

Research on application of “double-carbon power index” system based on delphi method

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Abstract: Double carbon-power index is an important index to measure regional carbon dioxide emission, regional economic development and carbon emission reduction implementation. It can determine whether carbon dioxide has reached a peak in a region or industry, so that the government can take targeted measures to guide enterprises to reduce carbon dioxide. Through build wuxi double carbon power index system, based on the Delphi method to carry out the comprehensive evaluation, explore their short-term carbon emissions to peak, the path of the development of long-term carbon neutral, assist the government in a timely manner to master carbon, carbon reduction status, so as to promote comprehensive ground application carbon reduction measures, for zero carbon high quality under the restriction of power in wuxi city development.

Keywords: Delphi method; Double-carbon power index; Integrated evaluation.

1 Introduction

Since Xi Jinping proposed at the 75th Session of the United Nations General Assembly on September 22, 2020 that "China's carbon dioxide emissions strive to peak before 2030 and neutralize before 2060", studies on carbon emission reduction in various industries have become more and more extensive. As a big economic province and a strong industrial province, Jiangsu province actively responds to the call of ecological civilization construction and continues to promote carbon emission reduction. Wuxi has a solid industrial foundation, developed manufacturing industry and high carbon emissions. In 2020, the total carbon emissions of Wuxi is about 97.74 million tons, accounting for 12.39% of Jiangsu province. High emissions and high carbon energy structure restrict the development of Wuxi. Therefore, in order to become the "pioneer" of "double carbon" work, wuxi municipal government has made it clear that the goal of carbon peak will be achieved by 2025, and the development mode of "green, low carbon and high efficiency" will be formed.

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Power grid is closely linked to energy production and consumption, which is the key to energy transformation and the pivot to achieve the "dual carbon" goal. It is crucial in the process of "dual carbon" goal transformation. Wuxi power supply company in order to conclude the city industry transformation and upgrading, through a comprehensive analysis of wuxi "double carbon" the status quo, and then study on wuxi double carbon power index, to accurately identify the key factor of "double carbon" trends, to explore the short-term carbon emissions to peak, the path of the development of long-term carbon neutral, ultimately promote the carbon reduction measures of comprehensive application of landing, Effectively guide enterprises and social groups to carry out carbon free, carbon reduction, carbon reduction and other projects to help Wuxi achieve high-quality development under the zero-carbon constraint.

2 Theoretical Basis for the Construction of Dual Carbon Power Index

Index is a relative number that shows the dynamics of social and economic phenomena. It can be used to measure the overall dynamics of social and economic phenomena and analyze the influence degree of the changes of various factors in the overall changes of social and economic phenomena. In statistical theory, for single factor index analysis, most of the classical methods such as Larson's index, Parson's index, Fisher's index and Mahe's index are adopted. For multi-factor index analysis, comprehensive index compilation (single factor index multiplication) or weighted average index method can be adopted. The double-carbon index is derived from a number of small indicators through weighted calculation. The index construction method with simple calculation and comprehensive evaluation should be selected for index construction. By comparing the addition scoring method, weighted scoring method, relative scoring method and multiple scoring method, it is found that the weighted scoring method should be used in the construction of dual carbon power index.

Table 1. Comparison of index compilation methods

Type	Strength	Weakness
Addition scoring	Straightforward.	It is not suitable for evaluating comprehensive index because of small differentiation.
Weighted scoring	The calculation is simple and the work is small.	It is more likely to be affected by subjective factors.
Relative scoring	Strong adaptability, wide application.	It is easy to lower the objective evaluation standard.
Multiplication scoring	Strong adaptability, wide application.	It's a little bit cumbersome.

Since the weighted scoring method is obtained by the weighted average calculation (multiplied) of multiple classification indexes and the weighted coefficients, it is necessary to determine the calculation method of the weighted coefficients. This paper chooses Delphi method to calculate the weight.

