BCAS Vol.35 No.4 2021

Building a Low-carbon Development Policy System towards Carbon Neutrality[i]

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Abstract: China has proposed that it will strive to achieve the carbon neutrality target by 2060, providing strategic guidance for China to accelerate the transformation of its development mode and economic restructuring. But it is very challenging to achieve the target. It requires systematic top design as well as scientific formulation of long-term planning, while multiple institutional policies and institutional mechanism reforms need to be strengthened, such as rule of law, administration and economy, to form a systematic and effective incentive and constraint mechanism. Through the exploration and improvement of its three five-year plans, China has formed a low-carbon policy guarantee system led by binding targets, highlighting key industries and regions, and comprising planning, laws, administrative orders, pilot projects, markets, finance and taxation, and other aspects. However, there are still many problems, including the lack of clear policy paths in the near, medium and long term, the absence of key systems such as total carbon emission control system and climate legislation, poor inter-departmental communication and coordination mechanisms, and inadequate systems such as carbon markets and climate investment and financing. Finally, taking into account the current opportunities and challenges, we propose a low-carbon development policy guarantee system for China to move towards carbon neutrality.

Key words: Carbon neutrality, Policy system, Low carbon development, Climate change, China

[i] This is an authorized translation from the Chapter Two of the *China Sustainable Development Report 2020: Exploring Pathways towards Carbon Neutrality* (in Chinese) drafted by the CAS Research Group on Sustainable Development Strategy, and released by the Institutes of Sciences and Development (CASISD) under the Chinese Academy of Sciences (CAS). This chapter is part of the Part One entitled "Exploring Pathways towards Carbon Neutrality" in the Report. *BCAS* thanks CASISD and the authors for their kind permit and support for the translation.

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Low-carbon development not only relies on technology, but also requires system and policy support. Systems and policies can provide important guarantees for technology research, development and application. At present, the low-carbon development in China lacks effective institutional and policy support, and gaps and shortfalls even exist in some areas. This is insufficient for achieving the carbon neutrality goal by 2060. Therefore, in response to the challenges of global climate change and the routine prevention and control of the Covid-19 pandemic, systems and policies shall be identified for the "14th Five-Year Plan" (2021–2025) and timetables, roadmaps and priorities shall be specified for mid to long-term low-carbon transition and development (Research Group of the Institutes of Science and Development, Chinese Academy of Sciences, 2020).

I. The Evolution of Low-carbon Development Policy System in China

The system of low-carbon development in China is gradually established. A policy guarantee system has been formulated that gives priority to binding targets, highlights key industries and regions, and covers a variety of areas including planning, laws, administrative orders, pilot projects, markets, fiscal and taxation. Starting from the "12th Five-Year Plan" (2011–2015), carbon emission intensity targets have been incorporated into the subsequent Five-Year Plans for National Economic and Social Development. A set of binding target systems of total energy, energy intensity, and carbon emission intensity was included in the "13th Five-Year Plan" (2016–2020). From the perspective of policy types, there is a gradual transition from administrative orders to a combination of both administrative orders and market-based policies. Meanwhile, China actively participates in cooperation on climate change, providing strong support for China's involvement in global governance.

1.1 Planning and target system

As a responsible developing country, in accordance with the relevant provisions of the *United Nations Framework Convention on Climate Change and the Kyoto Protocol*, considering the overall requirements of the sustainable development strategy, China has strengthened the establishment of institutions and mechanisms to address climate change, and issued a series of comprehensive planning documents (Table 1), promoting the efforts in addressing climate change.

China's response to climate change boasts a complete range of policy types and extensive practices. It has entered a period of equal emphasis on administrative measures and market-based practices. Administrative measures have distinct Chinese characteristics. However, since the "12th Five-Year Plan", the application of market-based policy tools has become more extensive to match administrative measures.

Nevertheless, in retrospect of climate governance practices in the past ten years, different features are presented for the "12th Five-Year Plan" and the "13th Five-Year Plan". During the "12th Five-Year Plan" period, domestic and international conditions were conducive to climate governance in China, so the climate policy development entered a golden period; since the mid-term of the "13th Five-Year Plan", the international driving forces have waned and the domestic climate policies have entered a period of adjustment. Various reasons have temporarily slowed the progress of climate policies and actions in China (Zhu Songli *et al*., 2020).

1.2 Legal system

Addressing climate change is not only an inherent requirement for achieving high-quality economic and social development in China, but also the responsibility of China to involve in global climate governance. The laws and regulations in China on addressing climate change are mainly formulated in the fields of ecological environment protection and energy. At present, China has established a national ecological environment legal system with the "Environmental Protection Law of the People's Republic of China" as the basic law in ecological environment protection. The *Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution*, which was implemented in 2016, stipulates the coordinated control of greenhouse gases and other air pollutants and promotes the joint prevention and control of regional air pollution to improve the quality of the air. The *Law of the People's Republic of China on Promoting Clean Production* and the *Law of the People's Republic of China on Promoting the Development of a Recycling*

Table 1 Planning documents related to climate change issued since the "12th Five-Year Plan"

Year	Document name	Content	Issuer
2011	*Outline of the 12th Five-Year Plan for Economic and Social Development of the People's Republic of China*	Incorporate indicators such as the proportion of low-carbon and non-fossil energy into the Five-Year Plan	State Council
2012	*The 12th Five-Year Action Plan for Controlling Greenhouse Gas Emissions*	Put forward the goals and main tasks of controlling greenhouse gas emissions during the "12th Five-Year Plan"	State Council
2012	*Action Plan to Address Climate Change in Industrial Sector (2012–2020)*	Put forward the goals and main tasks of the industrial sector to deal with climate change	Ministry of Industry and Information Technology, National Development and Reform Commission, Ministry of Science and Technology, Ministry of Finance
2012	*"12th Five-Year" National Special Plan for Scientific and Technological Development to Address Climate Change*	Put forward the goals and key directions of science and technology to address climate change	Ministry of Science and Technology, Ministry of Foreign Affairs, National Development and Reform Commission, *etc.*
2012	*Action Plan for Controlling Greenhouse Gas Emissions during the 12th Five-Year Plan in the Transportation Sector*	Put forward the goals and main tasks of the transportation sector to deal with climate change	Ministry of Transport
2013	*National Climate Change Adaptation Strategy*	Put forward the goals and main tasks of adapting to climate change	National Development and Reform Commission
2014	*2014–2015 Action Plan for Energy Saving, Emission Reduction and Low Carbon Development*	Put forward the goals and main tasks of energy-saving, emission-reduction and low-carbon development	State Council
2014	*National Climate Change Plan (2014–2020)*	Put forward the guiding principles and main goals for tackling climate change, and clarify key tasks	National Development and Reform Commission
2015	*Strengthening Actions against Climate Change-China's Nationally Determined Contributions*	Clarify China's 2030 action targets for addressing climate change	State Council
2016	*Outline of the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China*	Support the development of low-carbon technology industries, advance low-carbon pilot projects, and promote low-carbon development in key areas	State Council
2016	*The 13th Five-Year Action Plan for Controlling Greenhouse Gas Emissions*	Put forward the goals and main tasks of controlling greenhouse gas emissions during the 13th Five-Year Plan	State Council
2016	*National Afforestation and Greening Planning Outline (2016–2020)*	Put forward six tasks including reforestation, urban and rural greening	National Greening Committee, State Forestry Administration
2016	*Outline of the Plan for Restoration of Farmland, Grassland, River and Lake (2016–2030)*	Put forward the phased goals and policy measures for the restoration of farmland, grassland, river and lake	National Development and Reform Commission, Ministry of Finance, Ministry of Land and Resources, *etc.*
2016	*Action Plan for Forestry Adaptation to Climate Change (2016–2020)*	Nine key forestry actions	National Forestry Administration
2018	*Three-year Action Plan to the Blue Sky*	Reduce the total emissions of major air pollutants and greenhouse gas after three years of hard work	State Council
2018	*Clean Energy Consumption Action Plan (2018–2020)*	It is proposed that by 2018, clean energy consumption shall achieve significant results; by 2020, the clean energy consumption shall be handled properly	National Development and Reform Commission, National Energy Administration
2019	*Interim Regulations on the Management of Carbon Emissions Rights Trading (Draft for Solicitation of Comments)*	Propose that carbon emissions rights trading should be combined with government guidance and market regulation	Ministry of Ecology and Environment

