



Strategy Research on Deepening Green Supply Chain System of Energy State-Owned Enterprises from the Perspective of Green Economy

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Abstract. Based on the rise of green economy to the national strategic level, the development of green economy has become an important means to improve the social environment, and it is imperative to achieve green and low-carbon development of energy. In this regard, state-owned energy enterprises have carried out preliminary exploration of green trading in the building of e-commerce platforms, and should further deepen the building of green supply chain based on e-commerce trading in the future. Therefore, we can rely on PDCA cycle to build a strategy model for deepening the green supply chain system of energy state-owned enterprises into e-commerce, and promote the deepening of the green supply chain system through the formulation of green procurement standards, green transaction standards, green transaction evaluation, and scientific rewards and punishments, so as to realize the development of green economy in the energy industry and effectively protect the environment.

Keywords: Green economy · Energy state-owned enterprise · Low carbon transition · Green supply chain · PDCA · big data · E-commerce platform

1 Introduction

With the green and low-carbon economy becoming a consensus, it is imperative to realize the green transformation of energy [1] and create a low-carbon development environment [2]. To this end, the state has put forward the goal of “reaching peak carbon neutrality” and stressed the need to build a clean, low-carbon, safe and efficient energy system. Under the background of green economic transformation and development and driven by the two-wheel national two-carbon policy, it has become an important part of

the energy transformation strategy to play the leading role of energy state-owned enterprises and take the lead in realizing green and low-carbon transformation [3]. Based on this, energy state-owned enterprises have basically realized the e-commerce of procurement transactions and built an e-commerce procurement platform relying on resource advantages, and started the preliminary exploration of green transactions [4]. Next, it is necessary to further deepen the construction of the green supply chain system of the e-commerce platform, further deepen the green process of transaction and stimulate green consumption [5].

Based on the trend of deepening the green supply chain system of energy state-owned enterprises, many scholars have carried out relevant studies on green supply chain, and proposed to promote the construction of green supply chain by constructing a supply chain performance evaluation system, analyzing the connotation of green supply chain [6], building a procurement system based on green supply chain and other ways [7]. Some other scholars believe that green suppliers are the implementation subjects of green supply chain [8], and it is necessary to make clear regulations on the R&D, design and production behaviors of suppliers [9]. In addition, the greenness of materials has also been included in the measurement criteria of green supply chain by many scholars [10].

As an important support for the realization of green trading, the core connotation of green supply chain is to integrate the green concept into the whole life cycle of raw material procurement, design, production, sales and reverse logistics. Based on the PDCA full-cycle quality management concept, this paper establishes clear green standards through the full-cycle trading links from purchasing plan to transaction execution and performance evaluation, supplemented by clear reward and punishment mechanisms, to promote energy state-owned enterprises to deepen the green supply chain system and realize green and low-carbon transformation.

2 The Necessity of Energy State-Owned Enterprises to Deepen the Green Supply Chain System

2.1 To Promote Enterprise Electric Business Platform Green Regulation

Under the background of energy digitalization development, building green digitalization supply chain and strengthening lean management are important measures put forward by energy state-owned enterprises to improve their core competitiveness. At present, most of the state-owned energy enterprises have basically achieved a breakthrough in the e-commerce procurement performance mode, and completed the preliminary construction of the e-commerce platform and digital intelligence supply chain. To deepen the green supply chain system is to further strengthen the green supervision on the basis of e-commerce transactions.

2.2 To Create a Favorable Social Environment

Promoting the green supply chain system of state-owned energy enterprises can give full play to the advantages of platform resource integration, promote the collective green

transformation of energy enterprises in the industrial chain, and then realize the high-quality transformation and development of the energy industry, create a green and low-carbon social environment, create a green ecosystem and meet people's yearning for a green life.

2.3 To Help the Country Develop a Green Economy

Based on the practical needs of the national green economic development, state-owned enterprises are the important subject of green economic development and construction. They have carried out extensive exploration in the construction of green supply chain. For example, State Grid Jibei Electric Power has built a green supply chain system that runs through the whole life cycle of products by integrating green design, green supply, green production, green packaging and transportation, green marketing and green recycling. Effectively increase the production capacity from 15,000 to 50,000 per day, and increase the qualified rate from 99.5% to 99.9%. By building a green supply chain and a carbon emission calculator, China Baowu Group Co. LTD has successfully built a zero-carbon e-commerce procurement zone, realized the integrated procurement management of 6,952 green items, and reduced nearly 50,000 tons of carbon emissions every year. It can be seen that deepening the green supply chain system of energy state-owned enterprises can effectively increase the proportion of green products in e-commerce transactions, realize energy conservation, emission reduction and waste recycling, promote green energy transformation and stimulate green energy consumption.

