

Literature Review on Carbon Emission Reduction in China's Traditional Manufacturing Industry and Research on The Driving Mechanism of Its Green Transformation

Haoyu Liu^{1,*}

¹ School of Business Administration, Anhui University of Finance and Economics, Bengbu, Anhui, 233030, China

* Corresponding author: Haoyu Liu (Email: 526298327@qq.com)

Abstract: At present, "double carbon" has become one of the most popular social topics. Realizing carbon neutrality and carbon peak is a solemn commitment made by our country. As an extremely important part of China's industrial system, the success of the green transformation of the traditional manufacturing industry also determines whether China's "double-carbon" goal can be successfully implemented. This paper focuses on the Chinese traditional manufacturing carbon emission reduction related literature research, through the relevant literature integration of the modern traditional manufacturing carbon reduction research direction and focus, based on the PSR model to Chinese traditional manufacturing green transformation power analysis, from the perspective of system driven, to establish green transformation power analysis framework, from the system level to explain the dynamic mechanism of traditional manufacturing green transformation.

Keywords: Traditional manufacturing; Transformation power; PSR analysis model.

1. Introduction

In the face of the current global climate change, reducing carbon emissions has become a major challenge facing the whole world. As active practitioners as the Paris agreement, based on the construction of human destiny community responsibility, Xi Jinping announced that general secretary of China will strive to achieve in 2030 years ago, carbon dioxide emissions, 2060 years ago, carbon neutral, China as the world's largest developing country, will complete the world's highest carbon intensity drop, with the shortest time in the history of the world from carbon peak to carbon neutral. As the foundation and core of China's industrial development, the manufacturing industry plays a key role in influencing its economic activities on carbon emissions. In particular, while the traditional manufacturing industry is promoting economic development, it is also accompanied by high energy consumption, high pollution and low added value, which also makes us pay a heavy environmental price. The 18th CPC National Congress made the ecological civilization included in the "five-sphere integrated" overall plan, and the report to the 19th CPC National Congress once again pointed out that the reform of the ecological civilization system should be accelerated to build a beautiful China. The Fifth Plenary Session of the 19th CPC Central Committee further clearly stated that "to accelerate green and low-carbon development". The Central Economic Work Conference will take "doing a good job of carbon peak and carbon neutrality" as one of the key tasks in 2021.

At present, as the largest developing country and the second largest economy in the world, China ranks first in the world in total carbon emissions, and its energy demand will remain growing for some time to come. China is facing unprecedented pressure, both at home and abroad. As a responsible big country, China will be duty-bound to contribute to the realization of the sustainable development of

mankind. Therefore, realizing low-carbon development is the inevitable requirement of high-quality development in China. In 2015, Premier Li Keqiang put forward the "Made in China 2025" development strategy, and the "Made in China 2025" put forward specific low-carbon development goals, taking low-carbon development as a main development line. At the same time, its core concept is to continuously enhance the competitiveness of the manufacturing industry. Therefore, as the main industry of China's traditional manufacturing industry should also focus on carbon emission, a typical behavior that causes negative externalities.

Table 1. Three Scheme comparing

| Number | Scheme 1 | Scheme 2 | Scheme 3 |
|--------|----------|----------|----------|
| 1 | 456 | 456 | 123 |
| 2 | 789 | 213 | 644 |
| 3 | 213 | 654 | 649 |

To modify the header, double-click in the Header section at the top of this page. Fill in the author and article titles.

To insert images in Word, position the cursor at the insertion point and either use Insert | Picture | From File or copy the image to the Windows clipboard.

2. Literature Review

This paper will explain the research status and development trend of low-carbon development status, carbon emission influencing factors and carbon emission reduction path.

2.1. The low-carbon development status of the traditional manufacturing industry

The sustainable development of manufacturing enterprises themselves is more prominent. The traditional manufacturing industry lick the brick and also pays the environmental price for economic development. Without the low-carbon

development of the manufacturing industry, a "low-carbon economy" will be a castle in the air (Tang Decai et al., 2012 [1]). The "extensive" prosperity of China's manufacturing industry is also accompanied by a large amount of energy consumption and carbon emissions. Manufacturing industry is a pillar industry and a major carbon emitter in China, and its carbon emission reduction effect directly determines whether China's overall carbon emission reduction target can be successfully achieved. (Shao Shuai et al., 2017[2]). The low-carbon transformation and upgrading of traditional manufacturing clusters is a complex dynamic process in which enterprises in a cluster interact and game with each other, eventually leading to the emergence of complex phenomena. There is an unbalanced development of the "greening" of the traditional manufacturing industry (Zhang Hongjuan et al., 2016[3]). In the Survey Report on Energy Conservation and Emission Reduction of Chinese Enterprises since the 13th Five-Year Plan, about 10% of the sample enterprises cannot ensure the annual energy conservation and emission reduction plan; about 30% are not solid enough in energy conservation and emission reduction work (Liang Yongmei, 2021[4]). It can be seen that domestic scholars all believe that traditional manufacturing enterprises should vigorously move towards the direction of low-carbon development, and there is a phenomenon that enterprises cannot complete the low-carbon target on schedule. However, there is little research on the carbon emission reduction path of the traditional manufacturing industry in China. Abroad, some western developed countries have already taken the lead in the development of low-carbon industry. Take the UK as an example. Since the 2003 UK Energy White Paper, *Our Future of Energy: Creating a Low-carbon Economy*, the UK government has proposed a series of legal and institutional frameworks to promote the low-carbon transition (Huang Ping, 2015[5]); Rakesh argues that carbon emissions in industrial processes can be controlled by applying technology at different stages of industry, while Peter assumed in 2007 that every 30 percent reduction in carbon dioxide emissions in the post-Kyoto era could cause an 8 percent increase in costs in the heaviest industrial sector. In addition, in the evaluation of low-carbon economic development, there are mainly core index evaluation methods and comprehensive index evaluation methods. The former is to evaluate the development of low-carbon economy based on key indicators such as carbon emissions and carbon productivity, while the latter is to comprehensively evaluate all indicators related to social and economic development.

