Proceedings of the 4th International Conference on Materials Chemistry and Environmental Engineering
DOI: 10.54254/2755-2721/59/20240782

Research on the critical role of clean energy for dual carbon targets

Hanyang Wang

Faculty of Forestry, University of British Columbia, Vancouver, Canada

why311@student.ubc.ca

Abstract: Dual-carbon targets typically refer to the goal of reducing greenhouse gas emissions to almost zero in order to address the challenges of climate change and global warming. Achieving the dual-carbon goal means taking significant steps to reduce carbon emissions, promoting the adoption of clean energy, improving energy efficiency, and adopting sustainable development practices to mitigate the effects of climate change. This study aims to assess the critical role of clean energy in achieving the dual carbon goals. This study is organized around the concept of "dual carbon goals". These goals involve an integrated approach to combating climate change by significantly reducing greenhouse gas emissions to near-zero levels. The main objective is to address the challenges posed by climate change and global warming. This thesis will explore various strategies and approaches to achieve emission reductions. Clean energy plays a pivotal role in achieving the dual-carbon goal. The study focuses on the importance of clean energy sources such as renewable energy (e.g., wind, solar) in reducing carbon emissions. Sustainable development practices are mentioned as part of the approach to mitigating the effects of climate change. This suggests that the study could also explore the wider implications of dual carbon targets for sustainable development. This study used literature and descriptive research methods, relying on existing data, literature, and descriptive analysis to assess the current role of clean energy and how dual carbon targets could be achieved in the future.

Keywords: Clean Energy, Emission Peak, Carbon Neutrality.

1. Introduction

The research in this paper is conducted in the first phase of the dual-carbon policy, i.e., the carbon peaking phase. This paper summarizes and outlines the content of the dual-carbon policy and the current status of clean energy development. The popularization of clean energy and the implementation of the dual-carbon strategy are inextricably linked, and they are mutually reinforcing.

In the area of carbon peaking and carbon neutralization, despite important research advances, a number of research gaps and challenges remain. While there is some research on carbon-negative technologies, such as biomass charcoal capture and direct air capture, the feasibility and efficiency of these technologies still require more research and investment. Carbon-neutral measures can have far-reaching impacts on society, including employment, social equity, and the structure of the economy, and more research is needed to understand these impacts and find solutions. Shifting energy systems to renewable energy and cleaner technologies is key, but challenges such as energy storage, network expansion and renewable energy reliability need to be overcome. More policy and economics research

DOI: 10.54254/2755-2721/59/20240782

is still needed on how to create effective carbon pricing mechanisms to encourage carbon emission reductions. Reducing the cost of carbon capture and storage technologies is critical to achieving carbon neutrality goals, but this remains a research and engineering challenge. Research on carbon peaking and carbon neutrality is of great significance as they are directly related to the key challenges of combating climate change, maintaining the Earth's ecological balance and ensuring a sustainable future.

2. Analysis

2.1. Interpretation of the dual-carbon policy

The dual-carbon policy is broadly divided into three phases. Phase I: Peak Carbon Phase (before 2030). The main objective is to prevent carbon emissions from peaking at a high level by resolutely curbing the blind development of high-energy-consuming and high-polluting projects, and to complete the overall layout of high-carbon-emission industries to meet the future development needs on the basis of scientific assessment. Phase II: Peak Carbon Platform Period (about 5 years after the carbon peak). Main objective: Consolidate the emission reduction results of the previous phase and prevent the peak from breaking through. Phase III: Toward carbon neutrality (5 years after reaching peak carbon until carbon neutrality). Main objective: to steadily promote the gradual decline of carbon emissions. Carbon Neutral means that within a specified period of time, the anthropogenic removal of carbon dioxide offsets the anthropogenic emissions and reaches a relative "zero emission"[1].

2.2. Status of Clean Energy Development

2.2.1. Definition. Clean energy, or green energy, refers to energy sources that do not damage or harm the environment and do not emit pollutants. Renewable energy is energy that is obtained by extraction from natural resources and is replenished at a rate that is meaningfully fast enough on human time scales to meet existing consumption. Green energy, on the other hand, is energy that does not damage or harm the environment and does not emit pollutants. Most renewable energy sources are also clean energy sources, which can be replenished endlessly in nature and are used without damaging the environment or polluting it. Since almost all clean energy is also renewable, in recent years, due to the increasingly serious problem of climate change, countries around the world have adopted policies to encourage the development of green energy development and have implemented many programs to produce clean energy such as wind power and solar power [2].