3 Research on douBLE-carbon power index system

3.1 Characteristic of double-carbon standards

In this article, through comprehensive analysis of "carbon peak, carbon neutral" of the key factors, present situation and development needs in wuxi, from three aspects of carbon emissions, energy and economic product of total score method is used to build a multi-level and multi-dimensional dynamic index city double carbon data model, through the analysis of the historical data accurately the change trend of city double carbon up to the peak, Assist in the efficient promotion of dual carbon work. Through the study of carbon peak process in developed countries and regions, it is shown that carbon peak process has its outstanding characteristics. At a high level of social and economic development, adjusting the ratio of petrochemical and non-petrochemical energy can further reduce carbon emissions and achieve carbon peak through industrial structure optimization.

3.2 Composition of double-carbon index

3.2.1 Calculation method of double-carbon index

The "double carbon" target power index forms a double carbon index model based on the measurement indicators of carbon emissions, energy consumption and economic development and the correlation among them by studying the composition and analysis methods of typical indexes.

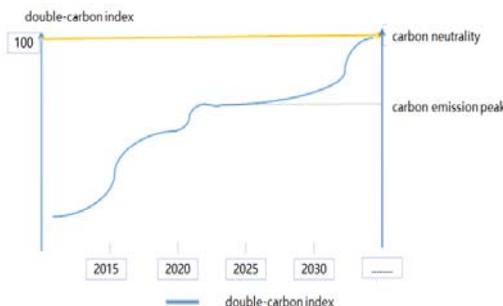


Fig. 1. Double carbon index curve

"Dual carbon" power index includes 4 first-level indicators and 9 second-level indicators, among which carbon emission indicators determine low-carbon development mode, energy control indicators determine energy consumption mode, carbon emission compliance indicators determine enterprise credit, and carbon emission reduction indicators examine the implementation of carbon emission reduction related work of enterprises.

*Calculation formula: $double\ carbon\ index = \sum carbon\ emission * weight\ coefficient + \sum energy\ consumption\ control * weight\ coefficient + \sum carbon\ emission\ performance * weight\ coefficient + \sum carbon\ emission\ reduction * weight\ coefficient$*

Note: There is a non-linear positive correlation between the achievement of the double carbon target and the value of the double carbon index, that is, the higher the double carbon index, the more unfavorable the achievement of the double carbon target. As shown in the figure 2.

The double carbon index ranges from 0 to 100, and it has different performance in different stages of economic development:

(1) When it is less than 50, it indicates that the current development trend of carbon dioxide exceeds the warning value and needs to be regulated to curb its development trend;

(2) When the value is greater than or equal to 50 and lower than 75, it indicates that the development trend of dual carbon is still in an unfavorable situation and needs to be paid attention to;

(3) When the double carbon index gradually stabilizes in successive counting years, that is, the carbon emission plateau is realized, while the index value in subsequent years is in a decline state, the peak year is considered to be the carbon peak year;

(4) When the double carbon index approaches 100, it indicates that it is in carbon neutral state.

3.2.2 Composition of dual carbon index

The dual carbon index mainly analyzes the carbon peak and carbon neutral efficiency comprehensively from four aspects of carbon emission, energy, carbon emission quota implementation and carbon emission reduction. Index scores are as follows:

Table 2. Double carbon index scores

First-level indicator	Secondary indicator	Describe	Score
1. Carbon emissions	1.1 Total carbon Emission (ton of standard coal)	>13000	0
		10000-13000	2
		5000-10000	4
		2000-5000	6
		<2000	8
		Carbon emissions are absorbed.	10
	1.2 Carbon Emission Intensity (Carbon emission per unit of GDP)	Increase by more than 10%.	0
		Increase of more than 5% and less than 10%.	2
		Increase by less than 5%.	4
		Decrease by less than 5%.	6
		Decrease of more than 5% and less than 10%.	8
		Decrease by more than 10%.	10
2. Control of energy consumption	2.1 Fossil energy consumption (ton standard coal)	>5000	0
		4000-5000	2
		3000-4000	4
		2000-3000	6
		1000-2000	8
		<1000	10
	2.2 Change Trend of fossil energy efficiency (Energy consumption per unit GDP)	Increase by more than 10%.	0
		Increase of more than 5% and less than 10%.	2
		Increase by less than 5%.	4
		Decrease by less than 5%.	6
Decrease of more than 5% and less than 10%.	8		

