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Research Progress of Standards Supporting Green Development of Industry in the Context of "Carbon Peak and Carbon Neutralization"

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Abstract: As an important part of climate change rules, standards are of great significance for supporting sustainable energy, energy conservation, and emission reduction to achieve green and low-carbon transformation and upgrading. Based on the double carbon strategic goal task, current situation of the development of international and domestic standardization, standardization power view of green industry development prospects of new energy, energy storage, carbon sink, carbon trading standardization practice process to study the way to solve problems and feasibility analysis, has been clear about the standard system construction in our country's low carbon energy transition economies the position and role of the upgrade planning, It provides the important reference value for our country green and sustainable industry's innovating development.

Keywords: Energy sustainability; Energy conservation and emission reduction; Green and low-carbon; Standardized

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1. The current situation of standards development under the background of dual-carbon green industry

1.1. The background of China's dual-carbon goals and green industry development

The resource and environmental problems caused by climate issues are common challenges faced by humanity. Green, low-carbon, and sustainable development is the common choice of global economies. The Intergovernmental Panel on Climate Change of the United Nations (IPCC) proposed that mitigating climate change is a long-term task, and it is necessary to balance the interests of development and emission reduction[1]. The proposal of China's dual-carbon goals of "carbon peaking by 2030 and carbon neutrality by 2060" is an inevitable requirement for a national energy and economic transformation and reform focusing on ecological and environmental issues. The solution to

sustainable development issues in the process of urbanization largely depends on the acquisition, allocation, and management of its energy and material resources [2].

At present, China's carbon market is faced with problems such as a large total amount of carbon emission reduction and heavy tasks, the lack of competitive advantages of new energy in the short term, and the corresponding negative carbon technologies still being in the initial stage. Therefore, China urgently needs to find a path suitable for energy recycling and utilization to avoid the negative impact of the energy structure transformation on the economy and complete the "dual carbon" goals as scheduled [3].

1.2. The significance of standardization in facilitating the development of the green industry

Standards, as a restrictive means to achieve the goal of carbon reduction, are the fundamental tools to support the green and low-carbon transformation and upgrading in all industries and fields. The goals of energy conservation, carbon reduction, and efficiency improvement can be achieved through the standardized guidance of carbon emission reduction management and recycling. By identifying and defining the key emission factors and driving factors in different social and economic environments through standardization, and calculating and constructing the carbon dioxide emission inventory of national urban agglomerations, it is of great significance for regulating market behaviors, strengthening the comprehensive utilization of resources, and leading the high-quality development of the economy and society. Take the standardized management of greenhouse gases as an example. Through the establishment of a scientific and efficient standardized management system and the monitoring, statistical reporting, verification, and certification of relevant data by certain principles and norms, the greenhouse gas emissions throughout the full life cycle of products and services can be effectively reduced [4].

1.3. The current development status of standards in the field of sustainable energy and low-carbon emission reduction

The Greenhouse Gas Protocol (GHG Protocol) was jointly initiated by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). In October 2008, the British Standards Institution (BSI) released the world's first technical specification for product carbon footprint assessment, PAS 2050. The related verification methods for carbon dioxide emissions have been successfully applied in nearly 30 cities [5]. In March 2022, the National Overall Group for Dual-Carbon Standardization was established, mainly promoting the formulation and revision of standards in areas such as low-carbon energy production, green energy consumption, and carbon emission reduction accounting. Currently, the standardized research in China is still in the primary construction stage, and related data accounting and comprehensive climate assessment models are in the continuous iteration and experimentation stage [6]. The energy balance database, as an effective statistical tool for energy production, transformation, and final consumption, can be widely promoted and applied [7].

