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Prediction on Carbon Emissions Reduction and Analysis on Economic Development Based on Energy Consumption Policy

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Abstract: As to the global warming, China has confidence in the development of the economy by bearing responsibility and obligation toward curbing global warming, which at this time can be achieved by reducing carbon emissions. Industry is an important material production department in the national economy, and plays a leading role in the national economy. Chinese industrial production is mainly based on the consumption of fossil fuels, resulting in a large amount of CO_2 emission. Therefore, how to find a way to predict the discharge of CO_2 by computer technology and make people realize the importance of low carbon development at industrial level is the focus of this study.

Keywords: CO_2 consumption, consumption policy, economic development analysis.

1. INTRODUCTION

Since human society entered the industrialization period, the long-time use of fossil fuels is responsible for a large number of greenhouse gas emissions. As the greenhouse gases increase in atmospheric concentration system, the change of climate brought by greenhouse effect has become one of the research hotspots in the field of energy policy and environmental management. With climate change having more and more attention, it has not only reflects the climate system itself, but also involves economic, political, energy, environment and other fields, which are a kind of major environmental problems influencing the survival and development of human being. The main cause of global climate change is the concentration increase of greenhouse gas emissions, which is thought to be closely related to human activities [1]. The fifth climate change assessment report of IPCC since the middle of the 20th century takes that human influence is most likely the main cause of global warming, the possibility is above 95%, which is higher than 90% of the fourth assessment report in 2007. Proposed by the end of 2010, the concentration of greenhouse gases blamed for global warming had been more than 390 PPM or 39% above the pre-industrial level [2]. These numbers reflected that the governments have to take measures to further suppress or reduce CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, among which CO_2 had made the most contribution to global warming [3], reaching 55%. Therefore, to protect the environment for human survival, to curb the damage of global warming to human beings, the emissions of CO_2 should be reduced in the first place. In 2009, the Chinese government announced the greenhouse gas emission reduction goals: the CO_2 emissions of gross domestic product each unit (GDP) by the year 2020 will be less than in 2005 at 40%-45%.

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2. RESEARCH ON REDUCTION POLICY

Global warming is a serious threat to the sustainable development of society, economy, and environmental pose. In December 1997, “Kyoto protocol” was passed during the third meeting of contracting party of “Framework convention on climate changes of United Nations” to limit greenhouse gas emissions in the developed countries to curb global warming. Common but distinguishing responsibilities are set out. In 2003, the British government put forward the concept of low carbon economy for the first time in the “Our future of our energy: create a low carbon economy”. Low carbon economy development problems have become the focus of attention. Research scholars both at home and abroad generally believe that a low carbon economy refers to low energy consumption, low pollution, and low emissions, on the basis of a kind of economic model, the essence of which is to transform traditional energy production and demand, to improve the efficiency of energy utilization, for a clean energy development, in the pursuit of green GDP. Its core questions are based on the innovation of energy technology and emission reduction technology, industrial structure and institutional innovation and fundamental change of human survival and development concept.

In October 2008, the Chinese government issued “Chinese policy and actions response to climate change” white paper to put forward Chinese response on climate change and the action plan to tackle climate change by reducing the drain of greenhouse gas emissions as the work target and taking strategy of slowing down and adaption to change of Chinese climate.

There are series of mature international frameworks or emission reduction policies formed [4-6], but whether these policies are suitable for China? Should the Chinese government choose the policy to make the maximum utility of emission reduction under the restriction of reduce emission targets? And How? These studies are scattered, not forming a system. And due to the inconsistent data and model, according to the same problem, the research conclusions tend to have big difference. In addition, as to the differences between Chinese provinces and domains, emission reduction policy also needs to reflect differences. Further, the questions regarding the impact of the two kinds of popular policies (carbon emission rights allocation and carbon tax), on the Chinese economy in whole, or at the regional level, brought about complexity. China is currently in a phase where carbon level is increasing year by year, may be due to two reasons: One is an inexorable law of the economic social progress, namely, China is in the phase of the primitive accumulation of capital. Because of the particularity of its national conditions, the present stage of economic development inevitably requires propulsion of China under both the inside and outside severe double environment pressure [7], to go through a stage of rapid growth of carbon emission.

3. DESIGN OF CHINA CARBON EMISSIONS REDUCTION FORECAST SYSTEM

Prediction optimization system is based on a comprehensive utilization of various data and models, developed on the basis of computer processing of human-computer interaction information system. The system can be fully integrated for database management, mathematical calculations, etc., which can improve the efficiency of prediction. And spatial prediction optimization system is mainly behavior orientated in space prediction optimization, and in certain cases extract implicit relationships of spatial data, in the form of graph and text for direct expression, to provide a variety of scientific applications for the reasonable prediction of optimization in the real world, in order to make the forecast more in line with the objective facts and rationality. At present, a lot of climate change models are based on a single model, only to solve one aspect of the problem, not involving the comprehension. Using the same data different models may produce different results. However, when the situation changes, it also needs to spend a lot of time to adjust a model, which reduces the model efficiency.

