Optimization Strategy of Manufacturing Carbon Efficiency

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Abstract
With the economic booming, especially in manufacturing, the protection of environment is also gradually advocated. The purpose of this study is to use the mathematical model to measure manufacturing carbon emissions from 2000 to 2014 and to study the optimization tactics of the manufacturing carbon efficiency, so as to work for the future manufacturing emissions proposed countermeasure, and ensure the manufacturing has a steady development in the future. The research on part of manufacturing carbon efficiency optimization work through literature research and field survey method was made. Deeper understanding about its current situation, characteristics and efficiency, evaluation about Carbon resource utilization was obtained. The development planning and optimization strategy about the carbon utilization efficiency of manufacturing in the future was put forward.
Key words: MANUFACTURING, CARBON EFFICIENCY, THE THREE-DIMENSIONLA EVALUATION ABOUT OPTIMIZING THE CARBON EFFICIENCY

1. Introduction

It is always a hot issue around the world that whether we should develop our economy at the expense of the environment or not. With the economic booming, especially in manufacturing, a better environment is more attractive to people. So people pay more attention to the carbon emission.

With more and more carbon emission, the global climate is getting worse and worse and the global temperature is also rising. So that our life and healthy is affected deeply. Besides, some natural disasters happen, which threaten our human survival. Low-carbon green has become a problem that we have to face, and first of all, our priority is to reduce carbon emissions. In such circumstances, to achieve reduction targets of carbon emission is delivered to the deeper research of carbon efficiency optimization in ma- nufacturing. Therefore, we should do well in carbon efficiency optimization to reduce carbon emissions and to find a way to achieve the sustainable development of low-carbon green.

In the era of low carbon economy, how to optimize manufacturing carbon efficiency and how to reduce carbon emissions have become the focus of international and domestic research. On the current situation of the study on efficiency for manufacturing carbon, domestic and foreign scholars have carried on the thorough research to it and get rich research achievements. It contains carbon decomposition method, the factors influencing carbon emissions, and carbon effi-

ciency, etc. The specific research results as follows.

In the study of carbon decomposition, there are a variety of carbon decomposition methods, such as, in 1964, the German scholar E.Laspeyres put forward the IDA (Laplace index method), which was to choose a variable factors from a number of carbon emissions influence factors [1]. Then, ReitlerW[2], Howarth R.B[3], Emmanouil , Heraeles P, Dias H[4], RamM.S and Gabrial A, Migara H.L[5] and soon, they all use IDA decomposition method to analyze the carbon emission factors in APEE, Greece, Asian-pacific region and other countries .They had good summary of the IDA decomposition method. In the 1990s, researches on carbon decomposition me- thods constantly enriched. The SAD [6]; AWD [7] ; logarithmic mean Divisia index LMDI[8];MRCI [9];GFI [10] were successively put forward. In China, scholars use them to study the energy consumption. In 2005,Wang can use LMDI to study influence factors of carbon emissions between 1953 and 2000 in our country. He thinks the key factor of carbon emissions is the discretion of the energy intensity[11].In 2006, Xu guoquan studied the influence factors of carbon emissions per capita with simple average method and he thinks that economic growth is the important reason for the increase in carbon emissions[12]. In 2008, Hu chuzhi et al use SAD to analyze the factors of carbon emissions in 1990-2005 . They think it is closely related to the economic scale, industrial structure and energy intensity[13]. In 2010, Wang junsong et al use Divisa to analyze the carbon emissions in 1990-2007 and they think that economic growth; energy intensity; population and the structural effect have an influence on carbon emissions.

There are some rich research results on carbon efficiency. In 1989,Kaya and Yokobori put forward the "Carbon production". After that Domestic scholars use all kinds of index to measure carbon efficiency. For instance, Mielnik, Goldemberg measure developing country's efforts to curb carbon emissions with energy consumption per unit of carbon emissions. Zhou P, Ang B.W, Han J.Y use MCPI productivity index to measure the carbon footprint in 18 countries, and studied the influence factors. Canadell think carbon productivity increases the concentration of carbon in the atmosphere. In 2007, Canadell think that carbon productivity increased concentration of carbon in the atmosphere. According to the literature research, we know that some researches are still not thorough, and do not conform to the actual situation. Besides, the conclusion is also questionable.

