ISSN 2616-5872 Vol.4, Issue 6: 49-55, DOI: 10.25236/AJEE.2022.040607

Dilemmas and Strategies for Global Climate Governance in Industry 4.0

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Abstract: *Considering the increasingly intricate international situation, global climate change is a threat to the essential interests of all the human community. With the arrival of Industry 4.0 which is based on intelligent manufacturing development combined with digital technology, the information and automation system is highly integrated with relatively mature intelligent manufacturing model. Whereas, to utilize the rapidly developing technologies in Industry 4.0 to assist global climate governance, and to establish a complete and efficient governance system in coordination with it, further discussion and research are needed. Accordingly, this paper analyzes the recent development of Industry 4.0, and in combination with the current climate governance mechanism. Based on the analysis, this paper proposes suggestions from the extant predicament of tackling global climate issues on industrial transformation and improve laws and regulations. While maintaining the legitimacy of the global climate system with the United Nations at the core, China will promote the continuous development of global climate governance from the United Nations Framework Convention on Climate Change.*

Keywords: *Industry 4.0, climate governance, international climate convention, institution building*

1. Introduction

1.1. Global climate governance mechanism

Global climate change caused by human activities has evolved over the past 30 years and had a huge impact on people's production and life. The emergence of extreme weather and climate migration led to the realization that climate change has become a major challenge for humanity. Effective global climate governance relies on countries around the world actively fulfilling their respective climate change obligations.

The long-term global temperature control target agreed by countries in Copenhagen in 2009 was adopted by the *Paris* Agreement in 2015, that is, the global average temperature will not rise more than 2 degrees Celsius. Also, a target of no more than 1.5 degrees Celsius under certain circumstances was also proposed. In addition, the UN Intergovernmental Panel on Climate Change (IPCC) confirmed the release of the *Special Report on Global Warming of 1.5* ℃ in 2018, setting up a clear target for addressing global climate change. Countries around the world are using this as a starting point for formulating policies and evaluating the effectiveness. Meanwhile, as the focusing on global climate change and in response to the challenges of climate change on global governance, carbon neutral, net zero emissions of greenhouse gases and other related concepts become the world's focus on content, researchers and government have put forward a series of major initiatives in exploring the way of tackling climate change. It is worth noting that so far, more than 100 countries and regions in the world have publicly announced their long-term goals of carbon neutrality, however, there is still a lot of room for the global economy to achieve carbon neutrality in practice. Therefore, it is significant for countries and regions to make long-term efforts to achieve decarbonization and green development while addressing global climate change.

Considering the current international situation, the outbreak of COVID-19 in 2020 brings a lot of uncertainties for countries' investment in various aspects such as financial resources in climate governance and the international cooperation afterwards. The importance of a community with a shared future for humanity has been further strengthened after the epidemic. Countries around the world needs to increase cooperation and tackle global problems together. The impact of COVID-19 on carbon emissions was obvious, with demand for travel sharply dropped during the outbreak, leading to a short term decline in global carbon emissions. Moreover, the epidemic accelerated the application of Internet technology, which increase the popularity of home office, online learning, and video conferencing. Quick

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development of Internet technology transformed people's working and living styles, and enhanced the development of social intelligence as well as information technology in Industry 4.0. However, the spread of COVID-19 outbreak caused some negative perception of globalization in some countries, believing that excessive globalization will bring security threats and instability. Therefore, calls for counter-globalization begun to emerge, reducing the willingness of countries to participate in joint cooperation to address global climate change, which adding obstacles to the global governance of climate change.

1.2. China's climate policy system to address climate change

Since the past 40 years of reform and opening up, China has created huge economic dividends. However, the traditional economic development model led to the excessive consumption of environmental pollution and natural resources within a stage. The existing environmental problems and the resulting climate change have prompted China to conduct appropriate intervention to promote the green transformation of industry and achieve sustainable economic development. Pigu once pointed out that from the perspective of long-term development, the income of promoting economic green transformation is much greater than its cost. The effective green transformation not only needs the promotion of government policies, but also relies on the operation mechanism of the market itself, that is, with the help of the market power to achieve the effect of incentive transformation. For a long time, China has always dealt with the problem of global climate change with a positive attitude. On the one hand, China has actively participated in international environmental protection affairs. And on the other hand, China has actively explored the “China plan” to tackle climate change and built the completely environmental rule of law with Chinese characteristics.

