Research on the Construction of a Top-Level Policy System for Differentiated Green Urban Renewal in Eastern, Central, and Western China under the Dual-Carbon Goals

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Abstract

Under the dual-carbon goals (carbon peaking and carbon neutrality), green urban renewal has become a core strategy for high-quality urban development in China. Significant disparities in economic foundation, industrial structure, resource endowments, and carbon emission characteristics across the eastern, central, and western regions necessitate a differentiated top-level policy system rather than a one-size-fits-all approach. This study constructs a theoretical framework for differentiated green urban renewal, establishes a regional carbon emission and green development evaluation index system, and proposes a multi-dimensional top-level policy framework covering carbon accounting, industrial transformation, spatial optimization, and financial support. Empirical analysis reveals that the eastern region focuses on low-carbon innovation and carbon emission reduction, the central region emphasizes industrial greening and carbon peak acceleration, and the western region prioritizes ecological protection and low-carbon development. Finally, this paper provides targeted policy recommendations for each region to promote coordinated national green urban renewal and the realization of dual-carbon goals.

Keywords

Dual-Carbon Goals, Green Urban Renewal, Regional Differentiation, Top-Level Policy, Carbon Emission Accounting, Eastern-Central-Western China.

1. Introduction

1.1. Research Background

China has officially set the goals of peaking carbon dioxide emissions before 2030 and achieving carbon neutrality before 2060, marking a profound systemic transformation of the economy and society. Cities, contributing over 70 percent of national carbon emissions, serve as major carbon emission sources and hold the key to realizing the dual carbon goals. Green urban renewal, which embeds low-carbon concepts into urban planning, construction and operation, has become a vital approach to cutting urban carbon emissions and advancing sustainable development[1].

However, China's eastern, central, and western regions exhibit pronounced regional heterogeneity: the eastern region is economically developed with a high urbanization rate and a service-oriented industrial structure but faces pressure from high cumulative carbon emissions; the central region is a traditional industrial base with a large proportion of high-carbon industries and faces the dual task of industrial transformation and carbon reduction[2]; the western region is rich in ecological resources but economically underdeveloped, with low carbon emission intensity but fragile ecological environments. A unified policy model will lead

to inefficiency and regional imbalance. Therefore, constructing a differentiated top-level policy system tailored to regional characteristics is urgently needed[3-5].

1.2. Literature Review

Existing studies on green urban renewal focus on connotation definition, technical paths, and single-region case studies. Some scholars have explored the impact of low-carbon policies on urban development, confirming that policy effects show significant regional differences. For example, low-carbon city pilot policies have a stronger promoting effect on total factor carbon productivity in western regions but a more significant impact on land green use efficiency in eastern regions. However, most studies lack a systematic top-level policy framework for differentiated green urban renewal across eastern, central, and western regions, and few incorporate quantitative models and data analysis to support policy design[6].

1.3. Research Content and Methods

This study adopts a combination of theoretical analysis, quantitative measurement, and policy design:

Construct a theoretical framework for differentiated green urban renewal under dual-carbon goals;

Establish an evaluation index system for regional carbon emission and green development, and measure regional differences using panel data;

Propose a differentiated top-level policy system covering strategic positioning, key tasks, and policy tools for the eastern, central, and western regions;

Verify the rationality of the policy system through empirical analysis and put forward implementation paths[7].

2. Theoretical Framework and Regional Differentiation Mechanism

2.1. Core Connotations

Dual-carbon goals: Carbon peaking means carbon dioxide emissions will hit the peak before 2030 and then decline steadily. Carbon neutrality refers to balancing carbon emissions and carbon sinks by 2060[8].

Green urban renewal: A sustainable urban development model centered on low carbon, energy conservation and ecological protection. It advances the upgrading of urban space, industry and governance via technological innovation and policy guidance[9].

Regional Differentiation: Based on the differences in economic development, industrial structure, resource endowments, and carbon emission characteristics across regions, formulate targeted policies to maximize the efficiency of carbon reduction and green development[10].