Economy focus on the combination of clean production and recycling, both of which will greatly reduce the generation of "three wastes" including greenhouse gases. In the energy sector, China has promulgated the *Law of the People's Republic of China on the Coal Industry*, the *Electricity Law of the People's Republic of China*, the *Law of the People's Republic of China on Conserving Energy* and the *Renewable Energy Law of the People's Republic of China*. The revised *Law of the People's Republic of China on the Coal Industry* and the *Electricity Law of the People's Republic of China* emphasize the protection of the ecological environment and the prevention and control of pollution; the newly revised *Law of the People's Republic of China on Conserving Energy* expands the field of energy conservation and increases incentive measures. The legal responsibilities have been identified, and this greatly increases the effectiveness and rationality of energy conservation and emission reduction. The newly revised *Renewable Energy Law of the People's Republic of China* provides detailed regulations on the development and utilization of a variety of renewable energy, greatly optimizing the energy structure of China. It also connects energy-related activities with greenhouse gas emission reductions, which has promoted the capacity building of China in response to climate change.

China has also formulated a series of national policies to deal with climate change. The *Outline of the 11th Five-Year Plan for Economic and Social Development of the People's Republic of China* listed energy consumption intensity as a binding indicator for the first time, requiring a reduction of about 20% in five years (State Council of the People's Republic of China, 2006); *The Outline of the 11th Five-Year Plan for Economic and Social Development of the People's Republic of China* and The *Outline of the 12th Five-Year Plan for Economic and Social Development of the People's Republic of China* proposed the binding targets of 17% and 18% reduction in CO_2 emissions per unit of GDP, both of which "actively deal with global climate change" (State Council of the People's Republic of China, 2011, 2016). In 2014, the *National Climate Change Plan* (2014–2020) put forward the main goals and key tasks for China to respond to climate change by 2020. In 2015, China submitted the Nationally Determined Contributions (NDCs) document *Strengthening Actions to Address Climate Change – China's Nationally Determined Contributions* to the Secretariat of the United Nations Framework Convention on Climate Change, which clearly stated that China has determined to make CO_2 emissions peak around 2030 and make efforts to reach the peak as soon as possible, reduce CO_2 emissions per unit of GDP by 60%~65% compared to 2005, maintain non-fossil energy for about 20% of primary energy consumption, and increase forest stock by about 4.5 billion cubic meters compared to 2005.

The provinces and municipalities of China have conducted explorations of climate change legislation. Qinghai and Shanxi provinces have introduced measures to deal with climate change, while Jiangsu, Hubei, and Sichuan provinces have researched provincial-level legislation to address climate change, forming draft legislation.

In summary, China has established a legal system to address climate change, which is mainly based on its Five-Year Plans and NDCs, and is supported by eco-environmental protection and energy structure optimization.

1.3 Management system

In September 2018, a scheme for the institution, staffing and responsibilities of the newly established Ministry of Ecology and Environment was announced. This reform addressed the long-standing problems of decentralized environmental governance functions and overlapping institutions in China. The governance of the Department of Climate Change shifted from the National Development and Reform Commission to the Ministry of Ecology and Environment, requiring new capacity building while the policies and related goals have not changed. The response to climate change involves all aspects of economic and social development, and it cannot be handled by a single ministry alone. For the response to climate change, this institutional reform has the following advantages.

1.3.1 Improve systems and mechanisms to address climate change

After the institutional reform, the State Council adjusted the institutions and members of the National Leading Group for Climate Change, Energy Conservation and Emission Reduction: In July 2018 and

October 2019, the State Council adjusted the members of the National Leading Group for Climate Change, Energy Conservation, and Emission Reduction twice. In July 2019, Premier LI Keqiang hosted the first meeting of the Leading Group after the institutional reform to conduct research and planning of relevant work. At present, the reforms and functional adjustments of climate change institutions across the country have been completed. In addition, although the response to climate change is a global cause, while environmental pollution control involves domestic governance in China, there is still great potential for their synergy. Institutional adjustments provide institutional guarantees for China to synergize the efforts to fight climate change and control environmental pollution, but it also faces new challenges ("Special Policy Study Group on Global Climate Governance and China's Role", China Council for International Co-operation on Environment and Development, 2019). Furthermore, China has put forward the mid and long-term climate change targets by 2020 and 2030. Implementation is paramount now. The ecological environment system has a very strong supervision system and mechanism. Coordinating and utilizing such a system is also of great significance to promoting the goals of addressing climate change.

1.3.2 Coordinated governance of climate change and environmental pollution

The transfer of climate change functions to the Ministry of Ecology and Environment is a very good opportunity to strengthen the overall planning and coordination in response to climate change, environmental pollution control, and ecological environmental protection. In 2018, ZHUANG Guotai, Deputy Minister of the Ministry of Ecology and Environment, stated that the institutional reforms transferring the functions of responding to climate change from the National Development and Reform Commission to the Ministry of Ecology and Environment was made from the weighty consideration of "reducing fossil energy consumption from the source, promoting coordinate prevention and control of air pollution, and integrating CO and CO_2 control"[iii]. Great synergy could be generated between tackling climate change, controlling greenhouse gases and pollutant emissions. If appropriate measures are taken, this synergy will be more beneficial because they are all produced by the burning of fossil fuels. Responding to climate change requires a series of measures such as adjusting the energy structure and optimizing the industrial structure, which is also conducive to the control of air pollution. Therefore, the response to climate change and environmental pollution control has great potential for synergy. In responding to climate change, greenhouse gas emission control, air pollution control, and broader ecological and environmental protection, it is necessary to further coordinate and integrate monitoring and observation, goal setting, formulating policy action plans, and monitoring and inspection mechanisms for the implementation of policy goals.

1.3.3 Save coordination costs and improve administrative efficiency

The integration of the functions in response to climate change and environmental protection helps reduce coordination costs between departments and improve administrative efficiency; although the coverage of the two functions is different, the targets are the same. A unified management system helps reduce the cost of compliance for enterprises; In addition, China's greenhouse gas and pollutant emissions are mainly due to improper industrial and energy structures; the integration of the functions is conducive to reducing governance costs and improving governance effects. Institutional reform is not only the adjustment of personnel and departments, and the expansion of the scale of the organization, but more importantly, the integration of functions. The design concepts of the management mechanisms for greenhouse gas emission control and air pollutant emission reduction targets are different. The mechanism reform helps optimize the emission reduction management mechanism, reducing the burden of corporate emission reduction and government management costs while ensuring the emission reduction effect. The shifting of the Department of the Climate Change Response from the National Development and Reform Commission to the Ministry of Ecology and Environment will

[iii] Technical guidelines for allocating of carbon quotas in the power generation industry are expected to be issued, and the first group of key emission entities is being drafted. http: //www. ideacarbon. org/newsfree/46711 [2020-11-2].

help form a "strong department" with coordinated functions, efficient operation, and strong supervision. Such integrated coordination is expected to address serious domestic environmental issues and urgent global environmental challenges simultaneously.

1.4 Regional policy

The pilot is a new model for China to explore green and low-carbon development, and an important attempt and starting point for innovative efforts to address climate change. Pilots at different levels and in different regions have played an essential role in improving the climate change policy system and enhancing policy pertinence and feasibility.

