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A Study on the Current Development of Carbon Neutrality and the Impact of the Epidemic on Carbon Emissions

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Abstract

As global industrialization continues to grow and the exploitation of fossil fuels continues, climate warming is becoming more and more serious and poses more and more problems. Carbon neutrality has become an important strategy for global climate governance. Currently, some countries and regions around the world have adopted climate change-related legislation to provide legal safeguards for achieving the “two-carbon” goal. However, some countries have adopted a conservative attitude towards the carbon neutrality target. This paper summarizes decarbonization technologies and initiatives, such as switching from fossil fuels to renewable energy and developing low-carbon technologies, in the context of the relevant documents published to date. However, the impact of the sudden epidemic on global environmental pollution since 2019 requires us to rethink carbon neutrality in this context. COVID-19 has both positive and negative impacts on global pollution and carbon neutrality. Under the epidemic, carbon emissions have been reduced due to the closure policy, which is beneficial for air governance. At the same time, the heavy use of masks and the packaging waste generated caused soil deterioration. We need to pay special attention to the possibility of an acute rebound of carbon emissions after the epidemic. Countries need to develop relevant strategies to control pollution and achieve sustainable development of environmental governance to improve environmental quality and human health.

Keywords: Carbon neutral; national policies; governance strategy; COVID-19.

1. Addressing the social context of climate change

Carbon neutrality is defined as a state of net zero CO₂ emissions, which can be achieved by using new energy technologies, saving energy and reducing emissions. Transportation, energy production, agriculture, industry and even economic sectors are closely related to carbon neutral processes (Auffhammer 2018, Hu, Raghutla et al., 2021). This suggests that human activities directly or indirectly lead to greenhouse gas (GHG) emissions, and global warming is becoming increasingly serious (Change 2014).

In recent decades, the international community has begun to pay close attention to the issue of global warming, aiming to solve the fundamental problems in the current economic development model and trying to establish a low-carbon and environmentally friendly model. The world signed the Paris Climate Agreement in 2015, which states that countries will “hold global average temperature increases below 2°C above pre-industrial levels and work to limit temperature increases to 1.5°C above pre-industrial levels.”, (Wang, Wang et al. 2017).

To combat climate change, the Chinese government has set a clear goal of reaching peak carbon by 2030, achieving carbon neutrality by 2060, and striving to gradually achieve net zero CO₂ emissions. To achieve this goal, each country should achieve a global peak in its greenhouse gas (GHG) emissions as soon as possible, which has the potential to achieve a carbon-neutral world by the middle of this century.(Zeng, Ma et al. 2022).

2. International policy background

Ensuring the stability and long-term nature of climate action is important because carbon neutrality is defined as a long-term goal. Therefore, it is critical to ensure that legislation is in place to support this process. For example, the U.S. withdrawal from the Paris Agreement in 2018 (Zhang, Chao et al. 2017) and the Brazilian government’s abandonment of deforestation control policies have prevented the countries from achieving their emission reduction targets consistent with the global 2°C goal (Rochedo, Soares-Filho et al. 2018). Climate legislation can make international agreements more meaningful (Rochedo, Soares-Filho et al. 2018).

Over the decades, climate law has evolved and improved at a rapid pace. The World Climate Change Law Database shows that there are more than 1,800 laws and policies on climate change around the world (Farber and Peeters 2016). The Climate Change Act (CCA) was passed in 2008, making the UK the first country in the world to have a legally binding, long-term framework for reducing greenhouse gas emissions and adapting to climate change (Dong, Liu et al. 2022). The Act sets ambitious targets, strengthens the implementation of mandates, strengthens the institutional framework, and clarifies the specific, normative responsibilities of the UK House and the top legislature, creating a new approach to addressing and responding to climate change.

