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Economy Development, Energy Consumption and Carbon Dioxide Emissions of China's Textile Industry

Lai-li Wang[1], Xiong-ying Wu[2], Xue-mei Ding[1]
[1] Fashion · Art Design Institute, Donghua University, 200051 Shanghai, China
[2] Shanghai Entry-exit Inspection and Quarantine Bureau, 200135 Shanghai, China

ABSTRACT

Textile industry has been playing an important role in the global economy development, international business and trade. In China, textile industry is a traditional pillar industry and an important livelihood industry. The proportion of textile industrial output on GDP has risen to approximately 7% in recent five years. Currently, the ever increasing amount of carbon dioxide emissions, which has been caused by anthropogenic energy consumption, seems to be aggravating the problem of global climate change. Through analysis of statistical data on many indexes, it showed that the total energy consumption and carbon dioxide emissions increased more than double from 1980 to 2009. Though the consumption of primary energy sources shrunk during this period, coal is still the dominating energy source. The decrease of carbon employment rate (CER) in China's textile industry was caused by the increase of industrial production efficiency of textile workers. However, this phenomenon exerts negative impact on development of green employment in the China's textile industry.

Keywords: *Energy consumption, Carbon dioxide emissions, Textile industry*

1. INTRODUCTION

Global climate change has been one of the most devastating environmental problems of our ages. The ever increasing amount of carbon dioxide (CO_2) emissions, the dominant contributor to the greenhouse effects, seems to aggravate this problem [1]. Anthropogenic energy consumption, especially traditional fossil fuel consumption, is one of the main causes of carbon dioxide emissions [2]. Being the largest developing country, China's economy has gained rapid development in the past three decades and overtook Japan as the worlds' second-biggest economy. However, it also consumed large quantities of energies and has caused large carbon dioxide emissions in the process of economy development. In 2010, the total amount of energy consumption in China exceeded 3249 million tons of standard coal equivalent (SCE) of which fossil fuel accounted approximately 91.4% [3]. According to a report from Netherlands Environmental Assessment Agency, China has overtaken the United States as the world's top annual emitter of carbon dioxide [4]. China is now and in the nearest future facing great pressure on reducing its energy consumption and carbon dioxide emissions.

Textiles are important daily life necessities for human beings. The textile industry has been playing an important role in the global economy development, international business and trade. It employs the largest share of the world's population and was considered as the engine for economic growth in developed countries during the Industrial Revolution [5]. In China, textile industry is the traditional pillar industry and an important livelihood industry. Relying on the relatively low cost and skilled labor, China's textile industry gained fast growth since the reforms and opening up to the outside world. The proportion of textile industrial output on GDP has risen to approximately 7% in the past five years. China has become the leading producer of textiles and clothing in the world as well as the largest exporter of textile and clothing commodities. However, because of an extensive mode of development with "high resources consumption, high wastes emissions" and fossil fuel dominant structure of energy consumption, there has been large carbon dioxide emissions along with the increasing economy of China's textile industry. In regard to stated objectives on carbon emissions decreasing, that reduces intensity in carbon dioxide emissions per unit of GDP in year 2020 by 40 to 45 percent compared with the level in year 2005. China's textile industry faces a great challenge for energy saving and emissions reduction in the coming eight years.

In this paper, energy consumption and carbon dioxide emissions of China's textile industry were analyzed on many indexes, *e.g.* energy intensity, energy structure, carbon dioxide emissions intensity, carbon economic efficiency, carbon employment rate *et al.*, according to statistical data. Specific recommendations for energy saving and emissions reduction options were also given accordingly.

2. METHODOLOGY

Model

In our research, many indexes were employed in order to interpret the relationship and trends of economy development, energy consumption and carbon emissions of China's textile industry. They are enumerated as follows:

Energy intensity [6]: It's the energy consumption per unit of GDP. It is a measure of energy efficiency of a nation's economy. The textile industry energy intensity refers to the amount of energy consumption of value-added to the industry. It can be calculated by equation (1).

$$I_E = \frac{E}{GDP} = \frac{\sum_{i=1}^{m} E_i}{V_a} \quad (1)$$

Where,

I_E is energy intensity (ton SCE/10000 Yuan).

E is energy consumption (ton SCE).

E_i is consumption of the i^{th} kind of energy (ton SCE).

V_a is value-added of textile industry (100 million Yuan).

Carbon dioxide emissions intensity: It's the carbon dioxide emissions per unit of GDP. This is a measure of the carbon dioxide emissions efficiency of a nation's economy. The textile industry carbon dioxide emissions intensity refers to the amount of carbon dioxide emissions of value-added to the industry. It can be calculated by equation (2).

$$I_C = \frac{C}{GDP} = \frac{\sum_{i=1}^{m} C_i}{V_a} = \frac{\sum_{i=1}^{m} E_i \times f_i}{V_a} \quad (2)$$

Where,

I_C is carbon dioxide emissions intensity (ton CO_2/10000 Yuan).