3 The Feasibility of PDCA Cycle for Energy State-Owned Enterprises to Deepen the Green Supply Chain System

As an important means of total quality management, PDCA cycle is widely used in quality management of all walks of life. The green supply chain system of energy state-owned enterprises involves many trading subjects and trading links. The PDCA cycle can be used to manage the green trading behavior of the whole chain, so as to make targeted improvements.

3.1 PDCA Cycle Connotation

PDCA Cycle Process Description

PDCA cycle is a total quality management method first proposed by Hughart, enriched by Deming and applied to the quality improvement link. It includes four stages: plan, do, check and act. Through analyzing the current situation, making plans, issuing schemes, executing them, checking the effect and evaluating the achievement degree. The cyclic process of problem summary and timely treatment improves the quality level of engineering projects, business operations and many other fields.

PDCA Cycle Example

Take enterprise operation as an example. Usually at the beginning of the month, the

supervisor of the enterprise will set assessment goals, namely plan, for the key work of the employee in the month. Employees perform specific work tasks according to the assessment objectives, namely do; At the end of the month, the supervisor will score and evaluate the work completion of the staff in the month, that is, check; On this basis, employees are required to reflect on and adjust the work of poor quality completed this month in the next month, namely act.

3.2 The Feasibility of PDCA for Energy State-Owned Enterprises to Deepen the Green Supply Chain System

The green supply chain of energy state-owned enterprises can be divided into green procurement plan formulation, green procurement activities, green effectiveness evaluation and the treatment of the previous remaining problems before the next transaction, which just corresponds to the PDCA cycle management process. Therefore, the PDCA cycle has important value for the deepening of the green supply chain system of energy state-owned enterprises. First of all, in the pre-purchase planning stage, purchasers need to analyze the current core transaction needs and make a reasonable purchase plan. Secondly, it is necessary to establish a set of perfect evaluation standards in the transaction execution stage, and make clear stipulations on the transaction behavior of the whole subject. Thirdly, in the diagnostic stage after the end of the transaction, it is also necessary to evaluate the trading behavior of the subject. Finally, based on the assessment and evaluation of the greenness level of trading subjects, it is necessary to summarize their weak points and guide them to improve before the next trading.

4 Strategic Scheme of Deepening Green Supply Chain System for Energy State-Owned Enterprises Based on PDCA Cycle

Based on the application value of PDCA cycle to energy state-owned enterprises to deepen the green supply chain system, on the basis of the analysis of the connotation of the green supply chain system of energy state-owned enterprises and the key factors affecting the deepening of the green supply chain system, the PDCA cycle can be used to construct the green supply chain system deepening model.

4.1 Influencing Factors of Green Supply Chain of Energy State-Owned Enterprises

Through the whole process of the green supply chain trading on the e-commerce platform of energy state-owned enterprises, it can be found that the key factors mainly include the purchased products, usually energy equipment and materials; Green management system of trading platform as trading carrier; The procurement performance behavior of both parties in the transaction is shown in Fig. 1.

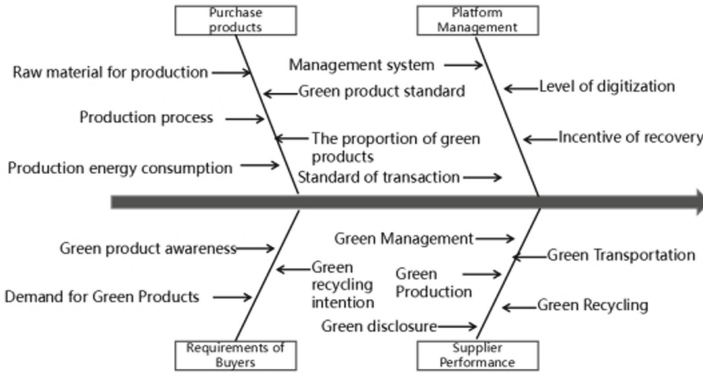


Fig. 1. Influencing Factors of Green Supply Chain System of Energy State-owned Enterprises. [Self-drawing]

4.2 Strategic Model of Deepening Green Supply Chain System for Energy State-Owned Enterprises Based on PDCA Cycle

After defining the key factors affecting the energy state-owned enterprises to deepen the green supply chain system, the strategy model including the planning period, implementation period, diagnosis period and treatment period can be built according to the PDCA cycle. The connotation of each stage is as follows:

Plan

As the source of full-chain transactions, a clear green procurement reference index should be established to guide purchasers in their procurement work, help them self-check whether the current procurement behavior is reasonable and plan for future procurement.

Do

Build a visual evaluation system for the actual trading behaviors of suppliers, platform companies and purchasers, establish clear standards corresponding to the responsibilities and obligations of each type of subject and its influencing factors on the greenness of the supply chain, and guide all subjects to carry out trading activities in strict accordance with the standards.

