Article

2025 3rd International Conference on the Sociology of the Global Economy, Education, Arts and Humanities (GEEAH 2025)

Study on Fiscal Policy Options for Promoting the Development of China's Low-Carbon Economy

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Abstract: In the field of international climate governance, the low-carbon economy has become an important path for China to achieve high-quality development. The current domestic energy structure is still dominated by fossil energy; the low-carbon transformation of industries is facing technological bottlenecks and cost pressure, which urgently requires fiscal policy to play an incentive and regulatory role. The existing fiscal tools also have their own shortcomings regarding support, structural optimization and cross-sector synergies, which limit research and development of green technology, clean energy substitution and carbon market construction. Inspired by the experience of the development of the international carbon tax system and green subsidy mechanism, a multi-level financial support framework should be constructed in line with the national conditions, and policy resources should be promoted for precise allocation towards the low-carbon sector, with the aim of striking a balance between economic growth and ecological protection dual goals.

Keywords: low-carbon economy; fiscal policy; policy options

1. Introduction

Faced with the compounding dilemmas of climate change and the goal of carbon neutrality, the low-carbon (or carbon-neutral) economy has moved from idea to implementation, becoming a pivotal variable in redefining the global competitive environment. As the world's largest carbon emitter, China faces the bind of energy security, industrial transition (or upgrading), and the environment. Fiscal policy is not only the baton of resource allocation, but it also acts as the regulator of market behavior, pushing the limits of traditionally designed logics. Existing policies have made gains in new energy subsidies and the development of an environmental protection tax system, but fragmentation lets down the synergies of both policies and expenditures of resources, and pressing challenges remain around centralizing investments around technology research and development, carbon pricing, etc. Finding a dynamic balance between promoting economic growth and meeting emission reduction constraints has become the core challenge in innovating fiscal tools.

Received: 10 March 2025
Revised: 18 March 2025
Accepted: 24 April 2025
Published: 29 May 2025

2. The Theoretical Basis of Low Carbon Economic Development

2.1. Concept and Connotation of Low Carbon Economy

A low-carbon economy is an economic system that reduces energy consumption, greenhouse gas emissions, and enhances energy efficiency. The low-carbon economy happens with a transition of our energy consumption structure and our means of production and is accomplished by fostering both economic growth and ecological protection through

technological innovation and institutional arrangement. The idea originated from the global climate governance framework and its heart is about internalizing carbon constraints in the market mechanisms, which avoids traditional high-carbon path dependencies. The low-carbon economy, by its nature, is not merely about phasing out energy-intensive industries. Instead, it entails systemic changes through clean energy substitution, improvements in energy productivity and efficiency, carbon asset management, and coordinated energy policies. These policies must operate across both the supply and demand sides, including efforts to alter consumption behavior and to enhance carbon sink capacity. Fiscal policy serves the function of correcting market failure induces tax leverages to correlate mismatches in resource allocation and motivates firms, through subsidy mechanisms, to engage in technological innovation and promote sustainable economic development to ultimately build a low-carbon value network across the entire value chain of production, circulation, and consumption. The establishment of this economic form marks the paradigm shift from industrial civilization to ecological civilization, and the depth of its development is directly related to the country's strategic position in global green competition [1].

2.2. Mechanism of Fiscal Policy to Promote Low Carbon Economic Development

Fiscal policy reshapes price signals in the transition to a low-carbon economy by correcting market externalities and directing production factors toward green sectors. The reconfiguration of the tax system directly intervenes in the cost function of firms, while the joint effect of a carbon tax and resource tax internalizes the negative externalities of environmental harm, compelling high-carbon firms to change their production process. Targeted subsidies and special transfers create positive incentives, lowering the marginal cost of research and development of clean technologies and facilitating faster commercialization of technologies in photovoltaic, energy storage, and other related industries. Establishing government procurement standards is significant when considering their role as a market signal. The strategy of preferential procurement for green products can drive the low-carbon transformation of the entire supply chain. More fundamentally, fiscal policy aims to create long-term stable expectations for the market through a carbon pricing mechanism, while also stimulating financial institutions to develop carbon financial derivatives, creating a value transmission chain from the production side to the consumption side. Central to this mechanism is the function of state finance's redistributive role to establish new resource allocation rules in a traditional area of market failure.