2.2. Research on the influencing factors of carbon emissions

At present, most of the academic research on industrial and carbon emission reduction focuses on the relationship between economic growth and environmental pollution, and the influencing factors of carbon emission reduction. As early as the early 1970s, the theory of "growth limit" began, which believed that economic growth would be restricted by limited natural resources without long-term sustained growth, and proposed that it is necessary to artificially reduce the economic growth rate in order to protect environmental resources. Facts have proved that after the reform and opening up, China's economic level has indeed achieved rapid growth in a certain period of time, but this period is also accompanied by the deterioration of the environment and the increase of carbon emissions. Foreign scholars have also done a lot of

research on the relationship between economic growth and environmental pollution, which shows that there is no fixed inverted U-shaped relationship between the two, but there are also U-type, N-type and linear relationships (Xu etc, 2018[6]; Yang etc, 2015[7]) It is believed that environmental pollution has a significant aggregation effect, and economic growth itself does not necessarily lead to high pollution.

In the study of the influencing factors of carbon emissions, scholars believe that the growth of economic aggregate is the most important factor leading to the increase of China's carbon emissions, and the energy structure and efficiency are important factors affecting carbon emission reduction (Guo Guoxian, 2011[8]). The improvement in energy efficiency has inhibit China's carbon emissions (Pan Xiongfang, 2011[9]). Specific to regions, scholars (Ye Yi'an, Zhu Jiye, etc., 2013[10]) It is believed that the large amount of coal consumption is the main reason for the rapid rise of industrial carbon emissions in the Yangtze River Delta region. At present, most cities in the Yangtze River Delta are in the stage of high energy consumption of economic development. In order to meet the needs of urban development, the amount of energy consumption will continue to increase, which will inevitably lead to the rising trend of industrial carbon emissions. On the other hand, the extensive energy consumption and economic growth mode are also the main reasons for the growth of industrial carbon emissions. However, with the economic development and the improvement of industrial technology level, the economic growth will gradually reduce the dependence on energy consumption, and the carbon emission intensity will show a downward trend. Therefore, adjusting the energy consumption structure, innovating the industrial production technology and improving the energy utilization efficiency are the primary tasks. The diversification of energy consumption structure is conducive to the transformation of countries from high carbon fuel to low carbon. Some scholars also use identities and models to determine the influencing factors of carbon emissions, and proposed that technology level has an inhibitory effect on carbon emissions (Wang Jian et al., 2018[11]); At the level of industrial structure, industrial structure is also an important factor affecting carbon emissions. The different production characteristics of various industries make the intensity of energy demand and utilization different, so the form and emissions of carbon dioxide emissions are different.

2.3. Research on the path of carbon emission reduction

Since China proposed low-carbon development, the research on carbon emission reduction path has also emerged at the historic moment. The research on carbon emission reduction path in China mainly focuses on low-carbon products and low-carbon industry (Chen Lihao, 2014[12]). In terms of the low-carbon development of products, the development of energy-saving products can promote the coordinated development of energy, economy and environment (Liu Qian, 2009[13]), The government should standardize the procurement of low-carbon products, set an example and lead the role for enterprises and consumers, increase consumers' awareness of energy conservation and promote the development of energy-saving products (Qi Ziyang, 2008[14]); In terms of research on industrial low carbonization, optimizing industrial structure, increasing government purchase efforts, carrying out financial activities

related to carbon trading, etc.) are all suggestions of scholars for the research of carbon emission reduction path in China. Some scholars have also put forward policy suggestions for the regional carbon emission reduction path through the perspective of "carbon unlocking" (Liang Zhong, 2018[15]). From the perspective of specific industries, the road of organic ecological agriculture can realize low-carbon agriculture, reduce the use of pesticides and fertilizers, and the extensive use of solar energy and biogas technology are helpful to the development of low-carbon agriculture, while the low-carbon service industry should be considered from the perspective of low-carbon logistics, low-carbon finance, low-carbon business and low-carbon tourism.(Bao Jianqiang, 2008[16]); The cement industry can reduce carbon emissions by developing such paths as innovative emission reduction combustion, energy saving and consumption reduction technologies, increasing the blending of alternative fuels, and the capture, storage and utilization of carbon dioxide (CCUS) (Liu Hao, 2021[17]), At the same time, CCUS technology is also the core and key technology of carbon emission reduction in the coal chemical industry (Zou Shaohui et al., 2021[18]). Some scholars have also found that the development of fintech helps to increase investment in environmental protection, reduce industrial pollution emissions, and plays an indispensable role in promoting the transformation of the green financial system and promoting environmentally friendly consumption.

