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The Practice and Challenges of Carbon Neutrality in the EU

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Abstract

In response to the tide of global climate change, the EU has earlier put forward the goal of carbon neutrality and regarded green development as a "systematic project" that combines policy-making, technological iteration, industrial transformation, social reform and ideological construction and an important path to create "competitive advantage". Through the analysis of EU green development, it is found that over the years, the EU has strengthened legal and policy guarantees, set up green development goals, set market rules, regulate enterprise behavior, put forward a series of transformation goals and development plans, and played a pioneering role in the international climate policy. We should support green technology innovation, establish a variety of research and development mechanisms, and invest a large amount of public finance to realize the renewal and iteration of green technology. Build a self-sufficient green industrial chain system, break through all links of the industrial chain, and gradually form a green industrial chain system suitable for the future; We will leverage the synergistic effect of finance and soft power to create sustainable demand for green development in the whole society. Despite many obstacles, the EU started green development early, is systematic and has plenty of room for strategic manoeuvre. In the future, a series of measures can be taken to address this problem. Promoting green development and building a new round of global competitive edge will be an unwavering strategic choice of the EU.

Keywords: Green development; carbon neutral; the European Union; policy framework.

1. Introduction

Climate warming has had a negative impact on industry, agriculture, transportation, coastal zones and even national security. Therefore, the concept of carbon neutrality, which is closely related to climate warming, came into being. Carbon neutrality means that the carbon dioxide (CO_2) emissions caused by human activities and the global anthropogenic CO_2 uptake reach a balance within a certain period of time[1]. Since the mid-20th century, studies have shown that human activity may be the main driver of global warming, with a probability of more than 95 percent[2].

It can be seen that achieving carbon neutrality is a necessary process for human beings to cope with the existential crisis. As of January 2021, about 130 countries around the world have proposed carbon-neutral targets[3]. The global consensus on carbon neutrality marks the end of the traditional industrial era and the beginning of a new era of development. Carbon neutrality is not only a reshaping of energy structure, but also a redefinition of human development paradigm and a "self-revolution" of production and lifestyle. Therefore, not only will the future natural environment and social state of humanity be affected by carbon neutrality, but the economic, political and military power of global economies will also inevitably be affected by carbon constraints.

2. The main policy framework and objectives of EU carbon neutrality

The EU's carbon neutral policy framework includes the deployment of focused measures to reduce emissions in key sectors, supporting scientific and technological research and development projects, and diversified fiscal and financial safeguards. For example, in November 2018, the European Commission first set out its vision for a carbon-neutral Europe by 2050; In March and December 2019, the European Parliament and the European Council approved proposals for this vision. In order to achieve the goal of carbon neutrality, the European Commission published the European Green Deal in December 2019[4], which put forward seven major transformation paths towards carbon neutrality in Europe. In March 2020, the European Commission adopted the European Climate Act proposal[5], which aims to ensure that Europe is carbon neutral by 2050 from a legal perspective. In July 2021, the European Commission published its "Fit for 55" package[6] and adopted nine proposals. Under the framework of the European Climate Act, the Carbon Reduction 55 Package and the European Green Deal[7], the EU has built and improved its carbon neutral policy framework mainly from seven aspects: increasing the greenhouse gas emission reduction target by 2030 from 50%-55% to 60%; Revision of climate-related policies and regulations; To co-ordinate all European Commission policies and new initiatives based on the European Green Deal and sectoral strategies; Constructing digital intelligent management system; Improving the EU emissions trading system; Constructing a just transformation mechanism; Standardizing the EU's green budget.

3. EU measures to reduce emissions in key sectors

According to the EU's 2030 Climate Target Plan, the energy industry is one of the industries that is expected to achieve emission reduction breakthroughs in the future, while industry, transport and forestry are relatively potential industries. Therefore, this study will focus on the energy, industrial, transport and forestry sectors to review the emission reduction measures taken by the EU.

3.1. Energy industry

Energy system transformation is a key driving force for economic decarbonization. The European Union's "Promoting a Climate-Neutral Economy: EU Energy System Integration Strategy" Outlines key actions to decarbonize the energy system, and identifies six pillars of key actions:

(1) Building an energy system that puts "energy efficiency first" and focuses more on recycling;
(2) Build a power system based on renewable energy to accelerate energy electrification;
(3) Promoting the use of renewable energy and low-carbon fuels in industries that are difficult to decarbonize;
(4) Improve energy market compatibility;
(5) Building an integrated energy infrastructure;
(6) Build an innovative digital energy system.

