbon emissions have the simplest marketing potential and economic benefits in China.

Therefore, we shall take the chance because the country is making efforts on energy conservation and emission reduction and also the expansion of their applications in various sectors. Within the industrial sector, energy conservation technologies should be spread through policies and measures when China is launching large-scale infrastructure construction, to catch up the global level in terms of business energy efficiency within the period from 2020 to 2030. Within the construction sector, energy-efficient buildings should be popularized. In urban areas, targets for building energy efficiency shall be met; in rural areas, efforts should be made to construct more low-cost and high-energy efficient buildings, to succeed in the goal of skyrocketing energy utilization efficiency by 30%–50% in 2030. Within the transportation sector, endeavor to create public transportation become mainstream transport tool are taken, hybrid vehicles become standard autos and electric vehicles involves be more popular. Clean energy technologies shall be encouraged through policy stimulus and therefore the establishment and completeness of relevant markets. Several clean energy technologies such as land wind generating techniques with great potential are competitive in marketing. As long as adequate policy supports and a healthy market environment are in place, those technologies will play their parts shortly. Encourages shall be made to scale up some off-grid renewable technologies by 2030, for in- stance, household renewable technologies (including solar thermal technologies, household PV technologies, household wind power technologies). Because China will keep relying on fossil fuels such as coal, still, be the biggest coal consumption country in the world, and occupy quite a large proportion in global coal consumption surge, more attention shall be paid to clean coal technologies, especially clean coal generating technologies.

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