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Study on the Transformation of Tongling Resource-based City from the Perspective of Carbon Peak and Carbon Neutrality

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Abstract

The 14th Five-Year Plan clearly states that "green development should be achieved in several strategic initiatives, industrial layout optimization and structural adjustment, and strive to achieve the goal of carbon peaking and carbon neutrality". Under the requirement of "double carbon", Tongling City has been actively promoting urban transformation. The statistical data reveals the carbon emission situation of Tongling industrial enterprises, and the study finds that the current green development process of Tongling has been effective, but the transformation development of Tongling still faces difficulties and challenges in order to achieve the "double carbon" target. Based on the analysis of many problems, we propose countermeasures and suggestions to promote the transformation of Tongling resource-based city, which can provide useful reference for the green and low-carbon transformation of cities in Yangtze River Delta.

Keywords

Carbon Dumping; Carbon Neutral; Tongling City; Urban Transformation.

1. Introduction

China is the world's largest carbon emitter, and by 2020, China's carbon emissions will have grown from 75.85 million tons at the beginning of the country to 10.251 billion tons, with excessive carbon emissions departing from the requirements of sustainable development. At present, China is in a critical period of transformation from a resource-consuming economy to a green and sustainable economy, and from a crude development model to a connotative development model, and must accelerate the transformation to an innovation-driven green and low-carbon development approach. In recent years, China has been paying more attention to the problem of "three high carbon" (high energy consumption, high emissions, high pollution caused by carbon), as early as in the "Eleventh Five-Year Plan" outline put forward energy saving and emission reduction. In 2020, China proposed for the first time the goal of achieving peak carbon and carbon neutrality, and the "double carbon" goal was incorporated into the national strategy. Since 2021, General Secretary Xi Jinping has made several international speeches on carbon reduction. From the perspective of carbon peaking and carbon neutrality, it will stimulate new green and low-carbon dynamic energy[1] , which will have a profound impact on the economic structure, energy structure, production and consumption structure, in line with the inherent requirements of green economic development[2] .

Tongling City is located in the Yangtze River Delta city group, known as "the first copper industrial base in New China", is a very typical resource-based city. In recent years, while Tongling has been developing economically, the contradictions of resources and environment have become increasingly apparent. According to the instructions of Anhui Provincial Government in the key tasks in 2021, "to strengthen the degree of double control, increase the proportion of non-fossil energy, to win the initiative for the carbon peak carbon neutral by

2030". Tongling City is following the policy requirements to achieve a comprehensive green transformation in economic and social development.

This topic is based on the logical line of how to realize the transformation of Tongling resource-based city under the vision of carbon neutrality, and the research method is based on the theory of regional economic development, using comparative analysis, statistical method and systematic research method. The paper also analyzes the current carbon emission situation of industrial enterprises in Tongling and their existing practices and achievements, as well as the difficulties and challenges faced by Tongling's transformation development under the requirement of "double carbon"; and finally proposes countermeasures and suggestions to promote the transformation development of Tongling resource-based city from the perspective of carbon compliance and carbon neutrality. It is hoped that this paper can provide a reference for Tongling's future urban transformation and low-carbon development, and provide a useful reference for the green and low-carbon transformation of cities in the Yangtze River Delta region.

