[*RESEARCH ON CHINA'S SUB-REGIONAL CARBON EMISSIONS INTENSITY AND ECONOMIC DEVELOPMENT*]

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Overview

China is the largest emitter of carbon dioxide, whileits total emissions keep increasing quickly. For the spacial imbalance on population distribution and economic activity, there is great difference in carbon emissions of every province. This paper proposes the concept of carbon emission per unit area (CEPUA), which can measure the responsibility of carbon emissions of different regions more scientifically and more objectively.

With calculation model which is recommend by IPCC, and the data of population, areas of every province, we calculate national total emissions, provincial carbon emissions per capita(CEPC), provincial CEPUA in China from 1995-2010. Further more, we analyse the associated patterns of the population, economy, CEPC and CEPUA.

Methods

The methods of calculation on carbon emissions in this paper is recommended by IPCCBaesed on this method and the data of provincial population, provincial areas, we calculated the CEPC and CEPUA. The equation is as following:

$$\begin{cases} PE_y = \sum_i Q_i \times NCV_i \times EF_i \times \frac{44}{12} \times OXID_i \\ CEPC_{jy} = PE_{jy} / POP_{jy} \\ CEPUA_{jy} = PE_{jy} / AREA_{jy} \end{cases}$$

In the equation：

PE_y: the carbon emissions in the year y (tCO_2)； Q_i: the mass of fuel i (t)；
NCV_i: net calorific value of unit mass fuel i (TJ/t)； EF_i: emission factor of unit mass fuel i (tC/TJ)；
$OXID_i$: oxidation factor of fuel i (%) $CEPC_{jy}$: carbon emissions per capita of province j in the year y (tCO_2)
POP_{jy}: population of province j in the year y $AREA_{jy}$: area of province j in the year y
$CEPUA_{jy}$: carbon emissions per unit area of province j in the year y (tCO_2/Km^2)

Oxidation factor of fuel can be obtained from IPCC guide(1996).

Results

The result shows that China's total fossil fuel-related carbon emissions reach 8.04 GT. The average increase rate from 1995 to 2010 is 10.4%. Western region emissions increase rate is 13%,while east region is 10% and the middle region is 8%.

In term of CEPC, Inner Mongolia, Ningxia, Shanxi are the three highest provinces, while Hainan, Chongqing, Jiangxi, Guangxi are the lowest provinces.

In term of CEPUA, Shanghai, Tianjin, Beijing are the three highest municipality directly under the central government, while Qinghai, Xinjiang , Inner Mongolia and Yunnan are the lowest provinces. Specifically, the increase rate of Inner Mongolia is the highest and reaches 30%.

Conclusions

（1） "High CEPC and high CEPUA" areas: Shanghai, Tianjin, Beijng, Liaoning,Hebei,Zhejiang, Shandong, Jiangsu. Among them, Shanghai, Tianjin, Beijng are three highest municipality directly under the central government, with high population density and high economic development, so their energy consumption is also high. Liaoning, Hebei, Zhejiang, Shandong, Jiangsu are heavy industry base and processing-manufacturing industry bases of China, high share of energy-intensive industries results in high carbon emissions.

（2） "High CEPC and low CEPUA" areas: Inner Mongolia, Ningxia, Shanxi are energy bases of China. They use coal to produce electricity and supply power to other provinces. Although they have high CEPC, only a part of energy is used by local people, the other is used by end consumers outside of the region.

（3） "Low CEPC and high CEPUA" areas: Guangdong, Hubei, Henan, Anhui, Chongqing have high population density and processing-manufacturing industry. Because of high CEPUA, their future development is under serious restriction of energy and environment. These provinces have difficulties in future sustainable development.

（4） "Low CEPC and low CEPUA" areas: Guizhou, Shanxi, Gansu, Fujian, Yunnan, Hunan, Jiangxi, Hainan, Guangxi have less energy-intensive industries, and have less GDP per capita (except Fujian). But their increase rates of energy consumption are high, and have problem of energy shortage.

(5) From international perspective, China's carbon emissions per capita are at medium level. China's CEPC is less than half of that in USA in 2010, but more than three times of that in India, and 1.24 times of that in Brazil. China's CEPUA is 1.73 times of that in India, but 7.62 times of that in Brazil, resulting from the difference of population density.

To sum up the above arguments, economic development still relies on the input of large amount of energy in most of China's provinces, and the quality of development is poor. At same time, energy shortage exists in every province. In order to define the responsibility of carbon emission, we must take account of Spacial imbalance of energy production and energy consumption. Carbon emissions due to energy end-use can reflect the responsibility of carbon abatement more objectively.

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