3.2. Industry

European industry is a global leader in many areas.In order to maintain its leading position, the EU published Our Vision for a Clean Planet for All[8]: Industrial Transformation, which describes the EU's industrial transformation vision from six aspects.

(1) climate change action to improve energy efficiency;
(2) Significantly reduce energy import dependence by 2050;
(3) Economic transformation enjoys first-mover advantage;
(4) Continue to increase the proportion of renewable energy;
(5) Strengthening infrastructure development;
(6) Focus on electrical migration for technological innovation.

3.3. Transportation industry

Transport accounts for a quarter of the EU's greenhouse gas emissions and is still growing. The Sustainable Transport -- Europe Green Deal[9] sets a target of reducing greenhouse gas emissions from the transport sector by 90% by 2050 and proposes the following key measures:

(1) digitizing traffic management systems to improve energy efficiency in the transport sector;
(2) Reduce or eliminate aviation and fossil fuel subsidies and incorporate environmental impacts into the pricing system;
(3) Build 1 million public charging stations and gas stations (currently 140,000), and improve the sustainable fuel supply system.

3.4. Forestry

With 43.52% of the EU covered by forests, forests are expected to play an important role in driving Europe towards carbon neutrality by 2050. On July 16, 2021, the European Commission issued the European Union 2030 Forest Strategy[10], which proposed the following four main measures:

(1) Protect and restore primary forests, proposing the goal of planting 3 billion more trees by 2030;
(2) Develop forest-based eco-tourism, prolong the service life of wood products, and improve the ecological, social and economic benefits of forests;
(3) Encourage people to understand forests better;
(4) Develop coordination a coherent framework for forest governance.

4. EU carbon neutral scientific and technological innovation research and development safeguards

From 2021 to 2030, the EU will mobilize at least 1 trillion euros to support the European Green Deal. The EU will support the R&D and demonstration of low-carbon technologies in the following key industries through the coordination of large-scale scientific programs such as the "Innovation Fund" and the "Horizon Program" [9], aiming to achieve carbon neutrality by 2050.

4.1. Key innovative technologies for clean energy and security transformation

(1) Renewable energy generation technology. Next-generation wind turbines, solar power generation, enhanced geothermal energy, offshore oscillating wave surge converters, advanced biofuels, tidal and wave energy technologies, offshore floating renewable energy generation equipment and large-scale integrated systems.
(2) Energy storage technology. Ultra-fast charging infrastructure, lithium-ion or new chemical battery technology, organic solar cells, heat storage technology, heat extraction and electricity storage technology.
(3) Power network infrastructure and transmission technology. Large offshore HVDC grid technology, inter-

device / inter-array dynamic cable and offshore substation connection facilities, port energy management systems and charging facilities.
(4) Hydrogen energy technology. Clean hydrogen terminal components, 100 MW electrolytic cell technology.
(5) Intelligent management and service technology. Blockchain technology, artificial intelligence technology, innovative digital energy system.

4.2. Key innovation technologies for industrial transformation

(1) Production of coke and refined petroleum products -- research and development of low-carbon tire production technology and alternative raw materials;
(2) Ferrous metal production -- direct reduction technology based on low hydrocarbon, electric furnace steelmaking, stove top gas recovery;
(3) Non-ferrous metal production -- low emission electrolysis, inert anode/wet drain cathode, magnetic billet heating, waste heat recovery;
(4) Manufacture of cement and concrete products -- composition optimization of low-carbon cement and concrete;
(5) Production of lime and gypsum products -- improving CO_2 concentration and oxygen-rich technology;
(6) Glass and its products manufacturing - electric furnace, oxygen rich combustion, low hydrocarbon and other alternative fuels;
(7) Manufacturing of clay products and refractories -- low carbon product design, electric furnaces and dryers;
(8) Paper and paper product production - new drying technology, fiber foaming, enzyme pretreatment, heat recovery, electrochemical depolymerization of lignin;
(9) Chemicals and chemistry.

