

Report | June 2026

# China Carbon Neutrality Tracker (CCNT) 2025 Annual Report

Green and Low-Carbon Transition in China's  
Provincial Level Regions: A Decade in Review



## ABOUT IGDP

The Institute for Global Decarbonization Progress (iGDP), established in Beijing in 2014, is a non-profit think tank dedicated to promoting green and low-carbon development. Since its inception, iGDP has provided policy-relevant analytical insight on China's green and low-carbon practices in view of the global climate challenge. iGDP serves decision makers, practitioners, and investors by promoting scientifically grounded energy and climate change mitigation solutions through interdisciplinary, systematic, and empirical research. iGDP collaborates with a wide variety of stakeholders to foster dialogue on green, low-carbon, and sustainable development, providing forward-looking analysis and developing knowledge products with a global perspective.

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## ACKNOWLEDGMENTS

We thank **Zhou Nan** and **Zhang Jingjing** from the University of California, Berkeley, for their valuable technical input on the research methodology and reporting framework. The report was independently prepared by iGDP, and all findings, interpretations, and conclusions are those of the authors.

We would like to express our gratitude to **Chen Ying**, Researcher at the Institute for Eco-Civilization at the Chinese Academy of Social Sciences; **Liao Cuiping**, Researcher at the Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences; and **Xi Xiping**, Director of the Energy Research Institute at Jiangxi Academy of Sciences, for their invaluable comments and suggestions during the preparation of this report.

Due to time and resource constraints, it was not possible to incorporate all of the valuable recommendations provided by the experts. We will continue to refine and improve our analysis in future research. We also thank our colleagues at iGDP: **Hu Min**, **Chen Meian**, **Wang Yanhui**, and **Lyu Yanning**, for their insightful comments and support throughout the development of this report. We thank our intern, **Che Yuyin**, for her assistance with the translation of tables.

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**Date** | June 2026

**Citation** | Yang Li, Zhu Tongxin, Song Manjiao & Li Xindi. (2026). CCNT 2025 Annual Report: Green and Low-Carbon Transition in China's Provincial Level Regions: A Decade in Review, Institute for Global Decarbonization Progress (iGDP)

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# Executive Summary

As China's "dual carbon" targets have been enshrined as national strategy and the "1+N" policy framework continues to take shape, the country's green and low-carbon transition has moved into a phase of accelerated implementation at the subnational level. Given China's vast territory and the significant differences among provincial level regions<sup>1</sup> in economy, energy mix, and resource endowments, the transition varies notably across regions in terms of starting points, pathways, and outcomes. Therefore, systematically tracking subnational climate action carries significant potential to inform policymaking and ensure the timely achievement of China's "dual carbon" goals.

This report applies Subnational Low-Carbon and Green Index for China (Subnational LOGIC), an indicator tool developed by iGDP, to track and quantitatively assess the low-carbon transition of 30 provincial level regions between 2013 and 2022. Subnational LOGIC encompasses 26 specific indicators under four categories: carbon productivity; carbon emissions (including six sub-categories covering energy, power, industry, buildings, transport, and agriculture); environmental conditions and land use; and policy systems and public participation, together capturing the overall quality of regional economic growth and progress on sectoral emission reductions.

As the first year of the 15th Five-Year Plan (15th FYP) period (2026–2030), 2026 will set the trajectory for a planning cycle that will determine whether China stays on course for both basic socialist modernization, a key national goal, and its "dual carbon" climate goals. By tracking subnational implementation of China's "dual carbon" strategy, this report aims to inform policymaking on coordinated regional development, resource-appropriate green transition, and the evidence-based design of low-carbon development policies for the 15th FYP period.

Tracking 30 provincial level regions from 2013 to 2022, Subnational LOGIC shows that green and low-carbon scores improved across all provinces, reflecting progress in regional transition and marking the beginning of an accelerated transition phase. In 2022, leading provinces performed well across all indicators, and each showed distinctive strengths, with no single province dominating in all dimensions. This demonstrates that provinces are charting diverse green development pathways shaped by their own resource endowments, industrial structures, and policy priorities, rather than following a one-size-fits-all approach.