3. Status Quo of China's Low Carbon Economic Development and the Problems It Faces

3.1. Energy Structure with High Carbon Characteristics Is Obvious

China's energy consumption has long been characterized by high carbonization, and the high proportion of traditional fossil energy has become the core contradiction constraining low-carbon transformation. The status of coal as the main source of energy has not yet fundamentally changed, and its deep penetration in power generation, industry and other fields has led to a higher carbon emission intensity per unit of GDP than the global average. Insufficient flexibility of the power system and renewable energy consumption bottlenecks are intertwined, and the process of clean energy substitution is subject to the double constraints of insufficient technical reserves and lagging infrastructure. In order to address the dilemma of the energy structure, the government has in recent years made efforts to build a diversified policy toolbox, photovoltaic wind power financial subsidy mechanism covering the whole industry chain, renewable energy power consumption responsibility weighting system to guide the market resource allocation, the national carbon market to start trading to form the price discovery function. The pilot project for clean winter heating in northern regions has promoted the treatment of loose coal through dedicated policy funding mechanisms, and the new energy vehicle purchase

tax reduction and exemption policy has continued to release green kinetic energy on the consumption side. The scale of application of clean energy technologies has continued to expand, and the completion rate of ultra-low emission transformation of coal power plants has exceeded the set target, but regional development imbalances and energy security concerns still pose real challenges to the low-carbon process [2].

3.2. Progress of Low Carbon Transformation of Industries Is Slow

China's industrial low-carbon transformation faces the dual resistance of path dependence and technological iteration, and the speed of energy efficiency improvement in heavy industry lags behind the international advanced level. High-carbon industries such as iron and steel and building materials still contribute significantly to the value added of China's manufacturing sector. As a result, the fossil energy lock-in effect remains pronounced, and the carbon emissions intensity per unit of product is approximately 30% higher than that of similar enterprises in the European Union. Germany set up a special transformation fund to support the Ruhr area coal and steel industry technology transformation, France to promote industrial ecological park model to promote industrial clusters recycling transformation, such experience on the upgrading of China's traditional industrial base has reference value. Although current fiscal policy has established green credit subsidies and a tax credit mechanism for environmental protection equipment, but enterprises still lack strong incentives to reduce emissions due to the financial burden associated with cost-sharing in the transformation process. Small and medium-sized enterprises (SMEs) are facing the dilemma of a single financing channel for cleaner production transformation, and the application of low-carbon technologies suffers from a lack of economies of scale. The British Industrial Decarbonization Challenge Fund adopts the cost-sharing model of the government and enterprises, and Japan has implemented the industry energy efficiency leader system to stimulate the innovation of enterprises, which can supplement the existing incentive system in China. A regional industrial synergy mechanism for reducing carbon emissions has not yet been fully established. Cross-provincial ecological compensation and the trading of carbon quotas still require improvement. Additionally, in some industrial parks, disruptions in material flows hinder the effective functioning of the circular economy system. Decentralization of clean technology R&D inputs restricts the efficiency of results transformation, and the collaborative innovation system of industry-university-research-use needs to learn from the multi-party linkage mechanism of the U.S. Energy Innovation Center.

3.3. Weak Innovation Capacity of Low Carbon Technology

China's independent innovation system for low-carbon technologies has yet to break through the core bottleneck, and there is a structural contradiction between insufficient patent layout and lagging transformation of achievements in key areas. The localization rate of key materials for clean energy equipment remains low, the engineering application of cutting-edge technologies such as hydrogen energy storage is still in the demonstration stage, and the commercialization of carbon capture and storage technology lags behind that of developed countries in Europe and the United States. In order to strengthen the ability to attack technology, the national level has established a special subsidy system for renewable energy technology, deployed a national key R&D program in the low-carbon field, and piloted a green technology bank to promote the securitization of intellectual property rights. Local governments have explored the establishment of industry-university-research joint innovation funds, and implemented targeted tax credits for niche areas such as thin-film photovoltaic batteries and smart grids. Shanghai Zhangjiang Science City has set up a low-carbon technology incubator cluster, Shenzhen has implemented a green patent fast-track examination channel, and the Science and Technology Innovation Board has set up a special channel for listing green enterprises to accelerate the integration of technology capital. Current R&D investment in low-carbon technology is fragmented.

The development of cross-disciplinary collaborative innovation platforms lags behind the model set by the Fraunhofer Institute for Applied Research in Germany, and the insufficient proportion of funding for basic research restricts the breakthrough of original innovation. The technical standard system and market application scenarios have not yet formed an effective connection, some laboratory results are difficult to match the actual needs of industry, and there is a risk that the pace of technological iteration may become misaligned with the rhythm of industrial upgrading.