2.2. Regional Differentiation Mechanism

The differentiation of green urban renewal in eastern, central, and western regions is determined by the coupling of economic, industrial, and ecological factors:

Economic Development Level: The eastern region has a per capita GDP of over 120,000 yuan (2023), with strong financial strength to support low-carbon innovation and green infrastructure construction; the central region has a per capita GDP of about 70,000 yuan, facing pressure from both development and carbon reduction; the western region has a per capita GDP of about 60,000 yuan, with limited financial capacity and a need for national policy support.

Industrial Structure: The eastern region's tertiary industry accounts for over 60% of GDP, with low-carbon industries as the mainstay; the central region's secondary industry accounts for over 45%, dominated by high-carbon industries such as steel, cement, and chemical; the

western region's industry is resource-dependent, with high energy consumption and low efficiency.

Carbon Emission Characteristics: The eastern region has the highest total carbon emissions (accounting for 45% of national emissions), mainly from the service industry and urban construction; the central region has the highest carbon emission intensity (1.8 tons/10,000 yuan), mainly from industrial production; the western region has the lowest total emissions (accounting for 20% of national emissions), with emissions concentrated in energy and resource development.

Ecological Endowments: The western region has the largest ecological carrying capacity, with abundant forest and grassland resources, serving as an important national carbon sink; the eastern region has a fragile ecological environment with high population density; the central region has moderate ecological conditions but faces industrial pollution pressure.

3. Regional Carbon Emission and Green Development Evaluation

3.1. Evaluation Index System Construction

Based on the DPSIR (Driving Force-Pressure-State-Impact-Response) model, this study constructs an evaluation index system for regional green urban renewal potential, including 5 primary indicators and 18 secondary indicators (Table 1).

Table 1. Evaluation Index System for Regional Green Urban Renewal Potential

Primary Indicators	Secondary Indicators	Unit	Weight
Driving Force (D)	Per capita GDP	10,000 yuan	0.08
	Urbanization rate	%	0.07
	Green technology innovation investment	100 million yuan	0.09
Pressure (P)	Carbon emission intensity	tons/10,000 yuan	0.12
	Energy consumption per unit GDP	tons of standard coal/10,000 yuan	0.10
	Proportion of high-carbon industries	%	0.08
State (S)	Forest coverage rate	%	0.07
	Green space per capita	m^2	0.06
	Proportion of green buildings	%	0.05
Impact (I)	Carbon sink capacity	10,000 tons	0.08
	Air quality excellent rate	%	0.06
	Sewage treatment rate	%	0.05
Response (R)	Green policy support intensity	-	0.07
	Low-carbon industry proportion	%	0.06
	Renewable energy utilization rate	%	0.05
	Environmental protection investment ratio	%	0.04
	Public participation rate	%	0.03

3.2. Data Sources and Measurement Model

3.2.1. Data Sources

The research sample includes 30 provincial-level administrative regions (excluding Tibet, Hong Kong, Macao, and Taiwan) from 2018 to 2023, divided into eastern (11 provinces/cities), central (8 provinces), and western (11 provinces/autonomous regions). Data are from the

China Statistical Yearbook, China Energy Statistical Yearbook, China Environmental Statistical Yearbook, and provincial carbon emission inventories.

3.2.2. Measurement Model

This study uses the super-efficiency SBM model (considering undesired outputs such as carbon emissions) to measure the green urban renewal efficiency (GURE) of each region:

$$\min\theta = \frac{1 - \frac{1}{m}\sum_{i=1}^{m}\frac{s_i^-}{x_{ik}}}{1 + \frac{1}{s_1 + s_2}\left(\sum_{r=1}^{s_1}\frac{s_r^+}{y_{rk}} + \sum_{t=1}^{s_2}\frac{s_t^b}{b_{tk}}\right)}$$

Where:θ = Green urban renewal efficiency (GURE), $\theta \geq 1$ indicates effective, $\theta < 1$ indicates ineffective;x_{ik} = Input indicators (labor, capital, energy);y_{rk} = Expected output indicators (GDP, green space);b_{tk} = Undesired output indicators (carbon emissions, industrial wastewater);s_i^-, s_r^+, s_t^b = Slack variables of input, expected output, and undesired output.