By region, China's green and low-carbon transition exhibits pronounced structural differences: eastern and economically leading regions excel in carbon productivity and end-use sector decarbonization, but their power scores are constrained by resource endowments, and future efforts should focus on cross-regional energy coordination and low-carbon technology innovation; central regions and areas like the Yangtze River Economic Belt show relatively balanced scores and should pursue deeper decarbonization in end-use sectors through institutional reforms; western regions and large energy bases show marked advantages in power and energy, but need to better translate green power endowments into industrial value added, shifting from resource-based energy suppliers to green industrial powerhouses; northeastern and key energy-supply regions have advantages in environment and land use, with future priorities around upgrading traditional industries and fostering new growth drivers.

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<sup>1</sup> "Provincial level regions" in this report refers to provincial level administrative units, encompassing China's 23 provinces, 4 municipalities directly under the central government, 5 autonomous regions, and 2 special administrative regions. Due to data limitations, the report does not at this stage cover Xizang, Taiwan, Hong Kong, and Macao.

By sector, carbon productivity, energy, and power have made progress nationwide, while transport, buildings, and industry remain the primary frontiers for deep decarbonization.

Analysis of Subnational LOGIC scores and growth rates across the 30 provincial level regions reveals four distinct provincial types: Decelerating Frontrunners (high scores & low growth rates), Comprehensive Leaders (high scores & high growth rates), High-Potential Risers (low scores & high growth rates), and Structural Reformers (low scores & low growth rates). Going forward, a differentiated approach should guide policymaking: leading regions should be encouraged to pursue institutional innovation to consolidate transition gains, while provinces with high potential should receive targeted support to fully unlock their green transition potential.

Based on a composite assessment of five indicators—per capita GDP, shares of the primary, secondary, and tertiary sectors, share of manufacturing value-added in total industrial value-added, resident population urbanization rate, and share of primary sector employment—this study ranks provinces from highest to lowest by economic development stage and creates four additional analytical groupings: Pioneer Economy, Leading Economy, Catching-Up Economy, and Developing Economy. Through case studies of Guangdong, Jiangxi, Shanxi, and Hainan, the report examines the differentiated pathways of green and low-carbon transition for regions in these four contrasting stages of economic development. Guangdong, as a Pioneer Economy, leads in carbon productivity and end-use sector decarbonization through industrial structure optimization and clean energy inflows, but local power decarbonization remains a weak point. Jiangxi, as a Leading Economy, has achieved notable results in reducing carbon intensity, but breakthroughs in industrial and transport decarbonization are still needed. Shanxi, as a Catching-Up Economy, has developed a distinctive emissions reduction pathway for coal-dependent areas, but its energy and industrial low-carbon transition still face significant challenges. Hainan, as a Developing Economy, has a relatively clean power mix and an economic structure underpinned by the service sector, but challenges remain in expanding non-fossil power generation and advancing industrial electrification. The experience of these four provinces shows that there is no universal template for green and low-carbon transition; each region should identify bottlenecks and apply targeted measures suited to its development and resource endowments to unlock its unique low-carbon development potential.

# I. Background and Overview of the Assessment Framework

Guided by the goal of achieving carbon peaking by 2030 and carbon neutrality by 2060, the green and low-carbon transition has become a national strategic priority. According to national strategy, by 2035 China aims to have largely established a green, low-carbon, and circular economy; and by mid-century, to have fully built a clean, low-carbon, safe, and efficient new energy system.

Energy transition is the key lever for achieving the "dual carbon" goals. China is accelerating the restructuring of its energy system, steadily increasing the share of non-fossil energy, and promoting greener, smarter, safer, and more efficient transition. In parallel, concerted efforts are underway to foster a green and low-carbon circular economy, with a focus on improving resource efficiency, strictly controlling pollutant emissions, optimizing industrial structure, and strengthening key technology innovation to coordinate economic development and environmental protection.

