Low-carbon Economy: Theoretical Study and Development Path Choice in China

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Abstract

Low-carbon economy is a basic economic pattern of economic development pattern from the ecological civilization perspective. This article observed the development rules and practical development conditions of low-carbon economy in China. It discussed the development path choice in China through six aspects of development objective, development path, development emphasis, development method, crucial technical and institutional innovation.

Keywords: low-carbon economy, technical innovation, institution innovation

1. Introduction

The main feature of Low carbon Economy is “three lows and one high”-----low energy consumption, low pollution, low emission and high performance [1]. In essence, low-carbon economy is a matter of energy efficiency and clean energy structure. The core is the energy technology innovation and institutional innovation. The goal is to mitigating climate change and promote the sustainable development of human beings [2]

Japanese scholars Kaya (1990) proposed Kaya formula, that is to calculate the carbon emissions of production activities. The formula is [3]:

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CE_P = \frac{POD \times GDP}{POP \times EC} \times \frac{CE_S}{EC}
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(1)

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It can be seen that carbon emissions of social and economic activities are continued product of total population of this region, per capita GDP, GDP energy consumption by unit and emissions of unit GDP energy consumption. Population scale, GDP per capita, energy intensity, and coefficient of carbon emissions consists of four basic factors affecting carbon emissions.

From the perspective of the history of different countries and regions' development, we can find: economic development and evolution of the relationship between carbon emissions follow three environmental Kuznets inverted U curves, namely carbon emissions intensity inverted U curve, per capita carbon emissions inverted U curve and total carbon emissions inverted U curve. This means that the relationship between economic development and carbon emission should realize three kinds of changes: from the rising of carbon emissions intensity to its stable dropping; from rising of per capita carbon emissions to its stable dropping; from the rising of total carbon emissions to its stable dropping, as shown in figure 1.

So, according to three inverted U curves, the relationship between a country or region's economic development and evolution of carbon emissions can be divided into four stages: (1) stage before the carbon intensity peak, that is the rising stage of carbon emissions intensity; (2) stage from carbon emissions intensity peak to per capita carbon emissions peak; (3) stage from carbon emissions intensity peak to total carbon emissions peak; (4) stage of stable dropping of carbon emissions.

Fig. 1: Paths of Carbon Emission: Three “Roller Coasters”

2. Current conditions of low-carbon economy development in China

China is still a developing country, development is the absolute principle. Vigorous development as well as low energy consumption, low pollution, low emission, high performance, high efficiency and high profit (three lows and three highs) is the only choice. The necessities are mainly embodied in five aspects as follows:
2.1. **As far as the stage of economic development and characteristics of industrial structure is concerned, China is currently in a rapid industrialization stage, and heavy energy supplies is the important condition of heavy industrialization development.**

On one hand, China's per capita energy savings are far less than the world’s average level. The energy resources structure of “rich in coal, poor in petroleum, less gas, lack of iron” in China decided its rising demand for imports of international petroleum and gas resources and iron ore resource.

On the other hand, as price of international energy and resources rises substantially, China considerably pays high for shortage of energy resources through international markets. We depend so much on it that the anti-risk ability is weak, which has severely affected the stability and industrial competitiveness of China’s economic growth.

2.2. **As far as process of social structure is concerned, China is currently in the stage of rapid urbanization.**

According to China’s city metabolic statistics, the proportion of consumption or emission of the urban population, approximately 46% of the total national population, is as follows: iron 86%, aluminum 88%, copper 92%, cement 75%, 80% of energy; CO₂ emissions of 90%, SO₂ emissions 98%, COD85%. As the urbanization process accelerates, urban expansion becomes faster and faster, controls upon the urban energy resource consumption and exhaust emission is crucial to carry out the strategy of energy-saving and emission reduction, and also follows the trend of low-carbon urbanization.

