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Countermeasures of Green Development of E-Commerce Under the Background of Double-Carbon Policy

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Abstract

In recent years, with the rapid emergence of the e-commerce industry, various industries in China have gradually undergone transformation and upgrading towards e-commerce, and the evolving consumption patterns have also had a significant impact on the trajectory of e-commerce's growth. Moreover, given the prominent global climate change for the past few years, countries, which have put forward different policies, aim to address this issue. Implementation of the dual-carbon policy undoubtedly serves as a forceful response from China to climate change. Consequently, amidst this overarching context, green consumption has progressively captured the spotlight of consumers, sparking widespread market responses and the initiation of green production capacity upgrades. However, substantial corporate funds will be occupied by the investment in low-carbon industries inevitably, leading to challenges such as capital scarcity for some small and medium-sized enterprises. Therefore, within the framework of low-carbon initiatives, it is of utmost importance for the strategic choices of e-commerce platforms to study the national development policies and the trend of green consumption development.

Keywords: Green consumption; e-commerce; dual carbon policy.

1. Introduction

With the continuous development of Internet era, the emergence of E-commerce platforms has become a significant symbol as the rising of this era [1-2]. Meanwhile, the E-commerce industry has also encountered new development opportunities during the epidemic. According to China 's Ministry of Commerce, the E-commerce transaction volume reached about 5.66 trillion yuan in the first half of 2022 in China, with a year-on-year increase of 30.1 %. The transaction volume of E-commerce platform has reached about 4 trillion yuan since 2022.

In recent years, environmental problems associated with e-commerce have become one of the important issues of international concern, and carbon reduction has become a key factor in solving this problem [3-4]. With the quality improvement of people 's daily life, more and more consumers begin to pay attention to the issue of green consumption. According to the statistics, more than 2.5 million people bought green

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products on the E-commerce platform during “the double eleven period” in 2021. According to PwC 's (PricewaterhouseCoopers) 2021 Global Consumer Insight Research on China Report, 74 % people of respondents in China are more willing to buy green or smaller items than other countries and tend to purchase traceable and well-sourced items. 72 % of people are willing to buy items produced by companies that focus on green or advocate green activities. Therefore, in terms of consumption consciousness, the concept of green consumption is deeply rooted in the hearts of the people and continues to develop in a better direction.

According to the survey of the E-commerce trading platform of the National Bureau of Statistics, the carbon emissions of E-commerce enterprises are expected to reach 116 million tons in 2025, with an increase of about 50 million tons of emissions compared to 2020, with a growth rate of 73 %. In 2021, the " Notice on Promoting the Green Development of E-commerce Enterprises " issued by the Ministry of Commerce further emphasized the requirements of the green development of E-commerce enterprises. (1) start from the energy saving and efficiency improvement of E-commerce enterprises, strengthen the construction of green data centers, (2) promote the greening of express packaging and reduce or substitute the use of disposable plastic products, (3) expand the sales of green products and guide towards green consumption, (4) E-commerce platforms are required to establish a sense of responsibility for protection of ecological environment, and take ecological environment protection and sustainable development as the basic criteria for enterprise development. The transformation of green E-commerce services has also become the most significant trend in the contemporary context. Technology upgrading and financial support have also become the key to solving this problem [5-6]. The low-carbon awareness of Consumers not only affects the market demand, but also promotes the transformation and upgrading of various manufacturers.

Current research has a very comprehensive description of low-carbon emission reduction in the E-commerce industry，but still lacks in integration of national dual-carbon policy into the industry and consideration on the development direction of small and medium-sized enterprises from the perspective of consumers.

With the rapidly development of E-commerce，a series of environmental and energy problems have been brought out. At present, there is a widespread attention and research on the low-carbon development of the E-commerce industry at home and abroad. The Ministry of Commerce of the People’s Republic of China announced the “Notice on Promoting the Green Development of E-commerce Enterprises” on January 11, 2021. 12 policies were published in the notice, including promoting energy conservation and efficiency of enterprises continuously, green management of supply chain for express packaging, giving full advantages of e-commerce platforms, creating a green development environment, and adopting corresponding protection measures [7-8]. The major domestic E-commerce platforms also actively respond to national policies and play a leading role. In the internationally accepted standard scopes 1, 2, and 3 for delineating the scope of carbon emission reduction (where scope 1 is direct emission, scope 2 is indirect emission, and scope 3 is indirect emission for upstream and downstream activities of the value chain). Alibaba first proposed the concept of scope 3+ beyond scope 3 in the carbon neutralization action plan released at the end of 2021, which is used to cover the carbon emissions generated by the platform enterprise and ecological partners (i.e., the roles of providing and consuming goods and services through the platform, such as third-party sellers, logistics service providers, consumers in the e-commerce platform ecology, travel platforms also include online ride-hailing drivers and passengers, etc.). Amazon and Alibaba have put forward the goal of carbon neutrality in their own operation scope and are also starting to promote carbon neutrality in the value chain, among the major e-commerce platforms at home and abroad.