Localities are where the "dual carbon" strategy meets the ground. They must tailor their green and low-carbon transition plans to local geographic conditions, resource endowments, economic foundations, and industrial characteristics, leveraging their comparative advantages.

In recent years, localities have built and refined "1+N" policy frameworks for "dual carbon" work, focusing on the 14th and 15th FYP periods. These frameworks establish development goals, action plans, and institutional safeguards in key sectors including energy, industry, transport, buildings, and agriculture. This framework provides clear guidance for regional green transition while placing higher demands on assessment, monitoring, and implementation.

Amid profound changes in global climate governance and the deepening implementation of China's "dual carbon" strategy, provincial level regions, as key implementers, play a direct role in delivering China's Nationally Determined Contribution (NDC) targets. Many provincial regions are large economies with high emissions, with some provinces emitting greenhouse gases comparable to those of major developed economies (Germany: ~670 million tonnes CO<sub>2</sub>, 2022<sup>1</sup>). Due to significant differences in economic development, energy mix, industrial structure, and resource endowments, the priority areas and challenges for carbon emissions control vary across provinces.

To systematically track progress and outcomes of regional energy green and low-carbon transition across China, we developed the Subnational Low-Carbon and Green Index for China (Subnational LOGIC). The system covers 30 provincial level regions over 2013–2022 and comprises 26 specific indicators across 4 categories and 9 sub-categories (see Appendix for methodology).

Subnational LOGIC builds on the "Low-Carbon and Green Index for Cities" jointly developed in 2017 by iGDP and Lawrence Berkeley National Laboratory (LBNL)<sup>[1]</sup>. It has been extended and refined for the provincial level, with updated indicators, weightings, and benchmark values to better capture subnational transition progress.

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1 EDGAR (Emissions Database for Global Atmospheric Research). (2023). [https://edgar.jrc.ec.europa.eu/report\\_2023](https://edgar.jrc.ec.europa.eu/report_2023)

The Subnational LOGIC system uses a multi-indicator assessment method, encompassing four categories: 1) Carbon Productivity; 2) Carbon Emissions; 3) Environmental Conditions and Land Use; and 4) Policy Systems and Public Participation. The Carbon Emissions category is further divided into six sub-categories: energy, power, industry, buildings, transport, and agriculture. The system is designed to capture progress in high-quality regional economic development, sector-level green and low-carbon transition, environment quality improvement, carbon sink enhancement, and policy framework development (see Table 1).