4.3. Key technologies of high energy efficiency building

Key technologies of high energy efficiency building.
(1) Scalable design of renewable energy communities;
(2) From design to construction workflow monitoring;
(3) Design of energy-efficient buildings that adapt to the local environment and climate;
(4) Volatile renewable energy generation and service infrastructure technology portfolio;
(5) Renewable energy heating and cooling solutions;
(6) Building and equipment safety energy-saving intelligent operation system based on digital technology;
(7) Low-carbon habit cultivation of citizens;
(8) Research and release of building and high voltage AC technical standards.

4.4. Key technologies of intelligent transportation

(1) Research and development of key components for electric vehicles;
(2) Automated and intelligent traffic management system development;
(3) Research and demonstration of large-scale technical solutions for green airports, oceans and inland green ports.

5. EU carbon neutral fiscal and financial safeguards

5.1. The EU has included climate-change-related spending in its main budget

Towards a modern clean economy and a fair society, the EU's Multi-Annual Financial Framework (2021-2027),

the European Sustainable Investment Plan and other major fiscal and financial transformation measures include seven:

(1) At least 108 billion euros will be raised from the European Cohesion Fund and the European Regional Development Fund in 2021-2027 to support integrated demonstration of renewable energy and low-carbon fuel production and consumption, financing of flagship projects of carbon-neutral industrial clusters, infrastructure development, and research and development of key components of electric vehicles.

(2) Under the Investment Plan for Europe, the European Investment Bank will develop a financial instrument for the efficient operation of buildings, using EU grants as guarantees to attract 10 billion euros of financing to improve the energy efficiency of buildings and lift 3.2 million households out of energy poverty.

(3) At least 60% of the budget of the Connected European Infrastructure Initiative is allocated to support transport, energy and digital infrastructure.

(4) Formulate an "outward investment plan" to attract additional investment of up to 44 billion euros using 4.1 billion euros from the EU budget. Three of the scheme's five investment Windows will be directed towards the goal of carbon neutrality.

(5) The EU will take structural support actions for coal and carbon-intensive regions.

(6) Compared with 2014-2020, the LIFE programme will increase spending by 72% (to 5.4 billion euros), with more than 60% of the increase going towards achieving climate goals.

(7) The Common Agricultural Policy and the Horizon Programme plan to allocate at least 40% and 35% of the budget respectively to support the priorities of the European Green Deal.

5.2. The EU Emissions Trading System (ETS) and carbon price mechanism help promote equitable transformation

In the practice of global greenhouse gas emission reduction, the EU carbon emissions trading system and carbon price mechanism are considered to be the most effective market economic means. In the early stage of operation, the allocation of free carbon credits in the EU ETS adopts the historical method, which has less binding effect on industrial carbon emissions. The problems exposed are the failure of the carbon price and the inefficiency of the EU's emissions trading system. The market stability reserve mechanism improves the effectiveness of the EU emissions trading system, but also creates the problem of industrial constraints. Up to now, although the EU carbon emissions trading system has gone through three stages of improvement, there are still problems. In February 2018, the EU approved the reform plan for the fourth phase of the EU Emissions Trading System (ETS) (2021-2030). By 2030, the total number of free carbon allowances in the EU ETS is expected to be 43% lower than in 2005, the first year of the scheme's operation, and the ETS will be extended to new sectors.

The main reform measures for Phase 4 of the ETS include:

(1) the market stabilization reserve will reduce overquota emissions by 24% per year from 2019 to 2023;

(2) From 2021, the annual decline rate of the total carbon quota will increase from 1.74% to 2.2%;

(3) Update the total amount of free carbon quota regularly according to technological progress;

(4) Encourage industry innovation;

(5) Ensuring affordable energy prices;

(6) 2% of the EU ETS reserve funds will be used to address the additional investment needs of low-income member states (GDP per capita is less than 60% of the EU average);

(7) 10% of the carbon allowances auctioned by member States in the EU ETS will be allocated to countries whose per capita GDP is less than 90% of the EU average, and the rest will be allocated among all member States based on verified emissions;

(8) We will extend the EU emissions Trading System to the maritime sector through the carbon boundary adjustment mechanism and the market stabilization reserve mechanism, and build new ETS for the construction and transport industries, so as to achieve the goal of reducing the emissions of the industries covered by the EU emissions Trading system by 61% from 2005 by 2030;

(9) Use the carbon Offset and Emission Reduction Scheme for international aviation for flights outside the EU Emissions Trading System.

