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Transitioning Towards Circular Construction in China: Breaking Barriers and Unlocking Sustainable Growth

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Abstract - **The construction industry is one of the industries with the highest concentration of resource consumption and carbon emissions in China, and it is also an important area for realizing the goal of sustainable development. In recent years, China has introduced several circular building policies; however, problems persist, including decentralized governance, a lack of standards, and insufficient participation by small and medium-sized enterprises (SMEs) in their implementation. This paper employs a qualitative research methodology to systematically assess the status of policy implementation, conducting a directed content analysis of national policy documents and comparing them with cases in Shanghai, Shenzhen, and Suzhou. The results show that China has made some progress in green standards, financial incentives and pilot explorations. Still, the cross-sectoral coordination mechanism is weak, the life cycle assessment criteria have not been harmonized, and enterprises, especially SMEs, face barriers in financing, certification and technology. Drawing on the European Union's experience in green public procurement, extended producer responsibility and life cycle management, this paper proposes a system optimization path centred on uniform national standards, regional differentiated implementation, inclusive policies for SMEs and an independent assessment mechanism. The study demonstrates that promoting the development of circular buildings is a crucial approach to achieving carbon neutrality, while supporting the implementation of Sustainable Development Goal 9 and enhancing industrial resilience and innovation capabilities.**

Keywords: **Circular Construction, Sustainable Development Goal 9 (SDG9), Policy Implementation, Governance, Small and Medium-Sized Enterprises (SMEs)**

I. INTRODUCTION

Against the background of global climate change and increasing resource constraints, the sustainable development transformation of the construction industry has become a core international issue. The construction industry has long consumed one-third of the world's energy and raw materials for a long time, contributing approximately 37% of global carbon dioxide emissions. (UNEP & GlobalABC., 2025). This shows that traditional energy conservation alone can no longer support the global emission reduction target, and a systematic transformation must be achieved through a circular economy.

Within the framework of the United Nations Sustainable Development Goals, Goal 9 emphasizes the need to build a resilient infrastructure, achieve sustainable industrialization and promote innovation. These priorities are closely related to the construction industry, although existing studies sometimes underestimate the extent of this association. (United Nations, 2025). As the practical embodiment of the circular economy in the architectural environment, circular construction is not limited to improving resource efficiency but can also achieve in-depth linkage with the three dimensions of the Sustainable Development Goals by adopting full-life-cycle design, using green building materials, and promoting industrial innovation. The International Energy Agency noted that if the construction industry widely adopts the circular model, it is expected to achieve a 20% emission reduction target by 2030, while also stimulating industrial development and technological progress (IEA, 2024).

International experience provides a broader vision. As an industry pioneer, the European Union took the lead in developing a Level(s) framework that integrates life cycle indicators into building performance evaluation. At the same time, regulatory tools such as green public procurement and sustainable product ecological design regulations are also promoting resource recycling, but the application of these tools in different governance environments is not always possible (European Commission, 2025). Finally, recent scholarship reminds us that without supportive business models, policy measures alone are insufficient. Circular business models form a crucial foundation for embedding circular economy practices in the construction industry (Shahidi Hamedani et al., 2025). As the world's largest construction market, China's policy orientation has a demonstration effect on the world. In recent years, China has introduced a series of policies, including the Work Program on Energy Conservation and Carbon Reduction in Construction (2024) (Ministry of Housing and Urban-Rural Development, 2024). Policies such as Opinions on Accelerating the Construction of a Waste Recycling System (2024) and the Government Procurement Guidelines for Green Building Materials (2025) (General Office of the State Council, 2024) have gradually formed a macro-institutional framework, ranging from green building standards and construction waste management to green building materials procurement.

However, the development of circular buildings in China still faces three challenges. First, policies are not well aligned with Sustainable Development Goal 9, with most policies focusing on energy efficiency and emission reduction, and a lack of holistic alignment with the triple dimensions of "resilient infrastructure-sustainable industry-innovation." (Iqbal et al., 2025) Second, regional implementation differences are evident, with eastern cities such as Shanghai and Shenzhen making faster progress in digital regulation and green building standards, while central and western regions rely more on centralized subsidies and demonstration projects, showing a lack of policy adaptation (Xiao et al., 2024). Third, the participation of SMEs in the transition is limited, and despite the policy's proposal of green loans and financial subsidies, the response of SMEs is still weak due to the difficulties in financing, high costs, and lack of technological capabilities (Rodrigues & Franco, 2023; Yeung, 2015).

Existing studies focus on policy review, regional comparison and analysis of emission reduction potential (Hu et al., 2023). However, there is still a lack of research on how circular buildings can be fully aligned with SDG 9, achieve regionalized implementation, enhance the participation of SMEs, and learn from international experiences in local contexts. These gaps limit the effectiveness of policy implementation and weaken the academic discourse's contribution to global governance.

II. Research Questions

Research Question 1: How do China's circular construction policies support the development of resilient infrastructure and sustainable industries in line with SDG 9?

Research Question 2: What are the main challenges and opportunities for innovation in advancing circular construction practices in China?

III. Literature Review

A. Global Research Progress on Circular Economy and Construction

The Circular Economy is regarded as an important path to deal with resource depletion and climate change. The construction industry has become the focus of application due to its high energy consumption and emissions, which not only involves design, materials and construction, but also the transformation of the industrial chain (Hailemariam & Erdiaw-Kwasie, 2023; Rosa et al., 2023). The United Nations Environment Program and the Global Construction Alliance emphasized that the circular economy is crucial for achieving emission reduction and sustainable development in the construction industry, and they called for the integration of national strategies. The International Energy Agency estimates that promoting life cycle assessment, green building materials, and reuse mechanisms could reduce construction-related emissions by approximately 20% by 2030. However, existing studies still favor technology assessment, and the integration of system integration with SDG 9 is insufficient (IEA., 2024).