In addition, major European countries such as Germany, France and Sweden have also adopted legislation to limit greenhouse gas emissions(Duwe and Evans 2020). The German legal system for carbon neutrality is systematic, and since the beginning of the 21st century, the German government has introduced a series of national long-term emission reduction strategies, plans and action plans, such as the 2008 German Strategy for Climate Change Adaptation, the 2011 Adaptation Action Plan and the Climate Protection Plan 2050. On this basis, the German government has adopted a series of laws and regulations, such as the Federal Climate Legislation, the Renewable Energy Priority Act, the Renewable Energy Act and the National Hydrogen Energy Strategy, etc. Among them, the Climate Protection Act, which was adopted on November 15, 2019, sets Germany’s medium- and long-term greenhouse gas emission reduction targets in legal form for the first time, including that the total greenhouse gas emissions should be reduced by at least 55% by 2030 compared to 1990. In addition, to further implement the concrete action plan, the German government adopted the Climate Action Plan 2030 on September 20, 2019, which plans to specify specific action measures for each industrial sector.

In August 2015, the French government adopted the Green Growth Energy Transition Act, which established a timeline for green growth and energy transition in France. In addition, the French government proposed the National Low Carbon Strategy in 2015, which led to the establishment of a carbon budget system. From 2018 to 2019, the French government revised the strategy, adjusting the 2050 greenhouse gas emissions reduction target to a carbon neutral target. On April 21, 2020, the French government finally adopted the National Low Carbon Strategy by decree. In recent years, some countries have taken a conservative approach when faced with carbon neutrality targets. For a long time, the United States has been uncertain and erratic in its carbon neutrality goals.

However, some countries are taking a conservative approach when faced with carbon neutrality targets. For a long time, the U.S. has been uncertainty and erratic in its carbon neutrality goals. However, the new U.S. administration is recently changing its attitude and approach. After successively withdrawing from the Kyoto Protocol and the Paris Agreement, it is rejoining the Paris Agreement in 2021, joining the ranks of carbon emission reduction and actively participating in the implementation of the Paris Agreement, committing to achieve carbon neutrality by 2050. At the state level, six states have now passed legislation setting a goal of achieving 100% renewable energy by 2045

or 2050. The Australian government has not been very enthusiastic about climate reduction and its climate policy is wavering. The Australian government rejected the Kyoto Protocol when it was signed, and did not sign it until 2007.

There is uncertainty about Japan's actions and attitudes toward carbon neutrality, with a commitment to achieve carbon neutrality by 2050, a more comprehensive technology deployment for long-term emission reductions in carbon neutrality-related documents, and an emphasis on technological innovation. International Energy Agency data show that Japan was the sixth largest contributor to global greenhouse gas emissions in 2017 and has made efforts in energy efficiency technologies since the Fukushima disaster in 2011, but remains dependent on fossil energy. In response to climate change, the Japanese government announced its "Green Growth Strategy" on October 25, 2020, confirming the goal of achieving net zero emissions by 2050, which aims to accelerate the transition to a low-carbon society through technological innovation and green investment (Eskander, Fankhauser et al. 2020).

3. Strategies related to carbon neutrality

Accelerated global industrialization and overexploitation of non-renewable energy sources have resulted in the release of large amounts of greenhouse gases and rising global temperatures (Wang, Harindintwali et al., 2021). These developments have had serious impacts on the human living environment, including loss of biodiversity, species extinction, forest fires, glacier melting, and sea level rise (Mora, Spirandelli et al., 2018; Yang, Chen et al., 2022). Achieving net zero emissions requires not only reducing CO₂ emissions, but also reducing the amount of CO₂ in the atmosphere through various technological measures. By net zero emissions, we mean balancing the total amount of carbon dioxide or greenhouse gas emissions produced directly or indirectly by a country, company, or individual over a certain period of time through carbon offsetting or removal initiatives.

3.1. Reduce the use of fossil energy

Currently, different countries, regions and cities have developed strategies to improve carbon removal or sequestration and achieve carbon neutrality (Hepburn, Qi et al. 2021, Huang and Zhai 2021). Under the general trend of development with carbon neutrality as the goal, developed countries and countries with large carbon emissions have to take the lead. It is not only necessary to have reasonable policies, but also to implement them into action. Countries around the world need to reduce the use of fossil fuels and provide clean energy technology support to developing countries (Laybourn-Langton and Smith 2022). Mitigation strategies that implement distributed solar power in buildings rather than fossil fuel energy lead to low carbon emissions in the energy sector. The use of distributed solar energy has synergistic effects with adaptation, as solar energy leads to a more resilient power supply system than the terrestrial grid, which is vulnerable to temperature changes due to storms and climate change (Ripple, Moomaw et al. 2022).

