

Analysis on Current Situation of Circular Economy Development in Yunnan under the Carbon Neutrality Goal

Rongsheng Xie^{1,a}, Min Zhong^{2,b,*}

¹Yunnan New Century Environmental Protection Research Institute, Kunming, China

²Yunnan Environmental Science Society, Kunming, Yunnan, China

^axiers90@sina.com, ^b244216781@Qq.Com

*Corresponding author

Keywords: Yunnan; carbon neutrality goal; circular economy; current situation

Abstract: In the current increasingly complex international situation, global climate governance faces more challenges. As the country with the world's largest total carbon dioxide (CO₂) emissions, China has pledged to strive to achieve carbon peak by 2030 and carbon neutrality by 2060. However, carbon neutrality is a complex system engineering, and the development of circular economy has been proven to be one of the important paths to address climate change and achieve carbon neutrality. Based on the actual situation in Yunnan, this paper explains the key role of circular economy development in achieving the carbon neutrality goal, and explores how Yunnan can help achieve the carbon neutrality goal through circular economy.

1. Introduction

At present, the global response to climate change is unprecedentedly urgent. In order to deal with climate change and reduce the total amount of greenhouse gas emissions, mainly carbon dioxide (CO₂), 37 countries, including China, formally committed to carbon neutrality by incorporating them into national laws, submitting agreements or policy declarations; and a further 52 countries have made verbal commitments ^[1]. As the country with the largest total CO₂ emissions in the world, China made a solemn commitment in September 2020 to strive to achieve carbon peaking by 2030 and carbon neutrality by 2060.

The report of the 19th National Congress of the Communist Party of China proposed to establish an economic system of green, low-carbon and circular development. As a scientific and brand-new economic development model, circular economy has changed the traditional linear economic model of "exploitation-production-disposal". The circular economy, which decouples economic development from resource extraction and environmental impact, is of great value in achieving carbon neutrality.

According to the calculation of China Circular Economy Association, the comprehensive contribution rate of circular economy to China's carbon emission reduction during the "13th Five-Year Plan" period exceeds 25%. On the one hand, circular economy can effectively improve

resource output rate, reduce carbon emission intensity per unit product, and reduce carbon emission in value chain, supply chain and industrial chain by saving and intensive utilization of resources and changing the production and use methods of products and materials. On the other hand, circular economy helps to open up the channels of factor circulation and realize the effective recovery of waste resources, which can improve the efficiency of resource circulation and reduce the dependence of economic development on primary resources. In this way, resource security is ensured and the resource constraints that may be faced in achieving the carbon neutrality goal are alleviated. In this context, this paper compares the development status at home and abroad, explains the key role of the circular economy in achieving the carbon neutrality goal, and puts forward policy recommendations for promoting the development of the circular economy and achieving the carbon neutrality goal.

2. Path analysis of circular economy to help carbon neutrality

Circular economy follows the laws of ecology and economics; it aims to construct a production and consumption mode of “resource-product-renewable resources” through the implementation of the “3R” principle of Reduce, Reuse and Recycle ^[2], which is an important path to achieve carbon neutrality.

2.1 Control source input and reduce carbon emission sources

Through ecological design and clean production, the input of various resources such as raw materials, energy and water is reduced to meet the established production purpose or consumption demand, thereby achieving resource conservation and carbon emission reduction at the source of economic activities. Taking the automobile manufacturing industry as an example, abandoning unnecessary accessories from the design side, simplifying the structure of the automobile, and switching to light-weight materials can reduce the resource consumption of the automobile manufacturing process and reduce carbon emissions by 89 million tons per year ^[3].

By innovating manufacturing technology, the circular economy can significantly reduce the consumption of key mineral resources from both the reduction of consumption and the substitution of materials, thereby ensuring the realization of the carbon neutrality path. Taking the ternary lithium-ion battery widely used in electric vehicles as an example, through tracking the material flow of electric vehicle batteries, it is found that adopting a circular economy strategy to enhance the elasticity and sustainability of the automotive supply chain can reduce the demand for lithium, cobalt, nickel and other primary resources; and reduce the mining of primary raw materials, thereby effectively alleviating the resource constraints caused by the rapid expansion of electric vehicles in the context of carbon neutrality. The technology-driven cobalt reduction strategy can reduce the cumulative demand for cobalt for electric vehicle batteries in the EU by 54.6% from 2017 to 2050 ^[4].