Our government has always been paying great attention to climate change and positively participating in international climate change negotiations, international conferences and climate change actions. In 1992, as one of the first parties to the *United Nations Framework Convention on Climate Change (UNFCCC)* and the sponsors of the Intergovernmental Commission on Climate Change (IPCC), China has greatly promoted the implementation process of the Convention in international cooperation and negotiations. Besides, China firmly upholds the principles and framework of the Convention, maintains that the principle of “common but differentiated responsibilities” should be implemented, and constantly strengthens the comprehensiveness and effectiveness of the Convention. Made an effort to the adoption of the Kyoto Protocol, which China signed in 1998 and ratified in 2002. At the same time, it also enhanced the formulation and implementation of laws, regulations and policies related to addressing climate change. For example, the *Renewable Energy Law* was adopted by the Standing Committee of the National People’s Congress in 2005. In 2007, *China’s National Program on Climate Change* released a clear description of the current situation of climate change in China, the impact of climate change on China, the measures taken to deal with climate change, as well as the impact and challenges brought to China by climate change, and promised to achieve all the goals. At this stage, the domestic Carbon Tax has also launched a heated discussion. In 2013, the Asian Development Bank (ADB) issued the national environmental report that “in order to reach the long-term goal of ecological civilization construction, policy makers of the People's Republic of China need to take comprehensive financial, economic and legal measures”, to which China also made a positive response. In 2015, China proposed the new concept of international climate governance of “win-win cooperation”, and constructively leading the negotiation and signing of the *Paris Agreement* on the Paris Conference of the UNFCCC. In 2016, “The green water is jinshan yinshan: China’s ecological civilization strategy and action” released, the United Nations Environmental Conference (UNEA) affirmed the efforts in the China’s process of sustainable development, believed that China’s ecological civilization strategy provides a "Chinese Plan" for the promotion of the concept of sustainable development in the world, which can be popularized worldwide. In 2017, Chinese Foreign Minister Wang Yi put forward the four principles for the formulation of the *World Environment Convention* to express China’s basic position. In 2018, the *Environmental Protection Tax Law of the People’s Republic of China* was formally put into effect. In the same year, China’s National Conference on Ecological and Environmental Protection has clearly put forward the desire to seek international cooperation in global environmental governance and climate change, and strive to promote the formation of solutions to world environmental problems. China also issued the *Opinions of the CPC Central Committee and the State Council on Comprehensively Strengthening Ecological and Environmental Protection and Resolutely Combat Pollution*, which shows that China will participate in international ecological civilization while promoting domestic environmental governance.

In recent years, *China's 12th Green Paper on Climate Change and the Climate Change Report 2020: Improving Climate Action*, released in 2020, expressed its firm confidence in the implementation of the *Paris Agreement* and said it would accelerate low-carbon transformation through policies and other ways.

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In 2020, China solemnly announced to the international community at the 75th United Nations General Assembly and several important international occasions that China will increase its independent contribution, peak in carbon dioxide emissions by 2030 and achieve carbon neutrality by 2060. In 2021, China passed the Proposal *of the Central Committee of the Communist Party of China on the Formulation of the Fourteenth Five-Year Plan for National Economic and Social Development and the Visionary Goals for 2035*, clearly pointed out that "widely form green production and life", "accelerate the green and low carbon development", "promote green development, promote harmonious coexistence between man and nature" and other goals, during the planning of the global climate change and China's climate governance action plan.

China has been exploring and practicing in the process of addressing climate change, striving to practice the various measures of a responsible power, and continuously contributing Chinese plan to the global change of climate change.

2. Industry 4.0 drives social change and social governance

2.1. Industry 4.0

Industry 4.0, the Fourth Industrial Revolution, is based on divisions made at different stages of industrial development. Industry 4.0, the fourth industrial revolution, is a division based on the different stages of industrial development. Industry 4.0 refers to a new technological revolution characterized by intelligence, integration and the industrialization of the Internet, with artificial intelligence, unmanned control technology and clean production technology as the main elements. It is another comprehensive and profound technological revolution following the first industrial revolution marked by steam engine technology, the second industrial revolution marked by the revolution in electricity technology and the third industrial revolution marked by the revolution in information technology.

The development of the Industry 4.0 has driven profound changes in the global society, mainly manifested in:

Firstly, various emerging technologies are in full swing in the fields of energy, biology, environment and information, and digital transformation has enabled technology to develop rapidly at an unprecedented pace. Industry 4.0 aims to promote digital products and services and achieve intelligent production and life, and to achieve intelligent transformation of industries by making full use of information technology and network virtual technology.