3.2. Reduction of airborne pollutants

The World Health Organization has released a report calling on countries to take immediate steps to reduce emissions of short-term climate pollutants in order to reduce the health risks caused by such pollutants. The so-called short-term climate pollutants are black carbon (soot), methane, ozone and HFCs, of which black carbon is the main component of fine particulate matter (PM_{2.5}). Among the pollutants, black carbon has the shortest residence time of a few days, while methane can reach 12 to 15 years.

It is well documented that these pollutants have a serious impact on the atmosphere and that climate has an impact on public health, food, water and economic security. In an effort to raise awareness of the dangers posed by short-term climate pollutants, WHO has released a report entitled "Reducing Global Health Risks by Reducing Short-Term Climate Pollutants". The report points out that short-term climate pollutants are not only contributing to global warming, but are also largely responsible for the premature deaths of more than 7 million people each year due to air pollution.

Therefore, controlling these short-term emissions can effectively mitigate global warming. For example, reducing

black carbon emissions will improve the health of several people and save lives, especially in low-income areas that rely on biomass burning. Thus, reducing methane and black carbon pollution reduces the harm to humans and allows for better adaptation to climate change pressures (Swart and Raes 2015).

3.3. Emphasis on forestry ecological construction projects

Maintaining natural ecosystems has climate mitigation potential and, at the same time, is the first line of defense against natural hazards. We need to implement favorable forest management policies. This entails allowing existing forests to continue to grow and reach their ecological potential (Moomaw, Masino et al. 2019).

Strengthen the development and implementation of laws and regulations. Accelerate the development, revision and cleaning of forestry laws and regulations. Develop special laws and regulations such as regulations on natural forest protection, regulations on the transfer of forest trees and forest land use rights; increase law enforcement efforts, improve the law enforcement system, strengthen law enforcement inspections, expand social supervision, and establish a dynamic monitoring mechanism for law enforcement. Reform and improve the existing industrial policy. Continue to improve the target management responsibility system for afforestation and greening at all levels of government and the departmental greening responsibility system, further explore various forms of compulsory tree planting for all people under market economy conditions, and formulate relevant policies to promote the further development of compulsory tree planting and departmental greening work (Frey, Hadley et al. 2016). Through the adjustment of relevant industrial policies, promote the further development of afforestation work and increase forest resources and forestry carbon sinks. Grasp the key ecological construction projects in forestry. Continue to promote the protection of natural forest resources, the return of farmland to forest (grass), protection forest system, wildlife protection and nature reserve construction and other key ecological construction projects in forestry, grasp the construction of biomass energy forest base, through the effective implementation of the above key projects to further protect the existing forest carbon storage, increase terrestrial carbon storage and sinks (Buotte, Law et al. 2020).

3.4. Economic measures

In addition to developing measures for low carbon related aspects, economic activities need to be modified. These measures can be supported by economic cycles. In a circular economy, investments in non-renewable energy sectors such as fossil energy and forest bioenergy are curbed. Increase investments in alternative industries, solutions (Seddon, Chausson et al. 2020). This will contribute to climate change adaptation and mitigation.

The financial and investment sectors play an important role in achieving the goal of carbon neutrality (Norris and Joshi 2005). Governments need to adapt by imposing carbon taxes, removing tax incentives for climate-destroying industries, incentivizing climate-friendly industries, and ideally requiring climate mitigation measures to include an adaptation component.

