

The Path of Empowering Digital Industry with Green Finance for Green and Low Carbon Development

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Abstract

Green and low-carbon development is a consensus among countries around the world on the development of the digital industry. The digital industry, as a pillar industry of China's economy, is a high energy consuming and carbon emitting industry. Therefore, the green and low-carbon transformation of the digital industry is of great significance for China to achieve its "dual carbon" goals. The achievement of the "dual carbon" goal relies on the support of financial services, and green finance plays three roles in guiding resource allocation, market price discovery, and risk management in its development process, mainly including financial products such as green credit, green bonds, green funds, and carbon markets. By building a green financial system that meets the requirements of low-carbon transformation, exploring new growth opportunities in the process of low-carbon transformation, taking precautions, using green finance, enterprise information environment disclosure and other means to guide the rational allocation of funds, using market means for low-carbon investment, reducing investment risks in the process of green transformation, and promoting low-carbon transformation of the digital industry.

Keywords

Green Finance; Digital Industry; Low Carbon Transformation; Carbon Reduction.

1. Introduction

Since the reform and opening up, the rapid advancement of industrialization has brought about rapid economic growth, and the extensive development model of "high investment, high energy consumption, and high pollution" has also made environmental problems increasingly severe. If effective measures are not taken and the environment is allowed to deteriorate, it will have a negative impact on human living environment and food security, thereby threatening human life and survival. China's carbon emissions have shown a slow growth trend from 78.58 million tons at the beginning of the founding of the People's Republic of China to 1.46 billion tons during the reform and opening up. According to data from 2022, China's total carbon emissions reached 1.05 billion tons, accounting for 30.7% of global carbon emissions. Among them, the carbon dioxide production in the industrial and power sectors was 4.2 billion tons and 5.14 billion tons, respectively, accounting for more than 84% of China's carbon emissions that year, accounting for 37.95% and 46.45%, respectively. The report of the 20th National Congress of the Communist Party of China proposes to take the coordinated development of environmental protection, ecological environment, and economic growth as an important path. In this context, green finance policies have emerged, and there is a close correlation between green finance and the digital industry. In China's social and economic construction, green finance policies are

essential tools, and adopting green finance methods can help promote the sustainable development of environmental resources.

The digital industry, as a pioneer in the world's technological revolution and industrial transformation, is a key area for seizing the commanding heights of future development in the new round of international competition. Its characteristics include a high level of digitalization, concentrated capital, and gathered technology. At the same time, it continues to penetrate various labor-intensive traditional industries and integrate with them, leading industrial transformation. Accelerating carbon reduction in the digital industry is of great significance for achieving China's "dual carbon" goals.

In the coming decades, digitization and greening are two significant technological revolutions with significant impact. In these two major historical processes, we need to jointly build the digital and green cornerstones in order to truly achieve China's "dual carbon goals" and contribute to China's carbon reduction work.

2. Literature Review

2.1. Related Research on Green Finance Policies

In September 2015, the Central Committee of the Communist Party of China and the State Council issued the Overall Plan for the Reform of the Ecological Civilization System, proposing for the first time the strategy of establishing a green financial system (Qi Huaijin et al., 2023). The promulgation of green finance policies will accelerate.

Green energy supply and sustainable development (Zhang et al., 2021; Cheng et al., 2023). In the report of the 20th National Congress of the Communist Party of China, it was proposed that promoting green and low-carbon economic and social development is an important step to achieve high-quality development (Dong Xin et al., 2024). Therefore, implementing the concept of green finance and expanding the space of green finance have gradually become the focus and important political task of the entire financial industry. (Yang Yiming, 2023). After the introduction of the Green Credit Guidelines, China's green finance policy has gradually developed from a single system in the past to a multi-level policy system mainly consisting of green credit policy, green bond policy, and green insurance policy, supplemented by various green finance policies (Meng Dabin et al., 2024). The rapid development of green finance provides good opportunities for the development of high polluting and energy consuming enterprises, and contributes to the rise of China's green ecological civilization industry (Cai Yang, 2024).