Furthermore, “environmental protection and sustainable development” has also become a hot spot in the development of cross-border E-commerce industry for foreign countries [9-10]. More than half of online consumers in Europe say they are worried about the environment problems because of the E-commerce development and hope to see more business offering sustainable packages. Consumers have greatly promoted E-commerce demand for sustainable consumption. According to the joint survey by European E-commerce logistics platform “Seven Senders” and market research institution “Appinio”, 3500 European online consumers were tested in Germany, France, Italy, the Netherlands, Austria, Spain and Switzerland. Within one year, consumers ' willingness to pay for sustainable transport goods increased from 54 % to 70.7 %. E-commerce consumers ' awareness of carbon reduction has continued to grow in the past few years. Overseas consumers’ requirement for sustainability also poses unprecedented challenges to the E-commerce industry. In 2021, 74% of consumers in Europe purchase individual goods or services through the Internet, an 11 % increase from 2016, while also bringing greater volume of logistics. However, the lack of accurate measurement methods of carbon dioxide emissions and carbon dioxide emission reduction methods has become a bottleneck in the development of the industry. The survey of SevenSenders shows that in the overall operation of e-commerce platforms, logistics have the largest carbon emission.

In this paper, the present situation on low-carbon emission reduction policies and status of the Internet retail platform will be combined to study the low-carbon equilibrium strategies of different links under the guidance of different strategies, and relevant policies will be considered as theoretical support. Secondly, the way of the leading E-commerce enterprises promoting the implementation of green updating and improving their own development efficiency will be investigated and discussed, to explore the potential changes in the E-commerce market brought by green consumption from the perspective of consumers. The results will provide reference for the e-commerce enterprises for the selection of path and theoretical innovation under the background of low carbon.

2. The Development of Low-Carbon E-Commerce in China

2.1. Analysis on China's E-Commerce Development Status and Problems

In the field of E-commerce, the E-commerce service industry has taken up the dominant role during the rapid development in recent years. Driven by various types of services such as logistics distribution, online payment and live streaming, E-commerce is in a stage of flourishing development. According to the head of the E-commerce department of China 's Ministry of Commerce, in the first three quarters of 2022, the overall Chinese online retail market showed an upward trend. According to the National Bureau of Statistics, in the first quarter of 2022, China 's online retail sales totaled 9.59 trillion yuan, with an increase of 4 % over the same period last year. Meanwhile, it is observed that China 's online retail market has certain characteristics. (1) The sales of certain products have doubled. (2) Northern and central regions are the fastest growing parts all over the country. Compared with the same period last year, the total online retail sales in the North-east and Central Plains regions increased by 13 % and 8.9 %, higher than the average national level of 9 % and 4.9 %, respectively. (3) The sales of network services and online catering are also going slowly on the right track. (4) The online agricultural retail industry has also developed significantly. Under the huge impact of the new coronavirus epidemic, the demand for consumption of E-commerce online services is gradually increasing. Consumers ' demand for online payment untouchable express delivery has skyrocketed. Upgrading new transportation logistics services, improving sales efficiency have also become the new focus of E-commerce sellers. E-commerce is also closely integrated with information technology platforms, such as the development of cloud platforms, the development of digital intelligence

in the E-commerce industry, the development of big data marketing and the technology to guess what you prefer, and the combination of artificial intelligence and E-commerce industry chain to achieve all-round intelligence [11-12]. All these progress show that while the E-commerce marketing mode and technology are more mature, the quality of E-commerce service is also constantly improving, and it has also become a mainstream way of E-commerce marketing. Meanwhile, the modern E-commerce third-party business developed through the emerging industry platform is also gradually transforming. Through the use of intelligent technology and sales strategy, the third-party service platform is built to improve the user experience and satisfaction of the consumers.

Although innovative service awareness has been implemented in the development of E-commerce by certain government, effective measures for innovation are still required for reform. Many governments strengthened on macro-coordination when formulating policies, and but there are problems such as policy generalization and insufficient in guiding. Therefore, it is difficult to implement the policy or there is a deviation from the expected situation. The innovation of E-commerce processes lags in some regions, which are still in a stagnant state, especially in cross-border E-commerce. The government 's public capacity needs to be improved. The government 's public service capacity is a cornerstone to ensure the smooth development of the E-commerce industry. However, there is a gap between the demand for public services and the actual situation in the development of E-commerce in some regions, which is related to local economic conditions and talent shortage [13-14].

2.2. Research on Relevant Policies of E-Commerce Industry in Carbon Reduction

Under the current background of green and low-carbon economy, the government should focus on encouraging enterprises to achieve green innovation, transformation and upgrading, so as to promote the high-quality development of E-commerce industry. It is more conducive to increase the income of green recycling platform for E-commerce through the study on subsidy of recycling policy for E-commerce supply chain and the manufacturers ' channel structure [15-16]. In Zhejiang Province, the concept of green logistics development was put forward, which is a detailed summary of the whole process of green development and infrastructure improvement in the process of logistics. Certain agricultural product platforms were found to be lack of guidance in relevant green policy and combining with serious environmental pollution problems in commodity packaging, transportation and distribution. Since the country 's implementation of green policies, the main pollutants associated with E-commerce agricultural products were investigated, to establish an environmental impact model and come up with analyzed model parameters and provide reference for green development for E-commerce agricultural products.