Check

According to the green transaction evaluation system, the greenness rating of the trading subjects is divided, and the greenness of the global subjects is grasped through the multiple evaluation mechanism.

Act

Based on the green level of the subject, encourage the green trading subject through scientific rewards and punishments, and order the subject with poor green degree to make effective rectification before entering the next trading.

5 Strategic Practice of Deepening Green Supply Chain System in Energy State-Owned Enterprises Under PDCA Cycle

5.1 Plan: Establish Green Procurement Standards for Energy Equipment and Materials

The product trading of energy state-owned enterprises mainly focuses on energy equipment and materials. In order to strictly regulate the greenness during the development period of the trading plan, the quantity index represented by inventory turnover, material reserve quota and the quantity to be purchased during the current period can be determined. The quality index represented by bad inventory ratio, purchase plan completion rate and energy consumption per unit product and the price index represented by current average purchase price and gross profit were used to construct the quantitative calculation formula. Based on this, enterprises can be further guided to help reasonable planning of procurement timing, efficient judgment of green product categories, scientific formulation of procurement plans, so as to improve the greenness of transactions from the source.

5.2 Do: Establish the Evaluation Standard of the All-Domain All-Chain Green Transaction

In order to ensure a feasible standard system for regulating the all-domain trading behavior, this paper starts from the two main subjects that affect the greenness of e-commerce transactions, suppliers and purchasing platforms, and sets the indicators and specific weights that affect the greenness of their trading behavior for each subject. For details, see Table 1, Table 2.

5.3 Check: A Multiple Evaluation Mechanism of Green Grade Self-Evaluation and Cross-Evaluation Has Been Formed

Based on the evaluation standards for the greenness of suppliers and platform companies, it is necessary to further clarify their greenness levels and evaluation methods.

Green Rating

According to the final score of the green rating table, this paper divides the greenness into four grades, which are: less than 60 points is considered as non-green; Between 60 and 75 points (excluding 75 points), it is light green; In the 75–90 zone (excluding 90 points), it is dark green; Greater than or equal to 90 points, dark green.

Cross-Evaluation Mechanism

Starting from the service objects and regulated objects of the three major trading entities, this paper divides evaluation subjects for each type of entities. Suppliers are mainly evaluated by the platform and purchasers, and the platform evaluates by self-evaluation and scoring by the e-commerce trading authority.

Table 1. Supplier Greenness Evaluation Criteria. [Self-drawing]

Index	Weight	Standard
Enterprise green strategy system	20%	<ol style="list-style-type: none"> 1. Make strategic plans for green development, green production, green marketing and green culture (30 points); 2. Establish and implement a management system that meets the requirements of GB/T45001, GB/T1900, GB/T24001 and GB/T23331 (30 points); 3. Implement the green concept into each module of human resource management when formulating the work of human resource management (30 points); 4. Hold at least three green concept trainings for all staff every year (15 points).
Green R&D and production	30%	<ol style="list-style-type: none"> 1. Obtain green intellectual property rights such as green patent right, green trademark right and green copyright, and get 5 points for each item. The upper limit is 30 points. 2. Green technologies such as precise forming and dry cutting are used in production (20 points); 3. The process and equipment prohibited and eliminated by the state are not used, the operation index parameters of the production equipment reach the general advanced level in China (30 points), and the intelligent production device is used to replace part of the manual work (20 points).
Green Products	15%	<ol style="list-style-type: none"> 1. The raw materials meet the requirements of the limited amount of substances in electronic and electrical products in GB/T 26572–2011 (50 points); 2. If the proportion of green products in all products is less than 20%, no score will be given; 20 points in the range of 20%-30% (excluding 30%); 30 points in the range of 30%-50% (excluding 50%); $\geq 50\%$ gets 50 points.
Energy conservation and emission reduction	15%	<ol style="list-style-type: none"> 1. Comprehensive energy consumption per unit of output value is lower than the average level of the industry (15 points) and decreases year by year (15 points); 2. No administrative punishment related to environment in recent 3 years (20 points). 3. Use new energy such as photovoltaic power generation or electricity replacement to reduce carbon emission (20 points); 4. Build a comprehensive carbon emission monitoring system and timely adjust the carbon emission plan (30 points).