By the above, now scholars at home and abroad in the face of carbon emissions, carbon emissions path, industrial structure optimization research become more and more

deeply, especially under the current "double carbon" background, in the past two years there are more and more domestic scholars in the study of Chinese carbon emissions, consider the point of view is also more and more comprehensive, this project has a lot of experience can reference, has significant reference significance. However, previous studies are mostly carried out on a certain country or region, and in the process of research, how to optimize the industrial structure, so as to realize the task of energy conservation and emission reduction. Review literature at home and abroad, few scholars stand in the perspective of an industry or industry to control energy consumption, reduce carbon dioxide emissions, no specific research Chinese traditional manufacturing carbon emission potential and way, the vacancy is unfavorable to our traditional manufacturing development, is unfavorable to follow the "made in China 2025" development platform. Therefore, focus on the traditional manufacturing industry in China, and the combination of energy consumption and emissions, determine the corresponding factors, using the PSR model of traditional manufacturing green transformation power analysis, to realize the traditional manufacturing low carbon development has important theoretical value and realistic basis, and according to the results to explore the traditional manufacturing carbon reduction way is of practical significance.

3. Transformation Power Analysis

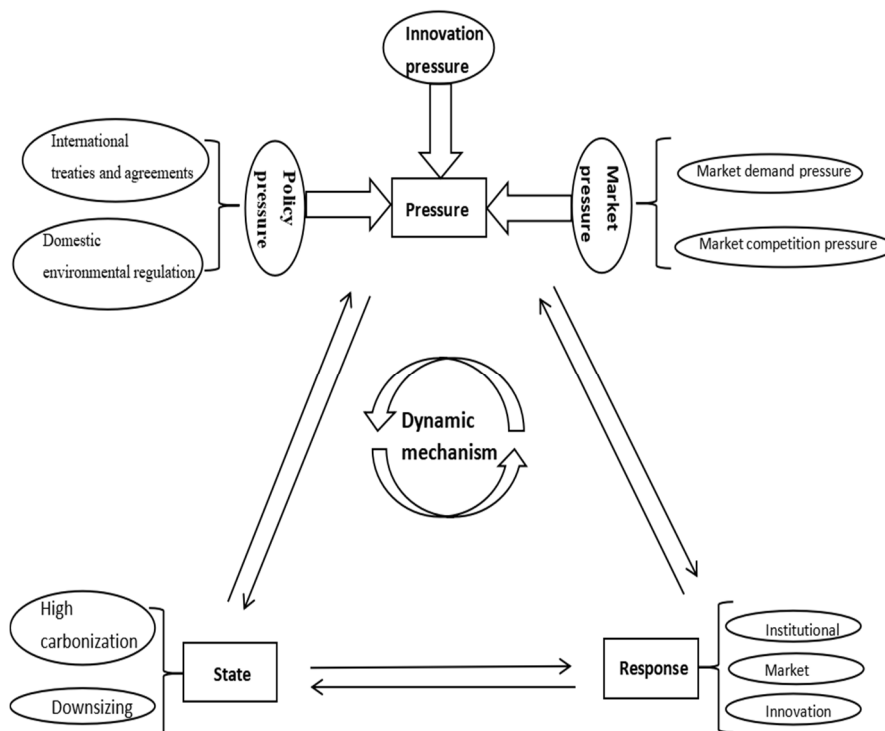


Figure 1. Driving mechanism model of green transformation of traditional manufacturing industry based on the theoretical framework of PSR

The party's 20th report calls for "actively yet prudently promoting carbon peak and carbon neutrality". As the "disaster area" of energy consumption and low-quality development, how to effectively realize the green transformation of traditional manufacturing industry in the new era has become an inevitable requirement to promote the

implementation of the "two-carbon" strategy. However, the traditional manufacturing industry is currently facing the dilemma of "high carbonization" and "low-end" locking, and the uncertainty and instability of the transformation road are increasing. Therefore, in such a complex situation, the road of green transformation of the traditional manufacturing

industry is bound to be hindered. Whether the traditional manufacturing industry can break through the green transformation block dilemma under the dual locking scenario mainly depends on the construction of the driving system and the grasp of the transformation opportunities. Under the phenomenon of "double lock", the traditional manufacturing green transformation and upgrading path is distorted, and curing the industry "high carbon, low-end" development model, this special lock phenomenon, also requires the transformation and upgrading of traditional manufacturing to overcome the tendency of generalization, at the same time, in the green transformation mechanism of differentiation between different industries, from the perspective of system driven, to establish green transformation power analysis framework, this section will focus on establishing traditional manufacturing green transformation drive system, from the system level to explain the dynamic mechanism of traditional manufacturing green transformation. This paper constructs the power system of the green transformation of traditional manufacturing industry using the "pressure-state-response" (PSR) model. PSR is an environmental quality evaluation model, which OECD and UNEP jointly develop and use in the environmental evaluation work. PSR is composed of three subsystems, stress, state, response, system mutual connection and mutual operation, as shown in figure 1, this study report adopts PSR model, build the green transformation of traditional manufacturing model, to understand the pressure and the development of the traditional manufacturing green transformation and develop the corresponding response paradigm, this section in the PSR analysis framework, on the basis of the dynamic mechanism of traditional manufacturing green transformation, for the traditional transformation opportunities provide the guidance of theory and practice, and finally according to the diversified transformation of the transformation of different opportunities.