2.2.2. Classification. Clean energy is mainly categorized into two concepts: the narrow sense and the broad sense. Clean energy, in its narrow sense, refers to renewable energy sources such as hydroelectric energy, bioenergy, solar energy, wind energy, geothermal energy, and ocean energy. These energy sources can be restored and replenished after depletion and rarely produce pollution. Clean energy in the broad sense includes the selection of mineral resources with low or no pollution to the ecological environment, such as natural gas, clean coal and nuclear energy, in the process of energy production and consumption.

2.3. Advantages of Clean Energy

First of all, clean energy has a certain degree of renewability, and renewable energy, the primary energy with the fastest growth rate, is expected to be used in two or three decades after the amount of its use will be the same as coal. Renewable energy will see increased development in the future. In addition, the underdeveloped areas have a large number of renewable energy resources, such as biomass energy, solar energy, and hydroelectricity. These have a strong renewable energy.

Clean energy is environmentally friendly, unlike fossil energy, which is more polluting and cyclical. For example, if a livestock farm with an annual output of 100,000 pigs produces 58,400 tons of manure annually, and if all these pollutants are recycled and utilized, it can produce 2.7 million cubic meters of high-quality biogas annually, which can be used by 4,000 households, about 12,000 people; and if it

DOI: 10.54254/2755-2721/59/20240782

generates electricity, it can produce 5.5 million kilowatts per hour annually; the energy generated can be reapplied to urban agricultural production, and the cycle of benefits is endless. Renewable energy provides a way out of import-dependent dependence on energy.

Renewable energy offers a pathway out of import dependency, enabling countries to diversify their economies and protect them from the unpredictable price volatility of fossil fuels, while promoting inclusive economic growth, new jobs and poverty reduction.

2.4. Clean energy measures to promote a dual carbon strategy

Fossil fuels, such as coal, oil and natural gas, are by far the largest contributor to global climate change, accounting for more than 75% of global greenhouse gas emissions and nearly 90% of all carbon dioxide emissions. Fossil fuels still account for more than 80% of global energy production, but clean energy is becoming more widespread. To avoid the worst effects of climate change, emissions need to be cut by nearly half by 2030 and reach net zero by 2050 [3].

1. Planning legislation: The government needs to formulate long-term peak carbon and carbon neutral planning with clear targets, timetables and action plans, and incorporate them into the legal framework to ensure the continuity and stability of the policy.

2. Management institutional mechanism: Establish an effective management system, including regulatory bodies, sectoral coordination mechanisms, and information collection and analysis systems, to monitor and evaluate the implementation and effectiveness of policies.

3. Binding system: Implement a series of binding measures, such as carbon pricing, an emission quota system or energy efficiency standards, to encourage the reduction of carbon emissions.

4. Incentive policies: Introduce incentive policies, such as subsidies, tax breaks, and carbon market incentives, to encourage enterprises and individuals to take low-carbon actions.

5. Science, technology, and innovation policies: strengthen support for science, technology, and innovation and invest in research and development of new technologies to improve energy efficiency and reduce carbon emissions.6. Technological innovation system: Encourage and support technological innovation, especially technologies related to clean energy, carbon capture and storage, and renewable energy.

7. Integration of low-carbon economy into social governance: incorporate low-carbon concepts into the social governance system to promote the popularization of low-carbon lifestyles and sustainable urban development.

8. Investment in green technologies: Encourage public and private sector investment in green technologies to drive innovation and growth in the areas of clean energy and sustainable development.

These measures can contribute to the implementation of carbon-peaking and carbon-neutral policies and to the reconfiguration of the global energy landscape to mitigate climate change and create new industrial opportunities. These policies need to be flexibly adapted at different stages to specific national and regional circumstances [4].