At first, this paper puts forward the thesis research background, then uses literature research and inductive method to analyze the domestic and foreign research status of carbon efficiency optimization, and summarize respectively from the carbon decomposition method, the factors influencing carbon and carbon efficiency . And then analyzes the manufacturing carbon efficiency optimization by adopting the combination of the theoretical analysis and empirical analysis research methods. Finally, on the basis of the above analysis, I put forward policy Suggestions on the future manufacturing carbon efficiency optimization. Calculation results of this paper can present existing manufacturing carbon efficiency optimization ability, and provide reference for the future manufacturing carbon efficiency optimization. This study enriched the manufacturing carbon efficiency optimization research, and provided the basis for the advice of the future manufacturing emissions .

Figure 1. Manufacturing carbon emissions in 2000 ~ 2014

2. Analysis of the status quo in manufacturing carbon efficiency optimization

Manufacturing relying on abundant mineral resources has a rapid development, at the same time, there are some serious problems, especially carbon emissions, which becomes one of the important prob-

lems facing the manufacturing. At present, the global emissions of CO_2 has been growing. In the past 30 years, manufacturing has been developing rapidly, but more than 60% of energy demand and more than 70% of CO_2 emissions are from it, which generate harmful substance and harmless about 5.5 billion tons and 700 million tons each year. Manufacturing cause carbon emissions growth and the entire industry energy consumption. Combined with carbon efficiency optimization of the imperfection of the equipment in parts manufacturing enterprises , the amount of carbon emissions only grow. Manufacturing is especially important in terms of strengthening carbon efficiency optimization, and how to effectively control manufacturing carbon emissions is urgently needed solving at present.

3. Analysis of the relationship with China's manufacturing industry development and carbon efficiency optimization

3.1. The premise of Carbon efficiency optimization to manufacturing development

Firstly, carbon efficiency optimization is put forward mainly for Low-carbon green. Low-carbon green requires manufacturing firms to give up the mode relying on energy consumption and to transform to the

sustainable development pattern in order to realize the low pollution, zero emissions targets. And the development of the manufacturing industry in our country is in a situation where growing is too fast and changing is slow, which is also the same to small manufacturing enterprises , large foreign companies, and state-owned enterprises. So what should be done is to control carbon emissions and realize the optimization of carbon efficiency

Secondly, carbon efficiency optimization should be taken into account by each industry and each enterprise. Manufacturing will be able to get sustainable development, only by protecting the natural environment and resources.

3.2. The guarantee of manufacturing carbon efficiency optimization

How to improve enterprise economy with Low-carbon green of manufacturing? The first thing is to protect the environment with asset growth, energy saving. Analysis of environmental pollution and carbon emissions is a necessity for enterprise development. For example, increase input, output and technical reform will make a great contribution to carbon efficiency optimization work, especially the output increase. In order to reduce carbon emission, perfect low-carbon facilities are needed. resource utilization will also make contribution to it

3.3. Characteristics of carbon optimization strategy in manufacturing

The main characteristics: (1)Periodicity. According to my research, it is concluded that during the years from 2000 to 2014, carbon emissions increased rapidly. From 2000 to 2002, carbon emissions keep stable . From 2003 to 2007 carbon emissions increased significantly. Although carbon emissions in 2010 has decreased, but so far in 2012, carbon emissions presents growth trend. (2)otherness. Because of the difference among the manufacturing industry, business leaders and staffs' environmental protection consciousness, the carbon emissions of manufacturing industries is also different. In a word, a strong environmental consciousness is strengthened. More and more enterprises realize that the importance of carbon efficiency work.