C is carbon dioxide emissions (ton CO_2).

C_i is carbon dioxide emissions caused by the consumption of the i^{th} kind of energy (ton CO_2).

f_i is carbon dioxide emissions coefficient of the i^{th} kind of energy consumed (ton CO_2/ ton SCE).

Carbon employment rate: The CER (person/ton CO_2) refers to the labor input per unit of carbon dioxide emissions, or the carbon dioxide emissions from increases in employment. CER of textile industry can be calculated by equation (3).

$$CER = \frac{L}{C} = \frac{L}{\sum_{i=1}^{m} C_i} = \frac{L}{\sum_{i=1}^{m} E_i \times f_i} \quad (3)$$

Where,

L is the employment number of textile industry (10000 persons).

Data Sources

The annual data were collected and used in our empirical study. Among them, energy consumption data were from "China Energy Statistical Yearbook", value-added and employment data were from "China Statistical Yearbook". Carbon dioxide emissions coefficients of the energies were consulted from IPCC Guidelines for National Greenhouse Gas Inventories [7].

3. RESULTS

According to equation (1), the energy consumption and energy intensity of China's textile industry was accounted and calculated. The results were presented in Figure 1.

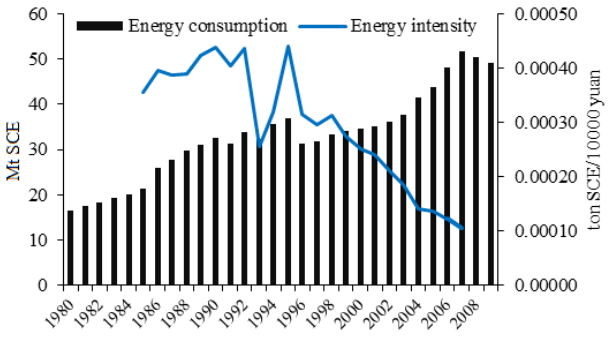

Figure 1: Energy Consumption and Intensity of China's Textile Industry

From 1980 to 2009, the total energy consumption showed a trend of fluctuant growth. During the period between 1980 and 1995, the total energy consumption increased at a slower rate. In 1996, there was a sudden decrease but then increased gradually with an accelerated rate and reached the highest level in 2007. Contrary, the energy intensity showed a decreasing growth rate, especially after 1995. Before 1992, the total energy consumption and energy intensity increased almost at the same rate. Subsequently, a "*V*" shaped curve appeared from 1992 to 1995.

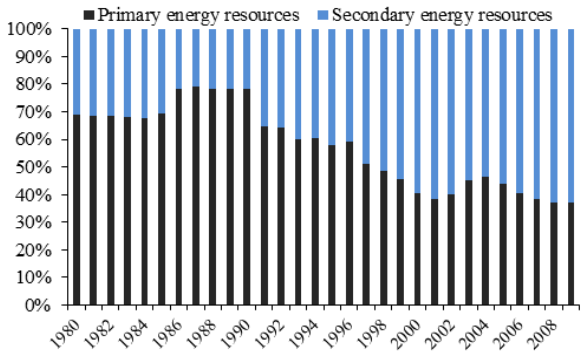

Figure 2: Composition of China's Textile Industry Energy Consumption

Figure 2 indicated the composition of China's textile industry energy consumption. Before 1998, primary energy resources, such as coal, oil and nature gas were the main sources of energy consumption. From 1986 to 1990, the proportion of primary energy resources went up to 80 per cent. With the fast increasing consumption of electricity and heat power, the proportion of secondary energy resources surpassed that of primary energy resources since 1998.

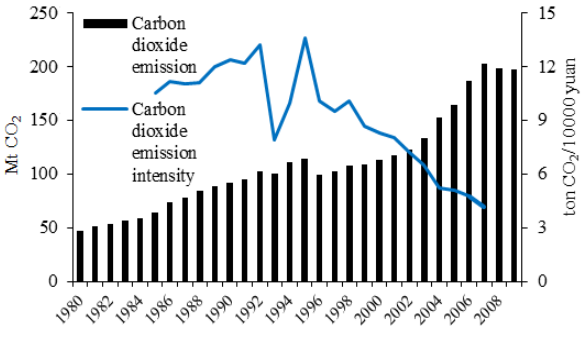

Figure.3. Carbon dioxide Emissions and Intensity of China's Textile Industry

The carbon dioxide emissions and the intensity of China's textile industry have a similar development trend with that of energy consumption according to Figure 1 and Figure 3.The peak in carbon dioxide emissions occurred in 2007 and reached 202 Mt CO_2, more than four times of 1980's emissions. The decrease in carbon dioxide emissions intensity indicates that the carbon dioxide output or carbon dioxide productivity, which refers to GDP output per unit of carbon dioxide emissions, is increasing.