**Table 1 | Subnational LOGIC Assessment Indicators**

Category	Sub-Category	Indicator (Unit)	Type	Benchmark	Weight	
Productivity: 20% High-quality regional economic development	Carbon Productivity	20%	Energy consumption per unit of GDP (tce/10,000 RMB, 2005 constant prices)	-	0.27	10%
		Carbon emissions per unit of GDP (tCO <sub>2</sub> /10,000 RMB, 2005 constant prices)	-	1.21	10%	
Carbon Emissions: 50% Sector-level green and low-carbon transition	Energy: Clean and low-carbon energy system	20%	Per capita carbon emissions (tCO <sub>2</sub> /person)	-	3.5	5%
		Per capita energy consumption (tce/person)	-	1.92	5%	
		Share of non-fossil energy in total primary energy consumption (%)	+	25%	5%	
		Share of electricity in final energy consumption (%)	+	37%	5%	
	Power: Power structure centered on new energy	10%	Share of wind and solar capacity in total power capacity (%)	+	50%	5%
		Carbon emissions per unit of power generation (gCO <sub>2</sub> /kWh)	-	92.63	5%	
	Industry: Green and low-carbon transformation and upgrading	10%	Carbon emissions per unit of industrial value-added (tCO <sub>2</sub> /10,000 RMB, 2005 constant prices)	-	0.2	5%
		Revenue share of energy-intensive industries (%)	-	0.11	5%	
	Buildings: Energy saving and carbon reduction in operation	4%	Per capita residential building carbon emissions (tCO <sub>2</sub> /person)	-	0.07	2%
		Public building carbon emissions per tertiary sector employee (tCO <sub>2</sub> /person)	-	0.11	2%	
Transport: Smart and low-carbon transition	4%	Share of electricity in final energy consumption in the transport sector (%)	+	0.1	2%	
	Carbon emissions per unit of converted transport turnover (tCO <sub>2</sub> /t-km)	-	0.08	2%		
Agriculture: Low-carbon sustainable development	2%	Carbon emissions per unit of agricultural value-added (tCO <sub>2</sub> /10,000 RMB, 2005 constant prices)	-	0.05	1%	
	Agricultural output per worker (10,000 RMB/person)	+	12.16	1%		
Environmental Conditions and Land Use: 20% Ecological carbon sink enhancement and climate resilience	Environmental Conditions and Land Use	20%	Per capita municipal solid waste collected (tons/person)	-	0.08	2%
		Share of days with good or excellent air quality (%)	+	5	5%	
		Annual average PM <sub>2.5</sub> concentration (µg/m <sup>3</sup> )	-	1	4%	
		Daily per capita domestic water consumption (L/person-day)	-	60	2%	
		Share of local fiscal spending on energy conservation and environmental protection (%)	+	0.05	2%	
		Forest coverage rate (%)	+	0.26	5%	
Policy Systems and Public Participation: 10% Improving green transition policy framework	Policy Systems and Public Participation	10%	Whether policy documents on fiscal support for the "dual carbon" goals have been issued	+	Yes	2.5%
		Comparison of 14th FYP renewable energy targets vs. actual 13th FYP growth	+	Yes	2.5%	
		Whether a medium-to-long-term climate change adaptation action plan has been issued	+	Yes	2.5%	
		Whether policies about promoting green consumption have been formulated	+	Yes	2.5%	

Note: + indicates positive indicators; - indicates negative indicators.

As a comprehensive assessment tool for regional green and low-carbon transition, Subnational LOGIC has a range of applications: evaluating the quality of regional green and low-carbon development across dimensions including the economy, energy, sectors, ecology, and policy; supporting coordinated regional development and informing differentiated policy making; identifying transition outcomes to provide data support for strategic adjustments; and raising public awareness to promote green awareness and social participation.

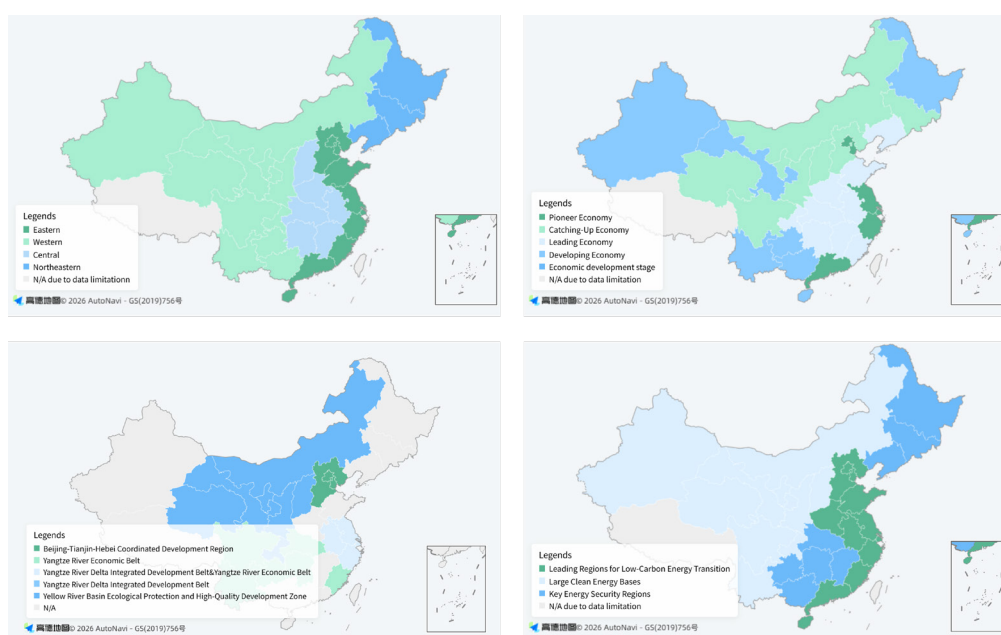
## II. Regional Perspective: Structural Divergence in China's Low-Carbon Transition

Provinces differ noticeably in geographic location, economic development, resource endowments, and national strategic positioning, which produces a wide diversity of green and low-carbon transition pathways. To understand the drivers and core challenges behind regional transition, this report uses a four-dimensional classification framework to categorize 30 provinces, (see Figure 1).