3.1. Pressure

3.1.1. Institutional pressure

The pressure from international institutional policies: since the Industrial Revolution, the rapid development of science and technology has continuously increased the economic aggregate, but also brought irreversible damage to the global environment. Land desertification is serious, Marine ecological environment deterior, global resources are exhausted, biodiversity is seriously threatened, and various extreme climate events have also caused great harm to life and ecological environment on earth. In response to climate change, the United Nations General Assembly adopted the United Nations Framework Convention on Climate Change in May 1992. Although some progress has been made in some environmental issues in some areas over the past three decades, the global ecological environment continues to deteriorate overall. Mountains and rivers exotic, wind and moon in the same sky. Despite the differences in governmental positions, in the face of the deteriorating climate situation, the international community and organizations are still actively taking measures to reverse the global environmental deterioration in order to achieve the goal of "net zero emissions". The 2015 Paris Agreement requires all Parties to control the global temperature rise within 2°C and strive to control the warming range within 1.5°C. It also calls on all countries to actively implement the agreement to achieve a global peak of greenhouse gas

emissions as soon as possible and achieve net zero greenhouse gas emissions in the second half of this century. As a continuation of the agreement, the communique issued by the G20 summit in 2021 called on countries to take meaningful and effective actions to keep the global climate target of a global temperature average of 1.5°C within reach. In addition, coal, as an inefficient energy source with high carbon emissions, is a key factor affecting global climate change. Therefore, the United Nations convention on climate change 26 party conference (COP 26) on the Glasgow climate convention called on countries to speed up to the low carbon energy system transformation, stop the new and gradually reduce coal-fired power generation projects, expand the scale of the use of clean energy, reduce subsidies for the development of fossil fuels, this is the first time in the United Nations climate conference in the final agreement documents on fossil fuels related content. As the world's second largest economy and a major carbon emitter, these international agreements and treaties not only bring opportunities to China's green and low-carbon development path, but also bring great pressure and challenges. On the one hand, at the 75th Session of the United Nations General Assembly, General Secretary Xi Jinping formally proposed the goal of achieving a carbon peak by 2030 and achieving carbon neutrality by 2060, making a solemn commitment to the world on the issue of carbon emissions. The realization of the two-carbon target can be said to be a tight time, difficult, heavy task. On the other hand, as the largest developing country, due to the resource endowment characteristics of "rich in coal, poor in oil and less in gas" and the lack of green technology innovation, China's coal-based energy consumption structure is difficult to fundamentally change in the short term, which has brought great pressure to China's green transformation journey.

The pressure given by the rigid control of domestic environmental regulation: all things grow together without harm, and the way is parallel without contradiction. As a responsible country, China adhere to practical action to fulfill international agreements and obligations, facing the plight of ecological environment deterioration and resource depletion, domestic in recent years has been implementing a strict environmental protection system, intention to use strict environmental justice and environmental legal system for the traditional manufacturing enterprises play rigid controls and constraints, reversed transmission traditional manufacturing enterprises take the road of green development. For example, the Air Pollution Prevention and Control Law requires strict control of the emission of dust and gaseous pollutants from steel, non-ferrous metal smelting and petroleum processing enterprises. Those enterprises that exceed the emission standards for air pollutants, fail to take measures to reduce exhaust emissions, and fail to install and use pollution prevention and control facilities in accordance with regulations shall be fined, and the production of producers and business operators that refuse to make corrections shall be forced to stop work or suspension of business for rectification. Again such as the law on the prevention and control of water pollution for industrial water pollution prevention and control, in the new does not conform to the national industrial policy of papermaking, printing, coking and other serious pollution of water environment production project at the same time, for the water pollution enterprise technical transformation, using raw materials, less pollutant emissions of clean process, improve the reuse of water, reduce

waste water and pollutant emissions. In addition, the Standardization Law says that enterprises should develop new products, improve products and make technical transformation in accordance with the standardization requirements of this law. Enterprises that do not meet the mandatory standards shall be investigated and punished in accordance with laws and regulations and recorded in their credit records; if a crime is constituted, criminal responsibility shall be investigated according to law. More and more stringent environmental regulations add pressure to the transformation and upgrading of manufacturing enterprises, increase the carbon emission cost of enterprises, and force enterprises to increase their tendency to adopt green innovation strategies.

3.1.2. Market pressure

Market demand pressure: With the improvement of living standards and education level, people now pay more attention to the environment and climate change, and gradually establish the concept of green consumption. They are more inclined to buy environmentally friendly products, and they are willing to pay extra for green products. In this context, the international green market is booming, and the global rise of green manufacturing and green trade has undoubtedly brought a certain pressure of transformation to China's manufacturing industry. In order to comply with the global trend of green consumption and low-carbon commodities, and provide green products to meet the needs of environmental protection, China's traditional manufacturing industry needs to establish and improve the green value realization mechanism as soon as possible, promote the construction of green consumption system, and transform to green and low-carbon production mode. In addition, for labor-intensive industries, there is now a deadlock where low-end products flood the market and high-end demand cannot be met. Such as the current overseas online shopping boom, purchasing upsurge this "consumer spillover" embarrassing situation, mainly because our country in brand and design of high value-added link competitiveness, cannot meet the demand of consumers higher level, urgently need to strengthen the brand construction, break the vicious circle of "by bottom competition", conform to the market demand at the same time realize the rising value chain.