4. Carbon neutrality under epidemic conditions

Since January 2020, the fight against Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) has become a top priority for countries around the world. COVID-19 has had an impact on environmental pollution and carbon emissions in countries around the world. These impacts include both positive and negative effects. Positive impacts such as the reduction in air pollution witnessed in many countries. During the pandemic, greenhouse gases that contribute to global warming were reduced (Rupani, Nilashi et al. 2020). At the same time, water pollution was temporarily mitigated and was generally lower than in the pre-COVID-19 period (Yunus, Masago et al. 2020). It is noteworthy that carbon emissions were significantly reduced during the period of the Corona Virus Disease 2019 (Praveena and Aris 2021).

In addition to the positive effects, COVID-19 has also caused a number of negative effects. For example, some urban areas have suspended their recycling programs. Sustainable waste management has been limited and soil contamination has become more severe (Patlolla, Smith et al. 2022).

Carbon emissions and other greenhouse gas emissions are changing around the world as a result of the embargo caused by COVID-19 (Patlolla, Smith et al. 2022). Overall, the International Energy Agency's World Energy Report 2020 notes a 3.8% decline in global energy demand, resulting in a 5% decline in global carbon emissions in the first quarter of 2020 compared to 2019. Surveys have shown that non-essential travel is prohibited during the COVID-19 embargo. As a result, fewer trips are made by cargo and passenger ships and carbon emissions are reduced (Duran-Grados, Amado-Sanchez et al. 2020). Similarly, with the closure control policy in place for the necessary period, there are fewer vehicles on the road and carbon dioxide emissions drop significantly (Zhang, Li et al. 2021). A survey conducted in Xi'an, China, showed a 7.5% reduction in CO₂ concentration during the period of full containment compared to the previous period (Wu, Zhou et al. 2021). In addition to this, a study made by Bournemouth University in the UK shows that campus carbon emissions are significantly reduced in 2020. This is due to campus lockdowns and online courses, resulting in a reduction in commuting and campus energy use (Filimonau, Archer et al. 2021).

In summary, carbon emissions have been reduced in different cities around the world. The policies implemented by the government to prevent the spread of novel coronavirus pneumonia have had a huge impact on global energy demand.

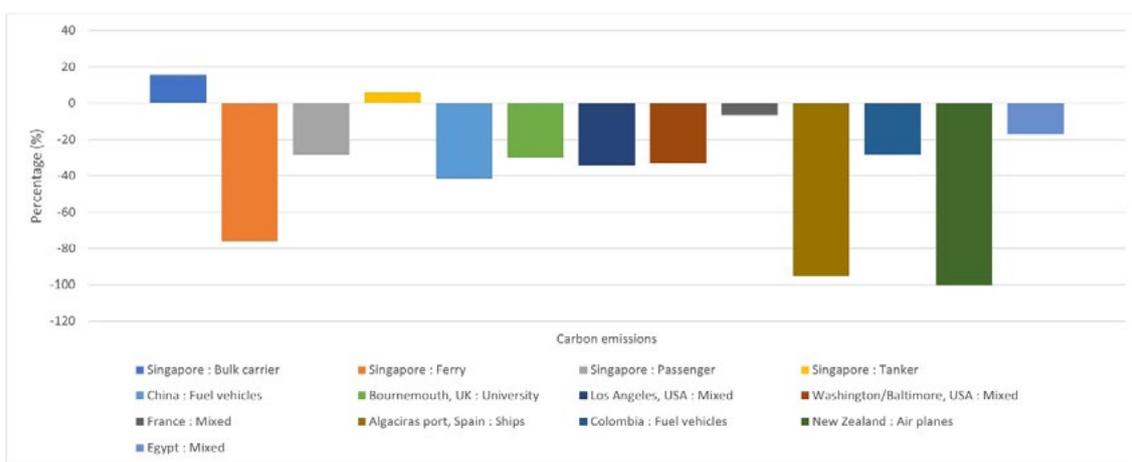


Fig.1 Percentage change of global carbon emissions (Yang, Chen et al. 2022)

We must recognize that the reduction in carbon emissions due to the epidemic is not sustainable. The relevant data show that in December 2020, CO₂ emissions not only picked up, but actually rose by 2% compared to the same month in 2019. The epidemic does act as a buffer for carbon emissions, but it is absolutely impossible to rely on it to achieve "net zero" carbon emissions. What has to be considered is the retaliatory increase in carbon emissions after COVID-19. It is necessary to think ahead of time to deal with this challenge.