Secondly, the technological achievements of Industry 4.0 have a profound impact on political, economic and social development, and are driving the transformation of people's production and lifestyles. Emerging technological achievements such as artificial intelligence, unmanned technology and virtual assistants are giving rise to new products and new rules of operation in the economic sphere, and traditional models are gradually being broken down, with new economic systems and corresponding governance mechanisms being reshaped.

2.2. Industry 4.0 drives global climate governance

Klaus Schwab, the founder of the World Economic Forum (WEF), believes that Industry 4.0 is no longer an innovation of a certain product or service, but an innovation of the whole system. These innovations and changes will profoundly affect all aspects of politics, economy, and culture, while bringing great changes to the management and governance system of the country and society. The intelligent and digital development of society leads to the further linkage of the whole world, resource sharing and information dissemination bring countless positive benefits and also lead to the globalization of social problems. Therefore, the problem is difficult to rely on a country or several countries to respond independently in industry 4.0, establish and improve the global governance mechanism, cooperation in dealing with climate change has become a broad consensus of the international community.

The digital and intelligent development of society in Industry 4.0 has given rise to emerging technologies such as big data technologies, which provide technical support for the decarbonization of the economy, the optimization of industrial structures, the transformation of energy structures and the development of transport electrification. The use of emerging technologies has led to a further pursuit of smart city construction. Information technology has enhanced the allocation and utilization of resources for urban development, which is conducive to activating bottom-up motivation for low-carbon development and has a beneficial impact on the global response to climate change.

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The new technological network platforms that have emerged and been improved in the era of Industry 4.0 have enhanced the ease of access to information for the public, which is conducive to the formation of a situation where individuals, enterprises and governments in society monitor each other and interact closely. The big data technology brought by Industry 4.0 makes it easier to share and analyse information, which is conducive to enhancing public awareness of climate change and active participation in climate action in their daily lives, as well as facilitating the public's timely attention to the results of the government's policy implementation in addressing climate change, mobilizing the participation of the government, society and the individuals, therefore promoting the multi-level climate governance mechanism to play the biggest role.

3. Dilemmas in the global climate change governance in Industry 4.0

Coping with global climate change is the high concern of the international community, the success or failure of global climate governance directly affect the future development, or even related to the survival and continuation of human beings. Therefore, to address global climate change, all countries in the world need to strengthen their willingness to cooperate, take joint actions and actively implement relevant obligations in domestic governance and international cooperation. Although the Paris Agreement establishes the global governance of climate change after 2020, we still find many shortcomings in the current global climate governance mechanism. How to improve laws and regulations to provide policy guarantee for the climate governance mechanism, how to comprehensively promote the implementation of the objectives of the UNFCCC and the *Paris Agreement* at the stage of Industry 4.0, and at the same time achieve a balance of finance, technology and response capacity building have become urgent issues to be resolved.

First, the global climate change response is not adequately funded and resourced, operation of the global climate governance mechanism is hindered. Although the European Union (EU) has pledged to invest 1.5% of its GDP in climate change governance, and countries such as the US and China have proposed to invest more in climate governance, it is far from sufficient to sustain the operation of the climate change governance mechanism. On 22 June 2021, the World Bank Group announced its new Climate Change Action Plan, which aims to provide developing countries with record levels of climate finance to reduce emissions and enhance adaptation, aligning financial flows with the objectives of the *Paris Agreement*. The *Paris Agreement* establishes a first tranche of the Green Climate Fund (GCF) at around US$10 billion in the current mechanism, but there has been little willingness from countries to contribute to the second tranche. As an international issue, climate governance requires a strong global mechanism to operate, and the issue of finance and the commitment of resources by countries is a major challenge that needs to be addressed by countries around the world.

Second, decarbonization of production in Industry 4.0 requires strong technological support, especially breakthroughs in decarbonization and renewable energy technologies. Since the industrial revolution, the world has developed a set of technological mechanisms centered on a range of institutions, such as intellectual property rights, which can fail in the public domain. It is difficult to achieve a truly efficient allocation of resources in response to public health emergencies by relying solely on market forces, as was the case during the COVID-19 epidemic when pharmaceutical companies inevitably sought financial returns in the development of nucleic acid testing reagents and vaccines. It is the same with climate change. It is difficult to respond to global climate change by relying solely on the market and waiting for enterprises to carry out green production and green technology research and development. Moreover, even if climate change mitigation and adaptation technologies are successfully developed, the application and transfer of these technologies still suffer very high barriers in the international market, thus, it is imperative to promote international cooperation in technical mechanisms.