In the period from 1985 to 2009, CER of China's textile industry showed a tendency of fluctuant decrease from 0.1438 to 0.0564 person per ton of CO_2 (Figure 4). This indicates that the incremental carbon dioxide emissions surpassed the incremental employment in the industry. It exerts a negative impact on low carbon development and green employment in China's textile industry.

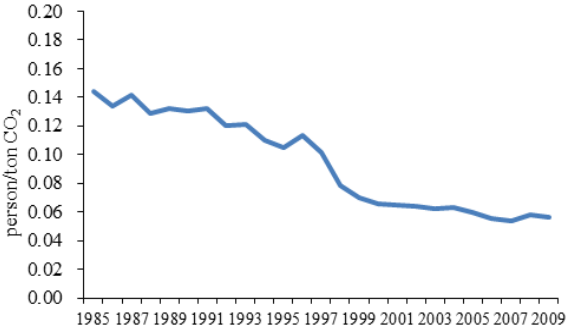

Figure 4: CER of China's Textile Industry

4. DISCUSSIONS

As the world's second-biggest economy, China's rapid industrial growth over the past thirty years has led to a rapid increase in energy demand. It now accounts for more than 16% of global primary energy demand and will overtake U.S. as the world's largest energy consumer [8]. Since energy demand is not increasing in the most efficient way, large quantities of carbon dioxide are emitted to the air along with the rising GDP. China is one of the most vulnerable countries prone to adverse consequences of global climate change which has been proved to have a close relation with excessive carbon dioxide (the most important GHGs) emissions. The government is paying great attention on reducing energy consumption and carbon dioxide emissions.

The textile industry is recognized as a precious national stone in China. It is a traditional pillar industry and an important livelihood industry. According to a survey, the evaluation index of the global competitiveness of the China's textile industry stood at first place, making China the most competitive country worldwide in the textile industry [9]. Since the reform and opening up of china, the textile industry experienced three development phases. From year 1978 to 1990, China's textile industry developed fast through quantity expansion. After that, the reforms among the state-owned enterprises were deepened from year 1991. Industrial structure adjustment and industry upgrading promotion were the focus in the period between year 1991 and 2000. On November 11, 2001, China officially entered the WTO, becoming its 143rd member. Afterwards, China's textile industry entered a new historic developing period.

Extensive development was a characteristic of the first development phase. On January 1st, 1978, primary ministry of light industry was divided into ministry of textile industry and ministry of light industry. As an independent government department, the main mission of ministry of textile industry was to vigorously promote the development of China's textile industry in order to satisfy the increasing domestic clothing consumption in the period. A lot of attention was given to the expansion of industrial process scales. However, the impacts on environment, such as carbon dioxide emissions and water pollution, gained little attention.

With the saturation of domestic market, international exports become the development core of textile industry since 1986 and China became the world's largest exporter of textiles and clothing in 1994. At the same time, large-scale textile and apparel companies moved into the mainland from Hong Kong and Taiwan with advanced processing technologies and management modes. Both of the production efficiency and product quality of the industry were improved. From 1995, the energy intensity showed a decreasing trend.

After entering WTO, China's exports of textiles and clothing gained a further development. Speeding up of structure regulation and promoting industrial optimization and upgrading became the new mission of the government in order to build a textiles powerful nation. In addition, energy saving and emissions reduction became one of the key problems of macro-control on environmental protection. Through elimination of backward production capacity, the energy intensity decreased continuously.

Textile industry is labor intensive and labor costs can have a considerable impact on the competitiveness in the global market. In recent years, many people moved from rural areas to the city searching for better jobs. This cheap labor has promoted the prosperous development of China's textile industry. However, with the improving level of mechanization, the production efficiency of textile worker increased significantly. This caused the increase of carbon dioxide emissions for each textile worker since industrial production and processing was still the characteristic of China's textile industry at present. This goes against the development of green employment in the industry. Therefore, it is important to increase the added value of textile and apparel products through design and brand improvement of which have a low carbon dioxide emissions.

5. CONCLUSIONS

China is now the world's second-biggest economy and it has a marked signet on the stage of global GHGs emissions. Textile industry is a traditional pillar industry and an important livelihood industry in China and it has been playing an important role in the global economy development, international business and trade. However, China's textile industry is also a high energy consumption and high carbon dioxide emissions section. From 1980 to 2009, the total energy consumption and carbon dioxide emissions showed more than a double increase. Though the consumption of primary energy sources shrunk from 1980 to 2009, coal is still an important energy source because thermal power occupies a considerable proportion in the structure of China's electric power. The decrease of CER in China's textile industry was based on the increase of industrial production efficiency of textile workers. This is not meaningful on the aspect of green employment. Only through improvements of design and brand value of textile and apparel products, the textile industry can achieve the low carbon development.

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