2.3. **As far as market potential and promise of industrial development are concerned, low carbon industry represented by new and renewable energy, is a promising industry with huge potential and great business opportunities.**

In the “post-crisis” era, carbon emissions are not only a new logo to measure the human economic development pattern, but also becomes a “green barriers” by developed countries in the era of economic globalization. In recent years, traditional Chinese predominant products’ exports continue to be suppressed and limited by developed countries such European countries and America. Thus, whether from the perspective of the industrial potential profits or from the expansion of market demand, job creations etc., low-carbon eco-industries are the promising industries representing the 21st century’s industrial development direction.

2.4. **As far as social development strategies are concerned, China’s extensive development pattern with high carbon emissions and other associated environmental pollution have caused serious consequences of environmental pollution.**

According to the development orientation of developed countries and the objective requirements of scientific development concepts, China’s ecological civilization should be based on national conditions to build a “resource-saving and environment-friendly, low carbon-oriented society” with specific Chinese characteristics, with the focus on energy efficiency and building a clean energy structure to carry out institutional innovation, technological innovation and management innovation [4].

2.5. **As far as the international development strategies are concerned, "carbon emissions" will become an important international strategic resources in the 21st century.**
Today, China is still located low-end of industrial chain in the international industrial and labor division system, with a relatively high proportion of resource and energy intensive products exports. China’s total energy consumption accounts for 1/4 of the world and total carbon emissions 1/5. However, with the economic and population growth, the share will continue to rise, and furthermore, China is facing increasing pressure on carbon emissions from the international community, demanding that the Chinese commit to undertake more greenhouse gas emission reduction obligations.

3. Advantages and Challenges of China's low-carbon economy development

As the rapid development of the largest developing country, China's development of low-carbon economy condition is facing opportunities and challenges.

3.1. Advantages of China’s low-carbon economy development

China can take advantage of the opportunities of developing low carbon economy to strengthen the research and innovation in some areas with potential advantages, making breakthroughs and gaining competitive advantages in energy saving and emission reduction technology in some key industries. The first step is to achieve a significant reduction in carbon intensity, and then next step is to arrive as early as possible the turning point in carbon emissions and energy consumption. China’s development of low-carbon economy has the following advantages:

• 3.1.1. Carbon emissions still own more space.
Since China’s industrial structure and consumption structure is in the high-energy phase, coupled with low levels of energy-saving technologies and greater vulnerability in energy management, China’s energy intensity and energy efficiency was apparently low.

• 3.1.2. Through restructuring and technological innovation and improvement of management, etc., there are still much scope for energy saving and emission reduction.

• 3.1.3. Cost of carbon emissions reduction is low compared with developed countries’.
It is not only because the cost of a large number of emission reduction technology is lower when applied in China than in developed countries due to the relative low labour costs and economies of scale, but also because China’s economy has the late-developing advantages, with cost of the establishment of new businesses lower than that of renovation of old enterprises and old equipment.

• 3.1.4. There are much potential in carbon emissions technology innovation and cooperation.
There is a big gap between China and developed countries in low carbon technology. International cooperation opportunities of low carbon are in increasing. As a developing country, China’s development of low carbon economy can obtain the financial and technical assistance from developed countries.

3.2. Challenges of China’s low-carbon economy development

Meanwhile, China’s development of low carbon economy is faced with many adverse conditions:

• 3.2.1. The heavy pressure of carbon emissions of current stage of economic development
China is now in the rapid development phase of heavy industrialization and urbanization, with growing and absolute size of the population, upgrading consumption structure, growing demand for energy brought by large-scale urban infrastructure construction as well as increasing greenhouse gas emissions.

• 3.2.2. The extensive economic development pattern
China’s economic development has long been featured with high input, high consumption, extensive development, relatively high energy and resource dependency, and the unit GDP energy consumption and
energy consumption of major products were significantly higher than that of major energy consuming countries on average.

- **3.2.3. Resource endowments and energy structure is not conducive to carbon emission reduction.**

  China’s energy resource structure of “rich coal, poor oil and less gas”, determines that China’s coal-based energy production and consumption patterns will exist for a long time. China’s proven energy resources per capita volume is only 135 tons of standard coal, equivalent to 51% of the world per capita, of which coal, oil and natural gas are 70%, 11% and 4% of the world average volume. The coal-based energy structure is particularly not conducive to lowering of carbon intensity.