1.4.1 Pilot low-carbon provinces and cities

In 2010, 2012, and 2017, 6 provinces including Guangdong and Hubei provinces, and 81 cities and counties such as Beijing, Shenzhen, and Guangyuan were selected in three batches to carry out pilots in low-carbon provinces and cities. Efforts are made to explore the practices and experience of both developing the economy and improving people's livelihood, and addressing climate change, reducing carbon intensity and promoting green development during the rapid development stage of industrialization and urbanization.

Each pilot takes account of the requirements of responding to climate change and local reality, combined with economic and social development plans. A target system for low-carbon development in the region was put forward to explore regional system innovation in line with national planning and regional practices to form a group of replicable and extendable low-carbon development systems. Pilot regions include Liu'an, Anhui Province-low-carbon development performance evaluation and assessment, Huaibei, Anhui Province-new project carbon approval and access mechanism, Jinan, Shandong Province-major project carbon evaluation system, Jinhua, Zhejiang Province-key energy-consuming enterprise emission reduction target responsibility assessment system, Sanming, Fujian Province-carbon data management mechanism and forest carbon sink compensation mechanism, Nanjing, Jiangsu Province-dual control system of total carbon emission and intensity (Table 2).

1.4.2 Low carbon industrial parks

In order to implement the "Notice of the State Council on Printing and Distributing the Work Plan for Controlling Greenhouse Gas Emissions during the 12th Five-Year Plan Period" and the *Action Plan for Response to Climate Change in the Industrial Sector (2012–2020)*, the Ministry of Industry and Information Technology and the National Development and Reform Commission jointly carried out the pilot of national industrial parks in October 2013, issued the *Notice of the Ministry of*

Table 2 Innovative practices of typical cities

Typical city	Innovative approach
Nanjing, Jiangsu Province	The double control system of total carbon emissions and intensity, paid use system of carbon emissions rights
Changzhou, Jiangsu Province	Total carbon emission control system, low-carbon demonstration enterprise creation system, green building development, and promotion
Lu'an, Anhui Province	Low-carbon development performance evaluation, green low-carbon, and ecological protection market system
Huaibei, Anhui Province	New project carbon approval and access mechanism, carbon financial system
Sanming, Fujian Province	Carbon data management mechanism, forest carbon sink compensation mechanism
Jinan, Shandong Province	Carbon emission data management system, total carbon emission control system, major project carbon evaluation system
Changsha, Hunan Province	Pilot "Three synergies" development mechanism, the carbon credit system
Jinhua, Zhejiang Province	Responsibility assessment system for emission reduction targets of key energy-consuming enterprises

Industry and Information Technology and the National Development and Reform Commission on Conducting the Pilot of National Low-Carbon Industrial Parks (Ministry of Industry and Information Technology [2013] No. 408). The notice called on relevant departments to research and formulate corresponding evaluation indicator systems and supporting policies, promote a group of low-carbon management models in industrial parks suitable for China's national conditions, and guide and advance industrial low-carbon development.

In June 2014, the Ministry of Industry and Information Technology and the National Development and Reform Commission reviewed and announced the first batch of 55 national low-carbon industrial park pilots. In 2015, 39 pilot implementation plans for low-carbon industrial parks were approved. The pilot parks accelerate the low-carbon transition of traditional industries and the development of new low-carbon industries by promoting renewable energy. In about three years, a group of low-carbon companies with core technologies and advanced low-carbon management capacities have been built to explore low-carbon management models in industrial parks suitable for the national conditions of China, and guide and promote industrial low-carbon development.

1.4.3 Low-carbon community pilot

"Low-carbon communities" refer to urban and rural communities that reduce energy resource consumption and achieve low carbon emissions by building a climate-friendly natural environment, as well as building, infrastructure, lifestyle, and management models (National Development and Reform Commission, 2014). In February 2015, the National Development and Reform Commission issued the *Guidelines for the Pilot Low-Carbon Communities*, which guided the pilot selection requirements, construction goals, coverage and standards of new urban communities, existing urban communities, and rural communities. The *Low-Carbon Community Pilot Evaluation Indicator System* and the research on the methodology of low-carbon community carbon emission accounting was launched in the same year.

In accordance with the *Guidelines for the Pilot Low-Carbon Communities* and related requirements, and combined with the realities in the region, local governments at the provincial level in China have formulated specific low-carbon community construction and development goals as well as related policies. The pilots of low-carbon communities are promoted throughout China.

1.4.4 Low-carbon city (town) pilot

In 2015, the National Development and Reform Commission issued the *Notice on Accelerating the National Low-Carbon City (Town) Pilot* and selected Shenzhen International Low Carbon City in Guangdong, Zhuhai Hengqin New District in Guangdong, Qingdao Sino-German Ecological Park in Shandong, and Zhenjiang Guantang Low-Carbon New City in Jiangsu, Wuxi Sino-Sweden Low-Carbon Eco-city in Jiangsu, Kunming Chenggong Low-Carbon New District in Yunnan, Wuhan Huashan Eco-New City in Hubei, and Sanming Eco-New City in Fujian as the first batch of national low-carbon cities (towns) pilot projects. Pilot implementation plans formulated by 8 pilot entities of low-carbon cities (towns) have obtained approval. The pilot focuses on absorbing and drawing on advanced international experience, combining with the actual conditions of various regions, and building a number of national low-carbon demonstration cities (towns) with the integration of industrial development and urban construction, reasonable spatial layout, intensive and comprehensive utilization of resources, low-carbon and environmentally-friendly infrastructure, low-carbon efficient production, and low-carbon lifestyles.

In addition, green transportation pilots, carbon capture, utilization, and storage (CCUS) pilots, and sponge city pilots have also been carried out. The government has conducted pilot carbon emissions rights trading, explored market-based carbon reduction mechanisms, and accumulated experience for a national carbon market.

In summary, in the process of advancing the pilot of low-carbon cities, various local areas have conducted pioneering practices, achieving significant results. Relevant experiences could be drawn upon later. At the same time, problems and gaps that restrict low-carbon development are also identified. There is still a gap between the pilot areas and social expectations in terms of low-carbon development goal setting, transition path exploration, and low-carbon development driver transformation. Especially under the downward

pressure of the economy, the lack of motivation is observed in some pilot cities (Zhuang Guiyang, 2020).

1.5 Industry policy

The industry governing body is the main formulator of China's policies for different industries. The industry policy not only reflects the overall strategic requirements for responding to climate change but also the characteristics of the industry's development and future trends. Overall, China's industry climate change policies have the following features.

1.5.1 Persist in addressing climate change as an important focus of industrial transformation and upgrading

Industries such as energy, manufacturing, construction, transportation, agriculture are not only key areas of national development but also major sources of greenhouse gas emissions. Since the reform and opening up, these industries have maintained rapid development, and the scale of the industry ranks among the top in the world. However, issues such as lack of strength and proper structure have plagued these industries. In recent years, a series of industry development plans and major policy documents formulated by China for energy, industry, construction, and transportation have incorporated the response to climate change and green and low-carbon development as an important part of their policy framework. The government promotes the green development of the industry through structural adjustments and technological advancements in the industry, and takes green and low-carbon as an important policy guide, provides an impetus for industrial transformation and upgrading, and realizes the integration and promotion of climate change policies and industrial policies. For example, the State Council announced the *Made in China 2025* in 2015, taking green development as an important guiding principle, promoting green manufacturing as a key task, and proposed energy consumption per unit of industrial added value and reduction target for CO_2 emission. A complete policy system has been established.