2.2 Extend product cycle and improve utilization efficiency

Achieve resource saving and carbon emission reduction by prolonging the life cycle of products and materials, and improving the utilization efficiency of products and materials in the production flow process. More than 50% of the greenhouse gas emissions in the industrial field come from material production, and improving the reuse rate of materials can reduce greenhouse gas emissions ^[5]. Taking plastic as an example, currently 95% of plastic packaging materials are discarded after their first use, and only 14% of plastic packaging can be recycled ^[6]. By improving the way plastic is used, carbon emissions will be drastically reduced. Simple processing of “bad-looking” fruits and

vegetables into cans or spreads, as well as discounts on expiring products, can extend the life cycle of foods. This can effectively avoid 50% of food waste and reduce global carbon emissions by 1.4 billion tons per year by 2030 ^[7].

Improving the recycling rate of materials also plays an important role in resource conservation and carbon emission reduction ^[8]. For example, it will cause huge waste to directly recycle the retired batteries of new energy vehicles. The scrapped power batteries are inspected and reorganized, and the lead-acid batteries are replaced. Under the premise of ensuring safety, the replaced batteries can be used in energy storage fields such as communication base stations and low-speed electric vehicles ^[9].

2.3 Recycle resources and reduce carbon emissions

By promoting the comprehensive utilization of waste, the savings and substitution of primary resources can be achieved, thereby reducing carbon emissions from the mining, smelting, and processing of primary resources. Taking the non-ferrous metal industry as an example, the utilization of recycled non-ferrous metal resources can greatly reduce energy consumption, and the energy consumption of recycled copper, recycled aluminum, and recycled lead production; compared with primary copper, primary aluminum, primary lead production energy consumption can be reduced by 1054 kg standard coal/ton, 3443 kg standard coal/ton, 659 kg standard coal/ton. In 2018, the global aluminum industry emitted a total of 1.1 billion tons of CO₂, of which primary aluminum production, which accounts for 2/3 of the output, contributed 95% of carbon emissions, while secondary aluminum production, which accounted for about 1/3 of the output, contributed only 5% ^[10]. In the case of growing demand, the production of secondary aluminum needs to be further expanded to achieve the goal of reducing carbon emissions by 75% per ton of aluminum produced by 2050 ^[11]. The recovery and utilization of key mineral resources are also of great value to achieve carbon neutrality. Improving the recycling level and utilization efficiency of key mineral resources can reduce the dependence on primary resources. In the agricultural field, regenerative agricultural practices can reduce the input of carbon-intensive production factors and increase soil carbon sequestration capacity ^[7].

3. Countermeasures for Yunnan to develop circular economy to achieve carbon neutrality

The “3R” principle of circular economy is of great value to achieve carbon neutrality. At present, developed economies such as the European Union have taken the development of circular economy as an important path to address climate change and achieve carbon neutrality ^[12]. The National Development and Reform Commission of China issued the “14th Five-Year Plan for Circular Economy Development”, which basically determined that the development of circular economy is one of the important paths to improve resource utilization efficiency and reduce greenhouse gas emissions, and support the realization of carbon peak and carbon neutrality goals. After years of development, Yunnan Province’s circular economy has made certain achievements. Under the background of realizing the new goal of carbon neutrality, Yunnan Province must focus on solving the existing problems and challenges in the development of circular economy, and steadily promote the innovation of circular economy mechanism, policy, model, technology and product oriented to the goal of carbon neutrality, so as to provide support and guarantee for realizing the goal of carbon neutrality.

3.1 Improve the circular economy institutional system for carbon neutrality

The connotation and relationship between circular economy and carbon neutrality should be

clarified, and the path for circular economy to achieve the goal of carbon neutrality should be clarified. At the provincial level, make overall planning and top-level design for circular economy and carbon neutrality, build a circular economy governance system oriented towards carbon neutrality goals, and play a leading role in the development of circular economy in all parts of the province.

To achieve the goal of carbon neutrality, in accordance with existing laws and regulations, accelerate the formulation of local normative documents such as “comprehensive utilization of resources” and “addressing climate change”, and further improve the circular economy legal system that adapts to carbon neutrality.

Formulate carbon-neutral circular economy development plans for key regions, industries, and enterprises by category, and clarify the stage goals, implementation routes, and action plans for green, low-carbon, and circular development of relevant entities. Set specific carbon emission reduction targets for circular economy-related industries and enterprises to ensure the coordinated advancement of circular economy development and carbon neutrality actions. Guide local governments to flexibly use fiscal and taxation policies and industrial policies to support the development of circular economy industries, efficient use of energy and recycling of resources.

3.2 Establish a circular economy technical support system for carbon neutrality

In recent years, Yunnan Province has made use of its green energy advantages and adhered to world-class standards to build advanced manufacturing clusters such as green aluminum and green silicon, and achieved remarkable results. However, there are still many industries at the middle and low end of the international industrial division of labor, relying too much on factor-driven, and there are shortcomings in industrial development, especially the level of manufacturing development is relatively low. Facing the new situation, we should seize the new opportunities of the new round of scientific and technological revolution and industrial transformation, and lead the strategic emerging industries to be driven by innovation.