According to the " Mail Express Packaging Management Measures " formulated by the National Post Office in 2021, and the express packaging materials and packaging methods of the E-commerce industry have been strictly regulated, and thus the process of green express was accelerated. During the ' Double Eleven ' period, a total of 1.8 billion green consumption behaviors were generated through Cainiao Logistics, and 53,000 tons of carbon were reduced, which indicated a significant change in green low-carbon consumption. In 2022, Greenpeace, an international environmental protection agency, participated in the planning and implementation of " From Concept to Practice - An Efficient Management Guide for E-commerce Platforms to Promote Merchants for Carbon Reduction. " The guide provides a clear prospect path and suggestions for E-commerce platforms to promote merchants to work together to reduce carbon emissions, and also provides reference for various Internet platforms.

Systematic research on the government 's carbon reduction and relevant policies was also conducted oversea. Under the background of upgrading for ecological consumption demand, the choice of E-commerce green investment and supply chain sales mode was investigated, which helps to improve the platform profit and the overall sales environment. However, the financing dilemma existed in green innovation of supply chain for E-commerce platform, game model, dynamic evolution law and data analysis were applied to study the relationship of green innovation and financing cooperation between E-commerce platform and manufacturers, the results will help the green development of E-commerce manufacturing industry in the future [17-18].

2.3. Factors Affecting the Low-Carbon Development of E-Commerce

2.3.1. Consumers

Though the " double carbon policy has been implemented in China, for ordinary consumers, the low-carbon consumption knowledge is insufficient. It is difficult for ordinary consumers to make an accurate understanding of the environmental impact and carbon emissions of their own consumption behavior [5]. Meanwhile, due to the network marketing subsidies, most consumers were encouraged to consume excessively, therefore, the promotion of the concept of 'low-carbon consumption' is also difficult. According to the 2020 Energy Fund 's" Family Low-Carbon Life and Low-Carbon Consumption Behavior Research," through the statistics and analysis of 3500 people 's questionnaires, 47 % of them answered they knew "low-carbon," 43 % of them believed that reducing meaningless consumption would help reduce carbon emissions, but only 34 % of them could identify "low-carbon" products, 64 % of them could not identify " low-carbon " products, and 47 % of them doubted the " low-carbon " function. The results indicated that the awareness of low carbon of the tested consumers is weak, it is urgent to improve the green sense of the consumers before implementing low carbon consumption.

Taking the E-commerce platform that focuses on consumption upgrading as an example, in 2020, the total emissions of the national E-commerce platform reached 68 million tons. Although it was only a small proportion of the total emissions of the year, its growth rate was very fast. From 2016 to 2020, the carbon emissions of E-commerce platforms increased by 105 %, while the carbon emissions ratio increased by only 6 % in China during the same period.

High-carbon industries such as energy and steel are vigorously promoting 'peak carbon dioxide emissions, carbon neutrality', if strong and efficient emission reduction measures are not taken in the E-commerce industry, the total carbon emissions are expected to exceed 116 million tons, accounting for about 25 % of the new carbon emissions during the ' 14th Five-Year Plan ' period. The carbon emission reduction associated with consumption upgrade scenarios is also urgent. For example, in the development of fresh E-commerce, in first-tier and second-tier cities, due to the accelerated pace of life, young people usually have insufficient time like their parents to choose fresh goods in the vegetable market. Therefore, fresh E-commerce provides them with a good choice with its convenience and benefits. China 's fresh E-commerce achieved 279.6 billion yuan in 2019 and 564 billion yuan in 2021. Carbon emissions caused by consumption upgrades have become a non-negligible problem faced by governments, enterprises, consumers and investors. Promoting the low-carbon sense of consumers is also an urgent task.

2.3.2. Process of E-Commerce Transactions

Compared with the traditional substantial economy, E-commerce can reduce the waste of resources and costs in the way of online transactions. However, the circulation process of E-commerce will also cause

new environmental pollution problems. Therefore, the impact of E-commerce industry on low-carbon development in terms of transportation, processing, storage, packaging and informatization was discussed as follows.

The operation of E-commerce in China mainly lies in the process of timely delivery of goods to customers by means of logistics and transportation. Its impact on carbon emissions mainly comes from the choice of transportation mode and the planning and design of transportation routes. First, the current transportation is mainly based on mechanical tools such as trucks, trains and cargo ships. A large amount of fossil energy is often needed for these vehicles, and the consumption of this energy will affect the environment through carbon dioxide emissions; secondly, whether the transportation route planning is reasonable is also closely related to the transportation time and transportation cost, which can save manpower, material resources and other resources in the process.

The product processing in the E-commerce logistics link mainly includes the process of secondary processing and increasing the added value of the product [18]. In the process of secondary production and value-added of the commodity, it is impossible to avoid the resource loss and energy waste generated during the processing. Meanwhile, more pollutants can be produced due to outdated value-added technology.