2. Review of the Literature

Carbon emission is closely related to economic development and ecological environment. With the promotion and practice of "two mountains" concept in recent years, carbon emission has been strongly constrained, and carbon peak and carbon neutral theories are gradually formed and developed. Carbon peak refers to the gradual decline of carbon dioxide emissions after reaching a peak. With the continuous development of ecological economy and effective implementation of national policies, academics have paid attention to the research on carbon peaking. ① The study of carbon peaking in typical cities. Zang Hongkuan, Yang Weisan et al. have made a determination of the carbon peak situation of 13 prefecture-level cities in Beijing, Tianjin and Hebei by enumerating the carbon dioxide emission inventories of prefecture-level cities in the Beijing-Tianjin-Hebei urban agglomeration through the IPCC emission factor method and combining the historical emission situation[3] . Cao Libin, Li Mingyu et al. made a judgment on the peak attainment of 41 cities in the Yangtze River Delta urban agglomeration based on historical and future emission scenarios and combined with the impact of the new crown epidemic[4] . Hanying Jiang, Yiran Duan et al. studied the peak carbon situation in 36 typical cities in China, and analyzed the characteristics of peak cities and typical cities at different emission stages[5].② The pathways to peak carbon are studied. Zhao, Mingxuan, and Lu, Lianhong, et al. investigated the pathway of carbon peaking based on Meta-regression analysis, i.e., the cost-benefit optimal peaking pathway[6].Liu, Renhou, Wang, Ge, et al. showed that China needs to integrate various relationships, such as overall and local, short-term and long-term, to reach the peak carbon target by 2030.[7]Yu, Biying et al. suggest a pathway to achieve carbon emissions from an industry perspective[8].③ To study the impact of carbon peaking on economic development. Liu, T. et al. introduced decoupling coefficients to conduct an in-depth study on the relationship between economic growth and carbon emissions in coastal industrial cities[9] . Wang Yong et al. studied three stages of China's economic development, i.e., 2025, 2030 and 2035, and pointed out the socio-economic impacts of carbon emission peaking in these three stages [10] . Cai Hao et al. explored the impact on China's economy before and after the carbon peak in 2030 from the perspectives of economic growth rate, GDP per capita, population growth, and urbanization [11].

Carbon neutrality refers to the balance between anthropogenic emissions and anthropogenic sinks through afforestation, carbon sequestration and storage (CCS) technology in a certain region over a certain period of time, thus achieving "zero" carbon emissions. With the development of the economy, carbon dioxide emissions from energy consumption have become a major factor of ecological damage, and more and more scholars are turning to the study of energy transition based on the perspective of carbon neutrality. He Jijiang, Yu Qiqi et al. studied the energy transition experience of Hamburg, Germany, and concluded that the focus of urban energy transition is to determine the carbon neutrality target[12].Using scenario analysis, Lin, Weibin, and Wu, Jiayi, use two dimensions of total energy consumption and structure to show that China's total energy consumption can be reduced to 2 billion tons and 3 billion tons of carbon dioxide emissions under the scenarios of 5 billion tons and 5.5 billion tons and 80% and 75% of non-fossil energy consumption[13].In addition, in another article, they talk about three major trends in China's energy transition under the carbon neutral vision, which are electrification of the energy system, decarbonization of the power system, and decentralization of the energy and power system [14].

From the literature review, we found that most of the existing studies on carbon peaking and carbon neutrality focus on the pathway of carbon peaking, economic impact, and energy transition, and mainly focus on the study of countries and urban clusters. There are few studies on the transformation of cities, especially the transformation of resource-based cities, from the perspective of "double carbon", and there is no in-depth investigation on the relationship between carbon emissions of industrial enterprises and industrial growth. In view of this, this paper takes Tongling city, a typical resource-based city, as an example, and statistics the overall carbon emissions of industrial enterprises and carbon emissions of different industries, and designs a development path for the transformation of Tongling resource-based city under the "double carbon" target requirements, and proposes countermeasures to promote the transformation of Tongling resource-based city from the perspective of carbon peak and carbon neutral. Suggestions.

3. The Current Situation of Carbon Emissions in Tongling City and the Practice and Effectiveness of Urban Transformation and Development

In view of data accessibility and completeness, the years 2011-2017 were selected as the years under examination. The data in the text were obtained from Tongling Statistical Yearbook.