(continued)

Table 1. (continued)

Index	Weight	Standard
Disclosure of Purchaser	5%	1. The bidding document shall contain the technological process (30 points), and actively disclose the specific technological process to the purchaser (30 points); 2. Consciously accept supervision and timely update the status of production and logistics on the trading platform (40 points).
Green packing	5%	1. Implement packaging reduction, and do not over-pack in addition to meeting basic packaging requirements (35 points); 2. No packaging materials harmful to human body and organisms are used (35 points); 3. Use degradable and recyclable packaging materials (30 points).
Green Storage	5%	1. Comply with the current national construction standards and warehouse construction provisions (40 points); 2. The comprehensive energy consumption of the warehouse is lower than that of similar conventional warehouses (20 points); 3. The location of warehouse with convenient transportation is preferred (20 points); Stay away from cultivated land or flooded areas (20 points).
Recycle and reuse	5%	1. Have the awareness of green recycling, and develop the relevant recycling system (60 points); 2. The benefit generated by recycling is greater than the recovery cost (40 points).

5.4 Act: Adopt Green Trading Behavior to Improve Multiple Scientific Reward and Punishment Measures

In order to fully mobilize the pursuit of greenness of each subject and ensure the significant improvement of greenness in the next round of trading, the subject that actively responds to green trading can be given corresponding incentives, and the subject that is lacking in greenness can be punished appropriately, including:

Reward Mechanism for Dark Green Subjects

Suppliers with dark green rating shall give priority to display their products on shelves, and give priority to match purchasers. To the dark green rating platform company, through the release of reports, give honorary title to publicity.

Reward Mechanism for Dark Green Subjects

For dark green rated suppliers, the ranking order and demand matching priority of their products are higher than that of light green suppliers. The company of Deep Green rating

Table 2. Evaluation Criteria for Trading Platform Greenness. [Self-drawing]

index	Weight	Standard
Platform green strategy system	20%	<ol style="list-style-type: none"> 1. A feasible green management system in supply, production and sales (25 points); 2. On the basis of ensuring the interests of the platform itself, suppliers and purchasers, select and determine effective combinations according to the principles of environmental protection and ecology, and carry out green marketing (30 points); 3. Implement the green concept into each module of human resource management when formulating the work of human resource management (30 points); 4. Hold at least three trainings related to green and environmental protection concepts for all staff every year (15 points).
Access mechanism	15%	<ol style="list-style-type: none"> 1. Develop detailed supplier access mechanism from green management, green production, green logistics and other aspects (50 points); 2. The green supplier access mechanism shall be updated at least once a year (50 points).
Supervision of behavior	25%	<ol style="list-style-type: none"> 1. Develop a sound supervision mechanism for suppliers from production to delivery of contract performance (40 points); 2. Actively ask for suppliers' green products, green supply chain and other relevant information and data (30 points); 3. Encourage purchasers to score suppliers' green performance (30 points).
Degree of digitization	30%	<ol style="list-style-type: none"> 1. Build a mature material management database with the help of digital technology to reduce search costs (25 points); 2. Integrated the database of all categories of materials and services within the business scope of the platform to improve the efficiency of source searching (25 points). 3. Build a new all-round service model of customized service, supply chain management and sharing mechanism (25 points); 4. The total number of intelligent products obtained by independent incubation accounts for more than 10% of the total number of products (25 points).
Green Recycling	10%	<ol style="list-style-type: none"> 1. Develop recycling standards (40 points) and standardized recycling procedures (40 points) for each business category of the platform; 2. Specify the time of buyer's return and supplier's active recovery (20 points).

platform will be reported and honored for its single performance with high greenness score.

Punishment Mechanism for Light Green Subjects

Light green rated suppliers shall remove their non-green products from the shelves and order them to rectify within a time limit. If the time limit is exceeded, they will be withdrawn according to the circumstances. The light green rating platform company, ordered to rectify within a time limit, beyond the time limit will be notified of criticism.

Withdrawal Mechanism for Non-green Subjects

Non-green suppliers shall be ordered to withdraw from the platform; Non-green platform companies shall be ordered to withdraw from the platform trading system.

6 Conclusion

In the context of green economy, the realization of green and low-carbon energy transformation has become the common pursuit of all trade entities, and strengthening the supporting role of green supply chain for green transaction has been written into national laws and policies, such as “Guidance on Accelerating the establishment and improvement of Green and low-carbon Circular Development Economic System”. However, due to the late start of our green supply chain, A complete construction and evaluation process has not yet been developed. Therefore, based on the research experience of domestic and foreign scholars and the current demand for green transaction construction of state-owned energy enterprises, this paper focuses on the deepening of green supply chain system of state-owned energy enterprises. With the help of PDCA cycle, this paper starts from the four major trading periods and establishes the procurement standards for green products. Visual green standards, multiple evaluation mechanism and scientific reward and punishment mechanism constitute a circular improvement mechanism for energy state-owned enterprises to deepen the green supply chain system, which can effectively promote energy transformation, help energy state-owned enterprises to effectively achieve the goal of green digital intelligent supply chain construction and social high-quality development.

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