2.2. Research on Low Carbon Development of Digital Industry

"Digitization" and "greening" have become an important development trend for China's future economic development (Jiao et al., 2023), and are also the key to achieving this goal. Against the backdrop of a new round of technological and industrial revolution, digital technologies represented by big data, artificial intelligence, and cloud computing have become important driving forces for promoting resource optimization and reducing energy consumption (Wang Peng, 2024), providing new ideas for China's green transformation and low-carbon development (Sang Xinping, 2024). The digital industry has become an important component of the digital economy due to its advantages of green and low-carbon, energy conservation and emission reduction, and efficient sharing (Guan Ning et al., 2022). Leading greenization with digitization and driving digitalization with greenization. Actively promoting new technologies and industrial systems that combine digitalization and green, providing new impetus for high-quality development, promoting profound changes in production and lifestyle, and contributing to achieving carbon peak and carbon neutrality goals (Chen Jingbin, 2022).

After reviewing existing literature, it was found that several articles have explored the situation of China's green and low-carbon development, low-carbon economic transformation, and reduction of carbon emission intensity under the background of "dual carbon". There are few discussions on the low-carbon development path and mechanism of the digital industry from the perspective of green finance, so it is of great research significance to explore how green finance affects the low-carbon development of the digital industry.

3. The Current Status and Transformation Path of Carbon Emissions in the Digital Industry

3.1. Current Status of Carbon Emissions in the Digital Industry

The digital industry is an emerging industry that takes information as its processing object, digital technology as its processing means, digital products as its achievements, and entering various fields of society as its market. It mainly refers to the information and communication industry, also known as the fourth industry. However, carbon emissions refer to the process by which greenhouse gases such as carbon dioxide are released into the atmosphere. Greenhouse gases are a type of gas that can absorb and re emit infrared radiation from the Earth's surface, including carbon dioxide, methane, Freon, etc. These gases can strengthen the greenhouse effect in the atmosphere, causing an increase in Earth's surface temperature. Therefore, reducing the carbon emission intensity of the digital industry through technological means has become an inevitable choice.

With the rapid development and popularization of the digital industry, the demand for energy is increasing. The operation and maintenance of facilities such as data centers, servers, and network equipment all consume huge amounts of electricity, and a considerable portion of this electricity is generated by mineral fuels, which can lead to an increase in carbon emissions. In recent years, with the development of cloud computing technology, the number and scale of data centers have been increasing, and energy consumption has also been increasing. According to the International Energy Agency (IEA), the proportion of digital industry in global electricity consumption has been increasing year by year and has become an important source of carbon emissions.

The digital industry involves the production and use of a large number of electronic devices, and both their production and disposal processes generate significant carbon emissions. The manufacturing of electronic devices consumes enormous energy, and various chemical raw materials such as rare earths and plastics release a large amount of carbon dioxide during the manufacturing and refining processes. In addition, due to the large amount of organic, metal and other pollutants contained in electronic waste species, the disposal of their waste will also generate a significant greenhouse effect.

As an important component of the digital industry, the energy efficiency of data centers has always been low. Many data centers rely on traditional air conditioning and power supply systems, resulting in low energy utilization efficiency. In order to ensure the normal operation of servers and network equipment, significant power consumption and cooling capacity are generated during their operation and maintenance. Some data centers are located in areas with unstable power supply or the use of high carbon energy, which will lead to an increase in carbon dioxide emissions. Although some data centers have started using renewable energy, the energy efficiency of the entire industry still needs to be further improved.

Digital transformation can bring about a reduction in carbon emissions, such as by reducing paper usage and optimizing energy utilization. However, in some cases, digital transformation may also lead to an increase in carbon emissions. For example, digital transformation may encourage more people to purchase electronic devices, thereby increasing the production and energy consumption of electronic devices. In addition, digital transformation may bring new

sources of carbon emissions, such as the rapid growth of e-commerce and cloud computing services, which may lead to an increase in carbon emissions in the transportation and logistics sectors. To reduce carbon dioxide emissions, some digital industry companies have started using renewable resources, such as solar energy and wind power. By using renewable resources in data centers and offices, the digital industry can reduce its carbon footprint. In addition, in order to reduce dependence on mineral fuels, achieve carbon neutrality and sustainable development goals, some digital industry enterprises are also vigorously investing in renewable energy projects.