3.1. Data Processing and Calculation of Carbon Emissions

According to consumption resources of industry and manufacturing for all kinds of energy of China from 1994 to 2011, combined with various energy folds into the China energy statistical yearbook of standard coal reference coefficient and the released energy carbon emission coefficient in IPCC national greenhouse gas emissions list provides guidelines for calculating carbon emissions from resources of industry and manufacturing of China, respectively using ZY and ZZ to express, see Fig. (**1**).

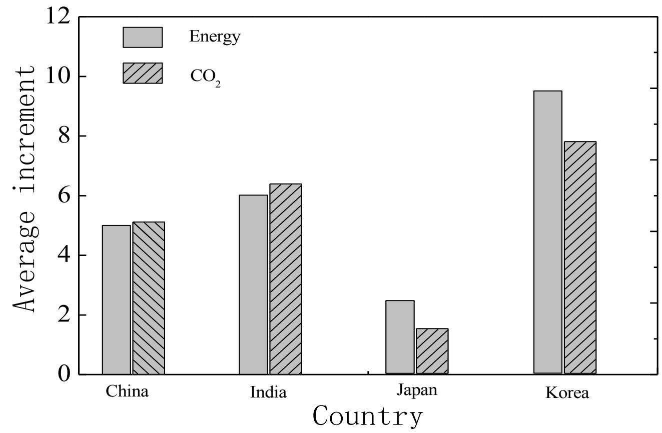

Fig. (1). Energy and carbon dioxide emission growth rates.

Industry carbon emissions calculation formula (He. *et al.*, 2012) is:

$$C_j = \sum_{i=1}^{n} N_{ji} \cdot g_i \cdot h_i (\text{i} = 1,2,3,\ldots,\text{n}) \quad (1)$$

Among them, the Cj expresses carbon emissions of j industry; i expresses energy consumption types, respectively including coal, coke, crude oil, gas oil, kerosene, diesel, fuel oil, natural gas, power, *etc*. Nji expresses the energy consumption of energy i in j industry in a certain period; gi expresses the coefficients of standard coal of i kind of energy conversion; hi expresses the coefficient of carbon emissions of i energy.

4. CARBON DIOXIDE EMISSIONS OF CHINA

It can be seen from Fig. (**2**) that since 1978 China's per capita carbon dioxide emissions and carbon emissions are increasing with convergence mode of growth. As per record, in 2010, the carbon dioxide emissions increased from 399 million tons in 1978 to 22.48 trillion tons, i.e. with the average growth rate of 5.55%. According to its growth speed observing trends in the graph, can be divided into two phases: in the first phase from 1978 to 2002,

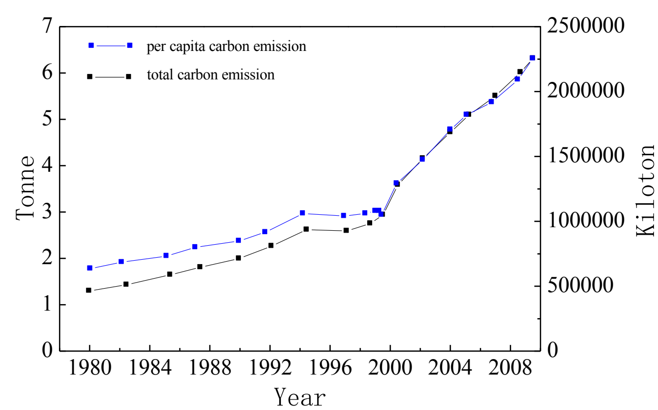

Fig. (2). Per capita carbon emissions and carbon dioxide emissions of China.

total carbon dioxide emissions growth rate is slow, with the average growth rate of 4.30%; in the second phase from 2002-2002, carbon dioxide emissions growth rate is faster, with the average growth rate as high as 10.55%. China's per capita carbon emissions 1.52 metric tons in 1978, increased by more than 3 times, i.e. 6.15 tons in 2010 with the average growth rate of 4.46%. Similarly, per capita carbon dioxide emissions will be divided into two stages: the first stage from 1978 to 2002, with an average growth rate of 2.95%, the second phase of 2002-2002, with an average growth rate as high as 9.95%. After 2002, per capita emissions of CO_2 and carbon dioxide increased at a high speed, which is closely related to the rapid development of China's economy after 2002.

With the development of Chinese economy, China's energy consumption requirement is also growing, as shown in Fig. (**3**),

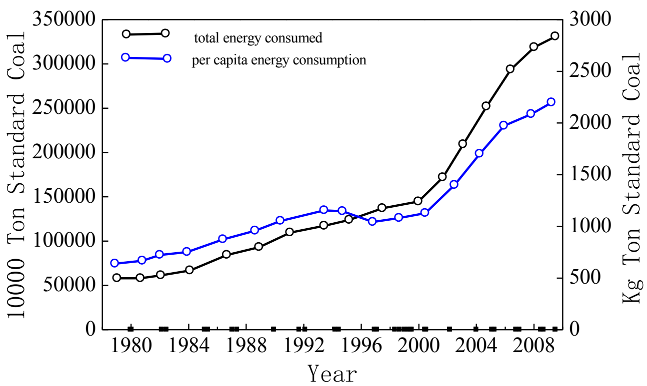

Fig. (3). Per capita energy consumption of China.