First, further improve the energy efficiency. Strengthen the research and development and promotion of energy-saving technologies to improve the efficiency of energy use. Reduce the use of fossil energy and make greater use of renewable energy sources such as solar and wind power. Strengthen the research and development and promotion of low-carbon technologies (Anh Tuan, Nizetic et al. 2021). Second, encourage governments to open up trade, as adherence to free trade will help the world achieve its emissions reduction targets. Regulations include imposing minimum energy efficiency standards for residential buildings, imposing zero carbon emission targets for new construction, limiting access to clean air zones for highly polluting vehicles, and banning the sale of new diesel and gasoline vehicles (Wang and Wang 2020, Wang, Wang et al. 2021). It is worth noting that the strict control of travel during the epidemic has reduced carbon emissions. This indicates that adopting an optimal travel structure can also reduce carbon emissions. For example, the use of high-speed rail instead of air travel. Therefore, controlling the traffic flow after the epidemic is also an effective approach (Hudda, Simon et al. 2020).

5. Conclusion

Global industrialization is accelerating and the burning of fossil fuels is leading to significant greenhouse gas emissions. Global temperatures are rising. Environmental issues and human health are under serious threat. Extensive research has been conducted to mitigate the effects of climate change caused by anthropogenic greenhouse gas emissions. The issue of carbon emissions needs to be addressed in the technical, economic, environmental, and policy fields.

With the trend of carbon neutrality as a target, it is extremely important to develop relevant policies. First, from the perspective of climate governance system design, the Paris Agreement under the United Nations Framework Convention on Climate Change has formed a basic system and corresponding general rules. This introduced policy requires consumers, businesses and governments around the world to work collectively to achieve carbon neutrality by the middle of the 21st century. In addition, different countries have also published corresponding laws and regulations according to their actual situation. For example, in 2008, the UK passed the Climate Change Act. The Act makes the UK the first country in the world to have a legally binding long-term framework for reducing greenhouse gas emissions and adapting to climate change. In addition, the German Bundestag passed the Climate Protection Act and the Renewable Energy Act to strengthen climate protection and develop renewable energy. However, some countries have taken a conservative approach when faced with the goal of carbon neutrality. Addressing climate change is not the obligation of a single country, but a shared responsibility of the international community. In the face of the "double carbon" target of the century, countries should take the "community of human destiny" as a guideline. They should firmly establish the new development concept, enhance their awareness of climate change, improve their ability to grasp green and low-carbon development, and make every effort to promote the work of carbon peaking and carbon neutrality, so as to make greater contributions to promoting high-quality development and building a modernization in which people and nature coexist harmoniously.

Global carbon emissions decrease due to the impact of the novel coronavirus pneumonia. Global carbon emissions from the fossil fuel industry could fall by a record 2.5 billion tons in 2020, down more than 5 percent year-on-year, according to Robe Jackson, a professor of earth system science at Stanford University, *The Guardian* reports. In order to contain the new coronavirus, several countries have imposed embargo policies, and large-scale industrial production and residential life are at a standstill. Carbon emissions from fossil fuels show a significant decline. National urban blockades isolate and reduce carbon emissions, giving the planet a chance to catch its breath. But we cannot see the dramatic drop in carbon emissions as a victory for climate change. This decline is due to the economic collapse, not to the right decisions made by governments in terms of climate policy. Fatih Birol, executive director of the International Energy Agency (IEA), warned that global carbon emissions could disappear in an economic rebound once the novel coronavirus pneumonia is under control. Countries around the world should prepare and plan for this early on. Future efforts could focus on the impact of changes in human lifestyles on environmental pollution and carbon emissions once the epidemic is successfully contained. Prolonging the positive impacts of COVID-19 and minimizing its negative impacts will lead to future sustainability.

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