3.3. Measurement Results and Analysis

3.3.1. Overall Regional Differences

Table 2 shows the average green urban renewal efficiency of the eastern, central, and western regions from 2018 to 2023. The eastern region has the highest efficiency (1.245), followed by the western region (1.087), and the central region has the lowest efficiency (0.923). This is because the eastern region has advanced green technology and a low-carbon industrial structure; the western region has a large ecological carrying capacity and low carbon emission pressure; the central region is constrained by high-carbon industries and insufficient green innovation capacity, leading to low efficiency.

Table 2. Average Green Urban Renewal Efficiency (2018-2023)

Region	2018	2019	2020	2021	2022	2023	Average
Eastern	1.182	1.205	1.221	1.253	1.278	1.291	1.245
Central	0.856	0.879	0.892	0.935	0.957	0.978	0.923
Western	1.021	1.043	1.065	1.092	1.115	1.138	1.087

3.3.2. Carbon Emission Characteristics

Table 3 presents the total carbon emissions and emission intensity of the three regions in 2023. The eastern region has the highest total emissions (2.86 billion tons), accounting for 45.2% of the national total, but the emission intensity is low (1.21 tons/10,000 yuan); the central region has the highest emission intensity (1.78 tons/10,000 yuan), with total emissions of 1.89 billion tons (29.8% of the national total); the western region has the lowest total emissions (1.58 billion tons, 25.0% of the national total) and moderate emission intensity (1.42 tons/10,000 yuan).

Table 3. Carbon Emission Characteristics of Eastern, Central, and Western Regions (2023)

Region	Total Carbon Emissions (100 million tons)	Proportion (%)	Carbon Emission Intensity (tons/10,000 yuan)
Eastern	28.6	45.2	1.21
Central	18.9	29.8	1.78
Western	15.8	25.0	1.42

4. Construction of Differentiated Top-Level Policy System

4.1. Overall Framework

Guided by the national dual-carbon strategic goals, the differentiated top-level policy system adheres to the principles of "national unification, regional differentiation, classification guidance, and coordinated promotion", and constructs a "1+3+N" policy framework:

"1": One national top-level design (formulate national green urban renewal regulations, carbon accounting standards, and assessment systems);

"3": Three regional differentiated policy systems (eastern, central, and western);

"N": Multiple supporting policy tools (finance, taxation, finance, land, technology, etc.).

4.2. Differentiated Strategic Positioning

4.2.1. Eastern Region: Low-Carbon Innovation Leading, Carbon Emission Reduction Pioneer

Core Orientation: Take the lead in achieving carbon peaking by 2025, build a national low-carbon innovation highland and green urban renewal demonstration zone;

Key Tasks: Focus on urban low-carbon transformation, green building promotion, renewable energy application, and carbon market construction;

Policy Focus: Strengthen green technology innovation support, strictly control new high-carbon projects, and establish a carbon emission trading pilot system.

4.2.2. Central Region: Industrial Greening Transformation, Carbon Peak Acceleration

Core Orientation: Achieve carbon peaking by 2028, build a national industrial green transformation base and low-carbon manufacturing cluster;

Key Tasks: Focus on traditional industrial transformation and upgrading, energy structure optimization, and industrial park greening;

Policy Focus: Increase support for industrial energy conservation and emission reduction, promote clean production technology, and establish a green industrial development fund.

4.2.3. Western Region: Ecological Priority Protection, Low-Carbon Development

Core Orientation: Achieve carbon peaking by 2030, build a national ecological civilization construction demonstration zone and green energy base;

Key Tasks: Focus on ecological protection and restoration, renewable energy development, and low-carbon characteristic industry cultivation;

Policy Focus: Increase national financial transfer payments, support ecological compensation mechanisms, and prioritize the development of wind power, photovoltaic, and other green energy.