3.1. Status of Carbon Emissions in Tongling

3.1.1. Overall Situation of Industrial Enterprises

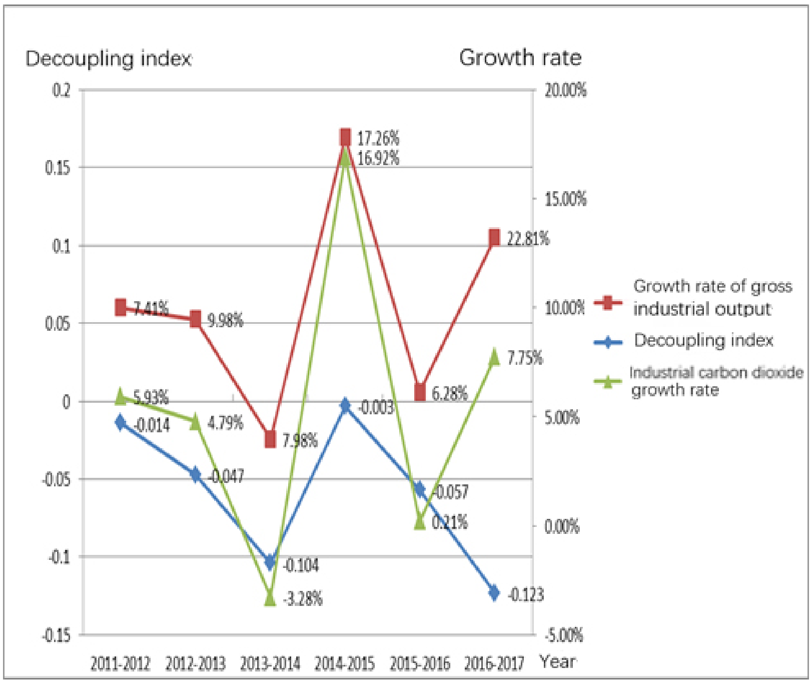

Figure 1. Total industrial output value, change rate of carbon emission and decoupling index

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(1) Decoupling analysis

The decoupling index can be used to illustrate the decoupling of energy consumption from economic growth. The formula for the decoupling index is constructed as shown below.

$$D = \frac{(\frac{C}{Y})_T}{(\frac{C}{Y})_0} - 1$$

Where, D denotes the decoupling index between industrial carbon emissions and industrial growth; C and Y denote industrial CO2 emissions and total output value, respectively; 0 and T denote the base period and the end period, respectively.

The decoupling index of total industrial output value and carbon dioxide, the growth rate of total industrial output value and the growth rate of industrial carbon dioxide emissions in Tongling City from 2011 to 2017 were measured according to the decoupling index formula, and the results are shown in Figure 1.

Overall, the relationship between gross industrial output value and carbon emissions in Tongling has experienced two states of strong and weak decoupling. Except for the strong decoupling (i.e., economic growth and carbon emission reduction) in 2013, the other periods are in the state of weak decoupling (i.e., economic growth rate is greater than carbon emission growth rate), especially in 2013-2014, which shows a strong decoupling relationship, because Tongling City formulated the "Implementation Opinions on Creating a National Energy Conservation and Emission Reduction and The reason is that during the 12th Five-Year Plan period, Tongling City formulated the "Implementation Opinions on Creating a National Model City of Energy Conservation, Emission Reduction and Circular Economy and Building Ecological Tongling", which effectively reduced carbon emissions and formed the characteristic model of energy conservation and emission reduction in Tongling, and realized the anti-growth relationship between economic growth and carbon emissions. It shows that the low carbon economy policy adopted by Tongling City during the 12th Five-Year Plan period has achieved remarkable results. Specifically, the growth rate of Tongling's industrial output value generally showed an upward trend from 2011 to 2017, with a stable trend from 2011 to 2014, ranging from 7.41% to 9.98%; while the growth rate of carbon emissions fluctuated from 2015 to 2017, ranging from 6.28% to 22.81%; the growth rate of carbon emissions did not change much from 2011 to 2017, with a stable trend from 2013 to 2017. The overall change is not much, among which the situation of sharp growth sharp decline and then growth in 2013-2017, and even negative growth in 2013. From Figure 1, it can be seen that the growth rate of industrial output value and the growth rate of industrial carbon emissions in Tongling City have basically the same trend from 2011 to 2017, which indicates that there is a close relationship between the growth of industrial output value and industrial carbon emissions in Tongling City, which shows the importance of exploring industrial enterprises to grasp the carbon emissions in Tongling City.

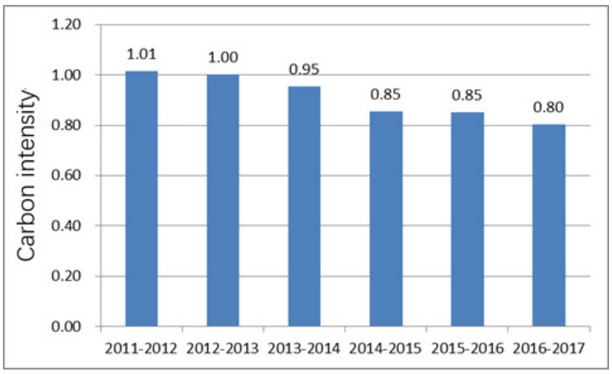

Figure 2. Industrial carbon emission intensity

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(2) Carbon emission intensity analysis

The industrial carbon emission intensity can illustrate the relationship between industrial economic development and industrial carbon emissions, which can be expressed as C/Y. The results are shown in Figure 2.

