



# The Current Status and Development Trend of Green transition in China's Manufacturing Industry

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**Abstract.** This paper is based on the research and background of the green transition of China's manufacturing industry and the development of China's green economy. The study takes the changes in the policy environment, technological innovation and green energy as the main research objects. The SWOT analysis model as well as literature review and data analysis are used to elaborate and analyze the green transition of China's manufacturing industry. The research results show that there are certain advantages and opportunities for the green transition of China's manufacturing industry, but there are certain problems and challenges in terms of cost issues and technological innovation capabilities. Therefore, the article puts forward suggestions to further strengthen policy support and increase investment in green technology innovation to achieve the goal of sustainable development. The enlightenment of the article is that for other countries and regions to make the green transition they can learn from China's experience and lessons and strengthen policy guidance and technological innovation. At the same time, enterprises should also realize the importance of developing their own innovation capabilities and take active steps to achieve a green transition to promote global sustainable development.

**Keywords:** Manufacturing Industry, Green transition, Clean Energy.

## 1 Introduction

Green development is about reducing environmental impacts while growing the economy, and manufacturing as a major contributor needs to undergo a major transformation. Key advantages for achieving a green transition are green total factor productivity and green innovative technologies, which help to improve industrial efficiency, reduce energy consumption, control pollution and conserve natural resources. The opportunities presented by a green economy are equally great. People are becoming more environmentally conscious and desire sustainable goods and services, which provides strong market incentives for green development.

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F. Balli et al. (eds.), *Proceedings of the 2023 2nd International Conference on Economics, Smart Finance and Contemporary Trade (ESFCT 2023)*, Advances in Economics, Business and Management Research 261, [https://doi.org/10.2991/978-94-6463-268-2\\_23](https://doi.org/10.2991/978-94-6463-268-2_23)

For the manufacturing industry, how to achieve the transformation from traditional to green industry is a pressing issue today. By adopting green technologies, management practices and R&D innovations, the manufacturing industry can achieve a green transition and gain an edge over the competition. Two challenges remain from a practical point of view: cost and pollution. Enterprises need to invest in technologies and management practices that promote environmental protection, which may lead to higher production costs. The concentration of pollution emissions in industrial clusters also hinders the effectiveness of green development and poses health risks to nearby communities.

This paper will explore the basic status of the green transition of China's manufacturing sector, including the strengths, weaknesses, opportunities and threats involved. By analyzing the current state and prospects of the green economy, the study seeks to provide an analysis of how China's manufacturing industry can be transformed towards a more environmentally sustainable direction.

## 2 Literature Review

The transformation of manufacturing refers to the development of the industry in a direction that is conducive to economic and social development, in response to the needs of the times and the market. This involves improving competitiveness through changes in production technology, management, and other areas to achieve sustainable economic growth and increased value of products and services, while adapting to market demands and exploring new business management directions through continuous reform [1]. The extent of the transformation of manufacturing can also be seen through the expansion of value-added services. Value-added expansion is a manifestation of the upgrading of the manufacturing industry, and the profitability of the industry is a key indicator of this transformation in empirical evidence [2].

The trend towards transformation is driven by increasing environmental regulations, resulting in higher production costs for manufacturers to reduce pollutant emissions. Although the green transition of the manufacturing industry may face obstacles in the short term, overall, the level of green transition will continue to rise [3].

China's manufacturing industry transformation now faces the predicament: for a long time, the manufacturing industry development has existed the characteristics of complete but not refined, large and not strong. Competitive private brands are few, core technologies are highly dependent on foreign countries, and key high-tech products cannot meet the needs of their own development and need to be constantly imported, which is subject to others. Currently, the supply of most products in manufacturing industry can only meet the low-end demand, facing the dilemma of excess capacity. China's manufacturing economy is now developing at the middle and low ends of the global value chain, while high-end items still need to rely on imports due to the country's significantly lower rate of technological innovation than the rest of the world. [3].

For the policy impact, the macro-mechanism of local government subsidies to encourage manufacturing industry is mainly reflected by its effect on national income.

Demand management local government subsidies usually advocate tax reduction or increase of direct fiscal expenditure to stimulate aggregate social demand. On the other hand, supply-managed local government subsidies advocate that resource production factors flow to local government subsidies through structural tax incentives to study the incentive effect of clean, high-tech, and high value-added manufacturing industries on the green transition of manufacturing industry, so as to promote the transformation and upgrading of manufacturing industry structure [4]. Zhao used static panel model and dynamic panel model respectively to explore the relationship between industrial structure and environmental regulation, and the research results showed that the impact of environmental regulation on industrial structure has a time lag, and its positive impact takes a certain amount of time to emerge. Wei's investigation concentrated on how environmental regulations affected the modernization of industrial structure within the manufacturing sector. The results showed that while environmental control levels might encourage the optimization of industrial structure, the effects of such regulation vary depending on the locality. Specifically, in areas with insufficient innovation capabilities, an improvement in environmental regulation levels could potentially hinder the upgrading of industrial structure. The level of environmental regulation promotes the optimization of industrial structure of the manufacturing industry, but in areas with insufficient innovation ability, the improvement of environmental regulation level will restrict the upgrading of industrial structure. Cheng pointed out through research that the promoting effect of environmental regulations on the upgrading of industrial structure can only be realized when the level of industrialization reaches a certain level, and when the city develops to a certain stage, the positive effect of environmental regulations will become weaker and weaker [5].