It should be noted that the economic-geographic dimension and economic development stage dimension serve as baseline classifications covering all provincial-level regions nationwide, while the national major regional strategy dimension and energy development positioning dimension focus specifically on provincial level regions with particular policy mandates or designated functions. Together, the two approaches ensure comparability at the national level while enabling analysis of how both common structural conditions and region-specific initiatives shape transition trajectories and challenges. Specifically:

- Economic-geographic dimension: following national statistical standards, provinces are grouped into four major regions: eastern, central, western, and northeastern;
- Economic development stage dimension: based on five core variables including per capita GDP, provinces are divided into Pioneer Economy, Leading Economy, Catching-Up Economy, and Developing Economy;
- National major regional strategy dimension: provinces are classified according to China's major regional development strategies, including the Yangtze River Delta Integrated Development Belt, Beijing-Tianjin-Hebei Coordinated Development Region, Yangtze River Economic Belt, and Yellow River Basin Ecological Protection and High-Quality Development Zone;
- Energy development positioning dimension: based on energy development positioning, provinces are categorized as Large Clean Energy Bases, Leading Regions for Low-Carbon Energy Transition, and Key Energy Security Regions.

**Figure 1 | Maps of Provincial Classifications**



*Note: Regional Classification of Provinces by Economic-Geographic Region (top left), Economic Development Stage (top right), National Regional Strategy (bottom left), and Energy Positioning (bottom right).*

From a regional perspective, the report examines average index scores and their changes over the past decade across different categories, and compares performance across nine sub-categories to identify the characteristics of green and low-carbon transition among different types of provinces.

Detailed classification methods and provincial groupings are provided in Appendix 2.

## 1. Economic-Geographic Dimension

In 2022, Subnational LOGIC scores ranked from highest to lowest were: eastern, central, western, and northeastern China. From 2013 to 2022, Subnational LOGIC scores in all four major economic-geographic regions rose significantly. The eastern region maintained the leading position throughout; northeastern and central regions showed the most notable Subnational LOGIC score growth, with increases of 51% and 48%, respectively (see Table 2).

**Table 2 | Subnational LOGIC Scores for the Four Major Economic-Geographic Regions**

Economic-Geographic Region	2013 Score	2022 Score	Score Growth
Eastern	39.4	55.8	42%
Central	35.4	52.3	48%
Western	34.8	47.8	37%
Northeastern	30.9	46.8	51%

### Analysis of 2022 Subnational LOGIC Sub-Category Performance by Economic-Geographic Region

The eastern region led in four sub-categories: carbon productivity, industry, buildings, and transport, primarily because of its relatively advanced industrial structure, as well as its nationwide leadership in industrial transformation and end-use energy decarbonization.

The central region was generally balanced but lacked standout areas. The central region's sub-category scores were the most representative among the four major regions, remaining relatively stable and balanced overall.

The western region, driven by its abundant clean energy and land resources, ranked first in energy and power sub-category scores. Its low scores in carbon productivity and industry reflected the challenges posed by a heavy industrial structure and the demanding transition toward a low-carbon economy while absorbing relocated industries.

The northeastern region, while scoring relatively higher in power as well as environmental conditions and land use, trailed in most other sub-categories. As an old industrial base, it faces steep challenges in upgrading traditional industries and improving energy efficiency in buildings and transport. Its low-carbon transition as a whole remains at one of the most demanding stages of the process (see Table 3).

