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Research on the Development Path of Green Printing Industry under the Background of Bi-carbon Goal

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Abstract: *Carbon peak and carbon neutrality is a major strategic decision made by China in the face of climate problems. This paper starts from the definition of double carbon, introduces the progress of double carbon work in China, clarifies the necessity and urgency of promoting the green development of the printing industry, organizes the technical strategies for the green development of the printing industry under the background of "double carbon", and proposes a model of collaboration among the government, industry and enterprises. The aim is to explore the prospect of green development in the printing industry under the background of "double carbon".*

Keywords: *Carbon Peak and Carbon Neutrality; Printing Industry; Green Development; Low Carbon and Emission Reduction*

1. Introduction

"Double carbon" refers to carbon peak and carbon neutrality.The goal of China's "double carbon" work is to strive to peak carbon dioxide emissions by 2030 and achieve net zero carbon emissions by 2060.In 2020,General Secretary Xi Jinping first proposed a dual carbon mandate at the 75th UN General Assembly General Debate.

China is the world's largest carbon emitter.According to the BP Statistical Review of World Energy 2022,China accounts for 31.3% of the world's total energy carbon emissions in 2021. China has effectively curbed greenhouse gas emissions through a series of carbon reduction measures.In 2019,China's carbon dioxide emissions per unit of GDP will drop by 18.2% compared to 2015 and 48.1% compared to 2005,exceeding China's commitment to the international community to reduce by 40% to 45% by 2020[1].

2. The Necessity and Urgency of Promoting the Greening of the Printing Industry

As the printing industry due to the fragmented nature of production, printing process control is difficult, has not formed an institutionalized printing pollution management system and other reasons, its pollution management is still a double carbon background of the industry to solve the problem. In 2013, China's printing industry emitted about 926,000 tons of VOCS, accounting for 35.8% of the total VOCS emissions from industrial sources in the country, up from 6.9% in 2010[2]. In 2017, the "List of Outdated Processes and Equipment to be Eliminated" issued by the Beijing Municipal Development and Reform Commission clearly included the traditional sun-drying process in the elimination directory. In 2021, "the Notice of Beijing Municipal Bureau of Ecology and Environment Beijing Municipal Bureau of Statistics on the Announcement of the List of Key Carbon Emission Units and General Reporting Units in Beijing in 2020" shows that 12 printing-related enterprises are key carbon emission units and 6 are on the list of general reporting units.

In September 2010, the former Ministry of Environmental Protection and the former General Administration of Press and Publication signed the "Implementation of Green Printing Strategy Cooperation Agreement", and the implementation of green printing in China was officially launched. In 2011, the "12th Five-Year Plan" and "12th Five-Year Plan for the development of the printing machinery industry" were released, indicating the direction for the green transformation of the printing industry. In October of the same year, the former Ministry of Environmental Protection and the former

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General Administration of Press and Publication jointly promulgated the "Announcement on the Implementation of Green Printing" (No.2 of 2011), which comprehensively arranged the green printing work during the "12th Five-Year Plan" period. Since then, important documents such as "Notice on the Implementation of Green Printing for Primary and Secondary School Textbooks" and "Notice on the Implementation of Green Printing for Tickets" have been issued to further promote the green development of the printing industry. In March 2011, the first green printing standard "Technical Requirements for Environmental Labeling Products Printing Part I: Lithographic Printing" (HJ2503-2011) was released. A series of related standards were subsequently promulgated, providing a traceable transformation for printing enterprises to take the road to green development.

The State Council issued the "Action Plan for Carbon Peaking by 2030" (State Council [2021] No. 23), listing "Carbon Peaking Action in Industry" as one of the "Ten Carbon Peaking Actions".The "Five Departments' Guidance on Promoting High-Quality Development of Light Industry" (Ministry of Industry and Information Technology Joint Consumption [2022] No. 68) released in 2022 states, "Green and safe development should be accelerated. Promote the process of carbon peaking in light industry in an orderly manner, and draw a roadmap for low-carbon development in paper and other industries." A series of policies and opinions have been issued to provide guidance and support for the development of green transformation of the printing industry.