1.5.2 Attach importance to the leadership of industry planning

The industry policy of China focuses on the overall design and long-term planning. Industry-specific planning is an important support for China's national mid and long-term planning system. Generally speaking, the industry authorities will formulate the five-year plan or medium and long-term strategy of the industries to identify the 5–10 year development goals in line with the national Five-year Plan. Among them, green and low-carbon development is an important task and key policy for industry development. The plan generally specifies the main binding and guiding indicators of the industry's green and low-carbon development, as well as specific development tasks. After the national overall strategic plan responding to climate change is formulated and promulgated, the industry authorities will break down and implement the national overall goals and tasks in the industry. Therefore, for the industry policy on climate change, the industry authorities take leadership in policy formulation and implementation. The industry policies to address climate change often have strong relevance to its respective industry and path dependence.

1.5.3 The role of fiscal and taxation policies in policy tools is more prominent

As a country in transition, the market reform tasks have not yet been completed in China. Government administrative means still play a key role in regulating industry operation. Correspondingly, fiscal incentives and tax preferential policies have become the most critical economic policies because they are relatively simple to operate and can be integrated with China's current administrative management system. The fiscal incentives provided by China for energy conservation and carbon reduction are reflected in all levels of economic development, including optimizing the industrial structure, eliminating outdated and excess capacity, developing low-carbon technology R&D, application and demonstration, implementing major energy-saving projects, and promoting energy conservation and green product consumption, advancing government procurement of green products, controlling coal consumption and implementing natural gas substitution, developing renewable energy such as solar energy, wind energy, and biogas, encouraging the development and utilization of coal seam gas, and promoting new energy vehicles. In terms of taxation policies, a tiered

electricity and water price system has been formulated, and differentiated consumption tax policies have been implemented. Based on implementing resource tax reforms on six categories, including crude oil, natural gas, coal, rare earths, tungsten, and molybdenum, a price-based resource tax is imposed on all applicable categories. The fee fund was reformed, and the preferential tax policies for contract energy management projects were implemented to further improve the tax incentives for enterprises and products such as energy-saving and comprehensive utilization of resources.

1.5.4 Value the supporting role of technological innovation and application

Innovative development is an important policy guide for China's economic and social development. Low-carbon technology innovation, promotion, and application are not only important means for industrial transformation and upgrading but also an important way for the industry to respond to climate change. In recent years, China has focused on promoting low-carbon technology innovation and application, utilizing new technologies, processes, and equipment to upgrade traditional industries, significantly improving the technical capabilities of industries such as energy, industry, construction, and transportation, and also driving a significant reduction in the industry's carbon emission intensity. For example, in the energy industry, the accelerated application of ultra-supercritical power generating sets, large hydropower generating sets, new-generation nuclear power, large-scale solar power, and wind power generation equipment has enabled the technical and energy efficiency of the industry to reach a leading level in the world. The government strives to advance the deep integration of information and industrial technologies, and transform the traditional industrial production equipment to be larger in scale, digital, intelligent, and network-enabled. For example, key emission reduction technologies such as pulverized coal catalytic enhanced combustion, secondary energy recovery techniques such as waste heat and energy utilization are promoted in the iron and steel industry; high efficiency and energy-saving mining equipment, energy consumption control, and optimization technology in the smelting process are adopted in the non-ferrous metal industry; new chemical process enhancement technology and efficient utilization of industrial exhaust gas is adopted in the petroleum and petrochemical industry. The government determines to promote the establishment of a technological innovation system with enterprises as the major participant entities that integrates industry, academia and research, and to promote the formation of market-oriented, low-carbon technology and industry alliances that combine various forms, providing strong technical support and guarantee system.

1.6 Funding policy

In recent years, China has carried out active explorations in climate investment and financing, laying a solid foundation for promoting climate investment and financing mechanisms. The *Work Plan for Controlling Greenhouse Gas Emissions during the 13th Five-Year Plan Period* issued by the State Council focused on "issuing comprehensive supporting policies, improving climate investment and financing mechanisms, making better use of the role of the Clean Development Mechanism Funds, and actively resorting to public-private partnerships (PPP) model and green bonds to support climate change and low-carbon development". At the same time, it is proposed that during the "13th Five-Year Plan" period, it is necessary to "focus on investment policy guidance and strengthen financial support to promote the development of pilot projects for climate investment and financing". In the *Guiding Opinions on Building a Green Financial System* jointly issued by seven ministries and commissions, "climate" or "carbon" were mentioned 20 times. The Opinion specifically discusses the "development of various carbon financial products". Climate finance and green finance overlap, but each has its own focus. Green finance serves environmental protection while climate finance focuses on climate change. Climate change is a progressive manifestation of environmental problems and also falls within the category of environmental protection (Wang Yao *et al*., 2019).

In fact, as early as 2011, China had already launched carbon emissions rights trading pilot projects in 7 provinces and cities, including Beijing, Tianjin, and Shanghai. In 2017, it released the *National Carbon Emissions Rights Trading Market Plan (Power Generation Industry)*. Since then, climate investment and financing mechanisms have also continued to

develop. In 2016, China added the statistical item of "low-carbon credit total" to set system standards for statistical green credit. The China Securities Regulatory Commission revised the Annual Report Information Disclosure Guidelines of Listed Companies twice in 2016 and 2017. In May 2017, the *Financial Industry Standardization System Building and Development Plan (2016–2020)* was released. Guiding documents such as the *Guidelines for Issuing Green Bonds*, *Guiding Opinions of the China Securities Regulatory Commission on Supporting the Development of Green Bonds*, *Catalogue of Projects Supported by Green Bonds (2020 Edition) (Draft for Comment)* have also promoted the development of green bonds.

On October 20, 2020, the Ministry of Ecology and Environment, the National Development and Reform Commission, the People's Bank of China, the China Banking and Insurance Regulatory Commission, and the China Securities Regulatory Commission jointly issued the *Guiding Opinions on Promoting Investment and Financing in Response to Climate Change* [Environment and Climate (2020) No. 57]. This is the first policy document in climate investment and financing, and it was released immediately after General Secretary XI Jinping proposed the new peak goal and the vision of carbon neutrality. It is a milestone in guiding and promoting climate investment and financing, helping to achieve the new peak goal and the vision of carbon neutrality.

1.6.1 Sources of funds

According to the features of funds, funds to address climate change can generally be classified into three categories: public funds, public-private funds, and private funds. On the whole, the sources of climate funding can be categorized into domestic public financial funds, foreign public funds, carbon market funds, traditional financial markets (including international financial markets and domestic financial markets), and corporate direct investment (including domestic corporate direct investment and foreign direct investment), philanthropy and non-governmental organizations. Although the above classifications are made, these parts of the funding sources are not completely independent but are interconnected or overlapped.

At present, the main international financing channels are facing the risk of shrinking capital scales, such as international capital and Clean Development Mechanism (CDM) funds. Restrictions in fiscal budget prevent large capital influx; the traditional financial market and the current carbon market are still in a stage where they have not fully realized their financing potential. The 2008 U.S. subprime mortgage crisis and the 2010 European sovereign debt crisis have forced European and American countries to take fiscal austerity measures. This has led to the inability to guarantee public funding in developed countries. It is difficult to fulfill the commitment to transfer climate funds to developing countries. In addition, there is a large gap between the supply and demand of domestic public funds for tackling climate change. Key public finance funds do not have the income directly related to climate change, which increases the financial pressure on public finance to support the fight against climate change. (Wang Yao, 2013). In summary, public funds have failed to play their due role in guiding social capital investment, and the ability of public funds to guide social capital is still insufficient.

In addition, the funding potential of China's traditional financial market has not yet been fully tapped. Although the China Banking and Insurance Regulatory Commission actively promotes the development of green credit, the proportion of green loans in total loans still falls short; the scale of bond financing and equity financing markets is also relatively small. Financing risks and limited channels restrict the development of various participants in climate finance, especially for companies. Relying solely on internal financing cannot meet the company's growing capital needs, while external financing channels are also very limited.

1.6.2 Funding policy tools

Policy tools refer to public finance or financial tools used to realize the transfer and distribution of climate funds. The main intermediary institutions of climate funds use various financing tools to invest in the climate field. China's climate investment and financing tools mainly include grants, preferential loans, policy incentives, carbon credits and derivatives, green bonds, green funds, market interest rate loans, and company equity.