To adapt to the increase of E-commerce production and scale expansion, the overall management level of commodities should be reorganized, a large number of storage construction and management personnel need to be invested. First, the establishment of storage bases and management sites will occupy a large amount of land resources, which can affect the utilization rate of land resources; during the storing period, the leakage of goods should be avoided that will pollute the environment. Secondly, the process of loading and unloading goods in the storing link will also lead to increase of carbon emission, such as the irregular use of goods loading and unloading tools and the waste of various resources.

In the process of E-commerce development, commodity packaging is undoubtedly an important part of environmental pollution. Commodity packaging plays an important role in protecting goods from damage during transportation. However, the current commodity packaging still faces problems such as excessive packaging, repeated packaging, and poor quality of packaging materials. First, for the quality of packaging materials, use of degradable packaging materials requires the use of a large number of forest resources, which will cause obvious ecological damage; secondly, most E-commerce logistics enterprises will use non-degradable packaging materials, which will pose a long-term serious threat to the environment; finally, most logistics enterprises have not clearly implemented the treatment of commodity packaging waste. The problem of discarding express packaging after consumption is becoming more and more serious. Unorganized and non-standard logistics packaging waste treatment will also cause certain environmental pollution and waste of resources.

The process of environmental pollution caused by the informatization failure of E-commerce development mainly lies in the comprehensive effect of incomplete and asymmetric information generated in all aspects of process. In the case of information asymmetry in the operation process, it often leads to waste of production capacity and idle goods, while information errors will lead to unreasonable distribution route design, packaging design, etc., resulting in unnecessary environmental pollution.

3. The Development Direction of E-Commerce Under the Background of Double Carbon

3.1. The Development Trend of E-Commerce Industry

With the trend of carbon neutrality, major E-commerce platforms have increased their efforts to reduce emissions and have successively issued carbon reduction plans: Alibaba will achieve carbon neutrality by

2030, while Jingdong Logistics will vigorously reduce carbon emissions by 2030. SuNingYiGou plans to increase the proportion of new energy electric vehicles to 70 % by 2030. In order to achieve the target of reducing carbon dioxide emissions, these companies have adopted new energy sources in production and offices, to improve energy efficiency and reduce carbon emissions. Alibaba and Jingdong, the two E-commerce companies, have laid photovoltaics in suitable places to promote and use renewable energy. The E-commerce platform, which is in the second tier of E-commerce, has not issued a detailed carbon reduction plan, but still made subtle changes for carbon reduction. For example, Vipshop has adjusted its energy structure and improved the utilization rate of renewable energy since 2020. However, there are still some small E-commerce platforms that haven't published any information on their carbon emissions. In recent years, with the popularization of carbon emission knowledge and the enhancement of environmental awareness, consumers have begun to pay attention to the importance of green consumption to personal health and daily life. The increase in demand for green consumption has also promoted the green development of the E-commerce industry market invisibly. During the " Double Eleven " period, whether it is the green venue opened by the E-commerce platform or the " Green Plan " for the selection of green products, these initiatives are actively responding to the country 's " double carbon " policy. Meanwhile, the platforms offer consumers vouchers or points to enhance consumers ' participation in carbon reduction. However, it is also necessary to correctly guide consumers ' consumption values and green consumption concepts, to ensure that consumers can consume rationally according to their own needs while shopping, avoid excessive consumption and reduce personal carbon emissions [19-20].

In the aspects of supply chain, it is necessary for the upstream and downstream of the supply chain to participate in the cooperation to achieve the full implementation of carbon reduction. In terms of commodity packaging, express packaging with strong compression resistance is expected to be selected to minimize the secondary packaging of goods, not only reducing the volume of packaging, but also lowering the packaging costs, as well as to reduce carbon emission to a certain extent. However, while upstream enterprises are more willing to upgrade packaging, small businesses do not have such a strong will, mainly because the change of packaging needs to transform the production line associated with high investment input. Therefore, it is necessary to offer green upgrade measures to ensure the benefits of small and medium-sized enterprises. Meanwhile, as the E-commerce platform has a greater impact on sellers of related enterprises, the platform should also promote the corporations to take the responsibility for carbon reduction.

3.2. Measures of Major E-Commerce Platforms Under the Dual-Carbon Background

As a major E-commerce platform in China, Alibaba is facing the current severe challenges. It needs to set up a green low-carbon circular economy driven by new technology and new energy, play a leading role, and drive the construction of green low-carbon circular economy, and establish creative space.

In response to the historic strategic deployment of national carbon neutrality and carbon peak, Alibaba has made three commitments to carbon neutrality, the first is to do a good job of green Alibaba; the second is to strengthen the green value chain, finally; they will make green ecology bigger and encourage green consumption behavior. As a connection between tens of millions of merchants and more than 1.2 billion consumers, Alibaba will promote green transformation from both the consumer side and the merchant side, advocate green behavior, enhance the supply of green goods, and promote the development of green low-carbon logistics and certification services from the consumer side. During the "2021 Double Eleven Shopping Festival", Alibaba set up a green online exhibition on Tmall, starting with primary energy-consumption home appliances, new energy vehicles, water-saving products, green food and other categories

to enhance consumers ' awareness of green goods. Consumers are further encouraged to practice green behavior in the process of using goods by an incentive mechanism, green certified goods are encouraged on the platform with higher supply and penetration rate. First, encourage more green products that meet national standards to enter the platform and give flow support to increase their sales. Secondly, the commodity that meets the requirement of green standard certification is still relatively few, certification agencies are invited to enter the platform to provide compliance services for merchants. Third, leading brands are invited to share low-carbon sustainable experience, relevant service providers are invited to provide supporting solutions, the merchants on the platform are encouraged to achieve the carbon neutral goals together with Alibaba. In addition, Tmall has also set up a " Green Business Alliance " with 14 brands to jointly issue a " Green Business Alliance Initiative ", to call on the market to expand green low-carbon supply from a more diversified dimension and provide richer " green products " on the basis of ensuring consumers ' quality life.