3.4. Insufficient Support of Low Carbon Development System

The development of low-carbon systems has not kept pace with the necessities of transitional practices, there are clear gaps in the legal system's fragmented structure, and there is a lack of an integrated market linkage mechanism between carbon emission rights trading and the trading of energy use rights. There is an institutional gap in the design of environmental taxes specifically targeting carbon emissions, and there are no established standardized rules for measuring the realization of the value of ecological products (marine carbon sinks and forestry carbon sinks) so that market incentives can reach their full potency. There are multiple blind spots in the regulatory framework, green financial standards and carbon accounting systems have not established a uniform national paradigm. The inconsistent quality of corporate environmental disclosures weakens the effectiveness of policy implementation. The deeper underlying contradiction is in not having existing linkages across sectors, with some examples being that ecological and environment policy tools and fiscal and taxation systems have not generated a combined effect. The low-carbon performance assessment indicators of local governments would additionally hinder cross-sector collaboration as they are still tied to a traditional GDP performance concept [3]. Problems are also evident in the lack of alignment with international frameworks, the EU carbon border adjustment mechanism and other external systems under the impact of the carbon footprint certification system of domestic enterprises has not yet established an effective defense barrier. Such institutional shortcomings reflect the crisis of adaptability between the modernization process of governance and low-carbon goals, and the urgent need to build a three-dimensional support system covering law, market and regulation.

4. Fiscal Policy Options for Promoting China's Low-Carbon Economic Development

4.1. Improving Fiscal Expenditure Policies

The optimization of fiscal expenditure policies should focus on the efficiency of fund allocation and sustainability. Through the establishment of a cross-sectoral coordination mechanism, special funds scattered in the energy and ecological fields should be integrated, so as to realize targeted support for key links in the renewable energy industry chain. Instead of the traditional installed capacity subsidy model, the relevant personnel can implement the project life cycle performance evaluation standard, and incorporate the operational efficiency of the equipment and ecological restoration into the assessment system. It is necessary to optimize the government procurement catalog, giving priority to low-carbon technology solutions with independent intellectual property rights, so as to guide the market to form expectations about the application of clean technology. The central government should set up a special transfer payment channel and implement a cross-regional compensation mechanism for regions with ecological barrier functions, so as to alleviate the pressure on local finances. The government should also establish a risk compensation pool to guide private capital into carbon capture projects by offering subsidized interest rates, thereby reducing commercialization risks. Yancheng, Jiangsu Province's "wind, hydrogen and storage" integration demonstration base, relying on the integration of provincial financial special funds, built the country's first one million kilowatts of offshore wind power supporting energy storage facilities, and its cross-regional eco-compen-

sation mechanism attracted social capital to participate in the development of beach photovoltaic, which demonstrated how government financial support can leverage and attract diversified investment from other sectors.

4.2. Optimizing Taxation Policies

In terms of tax policy innovation, a multi-dimensional adjustment mechanism needs to be constructed so that the cost of carbon can be accurately embedded in the decision-making system of enterprises. There is room for expanding the scope of the environmental protection tax to include aviation kerosene and marine fuel oil, thereby strengthening the regulation of carbon emissions from both the aviation and international shipping sectors. Consumption tax rates should be designed in a differentiated way to strengthen the economic constraints on energy-consuming consumer goods, and a dynamic adjustment mechanism should be introduced for the exemption and reduction periods of purchase tax on new energy vehicles. The VAT refund policy should prioritize carbon capture equipment manufacturing as well as the construction of hydrogen energy storage and transportation facilities, so as to stimulate the key links of the industry chain to achieve technological breakthroughs. It is necessary to explore the establishment of a pilot carbon tax linked to the carbon emissions trading system, and to implement a stepped taxation standard for emissions in the power and chemical industries. In the matter of cross-border tax coordination, reference can be made to the EU carbon border adjustment mechanism to design a program that meets localized needs, by imposing a carbon emission surtax on imported steel and aluminum. For example, Guangdong has taken the lead in piloting a tax on the carbon footprint of a product's entire life cycle in the manufacturing sector, as demonstrated by a ceramics company in Foshan that received a 12% green tax credit for enhancing methane recovery during production, allowing the incentive effect to trickle down to the upstream of the supply chain in terms of cleaner energy sourcing [4].