3. Technical Strategies for Green Development of Printing Industry in the Context of "Double Carbon"

3.1. Energy saving and consumption reduction

Although the printing industry is not a direct fossil energy burning industry, but the same is a major energy consumer, the consumption of electricity, water, paper, plastic, etc. larger. Taking printing paper as an example, in 2021, newsprint consumption is 1.6 million tons, uncoated printing and writing paper consumption is 17.93 million tons, and coated printing paper consumption is 5.83 million tons[3]. There is also a significant amount of energy loss in printing production. The waste heat generated during the printing process is more dispersed, and recovery is limited, resulting in large losses.The complex water quality of printing wastewater and the high content of hard-to-degrade organic substances make it more difficult to treat than general industrial wastewater, leading to the loss and waste of water resources.

Energy saving and consumption reduction throughout the printing process.As far as individual aspects of production are concerned, energy efficiency can be improved by adopting new technologies, developing new processes, and using new materials. For example, the use of computerized plate making and digital proofing technologies to reduce energy consumption. As a whole, to coordinate the pre-press, printing, post-press processing three stages, reduce the consumption of water, electricity, ink, paper and other energy and resources.

3.2. Low carbon emission reduction

Among the emissions produced by printing, the most serious harm to the atmosphere is the VOCs emissions. Volatile organic compounds (VOCs) is a general term for a class of atmospheric pollutants, defined by ISO as any organic compound that can self-volatilize in the atmosphere at room temperature and pressure. VOCs are important precursors of ozone and PM2.5. On the one hand, UV radiation allows VOCs to react photochemically with other substances in the atmosphere to produce photochemical smog. On the other hand, VOCs can easily lead to the suppression of the central nervous system of the human brain, and even cause serious physical damage.

Industrial sources of VOCs emissions in 2020 is about 13,575,000 tons.Industrial protective coatings painting, printing and packaging printing and oil and gas processing are the top 3 sources of emissions, with a combined contribution of about 34.7%[4]. Printing VOCs emissions mainly from the ink, fountain solution, car wash, adhesive, coating solution and other materials containing VOCs volatile. The share of unorganized emissions of printing VOCs in the total emissions can reach 60%[5]. VOCs have many types and involve many production and discharge links, so it is difficult to deal with disorganized emissions and difficult to collect. So far, for printing disorganized VOCs emissions, is still the focus of governance and difficult.

As an important air pollutant, the management of VOCs has an important synergistic role in achieving the dual carbon goal. First, the most common thermal decomposition method for VOC

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treatment will produce direct CO2 emissions through combustion (VOCs + O2 → CO2 + H2O + Heat). So reducing the emission of VOCs will control the carbon emission from the source. Secondly, greenhouse gases and VOCs are also similar in terms of control methods and effects, because greenhouse gases and VOCs have the same root and source and are emitted at the same time. VOCs as an important air pollutant, the study of printing VOCs synergistic emission reduction is important to build a low-carbon development model. Finally, the increase in carbon emissions will be accompanied by a simultaneous increase in VOCs emissions, which will put more pressure on improving environmental issues. All of the above points will push VOCs management towards a better direction.

4. Green Development Path of Printing Industry in the Context of "Double Carbon"

Green printing, refers to the use of environmentally friendly materials and processes, the printing process produces less pollution, saving resources and energy, printing waste easy to reuse re-cycle, can be naturally degraded, the ecological impact of small printing methods.

To build a green development path for the printing industry, the government should steer the course of development, the industry should play the role of uploading and transmitting, and enterprises should actively develop technology and carry out industrial upgrading and transformation. The three interlocking, in order to effectively promote the printing industry green development process.

4.1. Government: issuing policies and constraining supervision

4.1.1. Release the policy

Government departments play the role of indicating the direction for the development of the printing industry by formulating a series of policy documents. In 2010, the former Ministry of Environmental Protection and the former General Administration of Press and Publication jointly signed the "Implementation of Green Printing Strategy Cooperation Agreement" as the beginning, a series of green printing-related policies have been introduced one after another, building out the overall vein of green development in the printing industry. In 2017, the former State Administration of Press, Publication, Radio, Film and Television promulgated the "13th Five-Year Plan" for the development of the printing industry. In 2020, the State Council issued the third revised edition of the latest version of the "Regulations on the Administration of the Printing Industry" (State Council [2001] No. 315), which further standardized the printing industry standards and made every effort to build a green printing system. 2021 released the "14th Five-Year Plan for the Development of Circular Economy" (Development and Reform of the Environment [2021] No. 969) proposed "to guide enterprises in the production process to use non-toxic and non-hazardous, low toxicity, low (no) volatile organic compounds (VOCs) content and other environmentally friendly raw materials. Promote the reduction of packaging and packaging printing." These policy documents will be the implementation of green printing guidelines, scope objectives, organization and management, work arrangements and supporting measures to ensure the overall arrangement, and gradually build a complete system of green printing system.