B. Academic Dialogue between SDG 9 and Circular Building

SDG 9 aims to "build resilient infrastructure, promote sustainable industrialization, and foster innovation". Under this framework, circular building is not only about resource recycling, but also about industrial upgrading and institutional innovation. Iqbal et al., (2025) pointed out that circular strategies can help achieve net-zero goals. However, most of them are focused on carbon emission reduction and efficiency, and there is a lack of systematic discussion on the three dimensions of SDG 9. Recent studies have begun to emphasize the potential link between circular buildings and SDG 9, suggesting that their embedding could facilitate a shift from environmental performance to a holistic consideration of resilience and innovation. However, relevant empirical studies are still limited, providing room for expansion in this study.

C. Evolution of Circular Building Policies in China

As the world's largest construction market, China's policy evolution has attracted significant attention. Hu et al., (2023) review how China's green building policies are moving from piloting to institutionalization, but note insufficient cross-sectoral coordination and limited market incentives. Xiao et al., (2024) point out that the central and local policies

are fragmented, with varying implementation effects. The implementation of these policies has had mixed results. At the same time, recent research has shown that digital innovations can not only enhance the efficiency of circular economy practices but also strengthen their alignment with the SDGs, especially SDG 12 and SDG 9 and open new technological pathways for system transformation (Shahidi Hamedani et al., 2025). In recent years, the government has successively issued policies such as the Work Program on Energy Conservation and Carbon Reduction in Construction, Opinions on Waste Recycling System, and Guidelines for Government Procurement of Green Building Materials, laying down the institutional framework, but the direct interface with SDG 9 still needs to be strengthened.

D. Regional Differences and Policy Adaptation Research

Research shows that developed regions make faster progress in green standards, technology application and market incentives, while less developed regions rely more on centralized subsidies and policy orientation (Zhao et al., 2025). This regional difference triggers the discussion of "policy adaptation", i.e., how to design differentiated implementation paths according to local conditions. Existing studies are mostly confined to textual analyses and case comparisons, and they remain insufficient in terms of integrating with the SDG 9 goal of "inclusiveness and resilience." Therefore, regionalized paths are a key direction for future policy and academic research.

E. Small and Medium-sized Enterprises and Industry Transformation

SMEs play an important role in the construction supply chain but are not sufficiently involved in the cyclical transformation. Rodrigues & Franco, (2023) found that SMEs are generally facing difficulties in accessing finance, weak technology and high response costs. In China, despite policies proposing green loan and subsidy mechanisms, the lack of empirical research has led to limited knowledge of the role and challenges of SMEs. International experience shows that enhancing SMEs' participation through green finance, training and capacity building can significantly improve the greening level of the industrial chain (Reim et al., 2025), a topic that still needs to be deepened in the Chinese context.

F. Transplantation and Localization of International Experiences

The EU has formed a mature system of circular building governance, such as the Level(s) framework centered on LCA and Green Public Procurement (European Commission, 2025). However, China's institutional environment varies greatly: on the one hand, it relies more on top-down promotion, and on the other hand, regional development is not balanced, and the differences in policy implementation are obvious. Existing studies have emphasized the advancement of tools but neglected the differences in institutional fit and implementation environment. How to effectively "localize" international experience in China is still an academic and practical problem that needs to be broken through.

IV. Research Gap

Firstly, most existing research focuses on the technical or environmental aspects of circular buildings, such as emission reduction and resource efficiency, but fewer studies have directly aligned them with the triple dimensions of "Resilient Infrastructure - Sustainable Industries - Innovation" in Sustainable Development Goal 9. However, it is less often directly aligned with the triple dimension of "resilient infrastructure-sustainable industry-innovation" in SDG 9 (Hailemariam & Erdiaw-Kwasie, 2023; Iqbal et al., 2025). This makes the research results insufficiently supportive of policy design and institutional transformation.

Second, research on recycled buildings in China tends to view the whole country as a whole, ignoring regional differences. Developed cities in the east are one step ahead in digital regulation and green standard implementation, while central and western regions rely more on central subsidies and demonstration projects. The lack of systematic analysis of regional adaptation and differentiated implementation paths limits the effectiveness of policies in achieving the goals of "inclusiveness and resilience" (Wang et al., 2023; Xiao et al., 2024).

Third, SMEs have long been neglected in academic research. Although policy documents have proposed to incentivize their participation through green loans and financial subsidies, existing empirical studies have mainly focused on government departments and large-scale enterprises and have lacked in-depth discussions on the role and challenges of SMEs in the circular building transition. This not only creates a theoretical gap, but also weakens policy implementation (Rodrigues & Franco, 2023).

In summary, existing studies have three shortcomings: first, they are biased towards technology evaluation and lack institutional integration; second, they ignore regional differences and lack an adaptive framework; and third, they do not pay enough attention to small and medium-sized enterprises (SMEs). This study attempts to make up for these deficiencies by establishing the analytical framework of "Circular Building-SDG 9", combining regional differences and the role of SMEs, and drawing on the localization path of international experience, so as to provide theoretical and practical references for the institutional transformation of circular buildings in China.