Relevant departments such as the National Development and Reform Commission, the People's

Bank of China, and the China Securities Regulatory Commission have actively promoted the development of the green bond market. They have all formulated active green bond policies and systems. Guidance documents such as the *Guidelines for the Issuance of Green Bonds*, the *Catalogue of Projects Supported by Green Bonds*, and the *Guidance of the China Securities Regulatory Commission on Supporting the Development of Green Bonds* have been issued respectively. They have fostered the development of various green bonds such as green corporate bonds, green financial bonds, and green corporate bonds.

In 2011, the National Development and Reform Commission launched pilot projects for carbon emissions rights trading in 7 provinces and cities, including Beijing, Tianjin, Shanghai, Chongqing, Hubei, Guangdong, and Shenzhen, which has promoted the building of the carbon market. Pilot areas have explored carbon financial product innovation, including carbon quota pledge loans, carbon quota repurchase, carbon bonds, and carbon funds. At the end of 2017, the National Development and Reform Commission and relevant authorities launched the national carbon emissions rights trading market and announced the *National Carbon Emissions Rights Trading Market Plan (Power Generation Industry)*, which specified the transaction subjects and types, supporting systems, regulatory agencies and steps for the establishment, *etc*.

1.6.3 Use of climate funds

The climate funds are channeled towards areas such as mitigation, adaptation, capacity building, and international cooperation. A relatively large proportion of climate capital flows to the mitigation efforts; capacity building requires a large amount of investment in the early stage. Addressing climate change is a completely new field for governments, enterprises, and the public. Funds are needed in the initial stage to support the top-level design of policies, the establishment of systems and mechanisms, the development of statistical accounting capabilities for greenhouse gas emissions, and the improvement of scientific research capabilities, the cultivation of talents, the improvement of corporate business capabilities to tackle climate change, and public awareness. Climate change is a global issue. Therefore, climate investment and financing need to be carried out in a global context, including international cooperation in climate investment and financing with developed and developing countries.

China is currently playing its role as a major responsible power and actively promoting climate investment and financing across the world. The first is to strengthen South-South cooperation in addressing climate change. The second is to expand climate investment and financing channels. It is necessary to establish the Asian Infrastructure Investment Bank and the Silk Road Fund and tap the potential of Chinese banks to guide more capital into the areas of mitigation and adaptation. The third is to develop climate investment and financing tools. Take climate bonds as an example. Since 2016, domestic issuers in China have issued a number of climate bonds overseas. For example, on October 30, 2017, the Industrial and Commercial Bank of China issued "Belt and Road" green climate bonds with a value of US$2.15 billion on the Luxembourg Stock Exchange; on June 15, 2018, the London branch of Industrial and Commercial Bank of China issued green bonds certified as climate bonds of US$1.58 billion; in 2019, the Shanghai Stock Exchange, Shenzhen Stock Exchange, and Luxembourg Stock Exchange expanded cross-border cooperation in the field of green bonds and launched cross-border green bond information display.

1.7 Coordination policy

The coordinated governance of climate change and air pollution meets the needs of national conditions and governance in China. A huge amount of energy is consumed in the process of industrialization and urbanization. Coal is still a major part of the current energy structure in China, leading to high total emissions of greenhouse gases and conventional air pollutants. It will take a long time to reduce emissions and improve environmental quality. It is urgent for China to control air pollution as the largest developing country in the world. Therefore, it is necessary to effectively integrate the two types of policies. For a long time in the past, the control of climate change and air pollution in China is managed by different departments. The climate change authorities mainly control greenhouse gas emissions by formulating energy plans, energy efficiency standards, and industrial policies, while the air pollution authorities

reduce air pollutant emissions through measures such as terminal emission control and corporate production adjustments. The synergies between the two types of policies are relatively weak.

Since 2013, the Chinese government has invested a lot of human and financial resources to strengthen the terminal treatment of key air pollutant emission sources, which has greatly reduced air pollution in urban areas of China. However, terminal emission control can only reduce a certain percentage of pollutant emissions. For example, the average sulfur dioxide (SO_2) removal rate is about 95%, and the average nitrogen oxide (NO_x) removal rate of the deNO_x facility is about 85%. In reality, due to various factors, the actual removal rate is far from ideal. Moreover, thanks to the promotion of desulfurization, deNO_x, and dust removal facilities in recent years, China's potential for emission reduction through terminal emission control has been exhausted. It is necessary to drastically reduce the burning of fossil energy through adjustments in the industrial structure, energy structure, transportation structure, and land use structure to fundamentally improve the air quality in China. The structural adjustment in these sectors is also key to reach carbon peak in China.

Taking the power sector as an example, as China's largest source of CO_2 emissions, thermal power generation accounts for approximately 50% of the total carbon emissions in China (IEA, 2019). In 2018, the total installed capacity for thermal power plants reached 1.14 billion kilowatts (including 1.01 billion kilowatts of coal-fired power), accounting for 60% of the total installed capacity of the power sector and 71% of the annual power generation. Besides, the thermal power sector is also an emission source of air pollutants such as SO_2, NO_x and dust in China. It is one of the important causes of serious air pollution in recent years. China has drastically reduced pollutant emissions from the thermal power sector through measures such as the elimination of outdated units and ultra-low emission facility retrofits. However, according to calculations, the national thermal power terminal emission control only reduced 65% of SO_2, 60% of NO_x, and 72% of dust emissions during 2014–2017 (Tang *et al*., 2019). CO_2 emissions experienced a 7.7% increase. The research conducted by the team of Professor ZHANG Qiang of Tsinghua University on the emission changes of six air pollutants in 6 sectors such as electricity, industry, residential, and transportation showed that most of the emission reductions from 2010 to 2017 were achieved by terminal emission management (Zheng *et al*., 2018). In terms of residential heating, due to the transformation of "coal to gas" and "coal to electricity", the reduction in emissions has been achieved on a small scale by reducing fossil energy use. The potential for reducing emissions through terminal emissions management has fallen sharply. Therefore, the promotion of policies to reduce the total amount of fossil energy use in the future is an important way to achieve greater emissions reductions.

II. The Main Issues and Their Analysis of the Existing Low-carbon development policy system in China

2.1 The phased targets and emission reduction paths have yet to be clearly identified

On September 22, 2020, Chinese President XI Jinping delivered an important speech at the general debate of the 75th United Nations General Assembly and emphasized that "China will scale up its Intended Nationally Determined Contributions by adopting more vigorous policies and measures, and strive to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060."[iv] The long-term goal has been determined, but issues of how to integrate the long-term goal of carbon neutrality with the goals of such initiatives as the "14th Five-Year Plan", the realization of modernization by 2035, and building a modern socialist country by 2050 remains to be specified. In addition, the goals, paths, and policies of various regions and industries to support carbon neutrality also need to be further identified.

2.2 Absence of total carbon emission control system at the national level

The existing dual control system of total energy

[iv] XI Jinping delivered an important speech at the general debate of the 75th UN General Assembly. http://www.xinhuanet.com/politics/ leaders/2020-09/22/ c1126527647. htm [2020-11-2].

and intensity is not conducive to achieving a total greenhouse gas emission control and may inhibit renewable energy development. The key to total energy consumption control is coal control. The use of total carbon emission control instead of total energy consumption control can effectively reduce the increase in coal use and its proportion and does not restrict the growth of clean energy, especially zero-carbon energy. The total carbon control also gives local governments more options to achieve a balance between coal control and the development of renewable energy, encourage them to increase the proportion of renewable energy consumption, and realize energy structure adjustment and industrial green transformation development at the same time.

