Strategy Research on Accelerating Green and Low-Carbon Development under the Guidance of Carbon Peak and Carbon Neutral Targets

Yinan Li*, Keren Chen, Nan Zheng, Qiyuan Cai, Yuanfei Li and Changyong Lin
Power Economic Research Institute of State Grid Fujian Electric Power Company, Fuzhou, China

*Corresponding author: li_yinan@fj.sgcc.com.cn

Abstract. Since September 2020, General Secretary Xi Jinping has made seven solemn promises to the world that China will achieve "carbon peak" by 2030 and "carbon neutral" by 2060. Under the guidance of carbon peak and carbon neutral targets, it has become an inevitable choice for China to accelerate green and low-carbon development. Developed countries started earlier on the road of emission reduction and have accumulated rich experience with relatively sound relevant laws and regulations. This paper studies and analyzes the emission reduction status of developed countries, and summarizes and summarizes the practical experience that can be used for reference from five aspects: scientific planning of emission reduction path, establishment and improvement of institutional system, gradual improvement of carbon price mechanism, breakthrough in energy conservation and emission reduction technology, and comprehensive implementation of circular economy. On this basis, combining with the current situation of economic and social development in China, Suggestions are put forward from four aspects: policy guidance, market mechanism, technological innovation and circular economy.

1. Introduction
Since the birth of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, promoting green and low-carbon development has become the consensus of many countries around the world. In recent years, China has continued to strengthen efforts to promote energy conservation and emission reduction. In September 2020, General President Xi Jinping made a solemn commitment to the world that China would peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060. General President Xi Jinping announce some further commitments for 2030 at the Climate Ambition Summit in December that China will lower its carbon dioxide emissions per unit of GDP by over 65 percent from the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 25 percent, increase the forest stock volume by 6 billion cubic meters from the 2005 level, and bring its total installed capacity of wind and solar power to over 1.2 billion kilowatts[1-2].

Under this goal, how to accelerate the promotion of green and low-carbon development has become an urgent problem to be solved. At present, scholars have analyzed domestic and foreign emission reduction situations. Literature [3-4] studied and analyzed the long-term emission reduction strategies of various countries. Literature [5-8] tracked and analyzed the international progress of
Developed countries started earlier on the road of emission reduction, and the relevant laws and regulations are relatively sound, so they have accumulated rich experience. Therefore, this paper studies and analyzes the current situation of emission reduction in developed countries, comprehensively summarizes and extracts the practical experience that can be used for reference, and puts forward the strategy and strategy of promoting green and low-carbon development in China based on the current situation of China's economic and social development.

2. Current situation of carbon emission reduction in developed countries

2.1. European Union
As a pioneer of low-carbon economy, most countries in the European Union had achieved carbon peak before 2010, among which Germany and Norway had reached the peak earlier than 1990.

In 2019, EU governments reached an agreement on achieving net zero carbon emissions by 2050. Fifteen countries, including the UK and Germany, have adopted laws and policies to set the goal of achieving net zero carbon emissions between 2035 and 2050.

2.2. Japan
Since the beginning of this century, the annual growth rate of total carbon emissions and carbon intensity in Japan has been -1.0% and -0.9% respectively, gradually realizing the decoupling of carbon emissions from economic growth.

Japan's carbon emission intensity is relatively low, 1.7 tons of standard coal per US $10,000 GDP in 2019, which is only 20.2% of China's.

It is expected to further reduce to 0.5 tons of standard coal/US $10,000 GDP in 2050, lower than China's expected GDP of 0.8 tons of standard coal/US $10,000.

In October 2020, Japan announced that "domestic greenhouse gas emissions will be virtually zero by 2050".

2.3. United States
The United States, the second largest emitter of greenhouse gases after China, reached its carbon peak in 2007.

During the Obama administration, the United States paid particular attention to reducing carbon dioxide emissions. In the first half of 2015 alone, the United States announced 40 new measures to reduce carbon emissions, and pledged to reduce carbon emissions by 26-28% by 2025 compared with 2005.

After Trump took office and announced the withdrawal of the United States from the Paris Agreement, 50 states, hundreds of cities and thousands of companies have set their own targets to reduce greenhouse gas emissions, including California, which has announced it will be carbon neutral by 2045.

3. Major measures taken by developed countries to promote green and low-carbon development

3.1. Establish a strategic target system and scientifically plan the emission reduction path
As the air pollution is becoming more and more serious, many countries have taken emission reduction to the strategic level.

Since 2007, the EU has set and released targets for 2020, 2030 and 2050 on the proportion of renewable energy, the proportion of energy efficiency improvement and the reduction of greenhouse gases, forming a system of strategic targets for energy and climate development with multi-dimensional coverage and coordinated improvement.
On the basis of the EU strategy, Germany, France and other countries have, in light of their national conditions, legislated medium- and long-term energy transition targets, such as the withdrawal date of coal power generation and the proportion of renewable energy generation, effectively improving the continuity and operability of their energy strategies.