V. Research Methodology

A. Research Design

This study adopts a qualitative research design, focusing on institutional and policy-level analysis rather than a single technology path or engineering project. The qualitative approach is chosen because the promotion of circular buildings involves multi-sectoral governance, cross-level

policy coordination, and market-government interaction, and such complex processes are often difficult to be fully reflected by quantitative data. The institutional logic and governance model can be better revealed through systematic analysis of policy texts and cases.

Research Question 1 focuses on how China's circular building policy supports the triple aim of "infrastructure-industry-innovation" in Sustainable Development Goal 9, and therefore needs to be analyzed from the perspectives of institutional goals and implementation mechanisms; Research Question 2 focuses on the identification of institutional challenges and opportunities for innovation, and therefore needs to be analyzed from the perspective of institutional goals and implementation mechanisms. This study maintains a high degree of consistency between research questions and the research methodology in terms of research logic.

In terms of methodological choices, this paper adopts directed content analysis, using the three dimensions of SDG9 (infrastructure, industry, and innovation) as a coding framework for categorizing and interpreting policy texts (Hsieh & Shannon, 2005) . At the same time, a comparative policy analysis (Krippendorff, 2018) is combined to compare the differences between central and local policies vertically, and to compare the policy instruments and institutional logics of China and Europe horizontally, in order to highlight China's uniqueness and shortcomings in institutional design.

B. Data Sources

The data for the study are mainly from three types of authoritative literature and materials. The first category is national-level policy documents (2023-2025), issued by the State Council, the Ministry of Housing and Urban-Rural Development, the Ministry of Finance, and other core departments, which cover key topics such as building energy efficiency and emission reduction, construction waste recycling, and green building materials procurement. This timeframe covers the critical period of the "dual carbon" strategy and reflects the latest policy developments.

The second category comprises documents from international and multilateral organizations, primarily including the Level(s) framework of the European Union (EU) and the State of the World's Buildings and Construction Report issued by the United Nations Environment Programme. These documents not only represent the most influential standards and policy trends in the international arena but also provide a benchmark for China's institutional reform. The third category is a regional case study, with three cities of Shanghai, Shenzhen and Suzhou as typical samples. As a national pilot city, Shanghai focuses on standard-driven and digital supervision models; Shenzhen presents the integration path of financial instruments and industrial innovation; Suzhou reveals the contradictions and limitations of second-tier cities in financial dependence and pilot exploration. The selection of these three places balances representativeness and differences, helping to reveal regional adaptation paths.

C. Analysis Methods

The research analysis is divided into three steps. First, using targeted content analysis, the policy texts were systematically coded and categorized according to the three dimensions of SDG9 to identify the key areas of policy objectives, implementation mechanisms, and industrial incentives. Second, comparative policy analysis is employed to examine the differences between central and local policies in China, as well as the gaps between China and the European Union in terms of policy objectives, instrument systems, and implementation mechanisms in the international arena. This approach not only reveals the shortcomings of the policies themselves but also helps to propose directions for institutional improvement. Finally, a regional adaptation analysis is conducted to summarize the policy adaptation needs arising from regional differences by comparing the practice paths of Shanghai, Shenzhen, and Suzhou, thereby providing a reference for promoting policies in the central and western parts of China and less developed regions.

It is worth emphasizing that the choice of SDG9 as an analytical framework has both academic and practical significance. On the one hand, it provides a clear structure to systematize the presentation of policy objectives, industrial mechanisms and innovation dynamics; on the other hand, it responds to the global sustainable development agenda and enhances the study's fit with the international academic dialogue.

D. Research Limitations

Although this study employs a multidimensional approach, it still has some limitations. First, at the data level, this study primarily relies on publicly available policy documents and secondary literature, which limits its ability to fully reflect the actual situation in policy implementation, such as the deviations and challenges encountered by enterprises and local governments in their operations. Second, at the methodological level, this study lacks firsthand interviews and surveys with enterprises, industry associations, and regulatory agencies, and thus remains limited in its understanding of the actual logic behind SMEs' participation in the policy. Finally, the case selection focuses on the eastern developed regions, which, although representative, are not sufficiently generalized to the central, western and less developed regions. Future research can compensate for these shortcomings through questionnaire surveys, enterprise interviews and cross-regional comparative empirical studies, thus improving the reliability and generalizability of the findings.

VI. RESULTS AND DISCUSSION

A. Regional Implementation Pathways

The implementation of China's recycling construction policy shows significant regional differences. These differences are not only due to differences in the level of economic development and financial capacity, but also closely related

to the enthusiasm of local governments to promote policy innovation and their industrial structure. In general, eastern coastal cities tend to lead in policy implementation and institutional innovation, while central cities rely more on central financial support, and western regions mainly explore paths through pilot demonstrations. This "regional gradient" pattern clearly reflects the practical challenges faced by China in the implementation of Sustainable Development Goal 9 (building a resilient infrastructure, promoting sustainable industrialization, and promoting innovation).

1) Shanghai: Digital Oversight and Standard-Driven Development

Shanghai's pioneering practice in the field of circular construction, in particular, digital supervision and standard-driven development, are prominent feature. In 2023, the city established the country's first comprehensive data platform for carbon emissions and energy consumption in the construction industry. The whole process of tracking green buildings is from design and construction to operation and management. This platform not only enhances policy implementation transparency but also provides a practical model for institutionalizing Life Cycle Assessment (LCA) practices (Shen & Faure, 2021). Shanghai Green Building Regulation, 2024).