In the process of promoting carbon neutrality, Jingdong Group not only has the genes and attributes of the entity company, but also has innovative digital technology, to help improving the upstream and downstream of the entire supply chain. The advantages of ' green infrastructure and carbon reduction technology innovation ' were adopted to promote the full-chain sustainable development of green warehousing, green transportation, green packaging and green collaboration. In addition, Jingdong will also apply 5G (generation), Internet of Things (IoT), artificial intelligence, blockchain and other technologies into the field of energy conservation and emission reduction.

'Asia No.1' smart industrial park of Jingdong in Xi'an has been certified as green transaction, to be the first low-carbon logistics park in China. The use of solar cells throughout the park allows them to automatically neutralize greenhouse gas emissions and reduce carbon dioxide emissions. In the process of promoting ' carbon neutrality ', first use local abundant solar energy and other sustainable development of renewable energy, to maximize the use of local renewable green energy to replace conventional energy; Secondly, in terms of source control of the pollutants, improve the energy-saving management system, optimize the classified transportation process, accurately control regional heating demand, introduce special devices for new energy, and constantly improve the operation efficiency of enterprises and the electrification level of enterprises, to achieve the optimization of overall energy efficiency for enterprises.

Suning pursued green logistics and purchases a large number of new energy vehicles, which are mainly used in store distribution. New energy vehicles can travel 170 kilometers per day. Compared with the same kind of fuel vehicles, it can save 15 liters of fuel and reduce the emission of carbon dioxide by 34 kilograms. Therefore, every 100 new energy vehicles can reduce 1500 tons of carbon dioxide in one year. Meanwhile, Suning also plans to replace traditional vehicles in ways of leasing or purchasing in the future, to enhance the popularity of new energy transportation. Suning Logistics plan to build a full link greenization through the development of green warehousing, green transportation and green packaging. Meanwhile, Suning also promote shared express box program, to reduce environmental pollution and waste of resources. In terms of the practice and exploration of green development and carbon neutrality in all aspects driven by E-commerce green distribution, Suning has played an exemplary role among the E-commerce enterprises.

3.3. The Impact of Major E-Commerce Platforms on other E-Commerce Platforms

Although the E-commerce industry is not an industry with high pollution and heavy energy consumption, the huge economic benefits brought by the E-commerce industry in recent years have caused the total carbon emission growth level of E-commerce enterprises higher than other industries [21]. Therefore,

promoting carbon reduction in the E-commerce industry has become an important part of achieving the ' dual carbon ' strategy.

As domestic top E-commerce companies have successively issued carbon reduction plans and taken a series of measures to promote carbon reduction. First, the experience and problems in the process of participating in carbon reduction for large E-commerce platforms can give reference for small and medium-sized E-commerce enterprises (SMEs), so that they will not be confused in the practice process; secondly, major E-commerce platforms can provide small and medium-sized E-commerce companies with services to evaluate their carbon emissions, which in turn guides themselves to achieve environmental protection and low carbon in the production process; finally, the platform can provide financial support for small and medium-sized enterprises that lack capital investment through the service of green finance, and encourage the enterprises to achieve green low-carbon production.

SMEs generally have three ways to transform and control carbon emissions. First, low-carbon technology transformation can help small and medium-sized enterprises achieve a qualitative leap in carbon reduction. However, the cost of low-carbon technology transformation is relatively high for SMEs, which will potentially cause the problem of capital turnover. It is necessary to ensure enough capital investment and keep sufficient funds to maintain the enterprise until the completion of the transformation. Then the transformed enterprises can reduce the negative impact on the ecological environment to a certain extent. Secondly, enterprises can sign agreements with energy-saving service companies for future energy-saving benefits. If the company can achieve or exceed the energy-saving goal, the reduced energy costs can be extracted as a reasonable profit. This way can make small and medium-sized enterprises reduce part of the financial pressure, reduce business risks, and rationally optimize production capacity. Third, enterprises can lease the required technology, equipment and trade services on their own. In this way, enterprises have the right to use within a certain period of time. On the one hand, it reduces the financial pressure on enterprises. On the other hand, it can also make enterprises much easier in the low-carbon upgrading. The use of financial leasing to achieve phased cost sharing ensures the stability and normal operation of the enterprise capital chain.