Market competition pressure: the green market competition between countries and between peers also brings heavy pressure to the green transformation of the traditional manufacturing industry. On the one hand, in terms of the competition between countries, the global economy is transforming to green and low-carbon. The growing demand for green market brings opportunities for all countries to catch up. A good green image and green products that conform to the demand have become the key to victory. However, compared with other major countries, although China has a high degree of participation in the global green industry chain, most exported green products are concentrated in intermediate products, and capital products are relatively lagging behind, so it is difficult to gain competitive advantages. In the face of fierce supply chain competition, China urgently needs to improve the manufacturing capacity of capital goods, enhance the position of China's manufacturing industry in the global industrial chain and value chain, and reduce the investment adsorption effect based on the primary comparative advantage. On the other hand, although domestic traditional manufacturing enterprises have made great contributions to economic

development, facing the change of consumption trend, it is necessary to attract consumers through transformation and upgrading and design green products under the guidance of green development concept and seize market share, so as to realize the unification of economic benefits and ecological benefits. Compared with traditional products, the demand and competitiveness of green products are higher, but the production of green products not only requires a certain node in the production link to be green, but also requires the manufacturer to integrate green procurement, design, production, sales and recycling into all links of product operation[19], Is the green upgrade of the whole life cycle. Therefore, how to design green products to meet the differentiated needs of consumers has become the key point of enterprises' production decisions, and is also the key factor for enterprises to win in the market competition.

3.1.3. Innovation pressure

The development of green economy should be supported by the progress of green science and technology, and scientific and technological innovation is an essential and powerful lever to promote the advanced development of green economy.(Li Baoyuan, 2011[20]) As an organic combination of green development and innovation-driven development, green technology innovation can solve environmental problems while effectively improving the market competitiveness of enterprises. More importantly, it can promote the transformation of social economy to sustainable development. However, at present, compared with developed countries, China's green development is faced with problems such as insufficient scientific and technological innovation ability, low energy utilization rate, and relatively backward technical content of green products, which brings challenges to the green transformation of China's traditional manufacturing industry. On the one hand, represented by the United States with historical responsibility, more advantages in technology and capital of developed countries not only did not actively provide financial support, help developing countries promote green technology, reduce carbon emissions commitment, but to take this opportunity to incite big competition, science and technology containment and crackdown. On the other hand, since the reform and opening up, the economic development model of high energy consumption, high pollution and high emissions not only consumes a lot of energy, but also causes serious environmental pollution problems. Technological progress can not only improve the efficiency of traditional energy sources such as coal, reduce carbon dioxide emissions, and help to improve the technical efficiency of carbon environment, but also actively promote the development and popularization of clean energy sources such as solar energy, wind energy, water energy and biological energy, and improve the technical efficiency of carbon environment. Both the key technology blockade of developed countries and the rigid control of domestic environmental regulations have put forward more urgent demands for the green technology innovation of manufacturing enterprises.

In addition, we are still at the low added value of our products and the low end of the value chain. This means that China's traditional manufacturing green transformation is not just a simple to reduce carbon emissions, get rid of industrial carbon lock problem, but to achieve on the basis of green total factor productivity of high quality development, with "dual unlock" governance logic as the guidance, and the breakthrough "at the bottom of the global value chain growth"

and "carbon base path dependence" double lock state, which requires our traditional manufacturing system can drive, market endogenous drive, firmly grasp the time background and advantages, comprehensive mining enterprise innovation ability, with innovation drive green high quality transformation.

3.2. State

The source of the transformation block of the traditional manufacturing industry is the dual locking pattern of "high carbon-low-end". This section will deeply analyze and explain the locking state of the green transformation process of the traditional manufacturing industry, so as to provide a detailed analysis of the state for the improvement of the PSR framework.

3.2.1. High carbonization

In the process of traditional manufacturing industry in the development of China, most industries are in a state of carbon lock, especially the made in China 2025 mentioned six traditional manufacturing industry, namely ferrous metal smelting and rolling processing (steel), petroleum processing and coking industry (petrochemical), chemical raw materials and products manufacturing (chemical), non-ferrous metal smelting and rolling processing (nonferrous), non-metallic mineral products (building materials) and paper and paper

products (paper), but also in the moderate and depth locking state.(Liang Zhong., 2022[21]), As shown in table 1, the table carbon intensity data choose 1997-2017 carbon locking intensity average, as shown in the table, "made in China 2025" especially involved in the six traditional manufacturing carbon emission intensity is more than 0.6 tons / ten thousand yuan, are in a state of deep locking, from the point of carbon emission intensity this index, the development of traditional manufacturing in China is still high carbonization. Traditional manufacturing industry always plays a very important role in China's manufacturing system. Whether from the perspective of the scale of the traditional manufacturing industry, or from the proportion of its added value and the number of the employed population absorbed, the traditional manufacturing industry currently occupies a dominant position in China's manufacturing system. It can be seen that the green transformation of the traditional manufacturing industry is also the key to the implementation of China's "double-carbon" goal. However, at present, China's traditional manufacturing industry is still a disaster area of agricultural consumption and pollution emissions, so it can be said that the current development of traditional manufacturing industry is accompanied by high carbonization, which is obviously the opposite of the current "ecological environmental protection" environment.