In 1978, the total energy consumption of China is 570 million tons, which until 2010, increased to 3.25 billion tons, which has surpassed even the U.S. energy consumption requirement as the largest energy consumer in the world. In the total energy consumption, more than 90% is fossil fuels. The per capita energy consumption of China is in the same growth trend; in 1978, per capita energy consumption is 597.6 kg of standard coal, which increased to 2429 kilograms in 2010. From the point of international level comparison, as shown in Fig. (**3**), the energy consumption rate of United States, Japan, Canada and other countries in recent years, is on the basic flat of that in 2004 at a time, and unlike the increasing trend of the United States, the trend shows decline in the past two years, while the primary energy consumption of China is increasing constantly. So, the primary energy consumption rate in China and the United States basically remained unchanged, but in 2010 energy consumption of China exceeded to that of United States, becoming the world's largest energy consumer. In 2010, primary energy consumption of China reached 2.432 billion tons, accounting for 20.3% of the primary energy consumption of the world.

5. DESIGN OF CHINA CARBON EMISSIONS REDUCTION FORECAST SYSTEM

Prediction optimization system is based on a comprehensive utilization of various data and models, developed on the basis of computer processing of human-computer interaction information system. The system can be fully integrated for database management, mathematical calculations, etc., which can improve the efficiency of prediction. And spatial prediction optimization system is mainly behavior orientated in space prediction optimization, and in certain cases extract implicit relationships of spatial data, in the form of graph and text for direct expression, to provide a variety of scientific applications for the reasonable prediction of optimization in the real world, in order to make the forecast more in line with the objective facts and rationality. At present, a lot of climate change models are based on a single model, only to solve one aspect of the problem, not involving the comprehension. Using the same data different models may produce different results. However, when the situation changes, it also needs to spend a lot of time to adjust a model, which reduces the model efficiency.

Table **1** shows each type of energy emission reactors.

5.1. System Analysis

The purpose of system analysis is to set out to analyze and integrate based on Things in order to find feasible solutions to the problems coming across the system design; it mainly includes the system design and calculation of system analysis and integration.

5.2. System Design in Detail

Interface design must have characteristics of reusability, flexibility, complexity and reliability. The man-machine interactive interface is the system that is connected with the system intermediate link, and the main entrance to the decision makers to obtain all kinds of information and interactive interface.

This system uses the Windows interface, focus menus, toolbars, control panel and graphic display viewing area as a whole, all kinds of reduction parameters and other control parameters as input; input interface is consistent with the daily habits, which makes the system close to the users and the beginners to master. In addition, users also can set up and adjust the viewing area and make it suitable for user needs, eventually forming the strong operation of the user interface and clearing graphical user interface of man-machine interaction interface.

5.3. System Calculation

In this paper, corresponding to regional energy structure evolution computation IX: computational domain energy structure evolution is calculated from the subsystem of the optimal energy structure evolution of China. Because the energy structure evolution uses GAMS programming, the programming language cannot be the form of DLL. Therefore, in the design, the system uses the mixed programming, and the calculation module, to start the "call GAMS to calculate" button, to open a new process. On the other hand, exogenous policy preferences of the GAMS code are provided in C# system platform, to interact using EXCEL with data code for saving the different scenarios simulation results in a complete database.

Table 1. Each type of energy emission factors.

No.	Energy Type	TCO2/PJ	Code	Energy Type	TCO2/PJ
1	Raw coal	95700	6	Coal oil	71500
2	Coke	107000	7	Diesel oil	74100
3	Crude oil	73300	8	Fuel oil	77400
4	Gas oil	697766.67	9	Natural gas	56100
5	Heating power	-	10	Electric power	-

Since the module adopted in the system includes the fuzzy ti standard programming method, which is implemented by Matlab language; therefore, first of all, the Matlab code should be written in the functional form, translated into a DLL code and embedded in C# platform through the Deploy Tool.

CONCLUSION

Currently available international popular softwares related to carbon emission are restricted to the theoretical model of behind, lacking flexibility, which may not be conducive to Chinese national conditions. Therefore, the development of suitable a system and formulating policies related to carbon emissions path decision support platform of China, has a stronger practicability and urgency demand of the time. Thus, we developed a carbon emissions prediction software in this paper based on integration and software implementation of the previous models. The design carries on the policy which is based on energy consumption and regional carbon emissions requirements analysis and general design of China for the construction of the decision support system. It is based on the graphical user interface design, to carry on rational forecast of the carbon emissions. Besides, economy and energy optimization model, and the optimal energy structure evolution model are integrated into China's regional carbon emissions prediction system. Through the database and the external control, the interaction between the two models is realized. The system provides a great convenience for researchers as it is adaptable to their needs to accurately simulate all kinds of carbon emissions situations efficiently, to achieve accurate prediction, thereby improving the decision-making efficiency.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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