- **3.2.4. The industrial structure and trade structure is in the lower end of the international labour division system.**

  United States, Japan, the European Union and other countries have entered the period of knowledge economy or the service economy, being in a leading position in the global division of labour and the international trading system, while China’s industry and export products are still in the low-end position, with a wide gap with the developed countries in aspects of technical content, value-added products, and competitiveness, etc. [5]

- **3.2.5. China is faced with the contradiction between the industrial transformation and upgrading and the improvement of the livelihood of the people.**

  Since China is now in the accelerating phase of industrialization with huge population base and income disparities, creation of employment, counter-poverty and anti-poverty, guarantee of the livelihood of the people, improvement of the living standards of all people, and realization of national modernization are still the biggest tasks. China’s current per capita energy consumption is still low with thousands of people having no access to electricity, and its energy consumption is still for living, which means that energy consumption is inevitable to grow in the coming decades.

4. China’s Path Choice of Low-carbon Economy Development

4.1. China’s goal of low-carbon economy

  China’s goal of low-carbon economy is to build an ecologically civilized society of being resource-saving, environment-friendly, low carbon-oriented, and sustainable according to the requirements of the scientific development concept, and to reflect the ecologicalized low-carbon industries and low-carbon economy development in specific practice of the new industrialization and new city construction.

4.2. China’s path of Low-carbon economic development

  China’s path of Low-carbon economic development is based on the stage and level of economic development in China today, and is phased and gradual, mainly relying on technological progress and structural adjustment. First of all, reduce the carbon intensity, and strive to reduce CO2 emissions per production unit of GDP by 40% to 45% in the second decade of the 21st century, and then endeavour to reduce carbon emissions per capita, so as to achieve reduction in total carbon emissions by the middle of 21st century when the process of industrialization is finished. To achieve the overall decline in energy intensity, we should both adjust the energy structural and promote energy efficiency [6].

4.3. “One main method and two supplementing methods” to achieve energy saving and low-carbon development
China has “one main method and two supplementing methods” to achieve energy saving and low-carbon development, namely mainly relying on market means and supplemented by the government means and moral means. Options of means of energy saving include three aspects of government, morality and market, of which the market is the most effective and the most important one [7]. In short, the Government’s responsibility is to provide a market environment conducive to carbon emissions and the market mechanism and behavior is the key to carbon reduction.

4.4. The low carbon technology innovation for China’s economic development

The low carbon technology innovation for China’s economic development should focus on key practical alternative technologies and energy-saving technologies. The former refers to new energy technologies that use renewable energy instead of fossil fuels, while the latter mainly refers to the development and application of a new generation of clean coal combustion power generation technologies, such as IGCC.

4.5. China’s system innovation for low carbon economic development

China’s system innovation for low carbon economic development should be based on the guidance, incentives and norms for low-carbon industry, such as: (1) promote system innovation for CDM development, and establish a perfect institutional framework of management mechanism to promote the development of CDM projects; (2) promote carbon trading system innovation, establishment of standards for carbon reduction, carbon emissions alliances and trading platform for carbon projects, and expand carbon emissions trading scale; (3) promote carbon finance system innovation, through the following steps that include: to create a policy bank for low carbon and environmental protection, to establish and gradually improve the “green credit system”; to establish an environmental protection fund for carbon reduction and issue of “eco-fund” products; to promote “green insurance” products and carry out the pilot securitization of catastrophe risk; to implement “green” financial product innovation, and test the “green financial derivatives” [8] etc., in order to support and sustain low-carbon economy.

5. Conclusion

China is now a developing country with its own advantages and challenges. We should persist the direction of low carbon economy to develop its economy. Vigorous development as well as low energy consumption, low pollution, low emission, high performance, high efficiency and high profit (three lows and three highs) is the only choice.

China’s low-carbon economic development path choice should not only follow the general rules of social-economic development and climate protection, follow the trend of low-carbon economy, but also should, on the basis of China’s basic national conditions and national interests, scientifically determine the development goals, make proper choice of development path, clearly define development priorities, properly determine development methods, research and develop key technology by collective force, and improve the supporting system[9].
References