As a result, the carbon emissions of China's digital industry exhibit complex and diverse characteristics. Although some digital enterprises are committed to emission reduction, there are still issues such as increased energy consumption, carbon emissions throughout the entire lifecycle of electronic products, improved energy efficiency in data centers, digital transformation, and promotion of new energy. To achieve sustainable development, it is necessary to strictly control it, starting from improving energy efficiency, promoting renewable energy, and optimizing the lifecycle management of electronic products.

3.2. Digital Industry Low Carbon Emission Reduction Transformation Path

The digital industry is both a producer and a consumer of energy; It not only generates a large amount of carbon emissions, but also continuously reduces carbon emissions due to technological innovation and upgrading. On this basis, a top-level design concept guided by the system concept was proposed and incorporated into the industrial development strategy. To achieve the goal of carbon reduction, the digital industry must incorporate it into development strategies, governance mechanisms, risk management, and daily business activities. The development of the digital industry can promote the flow of market information, improve the production and resource allocation efficiency of enterprises, and reduce production costs; The research of this project will help improve the conversion efficiency of scientific and technological innovation achievements in China, enhance the pollution control capabilities of enterprises, promote the green development of China's economy, and thus enhance China's total factor carbon productivity. Compared with traditional industries, the development of digital industries can reduce the input of production factors and simplify the trade process; On this basis, this project proposes a new energy-saving and emission reduction method to meet the customized needs of users, achieve the goal of improving resource utilization and reducing energy consumption.

4. Green Finance Policies and Low-carbon Transformation

Guided by low-carbon transformation policies and incentive mechanisms, investment in green and sustainable development around the world is showing a thriving trend. In this context, how to promote investment and financing in related industries from national development strategies, support policies, and other aspects is the core issue currently faced. Green finance is a financial service aimed at supporting environmental reform, addressing climate change, and improving resource efficiency. With the gradual improvement of China's green finance system and market, green finance has gradually become an important force in the implementation of China's "dual carbon" strategy.

4.1. Green Loans

Green credit refers to a loan established by financial institutions for environmental protection, resource conservation, and sustainable development. The green credit system aims to promote the integration of economy and environmental protection, support the development of low-carbon economy, clean energy, energy conservation and emission reduction, and other aspects.

The report "Financial Technology Promotes the Development of Green Finance in China: Cases and Prospects (2023)" aims to showcase China's leading position in the global green finance field. The report shows that China has become the world's largest green credit market and the second largest green bond market. According to data released by the People's Bank of China, as of the end of 2022, the balance of domestic and foreign currency green loans in China has reached 22.03 trillion yuan, a year-on-year increase of 38.5%, which is 28.1 percentage points higher than the growth rate of various loans.

4.2. Green Bonds and Transformation Bonds

Green bonds refer to debt instruments in which the issuer uses the raised funds specifically to support environmentally friendly and sustainable development projects. These projects may involve areas such as clean energy, energy conservation and emission reduction, renewable energy, sustainable transportation, and ecological protection. The purpose of issuing green bonds is to attract investor funds to support solutions to environmental and climate change issues.

In 2023, the number of green bond issuances in China reached 475, with a total scale of 835.991 billion yuan, a year-on-year decrease of 4.29% compared to 2022, and a decrease of 8.30% in the number of issuances, but still at a relatively high level in recent years. Since the first green bond was listed in 2016, the scale of China's green bond market has rapidly expanded. With the proposal of the "dual carbon" goal, multiple departments have successively issued relevant documents to regulate the development of green finance and enhance financial support for the green sector. Green bonds have ushered in broad development space, with a significant increase in the domestic issuance of green bonds in 2021; In 2022, the issuance of green bonds in China reached its peak, with 610 green bonds issued and a scale of 804.403 billion yuan, a year-on-year increase of 32.3%; Starting from 2023, due to the impact of the macroeconomic situation and the increasing supervision of green bonds, the number of green bond issuances in China has decreased compared to the previous year, but the overall development momentum is still positive.