Third, international cooperation on climate governance is insufficient, and green regulation of climate investment and finance in regional cooperation needs to be explored. 2020, in the annual meeting of the NGFS, China and a significant number of member countries have recognized that the risks faced by the financial sector include environmental and climate change risks, yet most countries lack mandatory measures in green investment and financing, and have not made the obligation to disclose information on environmental and climate risks a mandatory requirement in their policies. At the same time, the investment and financing system does not make a clear distinction between the classification of brown and green assets. One of the three objectives of the Paris Agreement is to promote global financial flows to low-carbon, climate-resilient areas. It is therefore important for countries to establish a corresponding domestic and international green climate investment and financing system to promote the implementation of the carbon neutrality target.

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4. China's system construction for climate change under carbon neutrality target

Establishing low-carbon emission patterns and decarbonization development pathways is the fundamental guarantee for tackling global climate change. It is important to adhere to the concept of sustainable development, improve the legal and regulatory system relevant to climate governance. Providing support for the achievement of global climate governance goals in the form of climate change legislation, such as the implementation of the Environmental Protection Tax Law. At the same time, it will promote the improvement of fiscal and tax policy guarantee system, promote the adjustment of industrial structure and the low-carbon transformation of economy, and form a strong support in the energy price mechanism, carbon market trading field and the innovation of decarbonization technology.

4.1. Industrial structure optimization and energy structure transformation

The transformation of industry and energy structure is a key measure to ensure energy supply and reduce carbon emissions. Therefore, an energy system with renewable and new energy as the main body should be formed to reduce the direct use of fossil energy such as oil and other fossil energy. Promote the development of rules for a unified carbon emissions trading market in the Industry 4.0 process and give full play to the fundamental role of the market in the transformation of the industrial and energy structure. Besides, to achieve a low-carbon and clean industrial as well as energy structure from both the market mechanism and government regulation.

From the perspective of enterprise production and energy supply, promoting clean and low-carbon energy to become the leading role. To reduce the direct use of traditional energy sources such as coal and oil, and increase the use of zero-carbon energy sources such as wind power, hydropower and photovoltaic. In energy production, pay more attention to clean replacement, and rely on clean energy to produce electricity and heat. In addition, through the collection of environmental tax, market entities in economic activities, actively explore the change of production mode, reduce environmental pollution. The Organization for Economic Co-operation and Development (OECD) defines an Environmental Tax as a tax related to the environment, that is, obligatory, non-refundable payment to the government of any taxes on the environment-related tax base. It embodies the Polluter Pays Principle, a fundamental international Principle in environmental governance. Such policies can encourage companies to develop the digital economy, control and eliminate industries with high energy consumption and high emissions, and develop advanced manufacturing and emerging technology industries. For example, the production of pure electric vehicles to drive consumption of low-carbon production.

From the perspective of product and energy consumption, promoting electric energy consumption to become the dominant one. Guiding people towards green consumption in the process of urbanization and consumption upgrading, and strengthening the dissemination of theories on global climate change and decarbonization development. Raise public awareness and encourage societies and individuals to take active action and play their role in climate governance. At the same time, focusing on the construction of infrastructure in city, such as transportation and travel combined with the construction of smart cities. As a result, promoting the decarbonization of citizens' lives and reverse the transformation of production methods.

From the perspective of energy allocation, promoting the construction of energy networks and cross-regional distribution of resources. Energy transmission and allocation need to be realized through the power grid, so it is necessary to build an energy interconnection network to ensure the allocation of clean energy. China is rich in clean energy, hydropower resources are mainly concentrated in southwest China, wind energy resources are mainly concentrated in the north areas, and solar resources are mainly distributed in northwest China. However, China's power consumption is concentrated in the central and eastern coastal cities, far away from the enrichment of clean energy resources. Therefore, the development and utilization of energy must rely on a perfect energy network and achieve the effect of regional energy circulation through power grid transmission, so as to realize the regional distribution of clean energy.

4.2. Establishing an international and domestic climate investment and financing system

A report by the Climate Bonds Initiative (CBI) shows that the scale of global green financing has continued to grow during the COVID-19 epidemic. Global green bond issuance increased by the end of 2020 compared to $266.5 billion in 2019, totaling $269.5 billion. According to statistics, the proceeds of these green bonds are mainly invested in the energy sector, followed by green and low-carbon buildings

ISSN 2616-5872 Vol.4, Issue 6: 49-55, DOI: 10.25236/AJEE.2022.040607

and green and low-carbon transport. In addition, a large number of climate-related investment disputes have emerged in The International Center for Settlement of Investment Disputes (ICSID) investment dispute cases. Therefore, it is particularly important to establish a sound climate investment and financing system in the global climate governance mechanism. We need to promote the construction of a policy system for low-carbon development, and form an investment and financing market that supports green and low-carbon through fiscal investment and other policies.