In 2018, the Japanese government issued a new version of the Basic Energy Plan in accordance with the emission reduction targets of the Paris Agreement and the energy development plan for the period 2030/2050, clarifying the development path of accelerating the development of renewable energy, prudently restarting nuclear power technology, and actively promoting the application of hydrogen fuel, pointing out specific implementation directions for accelerating Japan's energy transformation.

3.2. To introduce relevant policies and regulations and establish and improve the system

Energy consumption is the main source of carbon dioxide. Therefore, various countries have introduced a series of energy policies to promote energy conservation and emission reduction.

One is the energy efficiency, since the first oil crisis, Germany will gradually establish and perfect the three-level legal system of energy efficiency, including energy efficiency ordinance issued by the European Union, the German federal parliament enacted the energy law and other laws regulations and the German federal bureau issued "the national action plan for energy efficiency of energy efficiency, provides institutional guarantee for Germany to achieve efficiency.

Second, in terms of energy conservation, Japan regards energy conservation as a national policy. As early as 1979, Japan promulgated the Energy Conservation Law, which stipulates that enterprises must reduce energy consumption per unit of output year by year at a prescribed rate of reduction. In addition, Japan has also established a set of energy conservation management and consulting system composed of "government management department-energy conservation professional services or research institutions-enterprise energy managers", which has set up a good platform for the government to obtain timely information from enterprises and make efficient energy conservation policies.

Third, energy development and utilization. On the one hand, many developed countries have gradually begun to abandon coal and reduce coal. In July this year, Germany passed two bills to phase out coal power by 2038 at the latest. On the other hand, vigorously developing clean energy and promoting the transformation of energy structure have become the consensus of all countries in the world. About 150 countries have set specific targets for renewable energy power generation, and 50 countries have provided policy support for the direct use of renewable energy in transportation and heating.

3.3. Give play to the market incentive role and gradually improve the carbon price mechanism

In the 1990s, the Netherlands, Sweden, Denmark and other EU countries took the lead in imposing carbon taxes on the production or users of fossil fuels, raising the price of carbon-containing fossil energy and promoting the economical and efficient use of energy resources.

In 2005, the European Union carbon emission trading system was put into operation, allowing enterprises whose emissions are lower than the permitted value to sell their remaining emission rights on the market, and imposing penalties such as high fines and reduction of emission quota for the next year on enterprises with excessive emissions, so as to encourage enterprises to reduce consumption and reduce emissions by market means.

The successful operation of the carbon tax and carbon emission trading system in the European Union has promoted the wide application of the carbon price mechanism around the world. As of mid-2019, 46 countries and regions have established carbon price mechanisms such as carbon trading markets or carbon taxes.
3.4. Focus on core and key areas and make breakthroughs in energy conservation and emission reduction technologies

First, in terms of carbon capture and storage (CCS) technology, the US started early and is at the leading level in the world. It has been used in natural gas processing, fertilizer production, coal-fired power generation and other fields. There are currently 19 industrial-scale CCS projects in operation around the world, 10 of them in the United States, with a total capture of 25 million tons per year, equivalent to an annual reduction of carbon emissions from 5.4 million vehicles.

Second, in terms of new energy technologies, Europe has the most advanced offshore wind power technology. Rapid breakthroughs have been made in wind turbine manufacturing, unit hoisting, floating base and offshore high-voltage direct current transmission, effectively supporting wind power in large-scale and deep waters. Japan is the originator of lightweight photovoltaic power generation equipment. The integrated photovoltaic building (BIPV) product developed can fully rely on the external walls of buildings to generate electricity directly, and can also be combined with insulation and other components to improve the energy efficiency of buildings. The United States took the lead in putting forward the concept of "hydrogen economy" in the world, and has developed a megawatt proton exchange membrane electrolysis water hydrogen production device. It has a 2,500km hydrogen pipeline to realize long-distance large-scale transportation of hydrogen energy.

3.5. Advocate the concept of green development and comprehensively promote circular economy

The "circular economy", based on the principles of reduction, reuse and resource conversion, is a new economic model featuring low energy consumption, low pollution and high efficiency. It has already become an important way for developed countries to save energy and reduce emissions.

Germany is the country with the highest level of circular economy development in Europe. At first, it developed circular economy with the recycling of packaging waste as the starting point. In 1991, it issued the Regulations on the Management of Packaging Waste, which made it clear that product manufacturers and retailers should be responsible for the recycling and utilization of packaging waste. For this reason, Germany has established a specialized civil organization DSD, which is responsible for recycling and recycling the packaging wastes that have been paid to DSD and approved to be marked with "green dot", so as to promote the recycling of wastes.

Karenborg Eco Industrial Park in Denmark is a typical example of enterprise circular economy model. By integrating power plants, gypsum plants, sulfuric acid plants and other types of industries, it promotes multi-level reuse of energy and by-products, reduces waste emissions and effectively saves production costs.