2. Key focuses of standardization in facilitating the development of green industries

2.1. New energy

The energy and power industry, as the foundation of the development of the national economy, cannot do without the services and support of standardization work. Since 2008, a large number of leading national standards worldwide in wind power generation, photovoltaic power generation, solar thermal power generation,

microgrid, power energy storage, geothermal power generation, straw power generation, etc. have been jointly compiled by the Standard Quota Department of the Ministry of Housing and Urban-Rural Development, Chinese power enterprise design units, construction units, scientific research institutions, colleges and universities, and manufacturing enterprises, which have greatly promoted the development of industries in the new energy field [8]. For example, the introduction of a series of standards such as "Code for Design of Photovoltaic Power Station" GB 50797-2012, "Code for Construction of Photovoltaic Power Station" GB 50794-2012, and "Code for Acceptance of Photovoltaic Power Projects" GB/T 50796-2012 has laid a solid foundation for establishing the basic standard framework system for the construction of photovoltaic power projects [9].

2.2. Energy storage

In recent years, the construction of standardized energy storage has gradually attracted the attention of many countries. The International Electrotechnical Commission (IEC) established the Technical Committee for Electrical Energy Storage (TC120) in 2013, and the National Technical Committee for Standardization of Electrical Energy Storage was officially established in China in 2014. So far, 11 national standards and 10 industrial standards have been released, and with the application requirements, the construction of a related series of standards will continue to be carried out. Taking the standardized electricity storage management of new energy vehicles as an example, in 2017, China successively released national standards such as GB/T 34013-2017 "Product Specifications and Dimensions of Traction Battery for Electric Vehicles" and GB/T 34014-2017 "Coding Rules for Traction Battery of Automobiles," laying the foundation for regulating the full life cycle management of battery production, installation, use, maintenance, replacement, recycling and scrapping [10]. At present, domestic and foreign standardization organizations have successively formulated and released several power battery standards, such as electric road vehicles, thermal runaway safety management requirements, lithium-ion power battery reports and system test procedures, and lithium-ion power batteries for electric road vehicles. In the future, the standardized management of new energy vehicle battery systems and energy storage vehicle-pile battery systems, and the solution of flexible terminal configuration have become particularly urgent, and the role of standards will also be more prominent [11].

2.3. Carbon sinks

If calculated based on the proportion of carbon sinks that can offset carbon emissions at 5%, the annual carbon sink offset requirement is 500 million tons, which is a huge low-carbon industry market. Currently, the terrestrial ecological carbon sink capacity of forests, grasslands, etc., is far from meeting the expanding demand of enterprises for carbon emission reduction and carbon quota compliance. In the future, it is necessary to enhance the capacity of marine ecological carbon sinks and increase the carbon sink increment space of marine ecosystems. The Rida Waheed team found through the use of the autoregressive distributed lag model that in the long term, renewable energy consumption and forest area have a significant negative impact on carbon dioxide emissions. Fully researching and verifying the data will play a crucial role in promoting the generation of the national yearbook database and the standardized management of China's carbon sink industry [12]. At the same time, it is also necessary to accelerate the transformation and adoption of international standards such as ISO 27917: 2017 "Carbon Capture, Transport and Geological Storage — Terminology," ISO TR 27918: 2018 "Full Life Cycle Risk Management of CCS Integrated Projects," and ISO/TR 27915: 2017 "Carbon Capture, Transport and Geological Storage — Quantification and Verification," and give full play to the leading and regulating role of standardization

in negative emission technologies such as carbon capture, transport and geological storage (CCUS) [13].

2.4. Carbon trading

In November 2011, China issued the "Notice on Carrying out Pilot Work of Carbon Emission Rights Trading," which kicked off the construction of the carbon market. In June 2013, Shenzhen took the lead in conducting transactions, and other pilot regions also successively launched market transactions from 2013 to 2014. Carbon trading involves carbon measurement and verification, and the allocation of carbon emission rights. It involves a series of industrial chain linkage issues such as technology, management, and economy. It is necessary to establish a trading system with the market as the main body, policies as the guidance, and laws as the guarantee, fully covering trading entities, verification, assessment, performance, offset, and other intermediate agencies [14]. Taking the standardization process of forestry carbon sink trading in Beijing as an example, Beijing has currently formulated and issued normative documents such as the "Technical Guidelines for Forest Carbon Sink Enhancement Management in Beijing Area," "Technical Regulations for Forestry Carbon Sink Measurement and Monitoring," and "Technical Specifications for Validation and Verification of Forestry Carbon Sink Projects," providing exemplary technical support and management basis for the development of forestry carbon sink afforestation projects and the implementation of carbon sink measurement and monitoring work in Beijing and the country [15].