At the same time, Shanghai links the certification of green building materials with public projects and requires that the proportion of green building materials used in government project bidding should not be lower than the minimum standard. Local governments further encourage enterprises to participate through special subsidies and incentive mechanisms. This dual-track system of "standard + finance" has significantly improved the use rate of green building materials in Shanghai in just two years. Practice shows that in areas with mature economic and technical conditions, the circular construction policy can be implemented efficiently.

2) Shenzhen: Financial Instruments and Industrial Synergy

Unlike Shanghai, Shenzhen places greater emphasis on integrating recycling construction policies with industrial innovation. In 2024, Shenzhen included circular construction in the key assessment and approval standards of urban renewal policies, while reducing the access costs of enterprises with the help of green financial mechanisms (Shenzhen Local Financial Supervision Administration & Shenzhen Securities Regulatory Bureau, 2025).

For example, Shenzhen, together with several state-owned banks and fund companies, has set up a "revolving building materials credit pool" to provide low-interest loans for enterprises that have obtained green building materials certification. This measure is particularly beneficial to small and medium-sized building materials enterprises, allowing them to participate in the production and application of recycled building materials while reducing the financing pressure. In addition, Shenzhen is exploring the establishment of a carbon credit system to link the application of green building materials with the comprehensive credit rating of enterprises, so as to deepen the integration of market mechanisms and financial mechanisms.

This financial-driven model highlights Shenzhen's ability in institutional innovation as a cutting-edge city in reform, and provides valuable inspiration for the use of market-oriented tools to promote the transformation of circular construction (Ma & Shen, 2024).

3) Suzhou: Fiscal Dependence and Pilot-Driven Progress

As a typical second-tier city, Suzhou relies heavily on financial subsidies and policy pilots from higher governments in the process of promoting the transformation of circular construction. In 2024, although Suzhou City issued guidelines for the development of circular construction, implementation remains concentrated in a few demonstration communities and industrial parks, lacking city-wide institutional arrangements.

In terms of financial support, Suzhou actively connects with the central "Rural Green Building Materials" plan and promotes the adoption of green building materials in some urban and rural projects through subsidies. However, limited by local financial resources, such policies are insufficient in terms of scale and sustainability. In general, Suzhou's practice shows that for cities with insufficient financial autonomy and technical reserves, the central government's support and regional cooperation are still the key driving forces for promoting circular construction (Wang & Shen, 2017).

The radar map in fig. 1 visually illustrates the differences in policy implementation among Shanghai, Shenzhen, and Suzhou. Shanghai has outstanding performance in financial support and standard implementation, Shenzhen has obvious advantages in the field of green finance and digital supervision, while Suzhou is relatively weak in green finance and standard implementation. These differences show that China's regional differences have surpassed the pattern of "strong in the east and weak in the west", reflecting the significant differences in local governments in policy innovation choices.

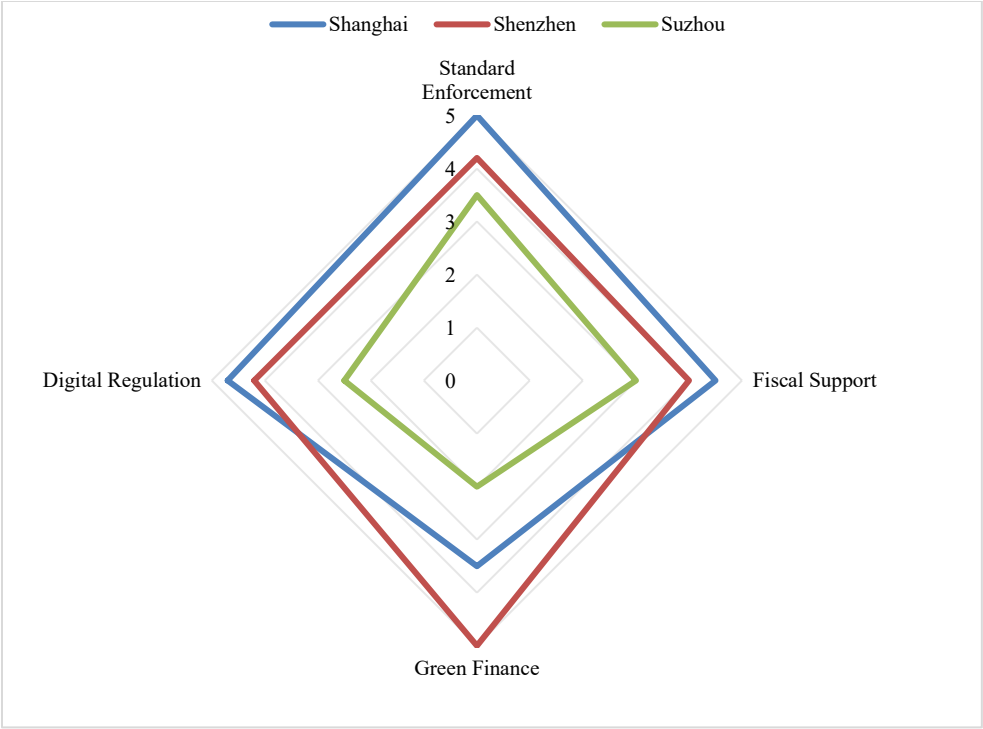

Fig. 1 Regional Policy Implementation Rader Chart

B. Overcoming Governance Challenges

Although China has established a broad policy framework for recycling construction and carried out pilot projects in various places, deep-seated governance challenges still exist. These challenges do not stem from isolation problems, but the result of a systematic interaction between institutional frameworks, standard systems and law enforcement capabilities. Failure to respond effectively may form a structural bottleneck in the process of achieving Sustainable Development SDG 9 (building a resilient infrastructure, promoting sustainable industrialization and promoting innovation).