As can be seen from Figure 2, Tongling's industrial carbon emission intensity showed a steady decline from 2011-2017, indicating that Tongling's low-carbon development path has been effective in recent years. Among them, the biggest decrease was from 2013-2015, from 0.95 to 0.85 tons per million yuan, which also shows the achievements of Tongling City in emission reduction during the 12th Five-Year Plan period.

(3) Analysis of carbon emissions from major fossil energy sources

This paper mainly counts the direct carbon dioxide emissions from the consumption of major fossil energy by industrial enterprises above the scale in Tongling, as well as the indirect emissions from electricity. The reference coefficients for various energy sources to convert standard coal and the formula for calculating CO2 emissions are adopted from the China Energy Statistical Yearbook and the formula specified in the internationally used IPCC Emissions Inventory Guidelines with uniform carbon emission conversion coefficients (Li Jianbao et al., 2015; Shen Yang et al., 2020). Eight major energy species, namely raw coal, fine washed coal, coke, natural gas, gasoline, diesel, combustion oil, and electricity, were selected for measurement.

CO2 is calculated as follows, and the results are shown in Figure 3 below.

CE (carbon dioxide emissions) = M (fossil fuel consumption) × SC (standard coal conversion factor) × C (carbon emission factor) × 44/12

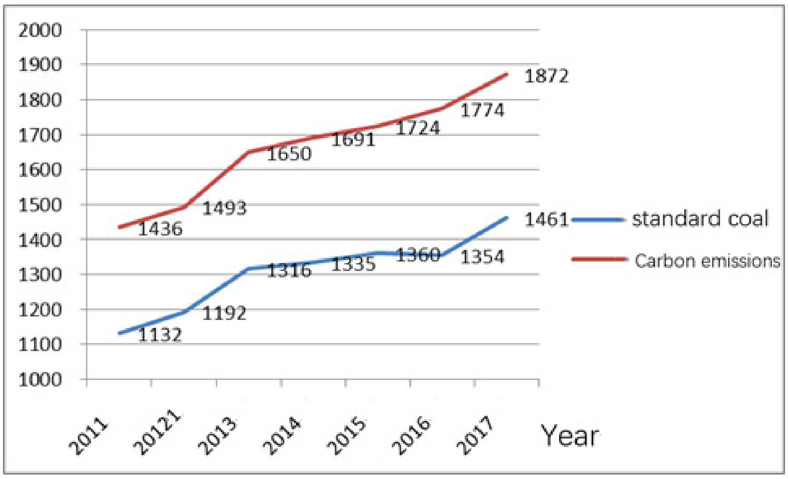

Figure 3. Main energy standard coal consumption and carbon emissions

Table 1. Carbon emission ratio of major energy sources in industrial enterprises

Indicators	2011	2012	2013	2014	2015	2016	2017
Raw Coal	41.57%	42.62%	37.75%	34.11%	32.38%	31.26%	33.59%
Fine washed coal	6.21%	5.25%	6.77%	9.82%	12.02%	11.86%	10.74%
Coke	2.68%	2.50%	1.92%	2.03%	2.29%	2.28%	2.10%
Natural Gas	2.53%	3.06%	5.21%	5.12%	4.74%	4.27%	4.49%
Gasoline	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Diesel	0.17%	0.19%	0.18%	0.17%	0.16%	0.15%	0.13%
Burning oil	0.19%	0.15%	0.13%	0.12%	0.06%	0.06%	0.06%
Power	46.63%	46.21%	4 8.03%	48.62%	48.33%	50.11%	48.88%

According to Figure 3, it can be seen that the total consumption of standard coal of the main energy varieties of industrial enterprises above the scale in Tongling was 63.34 million tons in 2011-2015 and 28.14 million tons in 2016-2017, with an increase of 20.12% during the "12th Five-Year Plan" and an increase of 7.87% during the "13th Five-Year Plan "The total consumption of standard coal grew slowly from 2013 to 2015, with a slight decrease in consumption in 2016, followed by a sharp increase. 2011-2015, the total carbon emissions of the main energy species of industrial enterprises above the scale in Tongling was 79.89 million tons, and the total carbon emissions in 2016-2017 was 36.45 million tons. "The growth rate during the 12th Five-Year Plan was 20.06% and 5.55% during the 13th Five-Year Plan. Compared with the late 12th Five-Year Plan, the growth rate of total carbon emissions in the early 13th Five-Year Plan is still rising.