3. The realization path of standards facilitating the development of green industry under the dual carbon goals

The realization of the national dual-carbon goals is inseparable from the construction of the relevant standardization system. The construction of the standardization system should adhere to the five principles of guidance, coordination, systematicness, innovation, and internationality. Combined with the development situation of China's green industrial economy, the following standardized construction ideas are suggested:

3.1. Construction of the standard system and top-level design

Establishing a standardized green industrial system framework and standardize the standard management process. By building an information platform based on the cross-application of digital and intelligent technologies, give full play to the advantages of efficiency, integration, and convenience of standardized monitoring in promoting the coordinated development of green industrialization [16]. On the other hand, through the full life cycle carbon verification system, a new energy substitution solution with higher ecological benefits is provided that integrates standardized assessment, feedback, and formulation. On the other hand, through the standardized carbon management mechanism of the circular economy system, establish a resource and environment-friendly overall planning system integrating technology, market transactions, certification evaluation, and ESG from different levels of regions, industries, enterprises, and supply chains [17].

3.2. Standard formulation and revision in key areas

Based on the existing international standards, centering on the development needs of energy conservation, green and low-carbon, for key areas of green and sustainable development such as new energy (such as power batteries, hydrogen production, storage and transportation), renewable energy (such as wind energy, solar photovoltaic, geothermal, tidal, forestry carbon sink), energy conservation, water conservation, carbon emission reduction verification, carbon sink absorption, and green parks, sort out, optimize and improve the lack of key

technical standards, and form a regularly updated detailed list of standards to realize the leading and supporting role of standards in the development of the green industry [18]. The formulation of standards also requires an international perspective, seizing the commanding heights of international standards, and strengthening the mutual communication and recognition of international standards to demonstrate China's influence in formulating international standardization rules [19].

3.3. Strengthening basic research and the application of new technologies

On common design technologies such as energy-saving and environmental protection new materials, green processes and equipment, reuse of waste resources, lightweighting, integration and intelligentization of green products, carry out research on life-cycle green evaluation technologies, expand the high-tech intelligent green industrial chain, supply chain and blockchain resource management system, form a network platform for industry-finance connection, case display and data construction, and build a large ecosystem for the sustainable development of the green industry [20].

3.4. Strengthening the standard service capabilities and publicity and implementation

In responding to the market and international competition, standardized research has laid a theoretical foundation and pointed out the strategic direction for the industrialization, standardization, large-scale, marketization, and internationalization of China's scientific and technological innovation technologies. The formulation and revision of standards rely on the joint participation and collaboration of scientific research institutions, universities, enterprises, various industry associations, and other group institutions. The level of standardized service and the ability of publicity and implementation depend on the scientific nature of the standardized system, the leading role of exemplary cases, the enthusiasm of all relevant participants, and the efficiency of resource information management.

4. Conclusion and outlook

In the field of promoting the development of green industries, the benign interaction between standardization actions and technological innovation is undoubtedly an important guarantee for enhancing the stability of industrial chains and supply chains as well as the comprehensive competitiveness of industries. In recent years, the International Electrotechnical Commission has included themes such as carbon neutrality, energy transition, and zero-carbon power systems in the strategic planning content for the next ten years, and has cultivated and formed a large number of international standards to promote the green transformation of energy. Under the guidance of the "dual carbon" goals, China has done a lot of work in deepening cooperation with international standard organizations such as the International Electrotechnical Commission, promoting the establishment of a standard system for carbon peak and carbon neutrality, and building a qualification assessment service platform in line with international standards, vigorously promoting green and low-carbon development through standardization construction.

Standards determine quality, and high standards lead to industrial transformation and high-quality development. In the future, standards will surely become a universal language in the development of the international community, promoting technological innovation and facilitating international exchanges. They have become key elements of the global economic governance system. We need to draw on international experience,

actively cultivate and form a large number of industry group standards, national standards, and international standards in the field of green and low-carbon development, and reflect China's voice in more international rule-making.

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