In general, the challenges facing manufacturing transformation include technology, human resources, and investment. Only through the joint efforts of the government and enterprises can the manufacturing industry successfully transform itself to meet more unprecedented opportunities and challenges.

### 3 Analytical Framework and Discussion

#### 3.1 Advantage and Disadvantage of China's Green Manufacturing Transition

**Strength.** In recent years, China's manufacturing industry has made great efforts to upgrade and transform its industries, and remarkable results have been achieved in green and intelligent transformation. The emphasis on total factor productivity (TFP) in the green transition has contributed to China's manufacturing transformation. The core concept of the green economy is GTFP for green total factor productivity, which considers environmental performance and is developed by incorporating environmental variables based on traditional TFP indices. GTFP helps measure the ability of a given set of input elements in an industry to capture output while minimizing negative environmental impacts. Over the past few years, China's manufacturing industry has seen a gradual increase in its GTFP index, and this improvement in the efficiency of industrial

production is serving as a driving force for the industry's green transition and sustainable development. Improving energy efficiency, reducing emissions, and transitioning to greener practices have become crucial factors in promoting the sustainability and efficiency of the manufacturing industry's green transition.

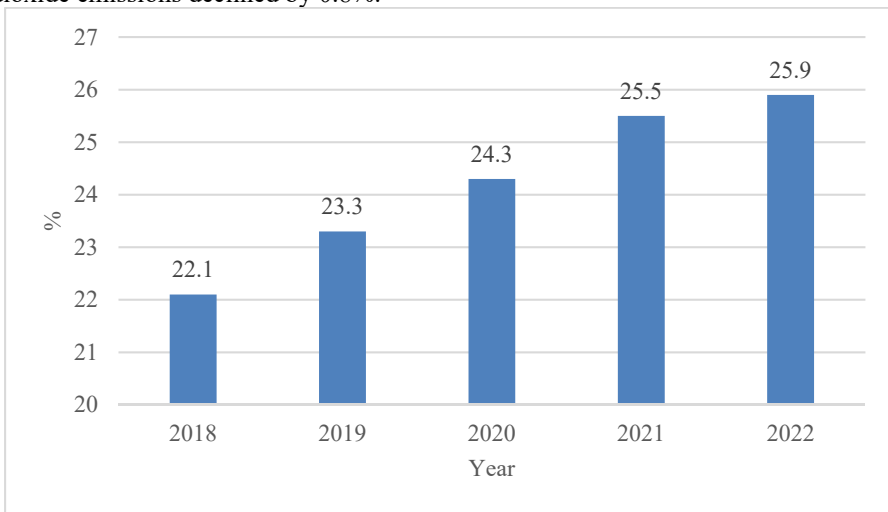
Green technological innovation has become the most critical driver of manufacturing growth in China, propelling companies to excellence and ensuring competitive advantage. A growing number of Chinese manufacturing companies have adopted green innovation as a key component of their strategies to mitigate the negative impact of traditional growth patterns. Green technological innovation involves developing and implementing environmentally sustainable technologies, products, and processes, while green non-technological innovation focuses on organizational and managerial practices that promote sustainability. Both types of innovation are crucial for achieving sustainable development and reducing the environmental impact of economic activities. The former aims to absorb advanced and new technologies that can improve existing processes and products in order to reduce energy consumption, prevent pollution and conserve natural resources. The latter includes the adoption of restructuring corporate management strategies, namely, environment, energy, quality management, green supply chains and green marketing, to minimize harmful environmental impacts.

**Weakness.** The cost of a green transition in Chinese manufacturing remains high. It becomes a difficult problem for related enterprises to implement the green transition. This is because a green transition will require significant investment in technology, management and more environmentally friendly production methods and materials, all of which will lead to higher costs. For traditional businesses that have been around for years, the cost of a green transition is even higher. The use of clean energy by manufacturing companies, for example, may require higher energy costs and operating costs. Common solar panels and wind turbines are much more expensive to build and maintain than conventional coal-fired power generation.