4. Suggestions on promoting green and low-carbon development strategies

4.1. Strengthen policy guidance

First, we should review the types and areas of existing emissions-reduction policies, assess their role in detail, revise and improve policies and regulations in accordance with the carbon peak and carbon neutral targets, and make them more systematic, integrated and coordinated, so as to complement each other's strengths and better leverage our synergy.

Second, we should continue to strengthen management of energy conservation and emission reduction in key energy-using enterprises, deepen the system of enterprise energy managers and the energy utilization reporting system of key energy-using units, make it clear that high-energy consuming enterprises must have energy managers and regularly submit medium - and long-term energy conservation plans and related reports to the government, so as to improve their energy planning and management level.

4.2. Optimize the market mechanism

First, we should accelerate the national carbon emissions trading market the real operation, fully considering the trend of economic development in our country, to reach peak carbon and carbon...
neutral targets as constraint, China's reasonable control total long-term carbon emissions trading market quota, optimizes the key units to be emissions quotas, earnestly to the enterprise conduction government pressure to reduce emissions, ensure upper and lower linkage to form resultant force.

Second, we should continue to enrich carbon financial derivatives such as carbon funds, carbon bonds, carbon insurance, carbon crowdfunding and carbon futures, encourage various financial institutions such as banks, securities, insurance and funds to participate in and promote the carbon trading market, build a multi-level carbon financial market system, increase the activity of the carbon trading market, and encourage enterprises to increase energy conservation and emission reduction efforts.

4.3. Speed up technological innovation
First, with the new energy industry as the starting point, benchmarking international cutting-edge technologies, speed up basic research breakthroughs and core technology breakthroughs around energy storage, wind power, hydrogen energy and other new energy fields, realize the industrialization of key materials and devices, and lay a solid foundation for the clean replacement of energy.

Second, promote the resource utilization of carbon dioxide, and carry out research on cutting-edge carbon capture technologies such as new membrane separation, new chemisorption and chemical chain combustion, so as to significantly reduce the cost of CCS. We should give full play to the human and financial advantages of large energy enterprises, accelerate the construction of full-process carbon capture and storage demonstration projects, explore the establishment of a regional commercial operation model of CCUS, and improve the adaptability of CCUS technology.

4.4. developing the circular economy
First, pilot development of ecological industrial park, from the industrial chain of "extending chain repair chain", choice of enterprise symbiosis and circulation development science, enterprises in the park to establish industry metabolism and symbiotic coupling relations of mutual benefit, strengthen the exchange of substance, energy and information between enterprises and integration, promote a virtuous circle between environmental protection and economic development.

Second, strengthen the government's participation in the field of resource recycling, systematically plan the resource recycling system from the macro level, optimize the existing resource recycling and utilization network, and innovate and develop the new model of "Internet + recycling". We will introduce fiscal and tax support policies to encourage private capital to actively participate in the development of waste recycling, transportation, recycling and research and development of recycling technologies, and continue to strengthen the industrial system of circular economy.

5. Conclusion
First, from foreign experience, the promotion of green and low-carbon development of economy and society cannot be separated from the support and guidance of policies. At the same time, the role of market should be given full play to stimulate the endogenous driving force of various subjects.

Second, China started late on the road to emission reduction, and there is great pressure to achieve carbon peak and carbon neutral. We should fully absorb the advanced experience of foreign countries, take multiple measures, and promote high-speed emission reduction.

Third, CCUS technology is an important means to achieve carbon neutrality. All parties should intensify research efforts, resolve the contradiction between economy and technology, and accelerate the popularization and application of CCUS.

References
[1] Ruan Y Z, Tu D D. Climate ambition summit highlights global ambition[J]. Ecological Economy,2021, 37(2): 1-4
[2] Zhou Y M. The Climate Ambition Summit opens a new journey for the global response to climate change[J]. Flag,2021 (1): 88-89
[3] Chen X T. Comparative analysis and enlightenment of the 2050 long-term low emission development strategy [J]. World Environment, 2018 (1): 82-85

[4] Tian C, et al. Comparison analysis of the long-term low greenhouse gas emission development strategies of main countries [J]. Climate Change Research, 2019, 15 (6): 633-640

[5] Mahone A, Subin Z, Mantegna G, et al. Achieving carbon neutrality in California [R]. New York: Energy and Environmental Economics, 2020

[6] Natural Capital Partners. The carbon neutral protocol [R]. Europe: Natural Capital Partners, 2020

[7] Salvia M, Reckien D, Pietrapertosa F, et al. Will climate mitigation ambitions lead to carbon neutrality? An analysis of the local-level plans of 327 cities in the EU [J]. Renewable and Sustainable Energy Reviews, 2020, 135: 110253

[8] Deng M J, Luo W B, Yin L J. A systematic review of international theory, research and practice on carbon neutrality [J]. Resources Science, 2013, 35 (5): 1084-1094