According to Table 1, it can be seen that the carbon emissions of industrial enterprises above the scale in Tongling mainly come from the consumption of electricity and raw coal. From 2011-2017, the proportion of carbon emissions from electricity consumption is the largest at about 48%, and there is an increasing trend. The proportion of carbon emissions generated by the consumption of raw coal is about 35%, but has shown a downward trend in recent years. Gasoline consumption produces the smallest share of carbon emissions, maintaining at about 0.01%, and diesel, combustion oil and other oil consumption produce a small share of carbon emissions.

3.2. Carbon Emissions of Industrial Enterprises by Industry

In terms of industry energy consumption, industries with energy consumption above 10,000 tons of standard coal in industrial enterprises in Tongling City in 2015, 2016 and 2017 were selected as samples, as shown in Table2.

Table 2. Energy consumption of industrial enterprises by industry

Industry	2015		2016		2017	
	Integrated energy consumption	Carbon dioxide emissions	Integrated energy consumption	Carbon dioxide emissio	Comprehensive energy consumption	Carbon dioxide emissio
Colored	23416	62286.5	20988	55828.0	20417	54309.2
Non-ferrous metal mining industry	23416	62286.5	20988	55828.0	20417	54309.2
Textile	32770	87168.2	27682	73634.2	30266	80507.5
Textile industry	32770	87168.2	27682	73634.2	30266	80507.5
Petrochemical	284165	755878	326036	867255	320549	852660
Petroleum processing, coking and nuclear fuel processing industry	96078	255567	126643	336870	116945	311073
Chemical raw materials and chemical products manufacturing	188087	500311	199393	530385	203604	541586
Building Materials	3015198	8020427	2999158	7977760	3106196	8262481
Non-metallic mineral products industry	3015198	8020427	2999158	7977760	3106196	8262481
Smelting	1400454	3725208	1414810	3763395	1389642	3696447
Ferrous metal smelting and rolling processing industry	604900	1609034	606024	1612024	592255	1575398
Non-ferrous metal smelting and rolling processing industry	795554	2116174	808786	2151371	797387	2121049

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Automotive Manufacturing	56345	149877.7	55525	147696	70101	186468.7
Railroad, ship, aerospace and other transportation equipment manufacturing	14707	39120.62	13307	35396.6	20988	55828.08
Electrical machinery and equipment manufacturing	41638	110757	42218	112299	49113	130640
Electronic	23061	61342	23900	63574	28691	76318
Computer, communications and other electronic equipment manufacturing	23061	61342	23900	63574	28691	76318
Power	2335559	6212587	2321766	6175898	2776443	7385338
Electricity, heat production and supply industry	2335559	6212587	2321766	6175898	2776443	7385338

According to Table 2, it can be seen that in 2015, 2016 and 2017, there were eight industries with energy consumption above 10,000 tons of standard coal in Tongling City industrial enterprises, namely, non-ferrous, textile, petrochemical, building materials, smelting, automobile manufacturing, electronics, and electric power. Among them, the energy consumption of the four major industries of building materials, smelting and electricity is high, accounting for a total of more than 95%, and the trend has been on the rise in recent years.

3.2.1. The Practice of Transformation and Development of Resource-Based Cities in Tongling

In recent years, Tongling City has actively implemented the national and provincial carbon peaking and carbon neutral development plans, formulated development plans and implementation plans in line with local development, firmly promoted the transformation of resource-based cities, and achieved important results in stages.

First, adhere to the innovation-driven, with the first move to stimulate the transformation. Insist on enterprise-oriented scientific and technological innovation, the number of high-tech enterprises in Tongling City and the ratio of industrial enterprises on the scale reached 46.8%, ranking second in the province. Strengthen the construction of innovation platforms, with the University of Science and Technology, Jilin University, Wuhan Institute of Technology and other universities and research institutes to deepen cooperation between industry, academia and research, built 113 provincial-level enterprise R & D platform, industrial enterprises accounted for more than 34% of the comprehensive R & D institutions of the city's enterprises. Accelerate the gathering of innovative talents, the cumulative introduction of high-level scientific and technological talent team 64.