Table 1. High carbonization status index of traditional manufacturing green transformation

| Metric | | iron and steel | petrified | chemical industry | coloured | building materials | papermaking |
|---|---------------------------|----------------|-----------|-------------------|-----------|--------------------|-------------|
| High carbonization status quo of traditional manufacturing industry | Carbon emission intensity | 3.8198 | 1.4347 | 0.7773 | 1.2146 | 4.7794 | 0.6389 |
| | Lock state | Deep lock | Deep lock | Deep lock | Deep lock | Deep lock | Deep lock |

3.2.2. Low-end

China's traditional manufacturing industry is facing the development of high carbon, which is also accompanied by the growth of the bottom of the global value chain, that is, China's traditional manufacturing industry is embedded in the bottom of the GVC in the process of embedding in the global value chain (Liu Zhibiao, 2018[22]), In the state of the low-end lock, the development of our country manufacturing industry will be further restricted, so measure the traditional manufacturing embedded GVC degree has profound

significance, China's manufacturing GVC concrete embedded position of measurement has three main: export technology complexity, the global value chain status index and industry upstream degree, etc. The "GVC status index method" of KPWW used in this research report is on the basis of accurately defining the global value chain including multiple links of the international division of labor, detailing the value change process of products or services in each link of the international division of labor, and clearly measuring the added value share of each country in the international trade of a certain product.

Table 2. Low-end status indicators of green transformation of traditional manufacturing industry

| metric | | labor intensive | resource-intensive |
|--|--------------------------------------|-----------------|--------------------|
| The low-end status quo of the traditional manufacturing industry | GVC degree of division of labor-2000 | 0.009975 | 0.0701 |
| | Degree of GVC division of labor-2010 | -0.02875 | 0.015825 |
| | Degree of GVC division of labor-2017 | 0.047125 | 0.08285 |

Table 2 lists the 2000-2017 GVC division of labor, the table data from the university of foreign economic and trade global value chain institute UIBE GVC Indicator Database, including labor-intensive industries selected the food, beverage and tobacco, textiles and textiles, rubber and plastics, wood and wood and cork products industry average; Resource-intensive

industries selected the average of paper and paper products, printing and publishing, coke, refined petroleum and nuclear fuels, other non-metallic minerals, base metals and metal processing industries. As can be seen from the table, GVC labor-intensive industries are low in the downstream of the global value chain, while traditional resource-intensive

industries are relatively high in the middle of the value chain.

3.3. Response

3.3.1. High Policy response

In response to the pressure of emission reduction, China actively assumes the responsibility of a major country. Based on its national conditions and development stage, China has issued a series of policies to respond to the call of green environmental protection, providing the most basic source of power for the green development of industries, and also playing a role in guiding and promoting the transformation and upgrading of the manufacturing industry.

In 2015, Premier Li Keqiang proposed to implement the implementation of the "Made in China 2025" strategy, to accelerate the transformation and upgrading of the manufacturing industry and promote China from a manufacturing power to a manufacturing power, and took "innovation-driven, quality first, green development, structural optimization and talent-oriented" as the guideline in the implementation of the strategy. In order to speed up the construction of a manufacturing power, the CPC Central Committee has been encouraging all governments to promote the optimization and upgrading of the traditional manufacturing industry according to the actual conditions of the region. Among them, Zhejiang, as a major manufacturing province, took the lead in comprehensively launching the transformation and upgrading of traditional manufacturing industry, and built a national demonstration area for the transformation and upgrading of traditional manufacturing industry in 2021. The establishment of such demonstration areas can not only provide a guarantee for the healthy development of the local economy, but also provide a useful reference for those cities mainly dominated by the traditional manufacturing industry, and drive all walks of life to inject new vitality into the development of the traditional manufacturing industry. In 2020, in the face of the complex and volatile global economy and the uncertain development of COVID-19, the CPC Central Committee put forward the major decision of "a new development pattern of mutually reinforcing domestic and international cycles". In this new development pattern with the domestic cycle as the main body, the manufacturing industry chain can be reintegrated, and the huge domestic market also adds impetus to the transformation and upgrading of the manufacturing industry and plays a role in demand-driven development, so as to realize the benign interaction between supply and demand (Guo Kisha et al., 2021[23]). In 2021, the "difference" planning will manufacturing development in the prominent position, emphasize the traditional industries, promote petrochemical, steel, nonferrous, building materials and other raw materials industry layout optimization and structural adjustment, expand the light industry, textile and other quality product supply, speed up the chemical industry, paper and other key industries enterprise upgrade, improve the green manufacturing system. These reasonable and powerful policy responses provide effective guidance for the green transformation of the traditional manufacturing industry to break through the current block state and realize the "dual unlocking".

3.3.2. Market response

While attaching importance to the basic impetus brought by the policy level, China adheres to the market demand orientation and gives full play to the positive role of the market in promoting green development.

Build a carbon market. In the 20th report of the Party, General Secretary Xi stressed that we need to actively and prudently promote carbon peak to improve the carbon emission statistical accounting system, improve the carbon emission market trading system, and actively participate in the global governance of climate change. The Kyoto Protocol promulgated in 1997 innovatively brought the carbon emission trading mechanism into the global carbon reduction industry, marking the beginning of the establishment of a carbon emission trading market. In order to promote the smooth completion of the emission reduction task, China has successively established eight carbon emission trading exchanges in Beijing, Shanghai and Hubei since 2013, and at the end of 2017, opened a unified carbon emission trading market mainly in the power industry. This point-based market demonstration can not only regulate the carbon emission reduction behavior of enterprises through the market mechanism, and mobilize the enthusiasm and initiative of all parties to participate in low-carbon development. At the same time, it can guide the flow of social capital, attract more funds to invest in energy conservation and environmental protection and low-carbon technology innovation, and promote the reform of social energy structure and green and low-carbon transformation (Wang Danzhou et al., 2018[24]).