4.3. Establishing a Synergy Mechanism between Fiscal Policies and Other Policies

Insufficient policy synergy constrains the effectiveness of low-carbon transformation, and fiscal tools have yet to align effectively with industrial regulations and financial instruments. There is a disconnect between the subsidies for the purchase of new energy vehicles and the planning for the construction of charging networks, resulting in the failure of financial investment to effectively leverage the marketization of ancillary facilities to follow up. There is a standard difference between green financial standards and financial subsidy policy, and it is still difficult for commercial banks to accurately identify low-carbon technological reform projects supported by the financial sector for green credit approval. When carbon market quota allocation and financial carbon emission reduction incentives are implemented in parallel, emission-control enterprises may receive double financial compensation, weakening the guiding role of price signals. Deeper contradiction lies in the inter-departmental policy goal conflict, some areas of photovoltaic power generation financial subsidies and grid consumption capacity construction is not synchronized, triggering the abandonment of light and power limitations and waste of funds coexist. Addressing this dilemma requires the establishment of a cross-sectoral policy simulation platform, the iron and steel industry ultra-low emission transformation and other typical scenarios for financial-environmental-energy policy coupling stress test. Establish a "negative list" for the connection between central and local policies to avoid local protectionism in the promotion of new energy vehicles, which would jeopardize the effect of national financial support. Strengthen the dynamic adaptation with the international carbon pricing mechanism, embed the product carbon footprint accounting module in the export tax rebate policy, and cope with the trade impact brought by the EU carbon border adjustment mechanism. The essence of such synergistic innovation is to reconfigure the policy ecosystem, enabling financial resources to function as a resilient connector among diverse governance instruments.

4.4. Strengthening the Implementation and Supervision of Fiscal Policies

The effectiveness of fiscal policy implementation is constrained by the lack of a closed regulatory loop, with a prevailing tendency to prioritize fund allocation over policy performance effectiveness. The dynamic tracking system for local low-carbon project banks has not yet been comprehensively implemented, resulting in a mismatch between the accounting of carbon emission reductions and the financial subsidy disbursement cycle for projects such as photovoltaic poverty alleviation. The third-party performance assessment mechanism lacks statutory validity, and the measurement of eco-efficiency of projects such as clean heating renovation fails to serve as a binding criterion for determining the scale of transfer payments. Regulatory technological innovation is lagging behind policy needs, and the application of blockchain technology in tracing the flow of carbon benefits is still in a localized pilot stage. A regulatory vacuum in the management of cross-regional ecological compensation funds has led to a systemic disconnect between compensation standards and actual ecological outcomes, and there is a phenomenon of decoupling the compensation standard and the effect of water quality improvement in the watershed in the horizontal compensation practice of the Yangtze River Economic Belt. International experience shows that the carbon pricing financial return mechanism needs to be accompanied by the establishment of enterprise carbon emissions data cross-validation system, to prevent the rebound effect of capacity expansion, particularly in industries such as electrolytic aluminum, caused by excessive green subsidies. To solve the dilemma, it is necessary to build a three-dimensional penetrating regulatory framework of "policy-funding-effect", and dynamically link the results of the carbon emission reduction performance assessment of key industries with the financial budget arrangement. Explore the establishment of a default resolution mechanism for environmental performance bonds, the green municipal bond issuer can not reach the predetermined emission reduction target to implement market access restrictions. Strengthen the role of social oversight, implement the construction of carbon emission reduction financial expenditure information visualization platform in key ecological functional areas, and activate the governance effectiveness of public participation in policy evaluation. The essence of this regulatory restructuring is to establish a policy life-cycle management mechanism that enhances the transparency of the use of funds while increasing the stability of the expectations of market participants [5].

5. Conclusion

Low-carbon economic transformation is essentially a systemic reform of production relations, and fiscal policy needs to shift from capital supply to system supply. The linkage design of carbon tax and green subsidies, cross-cycle budget arrangement, and performance-oriented fund allocation mechanism constitute the underlying logic of policy innovation. This not only needs to break through the barrier of sectoral interests, but also tests the strategic determination of policy makers. When financial tools and market mechanisms form a resonance, the technological revolution and institutional innovation to produce a chemical reaction, low-carbon development can be from government-driven to national consciousness. This practice of civilization change will eventually give rise to a new development paradigm through policy iteration and technological breakthroughs.

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