Transition bonds are a type of debt instrument that refers to financing to help businesses or industries achieve a transition from traditional high carbon emissions to a more green and sustainable environment. This bond aims to help enterprises or industries achieve a transition from high carbon to low-carbon, promote green economic development, reduce carbon emissions, and impact on the environment.

4.3. Green Fund

Green funds are an investment tool aimed at investing funds in environmentally friendly and sustainable projects and companies. These funds typically invest in areas such as clean energy, renewable energy, energy-saving technologies, sustainable agriculture, water resource management, waste treatment, and recycling. The Green Fund aims to promote environmental protection, mitigate climate change, and bring sustainable financial returns to investors in the process. These funds are typically managed by professional fund management companies, selecting investment targets based on environmental, social, and governance standards, while minimizing investment risks while ensuring maximum environmental and social benefits.

The "China Green Finance Practice Innovation and Development Report: 2023" shows that under the overall development trend of green finance, the scale of green credit is steadily increasing, the development potential of green insurance is enormous, the development direction of green bonds is diversified, the development of green funds is improving, and ESG funds are starting to take steps. As an indispensable part of the green finance system, green funds have gradually entered a rapid development track under the encouragement and guidance of relevant government policies, despite low social attention and late start. The

development momentum is rapid, and both in terms of fund size and amount of funds, significant improvements have been achieved. With the proposal of the "dual carbon" goal and the introduction of national support policies, the prospects for China's green industry during the 14th Five Year Plan period are promising. There is a huge investment demand in areas such as green transportation, sustainable energy, environmental infrastructure construction, ecological restoration, industrial pollution control, and energy transformation. The future development space of the green finance market is vast. Green funds are an important component of China's green finance system, with a wide range of funding sources and an increased scale. They can fully leverage the advantages of government departments, financial institutions, and private funds, and are an important part of the green finance system.

4.4. Carbon Market

The carbon market is a market used for greenhouse gas emission trading, which is generally achieved through carbon emission rights or emission permits. The carbon market is a new type of carbon trading system with elasticity, low cost, and sustainable development, aimed at providing economic incentives for different types of carbon emissions. This will promote companies and individuals to take into account their economic activities, thereby promoting their greener development.

During the 14th Five Year Plan period, the average price of carbon emissions trading in China is expected to exceed 105 yuan per ton; It is expected that during the 14th Five Year Plan period, the price per ton will exceed 200 yuan. Zhao Yingmin stated at the State Council Standing Committee Meeting held this year that the overall operation of the national carbon emission trading market has been stable since its launch for two and a half years; At present, the annual carbon dioxide emissions covered are 5.1 billion tons, with 2257 key emission units included, making it the carbon market with the largest greenhouse gas emissions worldwide; The carbon price has increased from 48 yuan per ton at its inception to around 80 yuan per ton, an increase of about 66%.

5. The Operation Mode and Successful Cases of Green Finance in China's Digital Industry

The organic integration of green finance and industrial development is a major measure for China's finance to serve the real economy. Building a green financial system that meets the requirements of low-carbon transformation, guiding the orderly reallocation of funds, and driving a large amount of funds to flow towards low-carbon transformation will help the low-carbon transformation of China's digital industry and promote the achievement of China's "dual carbon" goals.

5.1. Green Bonds

Green bonds are a financial tool used by governments and businesses to support environmental protection and sustainable development. Green bonds can help investors invest in projects that improve the environment and promote sustainable development, thereby achieving a win-win situation of investment return and social benefits. The operation mechanism of green bonds is implemented by the government and enterprises. Firstly, it is necessary to clarify the bond issuance and investment plans of the government and companies. Then, they can raise funds from investors by issuing bonds to achieve environmental protection and sustainable development goals. Finally, the government and enterprises should comply with laws and regulations on environmental protection and sustainable development, and regularly report the progress of green bond projects to investors.

Tencent is the largest network technology company in China, involving multiple fields such as social networking, gaming, cloud computing, and advertising. Tencent has been practicing

corporate social responsibility in recent years and regards environmental sustainability as its primary strategic goal. In 2019, Tencent issued its first green bond with a total amount of \$450 million. Through green bonds, Tencent has raised a large amount of funds to support a series of green projects, including improving energy efficiency in data centers, adopting clean energy, and promoting renewable energy projects.