1) Governance Fragmentation

China's circular building governance presents a unique "multi-head management" model. The Ministry of Housing and Urban-Rural Development focuses on the formulation of green building standards, the Ministry of Industry and Information Technology focuses on promoting the upgrading of the building materials industry, the Ministry of Finance emphasizes subsidies and financial incentives, and the Ministry of Ecology and Environment focuses on the construction of a carbon emission accounting system. Despite the consistent goals of these departments, the implementation of specific policies often lacks coordination and oversight. For example, some local governments give priority to financial subsidy projects during the implementation process, but ignore the enforcement of green standards, resulting in a situation where "funds take precedence over standards" (General Office of the State Council, 2024; Yu et al., 2022)

This fragmented governance not only increases the institutional cost of enterprises but also weakens the overall effectiveness of the policy. Many enterprises face multiple regulatory requirements from different departments, forming the so-called "compliance burden". Small and medium-sized enterprises are particularly vulnerable. Because it is difficult to meet the multi-dimensional requirements covering finance, standards and environmental protection at the same time, they are often excluded from the circular construction market (Gennari, 2023).

2) Standards and Data Gaps

The core of circular construction is life cycle assessment and carbon emission tracking, but China currently lacks unified national mandatory standards. Green building certification indicators vary significantly from place to place: Beijing will include LCA in the local certification system in 2024, while most cities in the central and western regions still only pay attention to energy consumption and energy efficiency indicators.

As a result of this difference, "green buildings" often have different connotations in different cities. The more serious problem is the lack of data. China has not yet established a national building carbon emission database, and provinces rely on the data of local associations or research institutions, which makes it difficult to cross regions.

For example, the Shanghai construction carbon emission monitoring platform can track the use of materials and construction energy consumption, but in Chengdu, Hefei and other cities, the relevant data is still at the level of project declaration, and lacks real-time update and a standardized index system (General Office of the State Council of the People's Republic of China, 2024)

The direct consequence of the lack of standards and data is the difficulty of evaluating and replicating policies. Even if a pilot project succeeds in one region, it is difficult to promote it nationwide due to the lack of a unified measure to define "success".

3) Weak Enforcement and Lack of Accountability

Even in areas with relatively perfect policy frameworks, weak law enforcement is still widespread. Some local governments regard circular construction as a "face project" and concentrate resources into demonstration areas, but lack the motivation to institutionalize and normalize policies. For example, the rural green building materials plan of a central province attracted widespread attention at the beginning, but with the gradual reduction of financial subsidies, the enthusiasm of local enterprises has also subsided.

In addition, the lack of an independent third-party assessment and accountability mechanism makes it difficult to maintain the effectiveness of the policy for a long time. At present, most evaluations rely on the self-evaluation of government departments, which leads to the phenomenon of "emphases project launch and neglect implementation" and "quantity and quality". This not only weakens the credibility of the policy but also shakes the confidence of enterprises in long-term investment.

4) Improvement Pathways

In order to overcome these governance challenges, institutional innovation is needed in three key areas:

Establish Cross-Departmental Coordination Mechanisms

The State Council should take the lead in setting up a coordination committee for recycling construction to coordinate the policy goals of the Ministry of Housing and Urban-Rural Development and other departments, Ministry of Industry and Information Technology, Ministry of Finance, and Ministry of Ecology and Environment. This will avoid policy duplication and fragmentation. The mechanism can also promote data sharing and standardized protocols to reduce the compliance burden of enterprises. Promote Nationwide Standardization and Database Development

Include the life cycle assessment in the national mandatory standards and gradually establish a national construction carbon emission database. This is not only conducive to the evaluation of policy effectiveness but also provides objective data support for regional policy comparison and international cooperation.

Improve the performance evaluation and accountability mechanism. Drawing on international experience, an independent third-party evaluation agency will be set up, and the White Paper on Circular Construction will be issued every year to transparently disclose the achievement of policy goals. At the same time, establish a dynamic revision mechanism to ensure that policies are continuously optimized with the development of the market and technology.

C. SMEs and Industry Adaptability

Small and medium-sized enterprises occupy a central position in China's construction industry chain. According to the statistics of the China Construction Industry Association, more than 90% of construction enterprises belong to the category of small and medium-sized enterprises. These enterprises are mainly active in the supply of building materials, construction subcontracting, renewable resource utilization and other fields, and are the key implementers of circular construction policies. However, this study found that small and medium-sized enterprises face multiple obstacles in the process of transforming to circular construction, resulting in the failure to fully unleash their potential. This situation not only hinders the industrialization of circular buildings but also fails to achieve the goal of "inclusive and sustainable industrialization" emphasized by Sustainable Development SDG 9.

1) Key Position and Practical Contradictions

Small and medium-sized enterprises have unique advantages in green transformation. On the one hand, its closeness to the local market makes it flexible to adapt to regional needs. For example, in the construction of Chengdu Green Low-Carbon Demonstration Zone, local SMEs pioneered the use of recycled concrete and recyclable steel, achieving significant reductions in carbon intensity. On the other hand, their limited scale and flexible organizational structure make them more flexible when testing new materials and technologies in the niche market.