4. Three-dimensional evaluation model of manufacturing carbon efficiency

There are many factors that affect Carbon efficiency optimization strategy. In previous studies, the analysis of manufacturing carbon efficiency mainly depends on carbon productivity and competitiveness index, and based on the two-dimensional evaluation model, production rate is introduced in this passage. Three-dimensional evaluation model of carbon emissions in manufacturing as follows:

$$C_i^{pro} = \frac{\sum_i IP_{it}}{\sum_i E_{it}^{CO_2}}$$

$$C_i^{com} = \frac{C_i^{pro}}{\sum C_i^{pro}}$$

$$CA_i^{pro} = (C_i^{pro} - C_{i-1}^{pro})_i$$

The above formula, C_i^{pro} represents carbon productivity, which refers to the carbon dioxide output per unit of GDP, the unit is ten thousand yuan/*t;* IP_{it} is represented as manufacturing added value, the unit is ten thousand yuan; $E_{it}^{CO_2}$ is manufacturing carbon emissions, the unit is *t*. C_i^{com} represents carbon competitiveness, CA_i^{pro} stands for the added value of carbon productivity, the unit is ten thousand yuan; *i* stands for the manufacturing industry type.In this paper, it contains 29 manufacturing industries such as food manufacturing industry and beverage manufacturing industry etc; *t is* the annual. What can be known from the formula given above is that three indicators represent the size of the carbon productivity, carbon productivity compared with other industries, and the change of carbon productivity.

First, we should calculate the carbon emissions of

manufacturing industries. Here are carbon emissions data of manufacturing industry in 2000-2014.Data mainly comes from historical statistical yearbook of manufacturing industry and research report, etc. We can know that carbon emissions is increasing from 2004 to 2014.According to the data, the added value of manufacturing is relatively stable. Manufacturing industry added value is 786.56 million RMB in 2000 , while 2.689 billion RMB in 2014. value added rate in manufacturing is far lower than in carbon emissions growth.

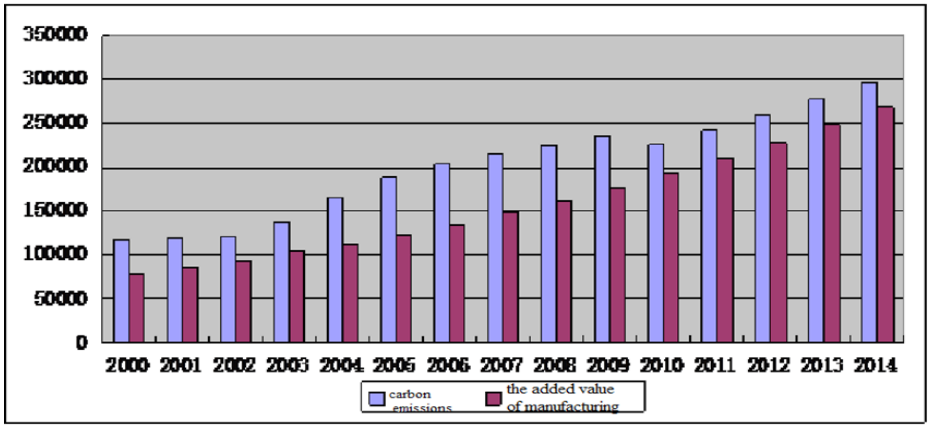

Figure 2. Manufacturing industry carbon emissions, the added value from 2000 to 2014