**Table 3 | Sub-Category Scores by Economic-Geographic Region (2022)**

Sub-Category	Focus Area	Economic-Geographic Regions				Full Score
		Northeastern	Eastern	Central	Western	
<b>Carbon Productivity</b>	Quality of green development	9.6	14.6	12.7	8.6	20.0
<b>Energy</b>	Decarbonization level of the energy system	10.1	12.9	13.0	13.4	20.0
<b>Power</b>	Progress in building a power structure centered on new energy	4.3	3.3	3.9	4.8	10.0
<b>Industry</b>	Green and low-carbon industrial transformation and upgrading	3.1	4.4	3.1	2.6	10.0
<b>Buildings</b>	Energy saving and carbon reduction in building operation	0.7	1.6	1.0	0.9	4.0
<b>Transport</b>	Smart and low-carbon transition of transport	1.0	1.8	1.2	1.2	4.0
<b>Agriculture</b>	Low-carbon transition and efficiency improvement in agricultural production	0.7	1.0	0.8	0.8	2.0
<b>Environmental Conditions and Land Use</b>	Ecological governance and carbon sink capacity	12.3	10.9	11.8	11.4	20.0
<b>Policy Systems and Public Participation</b>	Policy framework development and social participation	5.0	5.3	4.6	4.1	10.0

## 2. Economic Development Stage Dimension

Based on a composite assessment of 5 indicators—per capita GDP, shares of the primary, secondary, and tertiary sectors, share of manufacturing value-added in total industrial value-added, resident population urbanization rate, share of primary sector employment—provinces are ranked from highest to lowest by economic development stage and grouped into four categories: Pioneer Economy, Leading Economy, Catching-Up Economy, and Developing Economy.

In 2022, Pioneer Economies substantially outscored other types of regions, indicating that a robust economic foundation provides strong support for technology innovation and industrial upgrading. Developing Economies' average scores exceeded those of Catching-Up Economies, a structural characteristic primarily attributed to their relative advantages in low-carbon energy systems and environmental resource reserves, which offset the constraints associated with their smaller economic scale.

From 2013 to 2022, Subnational LOGIC scores for regions at all four economic development stages showed significant growth. Although Catching-Up Economies scored lower overall, their ten-year Subnational LOGIC score growth rate of 48% ranked top. Leading Economies followed with a growth rate of 42% (see Table 4).

**Table 4 | Subnational LOGIC Scores Across Regions by Economic Development Stage**

Economic Development Stage	2013 Score	2022 Score	Score Growth
Pioneer Economy	41.2	57.1	39%
Leading Economy	37.0	52.7	42%
Catching-Up Economy	31.0	45.9	48%
Developing Economy	36.3	50.6	39%

## Analysis of 2022 Subnational LOGIC Sub-Category Performance by Economic Development Stage

Pioneer Economies led decisively in carbon productivity and industry, scoring far above other economies. Notably, their power score (2.8) was the lowest, indicating that these regions still face a constraint of insufficient local resources in adjusting their energy structure.

Leading Economies showed the most balanced sub-category scores, with strength in environmental conditions and land use as well as carbon productivity.

Catching-Up Economies stood out in the power sub-category, indicating that they leveraged a late-mover advantage by rapidly deploying new energy systems and actively compensating for weaker economic foundations through policy guidance and institutional innovation.

Developing Economies scored highest in energy and environmental conditions and land use, underpinned by their superior natural resource endowments and a relatively low industrial intensity. However, there remains significant room for improvement in the greening of industry, buildings, transport, and other end-use sectors (see Table 5).