2.3 Absence of legislation to address climate change

At present, many developed countries, including the United States and the United Kingdom, have specialized or quasi-specialized climate change legislation, but China still has not issued a specialized law to deal with climate change. In 2009, the Standing Committee of the National People's Congress proposed in the *Resolution of the Standing Committee of the National People's Congress on Actively Addressing Climate Change*, strengthening relevant legislation to address climate change should be taken as part of the establishment of the socialist legal system with Chinese characteristics. Such an important task is included in the legislative agenda. However, as the first developing country to formulate and implement a national climate change plan, China has not incorporated the climate change law into the substantive legislative procedures.

The "Interim Regulations on the Management of Carbon Emissions Rights Trading" have not yet been officially promulgated. At present, relevant departments are conducting legislative review of the "Interim Regulations on the Management of Carbon Emissions Rights Trading". As important progress in building the national carbon market system, the Regulations provide a policy basis and legislative guarantee for the building of China's carbon market. However, the regulations have not been officially promulgated now, which is not conducive to the operation of the national carbon market and its further promotion to more industries.

2.4 The progress of building carbon market is slow, and the scope of industry covered is relatively limited

Compared with expectations, the development of the carbon market in China is relatively slow. During the operation of the carbon trading pilots, the scale and price of carbon trading are significantly different among the pilots. In addition, the current national carbon market only involves the electricity sector. Other sectors such as chemicals, steel, and non-ferrous metals that were expected to be included in carbon market trading in the past have not been included in the scope of the national carbon market due to various factors. Therefore, the progress of the existing carbon market is slower than expected and needs to be further accelerated.

2.5 The synergy between departments is not fully utilized

In recent years, climate change functions have been transferred to relevant authorities. Therefore, the local climate change functions have also shifted from the past development and reform departments to the local ecological and environmental protection departments based on the shifting of functions on a central government level. However, in terms of the ability to implement low-carbon development policies, the capabilities of local ecological and environmental protection departments are far inferior to those of development and reform departments. Therefore, the ability to implement low-carbon development policies at the local level is insufficient. In addition, the current low-carbon development administrative system in China is still faced with multiple problems of overlapping departmental functions, obvious interest division, and low policy implementation efficiency. The transfer of the function of responding to climate change did not solve the problem of poor policy implementation, and it also brought about issues of coordinated governance between climate change response, energy transition, and industrial transformation.

2.6 The climate investment and financing policy system is not well-established yet

China has not yet established a sound carbon pricing system. Compared with government

investment, the initiative and investment of social funds are insufficient. Limited investment is made in the private sector and small and medium-sized enterprises. In addition, insufficient financing channels could be tapped to address climate change. The leveraging effect of the market has not been observed yet. At present, most of the climate funds in China are invested in energy conservation, emission reduction, renewable energy in the field of mitigation, while insufficient funds are channeled towards the fields of adaptation, capacity building, and international cooperation. As for the carbon peaking target by 2030, there is a huge demand gap from traditional financial markets such as carbon market, green credit and green bonds, self-owned funds and private capital, with an average annual climate funding gap of 1.4 trillion to 2 trillion (Chai Qimin *et al*., 2019; Li Bihao *et al*., 2017).

2.7 Lack of awareness and participation of the public in low-carbon development

At present, there is a big gap between China and developed countries in the level of social participation in low-carbon development. The public lacks a systematic understanding of the concept and meaning of low-carbon development, target system, specific actions, and its positioning. The above deficiencies have led to insufficient public participation in low-carbon development in China. The low-carbon concepts and actions taken by the public are key to the ultimate goal of high-quality low-carbon development. Therefore, it is necessary to draw upon the experience of developed countries in public participation in low-carbon development and concept cultivation.

2.8 Insufficient attention to emission reduction from consumption

Due to the characteristics of the current economic structure and industrial structure, the industrial low-carbon development system is mainly focused on production. Insufficient attention is paid to the consumption that causes carbon emissions in production. With the transformation of the economy in China, the focus of low-carbon development should be shifted from production to consumption.

III. Suggestions for improving low-carbon development policy system in China to achieve carbon neutrality

3.1 Formulating consistent low-carbon transition goals and paths in the near, medium and long term to achieve carbon neutrality

Taking the development and implementation of the "14th Five-Year Plan", "Beautiful China 2035 Plan", and "Mid-Century Strategy" as an opportunity and starting point, establish and improve the departmental coordination mechanism to deal with climate change, green and low-carbon economic development, industrial efficiency upgrading and energy low-carbon transition, and take effective overall planning means to achieve collaborative control, management, and synergy, which specifically reflects China's leading role in global climate governance. The "14th Five-Year Plan" period is a critical time for implementing and strengthening NDCs goals. It is necessary to maintain strategic determination, firmly follow a sustainable development path of green and low-carbon circulation, persist in energy conservation and carbon reduction, and control the rebound and growth of energy consumption and CO_2 emissions, and formulate and implement a total CO_2 emission control system. In terms of intensity, efforts should be made to meet NDCs target and maintain the level of carbon emission reduction during the "14th Five-Year Plan" period. In the setting of indicators, a combination of three types of targets, including total carbon emissions, carbon emission intensity, and energy structure adjustment, is adopted. It is important to select relatively developed regions and industrial sectors in the east, especially raw materials sectors of high energy consumption, and formulate targets and roadmaps for achieving carbon peak in key regions and industries during the "14th Five-Year Plan" period. It is necessary to accelerate the improvement of the carbon emissions rights trading system and market building, and gradually replace energy rights trading.

We should promote industrial transformation and high-quality economic development with a focus on reaching the peak of CO_2 emissions as soon as possible. With the impetus of accelerated implementation of innovative development strategies, we should grasp the major opportunities of low-carbon technology

development and low-carbon industrial transformation based on the realities of China's development stage and energy resource endowments, focusing on the establishment, maintenance, and improvement of the competitive comparative advantage of the overall technological system and transform it into an industrial competitive advantage. Furthermore, it is vital to specify the main direction and breakthroughs of low-carbon technology innovation, plan ahead, build a complete low-carbon technology system, enhance the future low-carbon development technology and industrial competitiveness, and strive to build an economic system for green and low-carbon circular development, and lead the world towards a social development path of low emission and climate adaptation.

3.2 Accelerate the top-level design of laws to address climate change

The *Opinions of the Central Committee of the Communist Party of China and the State Council on Accelerating the Building of Ecological Civilization* issued in 2015 further specified the need to formulate laws and regulations on climate change. The 2016 "Climate Change Law" was included in the "Research Project" in the *2016 Annual Legislative Plan of the State Council*, but the law has never entered the substantive legislative process and has not yet been promulgated. The overarching law is absent for the response to climate change.

In the near term, it is necessary to strengthen in-depth interaction with the legislature to promote the visibility and influence of climate change issues at higher levels of political decision-making. Under the current shortage of legislative resources, revision of laws and regulations related to climate change could be considered to incorporate climate change into it, especially those in the fields of environmental protection and energy development. It is proposed to control greenhouse gas emissions and give priority to ensuring that there are laws to follow in response to climate change from the perspective of strengthening the coordinated control of conventional air pollutants. In the medium and long term, consideration should be given to formulating and promulgating a special climate change law to provide the legal basis and guarantee for related work to achieve a long-term low-emission strategy, fill the gaps in climate change legislation in terms of ecological environment, and build a complete ecological civilization legal system (Tian Danyu and Zheng Wenru, 2019).