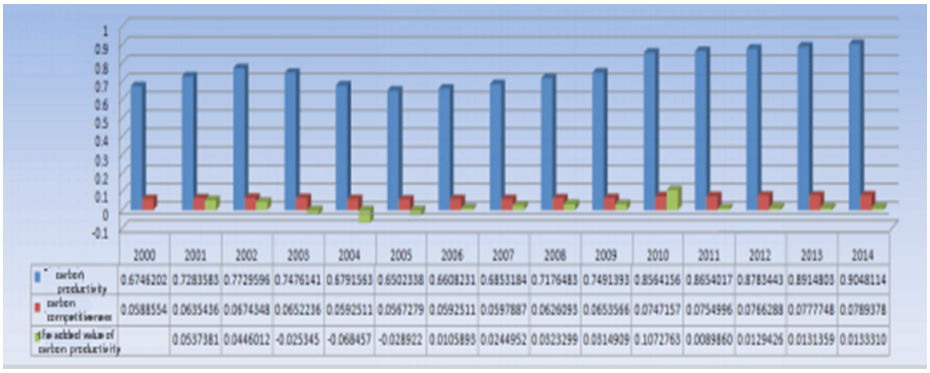

Figure 3. Manufacturing industry carbon productivity ,carbon competitiveness and the added value of carbon productivity from 2000 to 2014

From the figure, we can know that during 2000 ~ 2014, manufacturing. And during that time, the highest carbon competitiveness is in 2014 carbon productivity is 114600 yuan/t. The years when carbon productivity is highest are 2014, 2013 and 2012, for 9000yuan/t, 8900yuan/t and 8700 yuan/t respectively. And during that time, the highest carbon competitiveness is in 2014.There is a high carbon productivity growth rate in 2012.Although manufacturing carbon competitiveness increased., for the amplitude, manufacturing is still lack of carbon competitiveness. And the added value of manufacturing carbon productivity are below 10%, such as 5% in 2000, and about 1% in 2014.

Through analysis, we can know that lack of competitiveness in carbon manufacturing causes carbon productivity relatively weak and low carbon resource utilization efficiency .We need to adjust its structure and optimization.

5. Carbon efficiency optimization strategy recommendations of manufacturing in the future

At present, in the crucial stage of industrialization, there are many challenges for manufacturing. So after my study, I put forward some strategy of the carbon efficiency optimization of manufacturing

First, adjustment and upgrade of the Industrial Structure. They are main industries of manufacturing energy consumption and carbon emissions, like Textile, paper products industry, chemical raw materials and chemicals manufacturing etc. Part of the enterprises optimize carbon emissions according to industrial structure optimization. and make a critical difference to carbide decreases. They take steps such as develop low-carbon green products etc.

Second, improving the internal structure in order to avoid waste of resources. The measures realize the sustainable development of manufacturing carbon efficiency optimization work, such as rational utiliza-

tion of natural resources etc.

Third, using the energy conservation and emissions reduction technologies. Not only can improve the efficiency of energy utilization, but also can help manufacturing realize the goal of low energy consumption and low pollution. Besides, the development of the technology for energy conservation and emissions reduction is also very important.

Fourth, develop the low carbon manufacturing industry, which is also the future development direction of manufacturing industry transformation.

Fifth, to strengthen supervision of manufacturing emissions. At present, some related tax policy to reduce emissions is unveiled. But it is Not Executed. So laws and regulations about emission system is still needed perfecting. Besides, the government also need to supervise and check the manufacturing enterprises to reduce emissions.

5. Conclusion

In this paper, by analyzing the current situation of the development of manufacturing carbon efficiency optimization, a three-dimensional evaluation model is built. Combined with the content of the various research, to reduce the manufacturing carbon emissions are proposed.

The conclusion is as follows:

(1) In this paper, the data is typical. Therefore, studying the data has a certain guiding role to carbon efficiency optimization of manufacturing in the future

(2) In this paper, in combination with the practical situation of manufacturing industry development, five aspects are put forward to improve manufacturing emissions and optimize manufacturing carbon efficiency in our country. Such as 1)To promote structure adjustment and upgrading in manufacturing industry, 2)To reduce the waste of resources, 3)To use manufacturing technology widely, 4)To develop low carbon manufacturing industry positively, 5)To strengthen the management and the supervision

In this paper, we made a simple preliminary study of the optimization of manufacturing carbon emissions. Due to my limited ability , this paper still exists insufficient.

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