Among them, the energy-saving renovation of data centers is the focus of Tencent's green bond fund utilization. Tencent operates multiple data centers, which are the core components of the company's cloud computing services. Tencent has made significant investments in optimizing cooling systems, upgrading server performance, and managing energy consumption to improve its energy efficiency. This has greatly reduced the energy consumption and carbon dioxide emissions of data centers.

In addition, Tencent is actively promoting the use of renewable energy and increasing the adoption of clean energy such as wind and solar energy in data centers. This not only helps to reduce dependence on fossil fuels, but also significantly reduces the environmental impact on business operations.

In the process of issuing green bonds, Tencent not only received financial support, but also promoted the green development of the digital industry and set an industry model, inspiring more enterprises to focus on sustainable development. This move shows that through green financing methods, the digital industry can make positive contributions to environmental protection and sustainable development, and in the future, the digital industry will pay more attention to balancing environmental protection and economic benefits.

5.2. Green Fund

Green fund is a fund trust fund that specializes in investing in the environmental protection and renewable energy industries. Its operating mode includes fundraising, selecting investment targets, managing investment portfolios, risk control, and continuous monitoring. Green funds raise funds in the form of fund shares; On the basis of thorough research and due diligence, select high-quality projects; By allocating funds reasonably, controlling positions, and carefully selecting investment targets, stable returns can be achieved; In this process, it is necessary to develop a rigorous risk control strategy, effectively control risks, and continuously monitor in order to have a real-time understanding of the operation and market changes of the invested enterprise, thereby avoiding investment risks.

Huawei is committed to promoting sustainable development and green transformation of the digital industry through its green fund. Firstly, Huawei's green fund focuses on energy conservation and emission reduction, intelligent energy management, green supply chain, and electronic waste recycling, providing important support for green innovation in the digital industry. Secondly, Huawei leverages green funds and industry partners to jointly promote the research and application of green technologies, build a collaborative platform for the digital industry ecosystem, accelerate the dissemination and application of green technologies in the digital industry, and promote the development of the entire industry towards a green and sustainable direction. In addition, Huawei's green fund supports environmental protection projects and public welfare activities, calling on digital industry enterprises to practice sustainable development concepts and jointly contribute to society and the environment.

Huawei Technology Co., Ltd. has made positive contributions to the green development of China's digital industry through its green fund. They not only promote green innovation by funding environmental projects, but also inject new energy into the sustainable development of the digital industry by promoting cooperation and innovation, advocating social responsibility practices.

5.3. Green Credit

Green credit is a credit product aimed at environmental protection and sustainable development, aimed at providing financing for projects that meet environmental requirements to promote sustainable economic development in China. By screening out projects that meet the conditions for green credit, evaluating their feasibility, environmental impact, expected benefits, etc., and submitting a green credit application to a bank or financial institution. After the application is approved, the bank or financial institution will lend to the enterprise, which will use the loan for green projects. The enterprise will investigate and report on the project in accordance with the provisions of the loan agreement. During this process, the enterprise should regularly report the progress and results of the project to the bank or financial institution.

As one of the largest e-commerce and cloud computing companies in China, Alibaba Group has been committed to sustainable development and has obtained funding through green loans to support its environmental and energy-saving projects. Alibaba Group has issued a series of green loans in recent years to fund its projects in areas such as energy conservation and emission reduction, clean energy, and carbon neutrality. Among them, the most eye-catching is the company's innovative measures in the data center field.

Firstly, Alibaba has funded a series of energy efficiency improvement projects for data centers through green loans. This project aims to upgrade the equipment and infrastructure of the existing data center, utilize efficient refrigeration and energy-saving servers, and combine intelligent management methods to achieve effective control of energy consumption and carbon emissions in the data center. Secondly, Alibaba supports the application of clean energy through green credit, and to replace conventional mineral resources, it has established wind and solar power stations in multiple data center areas. In addition, Alibaba still uses green credit to fund a series of carbon neutrality projects, and through investing in carbon neutrality projects, it has achieved the reduction and absorption of carbon emissions to achieve carbon neutrality goals.