### 3.2 Opportunity and Challenge for China's Green Manufacturing Transition

**Opportunity.** The green economy has stimulated the rise of green consumption in China, and environment-friendly goods are popular with consumers. The green transition of manufacturing industry is faced with a wide commodity market. Under the conditions of continuous improvement of market supply, the demand of residents for quality consumption and green consumption is gradually increasing. During the first three quarters of 2022, retail sales of books and magazines, as well as cultural office supplies, increased by 6.7% and 6.8%, respectively, compared to the same period in the previous year. These figures were 3.2 percentage points and 3.3 percentage points higher than retail sales of goods above the limit. Furthermore, the sales of new energy vehicles have been rapidly increasing. Retail sales of new energy passenger vehicles were 3.87 million in the first three quarters, up 113.2% year-over-year, according to the Automotive Circulation Association [6]. In addition, cleaner energy in Chinese manufacturing is

being embraced by more companies, and the green low-carbon transition is accelerating. Regarding the energy consumption structure, the total energy consumption in 2022 reached 5.41 billion tons of standard coal, marking a 2.9% increase from the previous year. Specifically, coal consumption increased by 4.3%, crude oil consumption by 3.1%, natural gas consumption by 1.2%, and electricity consumption by 3.6%. Coal consumption accounted for 56.2% of total energy consumption, up by 0.3% from the previous year. In contrast, natural gas, hydro, nuclear, wind and solar energy combined accounted for 25.9% of total energy consumption, up by 0.4% (refer to Figure 1). Key energy-consuming industrial enterprises reduced their consolidated energy consumption per unit by 1.6%, while the consolidated energy consumption per unit of synthetic ammonia decreased by 0.8%. The consolidated energy consumption per ton of steel, however, grew by 1.7%, while it reduced by 0.4% per unit of electrolytic aluminum. Additionally, there was a 0.2% drop in the typical coal usage per kilowatt-hour of thermal power production. Per 10,000 yuan of gross domestic product, China's carbon dioxide emissions declined by 0.8%.



**Fig. 1.** The proportion of clean energy in China's total energy consumption (2018-2022).

**Challenge.** The huge manufacturing sector in China is still in the middle and low end of the global industrial chain, and the country is generally in the middle and late phases of industrialization. There are widespread problems of extensive production management, high pollution fuel use, high energy consumption and low value added of products. In the new situation, China's manufacturing transformation and upgrading also faces the problem of insufficient independent innovation capacity. For example, semiconductor and chip technology is backwards; Energy resources are not used efficiently, and the pollution caused by the extensive use of coal remains serious; Factor of production costs for all types of manufacturing are increasing year by year, and there is an urgent need to change the fossil-based industrial system.

### 3.3 Relevant Measures to Promote the Green transition of China's Manufacturing Industry

**Financial Support.** Governments can establish a special fund to support companies to conduct research and development and application of new energy technologies, green transition, and environmental technology innovation. For example, Chinese government pointed out that Efforts should be made to vigorously develop multi-level capital markets and strengthen funding support for the transformation and upgrading of the manufacturing industry. The listing or financing through listing should be accelerated for high-tech manufacturing enterprises and advanced manufacturing enterprises. Innovative bond varieties that meet the characteristics of advanced manufacturing and strategic emerging industries should be designed and developed to support the securitization of credit assets in the manufacturing sector [7].

**Technology Import.** Manufacturing enterprises have the potential to adopt new energy technologies, such as solar energy, wind energy, biomass energy, and more, and use green electricity, equipment, and materials to produce manufacturing products, reducing carbon emissions. At the same time, green transition also requires support for the research and application of new technologies. The government can establish industry technology innovation platforms to encourage enterprises to invest in technology research and development, and accelerate green transition [8].

**Cost Saving.** On the one hand, manufacturing companies can save costs through management. For example, strengthening training in cost control management to help executives recognize the important role it plays in business development. Establishing and improving the system of cost control management in the company, setting objectives for cost control management in each department. This is one of the simplest ways to save costs [9]. On the other hand, tax planning can also be carried out to save costs. Tax planning is legal in China, and companies can plan and arrange business operations, investments, financial management, and other activities to obtain tax benefits to reduce tax burden for their manufacturing business [10].

## 4 Conclusion

The key insights and findings of this study provide a comprehensive analysis of the green economy and manufacturing transformation. Firstly, the study shows that the green transition of China's manufacturing industry has its own advantages and opportunities, as evidenced by the rise of green consumption in the Chinese market adding motivation to the transformation of China's manufacturing industry and the rise of China's technological innovation capabilities accompanied by further improvements in the technological innovation capabilities of enterprises.

However, this study also reveals some shortcomings. Firstly, the high cost of green transition is a real challenge. Green transition requires companies to make significant

investments in technology and management, which may be beyond the affordability of some traditional companies. Secondly, the scope of the study is somewhat limited, and further expansion of the sample size and adoption of multiple data collection methods are needed to improve the generalizability of the findings.

Future research could further explore the following directions. First, the impact mechanism and related factors of green total factor productivity should be studied to promote the sustainable development of green economy and manufacturing transformation. Second, the research, development and application of green innovation technologies should be strengthened to reduce the cost of green transition and to promote the diffusion and adoption of green technologies. In addition, future research could focus on consumer demand for green products and services and examine how to promote the growth of green consumption.

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