However, these advantages face practical challenges. Despite the 2025 joint issuance of the "Implementation Guidelines for Expanding Government Procurement Support for Green Building Materials to Enhance, the Regulations on Construction Quality Management jointly issued by the Ministry of Finance, the Ministry of Housing and Urban-Rural Development, and the Ministry of Industry and Information Technology - which clearly requires government projects to give priority to green building materials - but it is difficult for small and medium-sized enterprises to directly benefit (Feng et al., 2026). This stems from their weak links in qualification certification, financing channels and technical reserves, which puts them at a disadvantage in bidding for government procurement contracts and large-scale projects. In other words, there is a significant "gap" between the policy goals and the actual capabilities of small and medium-sized enterprises.

2) Key Obstacles Faced

Research and case analysis reveal that small and medium-sized enterprises face three core challenges in the transformation of circular construction:

Financing difficulties: Banks and financial institutions generally tend to support large enterprises with stable collateral and strong credit qualifications. Although some cities (such as Shenzhen) have piloted the "Green Credit Pool" to provide low-interest loans for green building

materials and circular construction projects, the coverage is still limited, and many small and medium-sized enterprises have not benefited.

Technical Weaknesses: Digital tools such as LCA (Life Cycle Assessment) and BIM (Building Information Modeling) are widely used in promoting circular construction. However, small and medium-sized enterprises often lack technical personnel and application experience, making it difficult for them to meet the requirements of the bidding or certification process. This makes it difficult for them to meet policy standards even if they are willing to transform. Policy barriers are substantial: many policy documents clearly require participants to have certification in green building materials or qualifications in environmental protection. However, the cost of small and medium-sized enterprises to obtain such certification is high, and the information channels are still insufficient. Many enterprises reflect that despite the existence of central subsidy policies, most of the actual beneficiaries are leading enterprises, and small and medium-sized enterprises are in a dilemma of "looking away".

3) Case Studies

Shenzhen: In the urban renewal project in 2024, the Shenzhen government will integrate the circular construction indicators into the evaluation system and cooperate with state-owned banks to launch green loans. But the main beneficiaries are still large developers. Although small and medium-sized enterprises enter the supply chain, the profit margin is still limited.

Suzhou: Under the guidance of the local government, some small and medium-sized enterprises are trying to enter the government procurement catalog through the certification of green building materials. However, the lengthy certification process and high cost lead to only a few enterprises sticking to the end.

These cases show that even if policies are aimed at promoting green development, small and medium-sized enterprises often become passive bearers of systemic barriers in practice.

4) Policy Support Pathways

To make small and medium-sized enterprises really play a role, targeted measures need to be taken:

Green finance inclusiveness: In addition to the existing green loans and subsidies, set up a "green transformation fund" specifically for small and medium-sized enterprises, reduce the mortgage and approval threshold, and implement inclusive financial instruments.

Capacity building and technical training: Local governments and industry associations should jointly provide free or low-cost training to help small and medium-sized enterprises master basic tools such as life cycle assessment and building information models to narrow the gap with large enterprises.

Direct information channel: set up a special area for small and medium-sized enterprises on the government procurement platform, simplify the certification process of green building materials, and directly convey policy information to small and medium-sized enterprises through the Chamber of Commerce Association, to avoid the policy being reduced to paper talk.

5) Comparison with International Experience

International research shows that if there are no special support policies for small and medium-sized enterprises, the transformation of circular construction will face the risk of oligopoly. In the absence of capital and information support, the enthusiasm of small and medium-sized enterprises to participate in the circular economy is extremely low (Rizos et al., 2016). These experiences show that China urgently needs to integrate "inclusiveness of small and medium-sized enterprises" into the core elements of policy design.

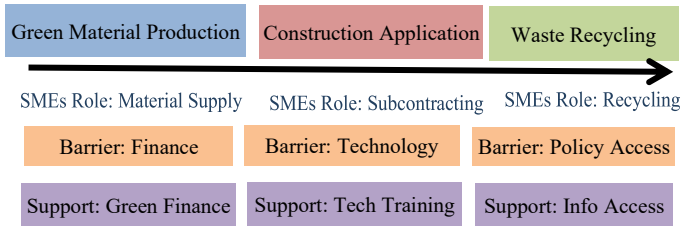

Fig. 2 SMEs in Circular Construction Supply Chain

Fig. 2 visually shows the key role of small and medium-sized enterprises in the circular construction supply chain and also reveals the obstacles and potential support tools they face. The figure shows that if the three core challenges of financing channels, technology applications and policy support are not solved, small and medium-sized enterprises will face the risk of marginalization. On the contrary, reducing barriers to participation through green finance, professional training and policy incentives will make it the core driving force of green transformation. This strategy is also in line with the "inclusiveness" requirements advocated by Sustainable Development SDG 9.

D. Lessons from the EU

The EU's practice in the field of circular construction and sustainable development is recognized as the most systematic and forward-looking model in the world. Through the introduction of tools such as Level(s) system, green public procurement and ecological design regulations, the European Union has gradually built a life cycle-based institutional framework.

Although these measures demonstrate how to integrate the principle of circulation throughout the whole process of construction and provide valuable experience for China, they cannot be mechanically transplanted.

The differences in the development stage, the uniqueness of governance logic and the differences in industrial structure all show that if we want to effectively promote the

construction of China's circular construction and achieve Sustainable Development Goal 9, we must draw on the experience of the European Union and make prudent adjustments in combination with the local reality.

1) Differences in Policy Objectives

The European Union has set a circular construction agenda around the goals of long-term sustainability and carbon neutrality. Its core is the Level(s) framework, which requires a life cycle assessment (LCA) at the design stage, covering indicators such as carbon emissions, energy performance and natural resource utilization. As a supplement, the Sustainable Product Ecological Design Regulations expand the scope of the circular economy to encompass the entire life cycle of product design, requiring full consideration of reuse and recyclability in the design process.