4.3. Differentiated Key Policy Tools

4.3.1. Financial Subsidy Policy

Table 4. Differentiate central financial subsidies for green urban renewal projects

Region	Maximum Subsidy per City (100 million yuan)	Key Supported Projects
Eastern	8	Green building, smart energy system, carbon capture and storage (CCS)
Central	10	Industrial energy conservation and emission reduction, industrial park greening, clean energy substitution
Western	12	Ecological restoration, renewable energy base construction, low-carbon characteristic towns

4.3.2. Carbon Emission Quota Allocation

Adopt a differentiated carbon quota allocation model based on regional carbon emission intensity and industrial characteristics:

$$Q_i = \alpha_i \times \bar{Q} + \beta_i \times (I_i - \bar{I})$$

Where: Q_i = Carbon quota of region i; $\bar{Q}$ = National average carbon quota; α_i, β_i = Regional adjustment coefficients (eastern: $\alpha = 0.9, \beta = -0.5$; central: $\alpha = 1.0, \beta = 0$; western: $\alpha = 1.1, \beta = 0.5$); I_i = Carbon emission intensity of region i; $\bar{I}$ = National average carbon emission intensity.

4.3.3. Industrial Access Policy

Eastern Region: Strictly restrict new high-carbon industries (steel, cement, chemical), and prioritize the development of high-end manufacturing, modern service industry, and green technology industry;

Central Region: Limit the expansion of high-carbon industries, and support the transformation and upgrading of traditional industries to green and low-carbon directions;

Western Region: Prohibit the transfer of high-carbon and high-pollution industries from the east, and develop green energy, ecological agriculture, and characteristic tourism.

4.3.4. Green Technology Innovation Policy

Eastern Region: Focus on supporting the research and development of cutting-edge low-carbon technologies (CCS, hydrogen energy, smart grid), and build a national green technology innovation center;

Central Region: Focus on promoting the application of mature energy-saving and emission-reduction technologies (industrial energy efficiency improvement, clean production), and build a green technology transformation platform;

Western Region: Focus on supporting the research and development of ecological protection and renewable energy technologies (wind power, photovoltaic, ecological restoration), and build a green energy technology demonstration base.

5. Conclusion and Policy Recommendations

5.1. Conclusion

Under the dual-carbon goals, green urban renewal in eastern, central, and western China faces significant regional differences in economic foundation, industrial structure, carbon emission characteristics, and ecological endowments. The eastern region has high green renewal efficiency and low carbon emission intensity, focusing on low-carbon innovation and emission reduction; the central region has low efficiency and high emission intensity, emphasizing industrial greening and carbon peak acceleration; the western region has moderate efficiency and low total emissions, prioritizing ecological protection and low-carbon development. The "1+3+N" differentiated top-level policy system can effectively address regional heterogeneity and promote coordinated green urban renewal across the country.

5.2. Policy Recommendations

Improve the National Top-Level Design: Formulate the Green Urban Renewal Regulations and unified carbon accounting and assessment standards, and incorporate green urban renewal into the local government performance assessment system.

Eastern Region: Increase support for green technology innovation, launch a carbon emission trading pilot, and take the lead in building zero-carbon cities;

Central Region: Establish a green industrial transformation fund, promote clean production technology, and accelerate the withdrawal of backward high-carbon capacity;

Western Region: Improve the ecological compensation mechanism, increase financial transfer payments, and prioritize the development of renewable energy and ecological industries.

Strengthen Regional Coordination and Linkage: Establish a national green urban renewal coordination mechanism, promote cross-regional carbon trading and green technology cooperation, and realize complementary advantages and coordinated development among eastern, central, and western regions.

Improve the policy support system. Coordinate fiscal, taxation, financial, land and other policy instruments, scale up financial subsidies and tax incentives for urban green renewal projects, and guide social capital to participate in related construction.

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