First-level indicator	Secondary indicator	Describe	Score
	2.3 Electricity Consumption (KWH)	Decrease by more than 10%.	10
		Increase by more than 5000000.	0
		Increase of more than 3000000 and less than 5000000.	2
		Increase of more than 1000000 and less than 3000000.	4
		Increase by less than 1000000.	6
		Decrease of more than 1000000 and less than 300000.	8
		Decrease by more than 300000.	10
	2.4 Variation Trend of Power Efficiency (Electricity consumption per unit GDP)	Increase by more than 10%.	0
		Increase of more than 5% and less than 10%.	2
		Increase by less than 5%.	4
		Decrease by less than 5%.	6
		Decrease of more than 5% and less than 10%.	8
		Decrease by more than 10%.	10
	3. Carbon emission compliance	3.1 Carbon quota implementation (including CCER and carbon trading rights)	>120%
100%-120%			2
90%-100%			4
80%-90%			6
60%-80%			8
<60%			10
4. Carbon reduction	4.1 Quantity of green cards and electricity	=0	0
		0-10	2
		10-20	4
		20-30	6
		30-40	8
		>40	10
	4.2 Proportion of green electricity consumption	=0	0
		<5%	2
		5%-10%	4
		10%-20%	6
		20%-30%	8
		>30%	10

3.2.3 Calculation of weight coefficient

The weight coefficient setting takes full account of the current development situation of dual carbon, and sets different weights for each type of influencing factors. Comprehensive factors are considered as follows:

- (1) Carbon emission and carbon emission intensity are the primary factors for an enterprise to achieve the dual carbon goal, so the weight coefficient is high;
- (2) Since the carbon trading market will be officially opened in 2021, and the current carbon trading market is limited to the power generation industry, the implementation quota of carbon emissions cannot fully reflect the development of dual carbon for the time being, so the weight is reduced;
- (3) Due to the high transaction price and the nascent carbon trading market, the transaction volume is limited, so the weight of the green card and green electricity market is relatively small.

Table 3. Dual-carbon index

First-level indicator	Secondary indicator	Weight
1. Carbon emissions	1.1 Total carbon Emission (ton of standard coal)	2
	1.2 Carbon Emission Intensity (Carbon emission per unit of GDP)	2
2. Control of energy consumption	2.1 Fossil energy consumption (ton standard coal)	1.5
	2.2 Change Trend of fossil energy efficiency (Energy consumption per unit GDP)	1
	2.3 Electricity Consumption (KWH)	1.5
	2.4 Variation Trend of Power Efficiency (Electricity consumption per unit GDP)	1
3. Carbon emission compliance	3.1 Carbon quota implementation (including CCER and carbon trading rights)	0.5
4. Carbon reduction	4.1 Quantity of green cards and electricity	0.2
	4.2 Proportion of green electricity consumption	0.3

4 Case analysis of dual carbon power index

Based on the carbon emission, energy and economic data of typical enterprises in Wuxi and the benchmark cities (Hangzhou, Shanghai, Qingdao and Suzhou), after introducing the calculation of dual-carbon power index, we can see the dual-carbon index results of five units in Wuxi, Hangzhou, Shanghai, Qingdao and Suzhou, as follows:

Table 4. Dual-carbon index results

No	City	Carbon emissions	Control of energy consumption	Carbon emission compliance	Carbon reduction	Composite scores
1	Hangzhou	32.01	35.11	4	3.6	73.72
2	Shanghai	28.54	34.62	4	3.45	70.61
3	Qingdao	27.28	33.52	4	3.24	68.04
4	Suzhou	26.12	31.77	4	3.43	65.32
5	Wuxi	22.13	31.8	4	3.09	61.02