3.3 Accelerate the implementation of the national carbon market and its supporting systems

To start with, continue to improve the top-level design of the national carbon market to provide long-term and stable market expectations. The top-level design and phased goals of the carbon market require a long-term vision, which should be with the new requirements of the development of socialism with Chinese characteristics in the new era and the two-phase goal of comprehensive building of a modern socialist country. In the future, the carbon market needs to maintain the carbon price at a certain level by ensuring the scarcity of the total amount of quotas, the design of market mechanisms including carbon finance, and strict market supervision, so as to realize the long-term and stable expectations of market entities for market carbon prices. The market will influence enterprises' investment decisions through an effective price conduction mechanism, thereby promoting enterprises to strengthen the innovation of low-carbon technology and products. The second is to consolidate the legal foundation for the carbon market. Clarification of property rights is a prerequisite for establishing a carbon emission factor market (Partnership for Market Readiness and International Carbon Action Partnership, 2016; Yu Tianfei, 2007), clarifying the asset attributes of carbon emissions rights, including whether carbon emissions rights are required and whether they could be defined as property, so as to avoid market failure in the process of allocation and trading of carbon emissions rights, and provide a legal basis for strict law enforcement in case of breach of contract, which can effectively ensure the sound operation of the carbon market. The third is to enhance policy linkage and capacity building in the process of national and local institutional reforms. The fourth is to formulate a roadmap for international cooperation in the carbon market and set phased goals and key tasks. On the one hand, continue to strengthen cooperation with the European Union and other developed countries and regions, and improve the top-level design of the carbon market by drawing upon the experience and lessons of the international carbon market, and predict the problems that may arise in the

process of market development. On the other hand, with the in-depth advancement of the "Belt and Road Initiative", China could choose to promote countries along the "Belt and Road" to join the carbon market cooperation, and participate in the formulation of relevant international rules in the process, establish a route for international cooperation in the carbon market, and setting phased goals and key tasks, so as to better connect with various measures in China to promote the building of a community with a shared future for mankind. Fifth, it is still necessary for China to reserve a policy window for the introduction of a carbon tax while carrying out carbon trading, and to promote the implementation of carbon tax policies when appropriate. Due to the limitations of government management capabilities and corporate trading capabilities, the carbon market cannot cover all companies and carbon emissions, and there is a possibility of price failure in the carbon market (Zhu *et al.*, 2019). In addition, due to the large differences in regional development in China, it is difficult to effectively regulate the carbon emission behavior of various regions by relying solely on the carbon market. Therefore, the carbon emission trading mechanism alone cannot fully achieve China's carbon emission reduction goals. Based on the realities of China, it is necessary for China to reserve a policy window for the carbon tax, and choose the opportunity to apply it and coordinate with carbon trading in parallel.

3.4 Promote the synergies between local governments and industry policies to facilitate carbon peaking

In order to ensure the effectiveness and international visibility and influence of actions taken by local governments, departments, and industries, it is recommended that the Party Central Committee and the State Council formulate and release the "Carbon Peaking Action Plan by 2030" as soon as possible. The core of the Action Plan is to promote local governments and industry awareness of the importance of the actions to reach carbon peak and require all local governments and key industries to formulate roadmap and action plans, clarify the responsibilities of relevant departments in actions, and promote the policy synergy and sound governance system to reach carbon peak.

Promote local governments and key industries to carry out actions to reach carbon peak. It is recommended that the Ministry of Ecology and Environment, in conjunction with relevant departments, support and promote various provinces (autonomous regions and municipalities) to conduct in-depth research on CO_2 emission reduction potential, put forward a clear peak target year, formulate roadmaps, action plans, key projects and supporting measures, and incorporate them into local and industry development plans for practical implementation. For provinces and cities that have already proposed the goal of reaching carbon peak, it is proposed to further strengthen the demonstration of the intensity and feasibility of the target, and release the action plan for carbon peaking in 2021; for the provinces and cities in developed eastern areas with previous foundations, they are required to publish their CO_2 emission peak target year and action plan before the end of 2021; for provinces and cities with a lower level of economic development and insufficient foundation, their CO_2 emission peak target year and action plan should be disclosed before 2023. Conduct research and put forward specific requirements for peak CO_2 emissions in key industries, including peak time, key technologies, and major measures, and give priority to promoting emissions peak in industries with high energy consumption and emissions. Furthermore, explore the means and paths for local governments and industry to coordinate with each other in reaching peak goals and policy measures.

3.5 Improving the climate investment and financing policy system

The first is to implement the *Guiding Opinions on Promoting Climate Investment and Financing* and gradually build a climate investment and financing policy system. It is necessary to incorporate climate factors into the existing green investment and financing system, ensure climate-friendly orientation for investment and financing from the source, provide a standard basis for guiding market entities to carry out climate investment and financing, and regulate the product innovations of financial institutions, so as to establish a policy environment conducive to climate investment and financing. The second is to start local pilot projects for climate investment and financing as soon as possible. It is necessary to select cities with suitable conditions to

start the first batch of climate investment and financing pilot projects as soon as possible, encourage and guide pilot cities to explore differentiated climate investment and financing development paths and models, and promote the establishment of replicable and extendable experience and best practices. The third is to encourage innovation in climate investment and financing products and tools. It is necessary to develop climate credit, and introduce preferential credit policies and related tax relief policies for climate-friendly projects. We should promote the issuance of climate bonds, explore the development of climate insurance business, and encourage financial institutions to continuously innovate in terms of service models, financial products, risk management and control. In conjunction with the carbon market, development and research on carbon financial products shall be carried out on the basis of ensuring the stable development of the carbon market and controllable risks. Relevant policy reserves shall be made. It is necessary to encourage Internet financial companies to develop financial technology businesses based on climate investment and financing, and use "Internet + finance" to provide diversified, personalized, and precise climate investment and financing products, to facilitate the innovations in the means of climate investment and financing, and to better help small and medium-sized enterprises to develop green and low-carbon projects. The fourth is to establish climate investment standards. We should identify the investment practices of multilateral financial institutions, policies, commercial banks, and enterprises in the "Belt and Road" countries, analyze the green and low-carbon investment risks they face, and develop an applicable, efficient, and advanced climate investment and financing standard system. Meanwhile, we should improve diversified funding governance structure, standardize the investment behavior and orientation of financial institutions and enterprises, reduce the climate risk of "Belt and Road" investment, help the host country to achieve economic growth while achieving its NDCs commitments and sustainable development goals to address climate change, and build a green and low-carbon "Belt and Road Initiative".

3.6 Improving and innovating low-carbon consumption systems, policies, and actions

In the future, China will continue to promote the transformation of the industrial structure, and the expansion of domestic economic demand will increase the pressure on carbon emissions caused by consumption. Therefore, we should accelerate the building of a low-carbon development policy system targeting consumption, which will facilitate the high-quality economic transformation in China.

3.6.1 Strengthen communication and education, raise awareness of low-carbon consumption

Actively launching low-carbon consumption communication and education in the whole society is the basics for cultivating low-carbon consumption. Awareness of consumers leads to low-carbon consumption. Without the initiative of consumers to change themselves, there will be no conversion to low-carbon consumption. The premise for reducing the cost of low-carbon consumption is to expand the scale of low-carbon product production, which requires the joint efforts of the government, enterprises and consumers. The government's guidance of low-carbon consumption is not only a public demand for improving their own quality of life, but also an inherent requirement for sustainable economic and social development (National Climate Change Strategy Research and International Cooperation Center, 2019). The government can take systematic measures to strengthen the cultivation and guidance of low-carbon consumption values to influence consumers' attitudes towards low-carbon consumption, thereby shifting the willingness and behaviors of consumers for low-carbon consumption. Governments and companies can provide consumers with more low-carbon consumption information and knowledge to change consumers' attitudes towards low-carbon consumption and enhance their willingness to buy low-carbon products.

3.6.2 Expand the supply of low-carbon products and services

Firstly, promote the certification of low-carbon products as soon as possible. Low-carbon certification and labeling are important means to improve consumer awareness. The certification of existing low-carbon products should be promoted as soon as possible to reduce the cost for consumers to identify low-carbon products and improve the recognition and market share

of low-carbon products. Secondly, public institutions such as party and government agencies, schools, and hospitals should take the lead and give priority to purchasing and using green and low-carbon products. It is necessary to establish conservation-oriented institutions, low-carbon schools, low-carbon communities, low-carbon hospitals, *etc*. Thirdly, scientifically plan urban construction, plan urban functional zones properly, develop low-carbon public leisure and entertainment facilities and cultural consumption infrastructure, develop urban public transportation, and provide convenience for low-carbon mobility.