Carry out market cooperation. As a major country in charge, facing the complex international situation, China has not only continued to promote domestic green and low-carbon development, but also contributed to the sustainable development of the international community. During his visit to Kazakhstan in December 2014, Premier Li Keqiang first put forward the major decision and initiative of "international production capacity cooperation". Since then, relying on the background of Belt and Road and with the help of the global consensus of green and sustainable development, China has actively launched green cooperation and industrial alliances with developing countries along the Belt and Road to expand the competitive advantage of green products. This strategic cooperation and market cooperation with other countries can not only realize the complementary advantages between countries, optimize the allocation of our resources and alleviate the problem of domestic overcapacity; but also build the industrial chain with China as the core, give full play to the comparative advantages of China and other countries in the industrial chain, and reduce the substitution in the international economy from the source (Juanjuan Wang, 2020[25]), Promote China's transformation and upgrading in the global value chain.

3.3.3. Innovative response

At the end of 2021, the Ministry of Industry and Information Technology issued the "14th Five-Year Plan for The Green Industrial Development", which emphasizes that "adhere to innovation as the first driving force, strengthen scientific and technological innovation and institutional innovation, optimize the innovation system, stimulate the vitality of innovation, accelerate the green and low-carbon scientific and technological revolution, and cultivate and strengthen the new drivers of green industrial development". In the face of the dilemma that key core technology fields are controlled by others, China actively participates in a new round of scientific and technological revolution and industrial transformation, takes intelligent manufacturing as the main direction, gives full play to the driving effect of innovation on green total factor productivity, and provides source technical guarantee for the green transformation of traditional

manufacturing industry.

Specifically, at the level of production technology, production technology innovation can not only effectively improve the economic benefits of enterprises, but also improve the utilization rate of resources of enterprises and reduce energy consumption. For example, with the design concept of "green, intelligent and efficient", Hegang Shigang New Area actively plans the top-level design of industrial structure adjustment and high-quality development to ensure the output and quality of products while achieving ultra-low emissions (Wang Xindong et al., 2022[26]). At the product level, product innovation can fundamentally enhance the market competitiveness and promote the transformation of traditional manufacturing scale advantage to value advantage. Such as in order to adapt to the needs of the personalized fashion consumers, enhance the competitiveness of color yarn in the international market, coastal cotton spinning industry of color yarn production varieties constantly innovation, located in Zhejiang huafu color spinning to successfully create their own brand, improve the market competitiveness of the enterprise, market share. In addition, the innovation of industrial mode can successfully lead the traditional manufacturing industry to the forefront of the world through the reform of production mode and industrial form. Such as Qingdao binary tires, seize the "Internet +" and "made in China 2025" new opportunities, actively explore new development mode of tire industry transformation, to the first industry model innovation and transformation, established the global tire industry first whole process "4.0" industrial tire intelligent factory, implements the "Internet +" and industry depth fusion.

4. Conclusion and Policy Recommendations

The double locking scenario faced by the traditional manufacturing industry in the process of green transformation indeed brings great challenges to enterprises, but it also contains huge opportunities for transformation. The construction of the driver system and the grasp of the transformation opportunities are the key. By analyzing the dynamic system composition of the traditional manufacturing industry, we can see that the three subsystems of pressure, state and response interact with each other to promote the realization of green transformation. Under the dual pressure of the international and domestic environment and the small industry market environment, the traditional manufacturing industry is often in the state of "carbon locking" and "value locking", which restricts the pace of its transformation and upgrading. However, through the response of policy system, technological innovation and other aspects, enterprises can gradually release these pressures, break the current locking state, and achieve the goal of green transformation.

4.1.1. Formulate incentive policies for green transformation

The government should formulate a series of incentive policies for green transformation, including tax incentives, fiscal subsidies and industrial funds, so as to guide and support the transformation of traditional manufacturing to green. These policies can reward enterprises in terms of energy conservation and emission reduction, resource recycling, and cleaner production, and encourage them to actively adopt green technologies and measures.

4.1.2. Strengthening support for technological innovation

The government should increase its support for green technology innovation, establish special funds and scientific research projects, and accelerate the technological upgrading and transformation of traditional manufacturing industries. At the same time, we can also set up green innovation demonstration bases and conduct technical training to promote the technical level of enterprises and promote the realization of green transformation.

4.1.3. Improve the system of policies and regulations

The government should improve the relevant policy and regulation system, establish and improve the legal and regulatory framework for the development of green industries, and clarify the guiding principles and policy guidance of green transformation. At the same time, supervision over environmental protection and energy conservation should also be strengthened to ensure that enterprises fulfill their environmental responsibilities in accordance with relevant regulations and promote the implementation of green development.

4.1.4. Expand international cooperation and exchanges

The government can strengthen international cooperation and exchanges, draw on and absorb foreign advanced experience and technology in green transformation, and promote China's traditional manufacturing industry in line with international standards. By participating in international environmental protection cooperation projects and signing green trade agreements, we will expand the international market of green industry and enhance the competitiveness of enterprises.

Through the implementation of the above policy suggestions, it can effectively promote the green transformation of the traditional manufacturing industry, promote the sustainable development of enterprises, and achieve a win-win situation of economic benefits and environmental benefits. The government, enterprises and all sectors of society should make joint efforts to make positive contributions to promoting green transformation and jointly build a bright future for a beautiful China.