As can be seen from the above table, although Wuxi adopts renewable energy power generation, afforestation and other measures to vigorously reduce carbon emissions, the overall situation of "dual carbon" is not optimistic, as detailed below:

(1) Wuxi's carbon emissions hover high, and the work of carbon emission reduction is urgent

In 2020, the comprehensive score of Wuxi's dual carbon index was 61.02, with a 4.97% increase from the previous quarter. The overall situation has just reached the qualified level, and the carbon emissions are at a high level. It is still in the state of "high carbon, high energy and high economy", so there is still a long way to go to achieve the dual carbon goal.

Hangzhou, Qingdao, Suzhou due to support tourism, so has natural advantages in "double carbon" job, as a leader in East China, Shanghai in carbon reduction technology, management, application and policy support in a leading position, so in Wuxi city at the same time of developing urban economy as soon as possible in advance "double carbon" goal, there is a certain difficulty.

(2) The overall carbon emission situation of emerging industries in Xinwu District is good, while the carbon emission reduction of traditional industries in Jiangyin is insufficient

According to the characteristics of regional industry, Xinwu District and Jiangyin city are selected as the representative regions for comprehensive analysis. As for Xinwu District, the comprehensive score of dual carbon index in 2020 is 68.5, which is higher than the average level of Wuxi, with a sequential increase of about 3.79%. Xinwu District is still in the development stage of "high energy, high carbon and high economy" on the whole, mainly because the development of information manufacturing industry and other new technologies in Xinwu District mostly belong to the incubation stage, and the production process mainly consumes fossil energy. Although there are achievements in economic aspects, they have not reached the mature stage. As for Jiangyin, the comprehensive score of the double carbon index in 2020 is 66, which is higher than the average level of Wuxi, with a 4.56% sequential increase. Jiangyin is still in the development stage of "high energy, high carbon and high economy" on the whole. Due to the fact that Jiangyin's industries are dominated by traditional industries such as textile industry, its current focus is mainly on economic development and insufficient attention is paid to carbon emission reduction.

(3) The information manufacturing industry is developing with high energy consumption, while the carbon emission reduction measures of textile industry are advancing slowly

According to the carbon emission characteristics of industries, the information manufacturing industry and textile industry are selected as the representative industries for comprehensive analysis. Information manufacturing, information manufacturing industry in Wuxi city, 2020 pairs of carbon index comprehensive scoring 60.33 points, the overall situation is lower than the average, in Wuxi city, an increase of just 0.37% month-on-month, and Shanghai, Hangzhou new industry double carbon index score over 70 points, hatch information manufacturing industry in Wuxi city is still in the growth stage, the fossil energy consumption is bigger. The fundamental reason is that China's information manufacturing industry is in full production due to the huge demand for international chip production and the country's investment in the development of information manufacturing industry to get rid of the influence of the international industry chain. In terms of textile industry, the comprehensive score of dual-carbon index in Xinwu District of Wuxi city in 2020 is 61.875, which is slightly higher than the average level of Wuxi city, with a 2.76% sequential increase, but there is still a gap from the advanced level of dual-carbon. The fundamental reason is that most enterprises in Wuxi textile industry belong to small and medium-sized enterprises. The main driving force of enterprises is the growth of economic output value, and the "dual carbon" work lacks sufficient motivation.

5 Conclusion

With the proposal of Wuxi "double carbon" power index system, it provides a new idea for the analysis of "double carbon" work and has a milestone significance. By identifying the key factor of "double carbon" trends, to explore the short-term carbon emissions to peak, the path of the development of long-term carbon neutral, new energy and improve the utilization ratio and to regional and enterprise low carbon development provides an executable landing measures and reasonable Suggestions, implement measures to reduce

emissions of comprehensive application of landing, promote wuxi under the restriction of zero carbon high quality development.

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