3.6.3 Increase efforts to promote the development of a circular economy

Promote the implementation of the extended producer responsibility system, build a green and low-carbon supply chain for enterprises and society, and extend the resource and environmental responsibilities of producers for their products from the production to the entire life cycle of product design, circulation, and consumption, recycling, and waste disposal. Promote low-carbon production and consumption through life cycle management.

3.6.4 Establish and improve the governance mechanism for low-carbon consumption

It is necessary to specify the functional positioning of relevant government departments in promoting green consumption. In the initial stage of promoting low-carbon consumption, the government should play a leading role in incorporating low-carbon consumption into economic and social development plans, formulate phased goals, and advance low-carbon consumption in a phased manner. We should strengthen the role of consumer associations in promoting green consumption, encourage enterprises to assume more environmental and social responsibilities, and establish a green consumption incentive and punishment system for the general public.

3.7 Reform and improve the global climate governance system

The first is to persist in developing international cooperation on climate change under a multilateral framework, actively play a leading role with the United States and the European Union, join hands to form a new global climate political leadership, and promote the full and effective implementation of the *Paris Agreement* in accordance with the principles of the *United Nations Framework Convention on Climate Change*. It is necessary to explore opportunities to expand leadership in a broader field of global governance through Track 1.5 or Track 2 dialogues. The second is to strengthen the green partnership with the EU, promote high-level dialogues on climate and environment between China and the EU, and conduct dialogues and exchanges at multiple levels including local governments, enterprises, and think tanks, and strengthen the cooperation between the 15th Conference of the Parties to the *Convention on Biological Diversity* (COP15) and the 26th Conference of the Parties of the *United Nations Framework Convention on Climate Change* (COP26), forming a good momentum of Sino-European cooperation. The third is to strengthen the top-level design of the "Belt and Road" climate cooperation, actively support the "Belt and Road" countries to formulate low-carbon development plans and action roadmaps, and transform from a single commercial project cooperation model to strategic cooperation. From the perspective of development, we should cooperate with countries along the "Belt and Road Initiative" to respond to climate change, build bilateral and multilateral cooperation platform for the "Belt and Road Initiative" to deal with climate change, support partner countries of the "Belt and Road Initiative" to update its NDCs targets, formulate and implement a long-term strategy for low greenhouse gas emissions by the middle of the 21st century, and promote extensive third-party international cooperation with developed countries under the "Belt and Road Initiative" to address climate change. At the same time, we adhere to the balance of righteousness and benefit and fulfill the promise of South-South cooperation. The fourth is to focus on mobilizing non-state actors. With the greater impact of global climate change and the rising public awareness of environmental protection, the role of non-state actors has become increasingly prominent (Yu Hongyuan, 2018). In view of this, it is necessary for China to attach importance to the power and positive role of non-state actors. Based on the current global climate governance, a more favorable environment and

conditions should be provided for non-state actors to participate in global climate governance. Tap into the potential of non-state actors to promote global climate governance and establish various alliances with non-state actors to achieve substantial results.

(Translated by SONG Xinyi)

References

Chai Qimin, Fu Sha, Wen Xinyuan, *et al*. 2019. Research on China's Funding Needs for Implementing Nationally Determined Contributions to Climate Change in 2030. *China Population, Resources and Environment*, 29(4): 1–9.

National Development and Reform Commission. 2014. Notice of the National Development and Reform Commission on Launching Low-carbon Community Pilot. http://www.gov.cn/xinwen/2014-03/27/content_2648003. htm [2014-3-27].

National Climate Change Strategy Research and International Cooperation Center. 2019. Results of interventions in public low-carbon consumption by communications. https://www. efchina. org/Attachments/Report/report-comms-20190804/%E4%B8%AD%E5%9B% BD2030% E5%92%8C2050%E5%B9%B4%E4%BC%A0%E6 %92%AD%E5%B9%B2%E9%A2%84%E4%BD% 8E%E7%A2%B3%E6%B6%88% E8%B4%B9%E9%A2%86%E5%9F %9F%E8%AF%86%E5%88%AB%E6%8A%A5%E5%91%8A.pdf [2019-8-4].

Li Bihao, Chen Bo, Huang Beijia, *et al*. 2017. China's climate funding needs analysis based on the CFDAM model. *Journal of Fudan University* (Natural Science Edition), 56(5): 557–563.

Tian Danyu, Zheng Wenru. 2019. Thoughts and suggestions on advancing the legislative process to address climate change. *Environmental Protection*, 47(23): 49–51.

Wang Yao. 2013, The bottleneck of climate finance needs to be broken. *Energy Review*, 1:62–63.

Wang Yao, Cui Ying, Hong Ruichen. 2019. International and domestic progress of climate finance and policy recommendations for China. *Environmental Protection*, 47 (24): 11–14.

Yu Hongyuan, 2018. Changes in the power of non-state actors in global governance: analysis of the international non-governmental organizations in the field of environment and climate. *International Forum*, 20 (2): 1–7.

Yu Tianfei. 2007. Property rights analysis of carbon emission rights trading. *Journal of Northeast Agricultural University* (Social Science Edition), 5(2): 101–103.

Research Group of the Institutes of Science and Development, Chinese Academy of Sciences. 2020. *China's policy guarantee system for low-carbon development*. Beijing.

"Special Policy Study Group on Global Climate Governance and China's Role", Chinese Council of International Cooperation on Environment and Development. 2019. Global Climate Governance and China's Role 2019 Annual Report. http: //www. cciced. net/zcyj/yjbg/zcyjbg/2019/201908/P020190830107215811332.pdf [2020-11-12].

The State Council of the People's Republic of China. 2006. The 11th Five-Year Plan for Economic and Social Development of the People's Republic of China. http://www.gov.cn/gongbao/content/2006/content_268766. htm [2020-11-12].

The State Council of the People's Republic of China. 2011. The 12th Five-Year Plan for Economic and Social Development of the People's Republic of China. http://www.gov.cn/2011lh/content_l825838.htm[2020-11-12].

The State Council of the People's Republic of China. 2016. The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China. http://www.gov.cn/xinwen/2016-03/17/content_5054992.htm [2020-11-12].

Zhu Songli, Zhu Lei, Zhao Xiaofan, *et al*. 2020. Review of China's climate change policies and actions since the "12th Five-Year Plan". China Population, *Resources and Environment,* 30 (4): 1–8.

Zhuang Guiyang. 2020. The policy design logic of China's low-carbon city pilot. China Population, *Resources and Environment*, 30 (3): 19–28.

IEA. 2019. CO_2 Emissions from Fuel Combustion. https://iea. blob. core, windows. net/assets/eb3b2e8d-28e0- 47fd-a8ba-160f7ed42bc3/CO_2_Emissions_from_Fuel_Combustion_2019_Highlights.pdf [2020-12-31].

Partnership for Market Readiness, International Carbon Action Partnership. 2016. *Emissions trading in practice: a handbook on design and implementation*. Washington, DC: The World Bank.

Tang L, Qu J, Mi Z, *et al*. 2019. Substantial emission reductions fiom Chinese power plants after the introduction of ultra-low emissions standards. *Nature Energy*, 4: 929–938.

Zheng B, Tong D, Li M, *et al*. 2018. Trends in China's anthropogenic emissions since 2010 as the consequence of clean air actions. *Atmospheric Chemistiy and Physics*, 18: 14095–14111.

Zhu JM, Fan YC, Deng XH, *et al*. 2019. Low-carbon innovation induced by emissions trading in China. *Nature Communications*, 10: 4088.