Together, these policy tools show the ambition to go beyond conventional environmental decompression, aiming to reduce the system's dependence on native resources.

In comparison, China's policy orientation is still at an early stage. The current measures focus on energy conservation and emission reduction and the promotion of green building materials. A typical example is the "Action Plan for Energy Saving and Carbon Reduction in the Construction Field in 2024" released by the Ministry of Housing and Urban-Rural Development, which mainly focuses on controlling operational energy consumption and encouraging the adoption of certified green building materials. The relevant provisions of whole life cycle governance are still in the exploration stage. This difference highlights the difference in policy focus: China's policy continues to give priority to "carbon control and efficiency improvement", while the European Union has turned to a broader "circular economy and systematic transformation" model.

2) Differences in Implementation Tools

The European Union attaches great importance to the market mechanism in its policy tools. For example:

Green Public Procurement (GPP) requires the government to give priority to products that meet sustainability standards when purchasing building materials, so that green products can gain a competitive advantage in the market. Sustainable Product Ecological Design Regulations (ESPR) starts from the product design stage, requiring building materials to meet the requirements of recyclability and reusability. These measures generate market demand and promote organic growth of circular buildings beyond policy requirements.

In China, although the Ministry of Finance issued the "Guidelines for the Implementation of Government Procurement of Green Building Materials" in 2025, requiring government projects to give priority to the procurement of green building materials, financial subsidies and administrative directives are still the main means. The means of marketization are limited, and the effectiveness of the policy largely depends on government intervention. In other words, China's circular construction transformation is still in the "policy-driven" stage, while the European Union has entered the "market-driven plus policy-guided" stage.

3) Differences in Governance Logic

The European Union emphasizes the participation and collaborative governance of multiple stakeholders. In addition to the government and enterprises, industry associations, research institutions and civil society play a key role in promoting recycling. For example, the index system of the Level(s) framework is formulated through extensive consultation with industry and academia. The European governance model is often considered to improve policy transparency and public acceptance at the same time.

However, in China, the governance logic is still dominated by the government, and most policies are drafted by central ministries and commissions and issued to provincial and municipal governments for implementation. Although this top-down structure can quickly introduce new measures, it limits the participation space of industry participants and civil society. As a result, many policies are energetically advanced by government agencies yet do not always achieve broad recognition or support at the societal level.

4) Localization Pathways

Given these structural differences, the lessons from the European Union need to be adapted rather than adopted wholesale in China. At the level of policy objectives, the focus should gradually move beyond "energy conservation and carbon reduction" toward a broader agenda of "lifecycle emissions reduction," in which resource recovery and material circulation become binding requirements. In terms of implementation tools, a shift is needed from relying mainly on administrative promotion to creating genuine market incentives, for instance, combining green public procurement with fiscal subsidies so that demand for green building materials is shaped by competition as well as by government projects. Finally, with respect to governance, the involvement of industry associations, research institutions, and other non-state actors should be encouraged in standard-setting and policy evaluation, thereby diversifying the sources of authority.

Overall, these measures will gradually shift China from a policy-led model to a model characterized by market orientation and social cooperation, to improve the long-term sustainability of policy results while maintaining the speed of administrative action.

E. Synthesis: Towards a Policy Roadmap

Examining regional practices, governance challenges, the role of small and medium-sized enterprises, and international benchmarks, China's recycling industry has reached a turning point, transitioning from a fragmented local experiment to a more coherent and integrated development stage. However, institutional fragmentation, regional differences and

insufficient industry participation are still the core obstacles to the comprehensive realization of SDG 9.

Based on the above findings, this section presents a comprehensive policy roadmap to address the practical challenges in transforming China's circular construction and provides guidance for future institutional optimization.

1) National Level: Unified Standards and Cross-Departmental Coordination

At the national level, the most pressing task is to address the issue of policy fragmentation. It is recommended that the State Council establish a coordination mechanism for circular construction covering key ministries and commissions, such as the Ministry of Housing and Urban-Rural Development. Ministry of Industry and Information Technology, Ministry of Finance, and Ministry of Ecology and Environment. Strengthening cross-departmental collaboration is crucial to preventing overlapping functions, conflicting goals, and inefficient resource utilization. At the same time, life cycle assessment should be included in mandatory national standards, so that a unified framework can guide the consistency of practice in various places.

On this basis, the existing green building materials certification system and carbon monitoring platform can be integrated to lay the groundwork for establishing a national building carbon emission database. The system can not only improve the comparability and transparency of policy implementation but also create the institutional conditions necessary to align with international practice.

2) Regional Level: Differentiated Approaches Tailored to Local Conditions

Regional differences are still a prominent feature of China's circular construction pattern. In well-developed eastern cities, priority should be given to strengthening digital supervision and standard implementation and promoting institutional innovation to a new level. The central and western regions, on the other hand, need to expand financial transfer payments and implement targeted capacity-building measures to bridge the gap between infrastructure supply and technical expertise gradually.

At the same time, the government can promote interregional collaboration through initiatives such as the "Yangtze River Delta Circular Construction Alliance" and the "Greater Bay Area Green Building Materials Platform," among others, to achieve experience sharing and standard unification. Such differentiated strategies can not only ensure regional fairness but also improve the overall policy effectiveness.

3) Industrial Level: Strengthening Institutional Support for SMEs

SMEs play a central role in the circular construction supply chain, but many enterprises still face challenges such as financing difficulties, obstacles to technology adoption and complex policy frameworks.