Green finance is conducive to optimizing the allocation of resources by issuing green credit securitization products and green bonds, establishing green investment and credit mechanisms, and improving guidelines for green investment projects to encourage enterprises, society and other funds to invest in green and low-carbon industries. In October 2020, China issued the *Guidance on Promoting Investment and Financing to Address Climate Change*, which clearly indicates the development targets for 2022 and 2025, thus promoting the achievement of the National Determined Contributions (NDC) target and providing a boost to the development of low carbon transition. In addition, financial institutions need to identify environmental and climate risks as key indicators in the risk control system for financial institutions' investment and financing activities. Establish rules of their activities that are compatible with international standards for climate investment and finance. Global climate governance objectives can be incorporated into the operations and investment and financing activities of banks at all levels through platforms such as central banks and regulators to clarify mechanisms for the development of green finance by financial institutions.

As for international cooperation, the setting of carbon neutrality targets is conducive to promoting environmentally friendly international investment and financing cooperation, enhancing the focus of international actors on climate protection in the area of investment. As a responsible developing country, China, in April 2019, signed the *One Belt and One Road Green Investment Principles* with 27 financial institutions from France, Germany, Kazakhstan and other countries and regions, actively organize green investment in countries along the Belt and Road and lead funds in the field of renewable energy and clean energy. As the climate governance mechanism continues to progress, China will collaborate with countries along the route to participate in clean energy construction and explore a low-carbon development path driven by scientific and technological innovation. In addition, China should also actively identify climate risks in international cooperation such as South-South cooperation and One Belt, One Road construction, consider the development trend of decarbonization and work with other countries to promote economic and social development in a more low-carbon way through climate-friendly investment projects.

4.3. Improve the mechanism of technology research and transfer in climate governance

Intelligent manufacturing in Industry 4.0 provides a boost to the development of decarbonization in response to global climate change. Achieving the goal of carbon neutrality requires breakthrough decarbonization technologies as support, which should be encouraged by complete legal and regulatory system, financial and taxation policies.

In terms of technological research and development, firstly, the development of low-carbon technologies for energy is particularly important in the fight against climate change, not only as an important means of achieving a transformation of the energy, but also in connection with technological innovation in society as a whole. The development of deep decarbonization technologies requires significant capital investment and is difficult to achieve through market forces. Greater government investment is therefore needed to fund technological innovation and to promote low carbon development in all aspects of the energy system, industry and transportation. Secondly, improve the environmental protection taxation mechanism to attach environmental protection restrictions to the operation of the market mechanism, and to play an incentive role in technological innovation. Environmental taxation can reflect various forms of tax subsidies and tax incentives in the tax system, such as tax deductions, tax exemptions and tax deferrals, to incentivize enterprises to invest more in research and development of low-carbon technologies, increase the use of resources and reduce the production of energy-intensive products.

In terms of technology transfer, improve domestic technology transfer rules to maximize the effectiveness of relevant technologies. At the same time, international negotiations on technological achievements in addressing climate change should be conducted to promote international cooperation in research, development and transfer of relevant technologies. To the extent possible, technology barriers to climate governance can be removed, and technological achievements can be shared through improved policy mechanisms to advance the global climate governance process.

ISSN 2616-5872 Vol.4, Issue 6: 49-55, DOI: 10.25236/AJEE.2022.040607

5. Conclusion

While the *Paris Agreement* establishes a new mechanism for global climate governance post-2020 and is now entering the implementation phase for the full implementation of the *Paris Agreement*. How to reflect and achieve the principles of the UNFCCC and the *Paris Agreement* is still a severe challenge for executives all over the world. Furthermore, the balance between promoting financing system, technology developing, capacity building and transparency is also need comprehensive adjustment and consideration.

On balance, it is indispensable to promote national industrial transformation and upgrading and high-quality development, and build a mechanism for coordinating economic development, technological progress and tackling climate change. It is reasonable to submit that, internationally, the consolidation and expanding of international cooperation in combating climate change and defusing the pressure on funds and decarbonize development are advantageous for future international manager to learn form.

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