**Table 5 | Sub-Category Scores by Region at Different Stages of Economic Development (2022)**

Sub-Category	Focus Area	Regions by Economic Development Stage				Full Score
		Pioneer Economies	Leading Economies	Catching-Up Economies	Developing Economies	
Carbon Productivity	Quality of green development	16.5	13.5	7.3	9.7	20.0
Energy	Decarbonization level of the energy system	12.9	13.1	11.1	14.3	20.0
Power	Progress in building a power structure centered on new energy	2.8	3.6	5.2	4.5	10.0
Industry	Green and low-carbon industrial transformation and upgrading	5.9	3.1	2.5	2.5	10.0
Buildings	Energy saving and carbon reduction in building operation	1.4	1.3	0.7	1.2	4.0
Transport	Smart and low-carbon transition of transport	1.6	1.1	1.6	1.3	4.0
Agriculture	Low-carbon transition and efficiency improvement in agricultural production	0.8	1.0	0.8	0.9	2.0
Environmental Conditions and Land Use	Ecological governance and carbon sink capacity	10.1	11.7	11.6	11.9	20.0
Policy Systems and Public Participation	Policy framework development and social participation	5.0	4.4	5.0	4.3	10.0

### 3. National Major Regional Strategy Dimension

In 2022, the Yangtze River Delta Integrated Development region led with a marginal edge over the Yangtze River Economic Belt in Subnational LOGIC scores, followed by the Beijing-Tianjin-Hebei Coordinated Development Region and the Yellow River Basin Ecological Protection and High-Quality Development Zone.

From 2013 to 2022, the Beijing-Tianjin-Hebei Coordinated Development Region showed the largest score increase at 55%, demonstrating the effectiveness of sound policy implementation. The Yangtze River Delta and Yellow River Basin are tied for second at 43% each, while the Yangtze River Economic Belt recorded an increase of 41%. (see Table 6).

**Table 6 | Subnational LOGIC Scores for Major Strategic Regions**

Strategic Region	2013 Score	2022 Score	Score Growth
Yangtze River Delta Integrated Development Belt	39.7	56.6	43%
Yangtze River Economic Belt	40.0	56.4	41%
Beijing-Tianjin-Hebei Coordinated Development Region	33.9	52.6	55%
Yellow River Basin Ecological Protection & High-Quality Development Zone	32.2	46.1	43%

**Analysis of 2022 Subnational LOGIC Sub-Category Performance by Major Regional Strategies**

The Yangtze River Delta Integrated Development Belt led in carbon productivity, industry, and buildings scores. This reflects the region's progress in end-use energy decarbonization alongside its strong economic growth.

The Yangtze River Economic Belt scored highest in energy and environmental conditions and land use, closely aligned with the strategic principle of "prioritizing large-scale conservation over large-scale development." Their scores reflect the region's capacity to leverage its clean energy endowments while significantly enhancing the river basin's carbon sink capacity and ecological asset value.

The Beijing-Tianjin-Hebei Coordinated Development Region performed strongly in industry and transport sub-categories. Beijing and Tianjin's technological and manufacturing strengths, combined with Hebei's reduction of excess capacity in traditional industries, have together driven industrial restructuring and green upgrading across the region. In transport, the region has leveraged its ongoing integration of transport infrastructure to shift freight toward lower-carbon modes, yielding significant progress in regional transport decarbonization.

The Yellow River Basin markedly outperformed other strategic regions in the power sub-category. Although constrained by a high share of traditional industries with considerable room for improvement in carbon productivity, the Yellow River Basin, as a key national energy base, is undertaking large-scale new energy development to support the low-carbon transition of the national power system (see Table 7).

**Table 7 | Sub-Category Scores by Regional Development Strategies (2022)**

Sub-Category	Focus Area	Regional Development Strategies				Full Score
		Yangtze River Delta Integrated Development Belt	Beijing-Tianjin-Hebei Coordinated Development	Yangtze River Economic Belt	Yellow River Basin Ecological Protection and High-Quality Development	
Carbon Productivity	Quality of green development	15.5	13.5	14.4	8.2	20.0
Energy	Decarbonization level of the energy system	12.9	10.4	14.3	11.9	20.0
Power	Progress in building a power structure centered on new energy	3.2	3.5	3.6	5.1	10.0
Industry	Green and low-carbon industrial transformation and upgrading	4.7	4.9	3.8	2.5	10.0
Buildings	Energy saving and carbon reduction in building operation	1.9	0.9	1.5	0.8	4.0
Transport	Smart and low-carbon transition of transport	1.5	1.9	1.1	1.5	4.0
Agriculture	Low-carbon transition and efficiency improvement in agricultural production	0.8	0.9	0.9	0.8	2.0
Environmental Conditions and Land Use	Ecological governance and carbon sink capacity	10.4	10.7	11.7	10.9	20.0
Policy Systems and Public Participation	Policy framework development and social participation	5.6	5.8	5.2	4.4	10.0