Acknowledgment

This work was supported in part by a grant from Anhui University of Finance and Economics Graduate Research Innovation Fund. under Grant ACYC2021124

References

- [1] Tang Decai, Zhong Fengxia, Shen Ziqi. Evaluation and analysis of the development status of low-carbon economy in China's manufacturing industry [J]. Business Research, 2013 (05): 198-203.
- [2] Shao Shuai, Zhang Xi, Zhao Xingrong. Empirical decomposition and peak path of manufacturing carbon emissions in China —— generalized Disney index decomposition and dynamic scenario analysis [J]. Industrial economy of China, 2017 (03): 44-63.
- [3] Zhang Hongjuan, Fan Ruguo, Zhang Youqing. Research on the evolution mechanism and strategy of low-carbon transformation and upgrading of traditional manufacturing clusters [J]. Business Economy and Management, 2016 (06): 64-72.
- [4] Liang Yongmei. Optimization and upgrading of traditional manufacturing industry: Review of the 13th Five-Year Plan

- and outlook of the 14th Five-Year Plan [J]. *Contemporary Economic Management*, 2021,43 (01): 7-15.
- [5] Huang Ping. Research on the correlation between low-carbon technology innovation and Industrial upgrading in China's manufacturing industry [D]. Harbin Engineering University, 2015.
- [6] Tao Xu. Investigating Environmental Kuznets Curve in China—Aggregation bias and policy implications[J]. *Energy Policy*, 2018, 114 : 315-322.
- [7] Haisheng Yang and Jie He and Shaoling Chen. The fragility of the Environmental Kuznets Curve: Revisiting the hypothesis with Chinese data via an “Extreme Bound Analysis”[J]. *Ecological Economics*, 2015, 109 : 41-58.
- [8] Guo Zhaoxian, Cheng Guojiang. Review and Transformation and Upgrading of China [J]. *Learning and Practice*, 2011 (06): 5-13
- [9] Pan Xiongfeng, Shu Tao, Xu Dawei. Changes in carbon emission intensity of China's manufacturing industry and its factor decomposition [J]. *Chinese Population, Resources and Environment*, 2011,21 (05): 101-105.
- [10] Ye Yi'an, Zhu Jiye, Li Shengfeng, Xu Qihui. Analysis of industrial carbon emission and economic growth in cities in the Yangtze River Delta [J]. *Resources and Environment of the Yangtze River Basin*, 2013,22 (03): 257-262.
- [11] Wang Jian, Zhen Qingyuan. Study on the relationship between economic growth and CO₂ emission —— Take the Yangtze River Economic Belt as an example [J]. *Finance and Economics*, 2018 (04): 36-45.
- [12] Chen Lihao, Zheng Yuli. Research on the Countermeasures to Accelerate the green Development in Jilin Province [J]. *Economic Horizontal*, 2014 (11): 101-104.
- [13] Liu Qian, Wang Yao. The development of the global carbon financial service system and China's countermeasures [J]. *Economy*, 2010 (07): 81-84.
- [14] Qi Ziyang, Sun Yong. Improve government procurement policies to promote the promotion of energy-saving products [J]. *Energy saving and environmental protection*, 2008 (10): 14-16.
- [15] Liang Zhong, Liu Jian. The window of opportunity and response strategy for industrial carbon unlocking [J]. *Social Sciences*, 2018 (01): 45-54.
- [16] Bao Jianqiang, Miao Yang, Chen Feng. Low carbon economy: new changes in human economic development mode [J]. *Industrial economy of China*, 2008 (04): 153-160.
- [17] Liu Hao. Analysis of carbon emission reduction path in cement industry [J]. *Cement Engineering*, 2021 (05): 1-3 + 21.
- [18] Zou Shaohui, Liu Bing. Research on carbon emission reduction path of new coal chemical industry under the background of carbon neutrality [J]. *Finance and Economy*, 2021 (09): 60-67.
- [19] Ling Yantao, Xu Jing, Zhang Hua. Vertical differentiation design and pricing strategy of green products based on heterogeneous consumer preferences [J]. *Journal of Management Engineering*, 2021,35 (06): 208-217.
- [20] Li Baoyuan. Human resource capacity building in the context of a green economy [J]. *Reference for economic research*, 2011 (02): 8-14.
- [21] Liang Zhong, Wang Yue. From "double dislocation lock" to "double unlock" —— Green transformation scenario and policy path of China's traditional manufacturing industry [J]. *Social Science Research*, 2022, (01): 68-76.
- [22] Liu Zhibiao. Build a manufacturing power on the path of global value chain [J]. *Learning and Exploration*, 2018, (11): 94-101 + 192 + 2.
- [23] Guo Kisha, Tian Xiaoxiao. Accelerate the construction of a new development pattern and the path of the transformation and upgrading of the manufacturing industry [J]. *Industrial economy of China*, 2021, (11): 44-58.
- [24] Wang Danzhou, Yang Detian. The driver of the carbon emission right trading price in China [J]. *Journal of Capital University of Economics and Business*, 2018,20 (05): 87-95.
- [25] Wang Juanjuan. The new channel connects "Belt and Road" and domestic and international dual cycle —— based on the perspective of industrial chain [J]. *Circulation economy in China*, 2020,34 (10): 3-16.
- [26] Wang Xindong, Huang Yongjian, Peng Shaofeng, Yu Yangyang, Li Shuangjiang. "Green, intelligent, efficient" new generation of electric furnace short process special steel plant —— He Steel Steel New Area [J]. *Steel*, 2022,57 (09): 1-10.