4. Research on Green Consumption of E-Commerce in China

4.1. The Consumption Choice Under the Dual Carbon Policy

The consumption demand stands as a pivotal factor under the background of dual carbon policy. Therefore, a survey questionnaire titled "Low-Carbon Consumption Behavior Survey" was conducted, to comprehensively grasp consumers' demands for green consumption and their overall experiences with product selection, service preferences, logistics experiences, as well as the impact of carbon reduction knowledge systems in the process of online shopping. This questionnaire was distributed electronically to diverse consumer groups to gather insights and data. Ultimately, a total of 222 completed surveys were collected. The relevant data gathered from the survey questionnaire was analyzed, to explore consumers' cognition and behavioral choices towards low-carbon consumption, to investigate their current consumer demands, and give reference for the green transformation of the e-commerce industry.

4.2. Logistics Distribution and Packaging of E-Commerce Consumption

4.2.1. Consumption Details

The following individual characteristics of consumers can provide a reference for the green transformation of the e-commerce industry. According to the statistics shown in Table 1, nearly half of the

surveyed people possess a bachelor's degree or above in terms of educational background, suggesting that the major proportion of e-commerce consumers belong to the highly educated group. Simultaneously, there is also a considerable percentage of those with educational levels below a bachelor's degree, indicating that, in the current era of the rapid emergence of e-commerce, middle-aged and elderly populations are gradually engaging in online shopping and other consumption methods. From the occupational perspective, individuals categorized as other professions, students, and self-employed entrepreneurs dominated among the consumers, reflecting the significant presence of young people with consumption needs, and they responded intensely to the popularization of green knowledge systems.

Table 1 Individual characteristics of consumers

Variables	Options	Number of samples	Portion
Education background	Senior high school	50	22.52
	Junior college	22	9.91
	Regular college course	86	38.74
	Master and above	14	6.31
	Others	50	22.52
Occupation	Administration and public institution	14	6.31
	Workers not in e-commerce	26	11.71
	Workers within e-commerce	16	7.21
	Individual household	48	21.62
	Students	52	23.42
	Dismission or retired	6	2.7
	Others	60	27.03

According to the statistics shown in Table 2 on consumers' online shopping behavior, the amount spent in a single online purchase was analyzed, 42.34% of consumers spend between 100 and 300 yuan, while 32.43% are willing to spend less than 100 yuan for a single online transaction, and only 25.22% spend over 300 yuan on a single online shopping occasion.

Furthermore, monthly frequency of consumers' online shopping was analyzed, which offers a valuable prediction for e-commerce consumption. Statistically, most of consumers prefer to shop online 2 to 4 times per month, with a portion of 32.43%. Following closely is the group that shops online once or less per month, with a portion of 22.53%. The portion for those made 5 to 7 online purchases monthly stands at 19.82%, while the proportion of those who shop 8 times or more is relatively low. The results indicated that a vast majority of consumers maintain a rational consumption mindset, which may benefit from the government's initiatives to promote rational online shopping, and the high level of acceptance among Chinese consumers towards the educational knowledge system.

The primary purposes of online consumption and the main categories of purchased products were further analyzed in Figure 1, the majority of consumers prefer purchasing daily necessities, food and snacks, as well as clothing accessories online, with the portion of 76.58%, 65.77%, and 64.86%, respectively. For consumers, their selection of daily necessities and clothing does not differ drastically from that in entity stores. Additionally, online prices tend to be lower, and the logistics and delivery process have less impact on the goods. Moreover, it allows consumers to purchase their desired items without leaving their homes, providing a profound level of convenience that greatly appeals to consumer groups. Besides, educational

books and electronic devices also account for a considerable proportion, with 34.23% and 31.53% respectively. As derivatives required by households, they are an essential component of the e-commerce consumer market. However, when it comes to other non-essential categories such as entertainment games, consumers tend to make fewer choices, accounting for only 19.82%. Furthermore, the survey reveals that for online consumption, the expenditure on daily necessities significantly outweighs that on non-essentials.

Table 2 Consumers' online shopping behavior

Variables	Options	Number of samples	Portion
The amount spent in a single online purchase	<100	72	32.43
	100-300	94	42.34
	300-500	30	13.51
	>500	26	11.71
Monthly shopping frequency	<1	50	22.52
	2-4	72	32.43
	5-7	44	19.82
	8-10	26	11.71
	>10	30	13.51

4.2.2. Logistics Distribution Mode and Packaging Selection

It is necessary to promote environmental awareness and waste sorting not only in daily life, but also green sense on consumption activities. The answers for whether e-commerce related to carbon reduction were listed in Table 3. 76.58% of the consumers were not familiar with the relationship, 20.72% were familiar with the relationship, and only 2.7% know well about the connection. Only 31.53% of the consumers had purchased green e-commerce products recently. In addition, this finding indirectly reflects that consumers have a limited understanding of green e-commerce consumption, along with a relatively one-sided knowledge of relevant rights, policies, and other aspects. Consequently, consumers are inclined to be more cautious in making their choices, which in turn hinders the promotion of green consumption in the market.