Alibaba has not only increased its influence in the fields of environmental protection and sustainable development through a series of green loan programs, but also set an example for the green transformation of China's digital industry. Through green credit financing, an organic combination of environmental protection and economic development can be achieved, injecting new impetus into sustainable development.

5.4. Carbon Trading

Carbon trading, also known as carbon emission trading, refers to treating carbon dioxide emission rights as a commodity, and the buyer obtains a certain amount of carbon dioxide emission rights by paying a certain amount to the seller, thus forming a carbon dioxide emission rights trading. Carbon trading aims to use market mechanisms to promote low-carbon development, achieve the goal of reducing greenhouse gas emissions, and create a win-win situation for both environmental and economic benefits. Carbon trading is a trading method aimed at greenhouse gas emissions, which can provide economic incentives for enterprises to reduce emissions, thereby prompting them to take emission reduction actions and generating significant environmental and economic benefits. In this process, the country first determines the total carbon emission limit for a certain region based on emission reduction targets, and then gradually decreases year by year; At the same time, allocate the total amount of carbon emissions; On this basis, the government will build a carbon emissions trading platform, allowing different emitters to freely trade. Track and monitor transaction activities to ensure compliance and transparency of the transaction process; Eliminate excessively released sources of pollution and continuously adjust them dynamically.

JD effectively manages and reduces corporate carbon emissions by participating in the carbon trading market, promoting low-carbon development and sustainable operations. JD Group first conducted a comprehensive carbon emission survey and evaluation to grasp the carbon emissions of the enterprise in the supply chain and operation process. Subsequently, they adopted measures such as energy conservation and emission reduction, clean energy, and optimized logistics and transportation to reduce the carbon emissions of the enterprise. Afterwards, it will fund carbon trading profits in carbon reduction and environmental protection projects. The promotion of electric vehicles and intelligent logistics systems in logistics has reduced carbon emissions at the end of logistics; At the same time, increase investment in clean energy projects such as solar and wind energy to replace traditional energy and reduce carbon emissions.

JD Group has effectively reduced the company's carbon emissions through activities such as carbon trading and funding for carbon reduction, while also playing a positive role in the green development of the digital industry. It has also played a certain reference role for enterprises in other digital industries, thereby promoting the transformation of the entire industry towards low-carbon and environmental protection.

6. Conclusion and Outlook

The low-carbon transformation and green development of the digital industry are key to achieving China's "dual carbon" strategy. Green finance plays an important role in resource allocation, price discovery, risk management, and other aspects. Introduce green finance into the digital industry, promoting its development of higher and more specific carbon neutrality commitments, and continuously promoting the low-carbon transformation of China's digital industry.

At the same time, we should still recognize that green finance is a double-edged sword. With the increasing attention of capital market investors to environmental issues, their emission reduction requirements for the digital industry will become more stringent. By formulating green finance policies, promoting digital industry enterprises to invest in low-carbon technology and innovation, and promoting their development towards environmentally friendly and energy-saving. Although green finance policies are of great significance for the development of the digital industry, their flow and application have a certain degree of uncertainty, which affects the implementation effect of policies and the actual low-carbon effect. At the same time, it can also cause market distortion and uneven resource allocation, thereby losing fair competition in the market. Therefore, it is necessary to seek a balance between policy flexibility and regulatory rigidity, strengthen supervision and evaluation of fund utilization, and ensure that policies can truly promote low-carbon transformation of the digital industry while reducing potential negative impacts.

China's digital industry should discover new growth opportunities in low-carbon transformation, lay out in advance, and fully utilize tools such as green finance and corporate environmental information disclosure. For example, in order to reduce carbon emissions and improve resource utilization, digital enterprises can achieve energy conservation and emission reduction by investing in intelligent energy management systems, green data center construction, and other projects; At the same time, digital enterprises can also collaborate with suppliers to build green supply chains and promote the low-carbon transformation of the entire industry. At the same time, we should actively learn from the successful experience of low-carbon transformation in developed Western countries, put forward higher requirements for the low-carbon transformation of China's digital industry, accelerate the development of China's carbon market, and enhance China's international competitiveness.

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