Second, adhere to the industrial city, with new momentum breakthrough transformation. Promoting the construction of "Triple One", 5 provincial major projects and special projects have been approved, ranking 4th in the province, and the proportion of new industries in the above industries is 39.6%, ranking 4th in the province. Accelerate the development of semiconductor, 5G and other industries, gather a number of industry chain node enterprises such as Huafeng Communication, Xutron Technology, etc., and a number of projects such as Gallium Special third generation compound semiconductor are completed and put into

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operation. Vigorously develop digital economy, such as "industrial brain", "city super brain" online operation, etc. Actively "seize copper, extend copper, not only copper, beyond copper".

Third, adhere to the green development, with a good ecological escort transformation. Provincial "23 + 80 + N" list involving the city's problem rectification rate reached 83.3%. The implementation of the "blue sky, blue water, clean soil" project, the full implementation of the river (lake) long system, the long system of forestry, the innovative implementation of the mine mountain long system, strengthen industrial emissions, diesel trucks, straw burning and other comprehensive management, upgrade the black sand river, Xiushui River and other urban black smelly water bodies, the proportion of good air days in 2019, surface water quality in the province, respectively The third and fourth place.

4. Difficulties and Challenges of Tongling's Transformation and Development under the Requirement of Carbon Neutrality of Carbon Peak

4.1. Inherent Deficiencies in Industrial Upgrading

The industrial transformation of resource-based cities can be affected by both subjective and objective factors. Objectively, the industrial structure is heavy. 2019 Tongling City, the three industrial structure ratio of 5.6:45.4:49.0, of which the copper industry accounted for the proportion of industry on the scale from 65% in 2010 to 64% in 2019, still high, Tongling non-ferrous output value accounted for 50.2% of the city's copper industry output value, "a copper alone ", "one enterprise alone" the situation is difficult to change in the short term. Industrial level is low. Scale industry in copper smelting, chemicals, building materials, iron and steel, electricity and other five major raw materials industry accounted for nearly 90%. Strategic emerging industries in the copper-based new materials industry accounted for 80.2%, high-end equipment manufacturing, new energy and other six into the industry accounted for less than 20%. Industrial layout is chaotic. The old industrial city is "production first, then life" development path, production, life, ecological three areas mixed, especially the history of the formation of a kilometer along the river copper smelting, chemical and other enterprises up to 20, accounting for 79% of the city's heavy chemical enterprises business income, against the "clear water, green shore industry excellent "requirements, the layout needs to be optimized.

4.2. The Support of the Elements is Not Strong

Insufficient innovation capacity. There are only 20 scientific research institutions cooperating with Tongling, mainly focusing on a few fields such as copper-based new materials, equipment manufacturing and electronic information. Serious lack of talents. Talent structure is single, human resources are too concentrated in resource-based industries and their supporting industries, the overall quality of industrial workers is not high, the technical level is relatively low, especially in recent years the city's non-ferrous, copper chemical, Tongfeng and other large backbone enterprises, the loss of outstanding management personnel, technical personnel is serious. The financial income and expenditure pressure is greater. On the one hand, with the national and provincial transformation policies expiring and retreating one after another, coupled with the impact of the epidemic, flooding overlap and the national implementation of large-scale tax reduction and fee reduction policies, the financial revenue reduction is high. On the other hand, the transformation and development of the rigid expenditure has increased, the local financial constraints are increasingly aggravated.

4.3. Ecological Management is a Long Way Off

Environmental capacity constraints have increased. The emission and generation of major pollutants per unit area is higher than the provincial and national levels. The task of pollution control is heavy, and the utilization rate of industrial solid waste was 71% at the lowest (2005), and the utilization rate increased to 99.38% in 2018, but the current annual production of solid waste is still about 15 million tons. Huge investment in ecological restoration. Promoting ecological and environmental management and restoration is a huge investment, such as the relocation and transformation of chemical enterprises along the riverfront a kilometer is expected to require funds of more than 8 billion yuan, the historical formation of the six countries of chemical phosphogypsum dumps still have about 3 million tons to be eliminated, requiring investment of 650 million yuan for treatment.