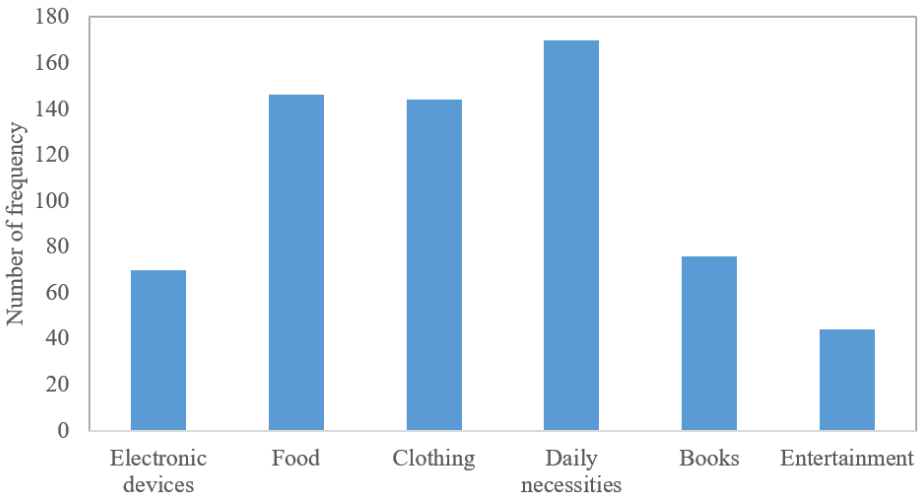

Fig. 1 Distribution of products consumers shop online

Regarding the logistics and express delivery packaging for consumer purchases, the choice of materials and size of the packaging varies depending on different logistics delivery methods and the specific goods being shipped. Firstly, in addressing the matter of how consumers handle their used express packaging, the statistical results typically reveal four major options: direct disposal, reuse, accumulation for selling purposes or other uses. Among these, the option of direct disposal holds the largest share, accounting for 54.95% of the total. Secondly, the usual disassembly of express packaging can be broadly classified into three categories: extremely intact (suitable for reuse), relatively intact (functional but with limitations), and severely damaged (non-functional). Among these, relatively intact dominated for a portion of 56.76%. Furthermore, approximately one-third of consumers were willing to choose second-hand packaging materials for shipping purposes.

4.2.3. Advantages and Disadvantages of Green Consumption

As the statistics show in Table 4, 77.48% of consumers prefer to choose the packaging in accordance with their own requirements. However, since there will be different costs involved in the selection of packaging, consumers were also surveyed to determine the acceptable range of price fluctuations for opting for green express packaging. Overall, the findings reveal that nearly half of the consumers are unwilling to accept an upward adjustment in packaging prices, while only 7.21% of them are not sensitive to the price fluctuation.

Table. 3 The relationship between green consumption and daily life

Variables	Options	Number of samples	Portion
About dual carbon policy	Not familiar	136	61.26
	Familiar	72	32.43
	Know well	14	6.31
The relationship between carbon reduction and e-commerce	Not familiar	170	76.58
	Familiar	46	20.72
	Know well	6	2.7
Green consumption experience	Yes	70	31.53
	No	152	68.47
Packaging after e-commerce consumption	Extremely intact	60	27.03
	Relatively intact	126	56.76
	Severely damaged	36	16.22
How to deal with the packaging	Direct disposal	122	54.95
	Reuse	58	26.13
	Recycle	34	15.32
	Others	8	3.6
Willing to use second-hand packaging?	Yes	158	71.17
	No	64	28.83

4.3. Problems Faced by Green Consumption

Only a minority of consumers have received goods delivered in recycled delivery boxes, whereas two-thirds of the consumers surveyed indicated that they have never had their goods packaged in green packaging for express delivery. Consumers are more interested in the types of low carbon products and how to identify such low carbon products (Fig.2). Certainly, it is also imperative to enhance product

packaging, logistics services, and the management of e-commerce platforms as well. The suggestions for further advancement of the green transformation and standardization of the e-commerce industry indicated that, close cooperation between multiple e-commerce platforms and various e-commerce enterprises should be emphasized. Moreover, government advocacy is indeed urgent to ensure each one in the whole society participate in the carbon reduction mission.

Table. 4 Attitude of consumers towards the e-commerce packaging

Variables	Options	Number of samples	Portion
Want to choose packaging?	Yes	172	77.28
	No	50	22.52
Acceptable price fluctuation	Unacceptable	110	49.55
	<1 times	82	36.94
	1-2 times	14	6.31
	2-3 times	0	0
	>3 times	0	0
Ever receive green packaging?	Yes	72	32.43
	No	150	67.57