To remove these obstacles, it is necessary to establish more inclusive green financial instruments - such as the establishment of a special "green transformation fund" to lower the loan threshold and broaden credit channels. At the same time, local governments and industry associations can establish partnerships to expand the scale of training projects and help small and medium-sized enterprises become familiar with tools such as life cycle assessment and building information models.

Simplifying certification procedures and establishing more direct information channels will further ensure that small businesses have fair opportunities for competition in public procurement and project bidding. The comprehensive implementation of these measures can not only enhance the inclusiveness of the circular construction policy but also improve the resilience and adaptability of the whole industry.

4) International Level: Learning from Experience and Localizing Adaptation

The European Union has accumulated rich experience in the institutional design of circular buildings, especially through mechanisms such as green public procurement and ecological design regulations for sustainable products. For China, the challenge is not to copy these models, but to carefully adapt to domestic conditions.

A feasible approach is to first include green procurement requirements in the central government's investment projects, while retaining financial subsidies as temporary support during the adjustment period.

In sync with this, it can take the lead in piloting life cycle standards in major cities and leading enterprises, and then gradually promote them to the whole country. This strategy of "pilot first, then promote" is not only in line with China's existing governance logic but also can reduce the risks often associated with large-scale institutional transformation.

5) Monitoring and Evaluation: Ensuring Long-Term Policy Effectiveness

The long-term effectiveness of the circular construction policy depends on a sound monitoring and evaluation system. An independent third-party organization can be established to issue the annual White Paper on Circular Construction, which should clarify policy objectives, track implementation progress and report performance results in a transparent manner.

Additionally, a dynamic revision mechanism should be established to update policies promptly in response to new technologies and market changes, thereby reducing the risk of policy rigidity or stagnation. These measures can not only enhance the credibility of the government but also instill confidence in the country's commitment to implementing circular construction among enterprises and the public.

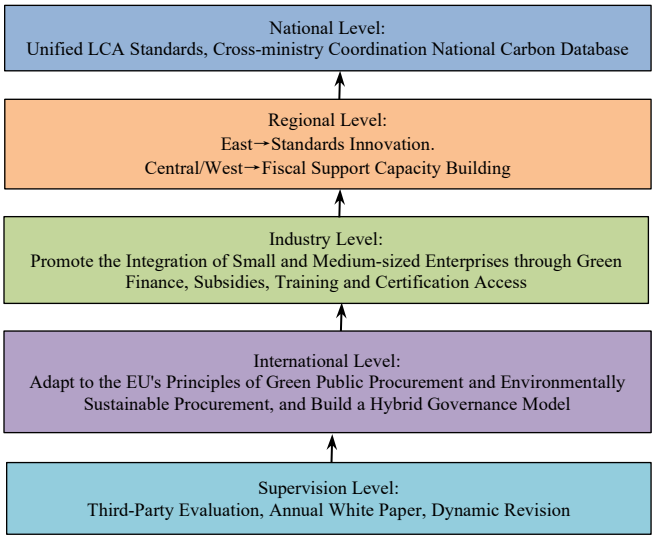

Fig. 3 Integrated Policy Roadmap

Fig. 3 summarizes the above five-level policy proposals and forms a circular construction policy roadmap in line with Sustainable Development SDG 9. The roadmap encompasses multiple dimensions, ranging from the national to the regional level, from industry to international levels, and from supervision to evaluation, thereby establishing a multi-level and systematic policy framework.

Its core goal is to gradually integrate market and social forces while ensuring administrative efficiency, thereby achieving the inclusiveness and sustainability of policies. The policy roadmap proposed in this study not only addresses the core challenges in China's current circular economy and development but also provides an operational framework for future policy optimization.

If following this path steadily, China is expected to establish a relatively perfect circular construction system by 2030. This will provide strong support for the achievement of the goal of carbon peaking and carbon neutrality, and at the same time, contribute "China's experience" to the governance of global recycling construction.

VII. Conclusion

Through the perspective of Sustainable Development SDG 9, this study examines China's progress and challenges in recycling construction, and analyzes policy implementation, governance mode and industry participation. The study found that although China has made remarkable progress in circular construction and some regions have formed replicable best practices, there is still an imbalance in the overall development. There are still significant differences in promoting circular construction in various parts of China. Relying on a stronger economic and technological foundation, eastern cities have made progress in standard implementation, digital monitoring and green financial innovation. By contrast, many central and western localities still heavily depend on subsidies and pilot initiatives, which often yield only modest results.

At the institutional level, several obstacles continue to hinder progress. Weak coordination across departments, together with the lack of common standards and data-sharing platforms, reduces transparency and makes it difficult to compare implementation outcomes across regions. SMEs also face persistent difficulties, including limited financing channels, technical shortcomings, and policy participation barriers, which limit their contribution and, in turn, affect the inclusiveness and resilience of the entire industry.

Looking to the future, China's transformation to circular construction needs to pay more attention to coordination and inclusiveness. The first move is to establish unified technical standards, build a national database, and provide a clearer green entry transformation point for small and medium-sized enterprises while supporting regional differentiated development. More fundamentally, progress depends on the gradual formation of a governance framework that integrates strong national leadership, market mechanisms, and broader social participation. Only through this multi-party participation model can policies maintain sustainability and continue to stimulate innovation.

Circular construction is not only a key area for China to achieve the dual-carbon goal, but also an important way to improve international competitiveness and create new advantages for sustainable development. Through continuous institutional optimization and multi-party collaboration, China is expected to form a replicable model and contribute experience and solutions to the global circular economy and sustainable development.

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