The scientific basis for guiding the realization of the “dual carbon” goal is global climate change, the global carbon cycle and its mutual feedback relationship. Currently, there are many uncertainties about the underlying theoretical and methodological issues that should guide the “dual carbon” goal. The basic scientific questions directly related to the “dual-carbon” goal that need to be answered urgently include: the technical principles of new energy sources and low-carbon industries; the climate effect of carbon neutral measures; the mechanism of formation and maintenance of natural carbon sinks; the capacity and potential of natural and anthropogenic carbon sinks; the inter-feedback mechanism between the terrestrial and oceanic carbon cycles and climate change; and the synergistic effect between various greenhouse gases. The synergistic effect between various greenhouse gases, etc. Energy structure transformation is the fundamental way to realize the goal of carbon neutrality, and its core issue is to accurately judge the alternative energy structure transformation technology pathways, understand the scientific principles of key energy transformation technologies, and break through the bottlenecks of decarbonization technologies in an effective way. Particularly important in terms of emission reduction technologies are key core technologies such as zero-emission/emission reduction, hydrogen industry, and energy storage. Industrial restructuring is an important measure for realizing the goal of "double carbon", and its core issue is to establish a new generation of multi-scale scientific research paradigm based on the breakthroughs in new energy technologies and energy substitution processes, the development of new industries and the scientific theory of carbon cycle regulation in social systems, and the development of the scientific basis for industrial restructuring. Utilizing the carbon sequestration function of ecosystems, protecting the stability of vegetation, soil and cryosphere carbon pools, and enhancing the functions of natural and man-made carbon sinks are considered to be the most cost-effective and scale-effective ways of carbon neutralization technology. The core issues are to understand the mechanism of the ecosystem carbon cycle process and the spatial and temporal variation of the carbon sink function, and the interaction between the ecosystem carbon sink and global climate change, as well as the mutual feedback. The core scientific and technological issue of ecological environmental governance is how to achieve synergistic development of environmental pollution reduction and industrial carbon reduction, synergistic development of the climate environment and human health and species protection, and synergistic development of territorial spatial management and carbon-neutral policies [5, 6].

3. Conclusion

This paper focuses on the key points regarding the impact of fossil fuels on climate change, the implementation of carbon peaking and carbon neutral policies, and the scientific basis and key issues associated with achieving these goals. Fossil fuels (e.g., coal, oil, and natural gas) are a major contributor to global climate change, accounting for the majority of global greenhouse gas (GHG) emissions. To combat climate change, measures are needed to cut emissions, including reducing them by nearly half by 2030 and achieving net-zero emissions by 2050. The implementation of carbon peaking and carbon neutral policies would require a range of measures, such as planning legislation, regulatory institutional mechanisms, binding systems, incentive policies, science, technology and innovation policies, technological innovation systems, integration of a low-carbon economy into social governance, and investment in green technologies. Achieving the dual-carbon goal needs to be based on the scientific foundation of global climate change and the carbon cycle and requires the resolution of a number of scientific issues related to carbon neutrality, including new energy technologies, mechanisms for the formation and maintenance of carbon sinks, the transformation of the energy structure, the restructuring of the industry, the carbon sinks of the ecosystem, and ecological and environmental governance. These perspectives highlight the urgency of addressing climate change and the importance of implementing carbon peaking and carbon neutral policies, as well as pointing out the scientific issues that need to be thoroughly researched and resolved.

Some of the immediate shortcomings of this paper are that the information gathered is not comprehensive enough to summarize the energy issues and current situation faced by all countries. There is also a lag in the information, with some of the information being old and not very informative.

References

[1] What are the advantages of clean energy What are the most common clean energy sources_Foxit News. (n.d.). https://www.foxitsoftware.cn/foxitnews/xinnengyuanzhuanqu/1143.html
[2] TAN Xianchun, GUO Wen, FAN Jie, GUO Jianxin, WANG Mingyue, ZENG An, SU Liyang, SUN Yi. Policy Framework and Technology Innovation Policy of Carbon Peak and Carbon Neutrality. Bulletin of Chinese Academy of Sciences, 2022, 37(4): 435-443
[3] Wikimedia Foundation. (2023, August 12). Wikipedia. https://zh.wikipedia.org/wiki/Wikipedia:%E9%A6%96%E9%A1%B5
[4] United Nations. (n.d.). Renewable Energy - Powering a Safer Future. https://www.un.org/zh/climatechange/raising-ambition/renewable-energy
[5] Zhao, Xuesong. (2022, September 3). Realizing the "Double Carbon" Goal Focuses on Science and Technology Innovation. https://eco.cctv.com/2022/09/03/ARTIgmRef4EkhRdq58SryBkB220903.shtml

DOI: 10.54254/2755-2721/59/20240782

[6] YU Guirui, HAO Tianxiang, ZHU Jianxing. Discussion on Action Strategies of China's Carbon Peak and Carbon Neutrality. Bulletin of Chinese Academy of Sciences, 2022, 37(4): 423-434