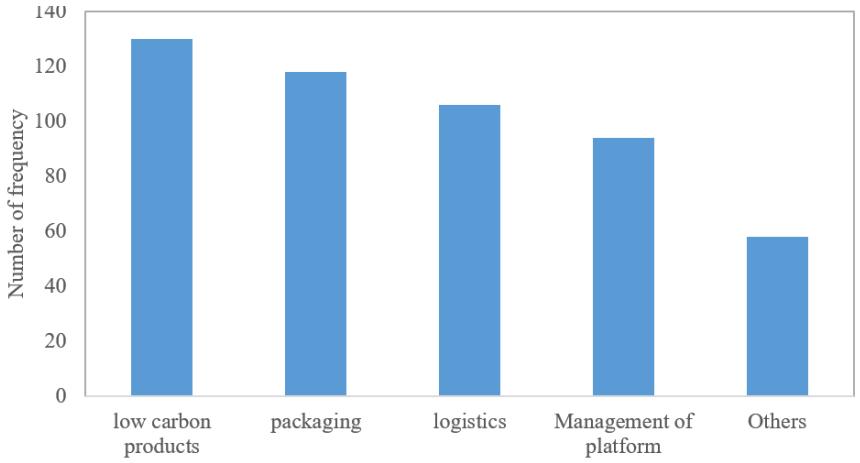

Fig. 2 Suggestion about green upgrading for e-commerce consumption

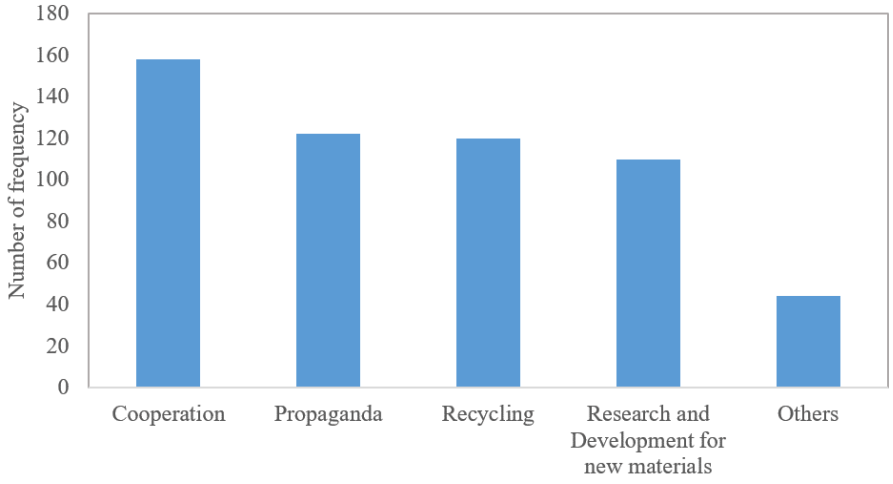

Fig. 3 Suggestion about green transformation for e-commerce industry

Compared with major e-commerce companies in China, small and medium-sized enterprises have more flexibility, and the cost of replacement and commissioning of the entire manufacturing device is relatively low. Meanwhile, the number of small and medium-sized enterprises in China is huge, a large number of innovations are appearing, and they have the potential to achieve green development. SMEs can introduce more participants to the carbon trading market and offer more carbon emission rights, so as to give full play to the vitality of the market and better convey the concept of green development, thus improving the enthusiasm of enterprises to participate and creating a good trading atmosphere. The evaluation scheme for carbon emission, relevant systems and legal systems of small and medium-sized enterprises should be improved and standardized. Secondly, simplified operation procedures should be provided for small and medium-sized enterprises, to broaden their access way. In addition, it is also necessary to lower the tax rate on carbon trading, to alleviate the development pressure of small and medium-sized enterprises and reduce the uncertainty of income and cost.

In terms of packaging design for express delivery, it is recommended to choose a minimalist style, which is convenient for secondary use. For traditional packaging, many E-commerce enterprises will inevitably choose to add decorations with unique style when choosing express packaging, which is undoubtedly a good way for enterprises to attract consumers. However, given the principle of advocating carbon reduction, it is recommended to change the packaging design structure without changing the practicality of the packaging. The express packaging can be split and reorganized for secondary use, which can not only extend the life cycle of the packaging and increase the utilization rate, but also promote the green innovation of the E-commerce express packaging.

Consumers at all stages are in a relative lack of green consumption awareness. With the implementation of policies and laws from relevant departments, the problem is also being alleviated to a certain extent. The enterprises need to speed up the adaptation to the changes in the green E-commerce market, develop and apply various products, develop products with functional attributes and optimized channels, and pay attention to the matching of green products and prices, and promote green products from the perspective of consumers [22-23]. In the big data environment, Internet information can be used to quickly understand consumers ' green demand and conduct accurate marketing on the targeted consumers. Meanwhile, the support for government can help solve the problems of unsatisfactory sales of green products, high cost and purchase channel restrictions, to achieve benign circulation and realize the dual-carbon goal. Therefore, green consumption propaganda should be widely carried out, to implement the concept of green consumption into all aspects of people 's lives and make green consumption a conscious behavior.

5. Conclusion

The small and medium-sized enterprises in China are trapped with capital problems and investment problems. In order to achieve energy conservation and emission reduction, small and medium-sized enterprises must carry out technological upgrading, equipment renewal, production process transformation, and must also purchase or lease environmental equipment. The green consumption in online shopping has not achieved the desired results. The waste of resources in the supply chain of merchants, the high energy consumption in express logistics, and the low reuse rate in product packaging. These all indicate the lack of consumers ' awareness of green consumption. Compared with the cost of ordinary products, green low-carbon products show higher costs in both production and logistics, which has a negative impact on the sales of green products. The determination of green standards greatly affects consumers ' recognition and perception. The legal system of green consumption is not perfect, although the current E-commerce

platforms have started the work of green product logo certification according to the relevant national standard system.

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