5. Suggestions for Measures to Promote the Transformation of Tongling Resource-based City from the Perspective of Carbon Neutrality in Carbon Peak

5.1. Improve the "Primacy" of Copper Industry

The key to achieving carbon neutral carbon peaks lies in industrial restructuring and in improving the "green content" of development. With intelligent green service high-end as the leader, actively build a modern industry system that is independent and controllable, green and low-carbon, to reduce emissions, reduce pollution and optimize ecology from the source. Tongling City to create industrial landmarks as an important grasp and goal of the construction of the new copper city, play a good copper as the biggest advantage, to seize copper, extend copper, not only copper, beyond copper. Work on the solid chain to ensure the stability and security of the industrial chain supply chain; work on the complementary chain to give full play to the leading enterprises to drive and guide the effect, accelerate the integration of industrial clusters and continuously expand the scale of the industry; work on the extended chain, targeting the downstream of the industrial chain and end products, to further clarify the main direction; work on the strong chain to strengthen the key industries of key cities in the Hefei metropolitan area, Nanjing metropolitan area, Wuhan metropolitan area The key areas of convergence and complementarity.

5.2. Enhance the "Concentration" of Innovation

Tongling has a pilot city of science and innovation in China, the Wanjiang Center, the Institute of Advanced Structural Materials Industry Technology and other innovation platforms, to further build and use all kinds of innovation platforms, and join hands to promote new knowledge, new technologies to new products, new industries, and strive to produce more results in original innovation, breakthroughs in more key core technologies. Actively explore the "two-way enclave" (outside the establishment of laboratories, science and technology incubation in Tongling), "science and technology enclave" (the establishment of enclave incubator or science and technology enclave incubator park in the pioneering region, to achieve "incubation in the field, Tongling transformation ") and other new innovation carriers and scientific and technological achievements into the construction of incubation platforms. The low-carbon transformation of energy is the focus of achieving carbon neutral carbon peak, Tongling should reduce the total consumption of coal, through the promotion of new technologies, the implementation of coal consumption reduction and replacement, solid promotion of coal power ultra-low emissions and energy-saving transformation, reduce reliance on traditional fossil energy, and continue to reduce the consumption of energy resources per unit of output and carbon emissions. Reduce the carbon emission intensity per unit of energy consumption and energy consumption intensity per unit of GDP through the application of innovative technologies.

5.3. Insist on Open and Green Development

Tongling City should improve the carbon attraction and storage capacity of the ecosystem and achieve a dynamic balance between emissions and absorption. Optimize the ecological layout, establish an ecological and environmental carrying capacity constraint mechanism, and explore the planning "white space" system to leave enough ecological space for sustainable development. Adhere to the development strategy of embracing and crossing rivers, reasonably allocate development factors and arrange the layout of productive forces; vigorously implement the development strategy of "industrial district, tourism district, and strong port district", focus on the development of leading industries such as photoelectric information and green building materials in the suburbs, promote the integrated development of both sides of the river, and accelerate the development of port economy with Jiangbei Port as the carrier. Promote Tongling from industrial and mining cities to port city integration; give full play to the ecological background of Tongling advantages, the riverfront to do beautiful, unswervingly grasp the big protection. Do a good job along both sides of the river greening and environmental transformation and upgrading, planning and construction along the "100-mile green corridor", carefully guard a river of clear water, green on both sides. Deeply promote the "loose and messy" enterprise rectification, condensing the development space.

5.4. Strengthen Policy Research and Development

Tongling City should continue to strengthen policy research and development, and strengthen the legal and policy guarantee of green development. The city should also introduce "carbon pricing" and raise the "carbon price" by setting a price for carbon emissions, linking the external cost of carbon emissions with the internal cost of emitters. Establish a carbon emissions trading system, i.e. carbon market; establish a carbon tax, i.e. set a tax rate on carbon emissions to directly put a price on carbon. Strengthen market regulation, promote market-based trading of emission rights, energy use rights, water use rights and carbon emission rights, actively participate in the construction of the national carbon emission trading market, and expand the participating industries, trading subjects and trading varieties in the carbon market.

Acknowledgments

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