4.1.2. Constraint supervision

The government builds the trading platform through market means, and makes rules and regulations through administrative means. In 2021, the national carbon emissions trading market opens.Enterprises receive a certain amount of carbon emission allowances, and emission entities with high production efficiency can obtain more emission allowances through free market transactions, thus improving overall emission efficiency. For the printing industry, the carbon emissions trading market will bring profits to enterprises that reduce emissions and bring more urgent transition pressure to enterprises with excessive emissions. Administratively, the government through the development of printing standards, product standards, testing methods, evaluation standards and other norms, clearly delineate the bottom line red line, not only for the relevant supervision and punishment to provide a practical basis, more enterprises how to take the road of green printing to provide clear data against and meet the requirements of the standard.

4.2. Industry association: Building bridges and awareness

4.2.1. Bridging the gap

As a bridge between the government and enterprises, the printing industry association plays the role

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of uploading and transmitting between the two. First, the industry association is responsible for passing information upward for the government. On the one hand, industry associations through the collection of enterprise production and pollution status data, the organization of industry experts to discuss the development of policy standards to provide basic information to assist government departments to develop industry green development planning, green printing standards, green testing basis, green evaluation system, etc.. On the other hand, by understanding the difficulties and constraints faced by printing enterprises in the implementation of green printing, industry associations provide feedback to the government so that it can adjust the layout and planning. Secondly, the industry association is responsible for providing services to enterprises downward. On the one hand, the Association conveys and interprets relevant policies to enterprises and promotes the promotion and implementation of green printing standards. On the other hand, industry associations pay close attention to domestic and international information, can be new technologies, new equipment, new processes, new materials to printing enterprises in a timely manner, so that enterprises quickly grasp the development of green printing industry trends at home and abroad.

4.2.2. Create awareness

The print industry association also serves as a sounding board and amplifier. Printing industry associations can publicize green printing policies to printing enterprises, so that they can keep abreast of the significance of implementing green printing standards, the requirements of green printing standards for enterprise production, and the related demand for technological innovation. The Printing Industry Association carries out various forms of education and training and policy explanation activities for employees of printing enterprises to enhance the awareness of printing industry practitioners for green transformation and development. Industry associations also organize various forms of communication meetings to improve the ecological and environmental awareness of enterprises and promote the transformation and upgrading of enterprises.

4.3. Enterprises: structural transformation, technology research and development

4.3.1. Structural transformation

Enterprises have to transform at the structural level, shifting the original crude production model to refinement. Take a refined path, requiring enterprises to green product production as the ultimate goal of the overall arrangement of the entire production process. Gradually form the "source reduction, process control, end of governance" governance model to solve the problem of recycling and treatment of printing waste. Adhere to the source to the process to the end of the idea, the prevention of printing pollution decomposition to pre-press, printing, post-press steps, from the standardization of raw and auxiliary materials control, pre-press plate control, printing production control, post-press pollution treatment to achieve comprehensive pollution prevention and management.

4.3.2. Technology development

Printing enterprises' own technological progress is always the fundamental driving force behind the green development of the printing industry. Enterprises should increase their technological research and development efforts to enhance their requirements in greening materials, processes and products. Materials, the use of water-based green ink, solvent-free ink, nano-materials, etc., can greatly reduce printing pollution emissions. Nano green plate making technology does not require exposure processing, and the lipophilic nanoparticle composite material is used as ink to print directly onto the super hydrophilic printing plate with micro and nano structures to achieve the effect of presenting information. On the process side, the Heidelberg Innovation Lab has developed a new manufacturing process for copper-based solderable circuits using 3D printing technology to print the circuits using screen printing methods, improving the wasteful situation of contamination caused by etched circuits. Digital printing technology is also combined with traditional printing technology to improve product quality and reduce environmental pollution by digitally spraying and digitally spraying transfer dyes, and digitizing the entire production process of printing using modeling technology, digital manufacturing technology, and computer network technology. In terms of products, green product standards force the greening of production. From the beginning of product design adhering to the green concept, pay attention to the green low-carbon standard requirements.

5. Conclusion

The printing industry should continue to take the green development path in the background of the

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double carbon. The government, industry and enterprises to coordinate and cooperate to build a green development of the industrial system and "source reduction, process control, end of governance" mode of governance, the printing industry will go wider and wider green development road!

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