Implement green and low-carbon recycling technology innovation and technical research actions. Incorporate circular economy and carbon neutral strategic technologies into key R&D plans and major scientific and technological projects. Set up relevant scientific research projects to promote the efficient utilization of rare resources such as key metals, the recycling and dismantling of new waste materials such as power batteries, and the R&D and application of circular low-carbon technologies including regenerative agriculture.

Encourage the deep integration of enterprises, universities and scientific research institutions. Collaboratively cultivate innovative talents in the field of circular economy and carbon neutrality, build green and low-carbon circular technology innovation project incubators and collaborative innovation and entrepreneurship platforms, and promote the transfer of green and low-carbon circular technologies and the transformation of innovation achievements.

Rely on scientific and technological innovation and increase technological research and development efforts. Organize relevant departments to carry out joint research on key technologies, and vigorously improve the technical level of circular economy such as the comprehensive utilization of co-associated resources and tailings, the development and utilization of biomass energy, and the cascade utilization of energy. Introduce and absorb foreign advanced circular economy equipment and technology, and promote the “Mode of Yunnan” utilization of technology.

4. Conclusion

Based on the results and discussions presented above, the conclusions are obtained as below:

(1) As the country with the world’s largest total carbon dioxide (CO₂) emissions, China has

pledged to strive to achieve carbon peak by 2030 and carbon neutrality by 2060. However, carbon neutrality is a complex system engineering, and the development of circular economy has been proven to be one of the important paths to address climate change and achieve carbon neutrality.

(2) Circular economy development is the key role to achieve the carbon neutrality goal in the current increasingly Yunnan situation.

(3) Clear carbon peaking and carbon neutralization strategies should be formulated, technical routes and action plans. Make full use of Yunnan's abundant water energy resources, light resources and forest carbon sink resources, and vigorously develop renewable energy, underground space energy industry, carbon reduction and coal reduction industry and hydrogen energy full chain industry. Combined with the use of carbon capture, utilization and storage (CCUS) technologies, it is believed that Yunnan is on track to reach its carbon peak by 2030 and be the first to achieve carbon neutrality in China by 2050.

Acknowledgments

This work was financially supported by the Environmental Protection Special Fund of Yunnan Province (XH2021014).

References

- [1] Data Information: An overview of academic research and government planning for global carbon neutrality. *Bulletin of Chinese Academy of Sciences*, 2021, 36(3): 367-370.
- [2] Dajian Zhu, Yuan Zhu. Deepen Theoretical Studies of Circular Economy under the Background of Eco-civilization. *Bulletin of Chinese Academy of Sciences*, 2013, 28(2): 207-218.
- [3] Allwood J M. Unrealistic techno-optimism is holding back progress on resource efficiency. *Nature Materials*, 2018, 17(12): 1050-1051.
- [4] Baars J, Domenech T, Bleischwitz R, et al. Circular economy strategies for electric vehicle batteries reduce reliance on raw materials. *Nature Sustainability*, 2021, 4(1): 71-79.
- [5] Hertwich E G. Increased carbon footprint of materials production driven by rise in investments. *Nature Geoscience*, 2021, 14(3): 151-155.
- [6] Ellen MacArthur Foundation. *The New Plastics Economy—Rethinking the Future of Plastics*. (2017-11-22) [2021-08-30]. <https://emf.thirdlight.com/link/ftg1sxxb19tm-zgd49o/@/preview/1?o>.
- [7] Ellen MacArthur Foundation. *Completing the Picture: How the Circular Economy Tackles Climate Change*. (2019-09-26) [2021-08-30]. <https://emf.thirdlight.com/link/2j2gtyion7ia-n3q5ey/@/preview/1?o>.
- [8] Mathews J A, Tan H. Circular economy: Lessons from China. *Nature*, 2016, 531: 440-442.
- [9] Safanama D, Ji D X, Phuah K C, et al. Round-trip efficiency enhancement of hybrid Li-air battery enables efficient power generation from low-grade waste heat. *ACS Sustainable Chemistry & Engineering*, 2020, 8(50): 18500-18505.
- [10] IAI. *Aluminium Sector Greenhouse Gas Pathways to 2050*. (2021-03-01) [2021-08-30]. <https://international-aluminium.org/resource/aluminium-sector-greenhouse-gas-pathways-to-2050-2021/>.
- [11] Cullen J M, Allwood J M. Mapping the global flow of aluminum: From liquid aluminum to end-use goods. *Environmental Science & Technology*, 2013, 47(7): 3057-3064.
- [12] Xiaoyan Meng, Yi Wang, Xinzhu Zheng. Circular Economy Strategy for the Target of Carbon Neutralization: Management Experience and Enlightenment from Turkey, Finland. *Environmental Protection*, 2021, 49(12): 76-80.