6. Key features of the EU carbon neutral policy system

The European Union has been at the forefront of efforts to achieve carbon neutrality. At present, the EU carbon neutral policy system has been relatively complete, and its main characteristics are as follows:

6.1. A sound policy framework

The EU has set up a top-down carbon neutral policy framework in three main forms, namely, setting up targets, enacting legislation and issuing strategic plans, which has pointed out the direction for the EU's short - and medium-term economic decarbonization.

6.2. Measures to reduce emissions in key industries with clear priorities

The EU has defined the key industries that give priority to decarbonization, issued medium - and long-term transformation and development strategies for key industries, and deployed emission reduction measures for key industries.

6.3. Science and technology first

By launching large-scale scientific programs, the EU has deployed a structured system of science and technology innovation focusing on key scientific issues and technologies such as renewable energy generation technology, energy storage technology, power grid infrastructure and transmission technology, hydrogen energy technology, intelligent management and service technology, research and development of key components of electric vehicles, research and development of alternative raw materials, and research and development of industrial decarbonization process.

6.4. A complete set of financial and financial safeguards

The EU has introduced corresponding large-scale investment and financing plans, actively explored and improved fiscal and financial safeguards, and promoted the development of the EU economy, society and industry along the set direction.

6.5. The development of new nuclear power generation technologies and CCUS technologies still faces challenges

The emission of chemical industry and electric power industry is inevitable. CCUS technology and new nuclear power generation technology may become difficult to reduce emissions.Key technologies for carbon neutrality. However, there are still security risks and high costs in the large-scale application of the above technologies. Therefore, how to improve and promote relevant technologies is an important challenge facing the EU at present.

6.6. The emissions trading system and the carbon price mechanism are still being improved

Up to now, although the EU carbon emissions Trading system has been in operation for 16 years, how to find a balance point between the carbon emissions trading system and carbon price, while increasing the carbon emission reduction efforts, minimize the constraints on the development of the industry, and seek for the fair and just transformation of different member states and different industries is still an issue worthy of in-depth discussion.

7. Conclusion: EU green development prospect analysis

As the main policy direction of European Commission President Ursula von der Leyen since she took office, implementing the "green New Deal" and promoting green development are the means and potential advantages for the EU to participate in global competition. In the future, continuing to promote green development and build a new round of global competitive advantages will be the unswerving strategic choice of the EU. Green development has became a consensus in the EU and is regarded as a "core value". Despite development obstacles, the EU has more room for strategic manoeuvre in the future.

To address the challenges of heterogeneity in green development within the EU, and to further bridge the "green development gap", the EU has set up the Modernisation Fund and the Just Transition Mechanism in 2020. Help low-income member countries or hard-to-transition regions transition to carbon neutrality through targeted financing and transfer payments. The modernisation Fund represents 2 percents of the carbon allowances auctioned in the EU's Emissions Trading System from 2021 to 2030, with the aim of helping low-income member states achieve energy systems[11].

In response to the challenge of insufficient capital input to encourage enterprises to meet the green transformation, the EU emission trading system and green finance and other investment and financing mechanisms have been deployed in place, and the carbon border adjustment mechanism has been put on the agenda, leaving room for guiding the "induced technological change" of traditional carbon emission intensive industries and supporting the long-term development of low-carbon industries in the future. In addition, the €750 billion "Next Generation EU" recovery Fund has strengthened the EU's public finance position, and the implementation of the carbon border adjustment mechanism has expanded financing channels. In the EU, multinational companies and financial institutions have increasingly formed a consensus on green development

In terms of meeting the challenges of green technology selection and deployment, the EU has an early start in green development and a strong industrial foundation. Once it achieves breakthrough technological innovation or locks in the path of technological iteration, its already established green industrial chain system can be quickly compatible, and it is expected to seize the "commanding heights" of global green development in a short time and form a new round of international competitiveness. At present, the selection and deployment of green technologies in the EU are more concerned with the long-term application and social effects of green technologies based on the long-term effects of achieving carbon neutrality, social changes, ecosystem integrity and the situation of vulnerable groups. Therefore, the EU also conducts in-depth research and steps by steps in the deployment of technology, rather than blindly pursuing short-term economic benefits and "big and fast" projects.

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