## 4. Regional Energy Development Positioning Dimension

China's 14th FYP for a Modern Energy System sets out a coordinated approach to raising regional energy development standards, identifying three types of regional energy development priorities:

Type 1: Leading Regions for Low-Carbon Energy Transition: regions guided by green and low-carbon pilot demonstrations in distributed renewable energy and smart energy systems, including the Beijing-Tianjin-Hebei and surrounding areas, the Yangtze River Delta, the Guangdong-Hong Kong-Macao Greater Bay Area and surrounding areas, and other regions.

Type 2: Key Energy Security Regions: regions that prioritize local renewable and non-fossil energy development while ensuring energy security, including the "Two Lakes and One River" area (Hubei, Hunan, and Jiangxi), northeastern China, and other regions.

Type 3: Large Clean Energy Bases: regions designated for large-scale, centrally coordinated development of hydro, wind, and solar power, including Yunnan-Guizhou-Sichuan-Tibet, Qinghai, the Yellow River "Several-Bend" Arc, the Hexi Corridor, Xinjiang, the Songliao Plain, northern Hebei, and southeastern coastal areas.

In 2022, Leading Regions for Low-Carbon Energy Transition ranked first in Subnational LOGIC scores, followed by Key Energy Security Regions, while Large Clean Energy Bases lagged behind with a noticeable margin. From 2013 to 2022, Key Energy Security Regions showed the highest Subnational LOGIC score improvement (45%), while Large Clean Energy Bases showed the lowest (39%) (see Table 8).

**Table 8 | Subnational LOGIC Scores by Energy Development Strategic Positioning**

Energy Development Strategic Positioning	2013 Score	2022 Score	Score Growth
Leading Regions for Low-Carbon Energy Transition	39.1	55.7	43%
Key Energy Security Regions	35.3	51.0	45%
Large Clean Energy Bases	33.1	46.1	39%

### Analysis of 2022 Subnational LOGIC Sub-Category Performance by Regional Energy Development Positioning

Leading Regions for Low-Carbon Energy Transition led in carbon productivity, industry, buildings, and transport. These regions exhibited a well-rounded and balanced transition, reflecting their leadership in high-quality development and the decarbonization of energy systems.

Key Energy Security Regions scored highest in environmental conditions and energy, with other scores slightly below Leading Regions for Low-Carbon Energy Transition.

Large Clean Energy Bases exhibited a typical structure characterized by strength in energy but weakness in industry. Their high power score reflects significant achievements in large-scale development of new energies including wind and solar power, but their scores of carbon productivity and industry remained relatively low (see Table 9).

**Table 9 | Sub-Category Scores by Regional Energy Development Strategic Positioning (2022)**

Sub-Category	Focus Area	Regional Energy Development Strategic Positioning			Full Score
		Leading Regions for Low-Carbon Energy Transition	Key Energy Security Regions	Large Clean Energy Bases	
Carbon Productivity	Quality of green development	14.5	11.4	8.1	20.0
Energy	Decarbonization level of the energy system	13.1	12.9	12.4	20.0
Power	Progress in building a power structure centered on new energy	3.4	3.9	4.9	10.0
Industry	Green and low-carbon industrial transformation and upgrading	4.3	3.0	2.5	10.0
Buildings	Energy saving and carbon reduction in building operation	1.6	0.9	0.8	4.0
Transport	Smart and low-carbon transition of transport	1.7	0.9	1.4	4.0
Agriculture	Low-carbon transition and efficiency improvement in agricultural production	0.9	0.8	0.8	2.0
Environmental Conditions and Land Use	Ecological governance and carbon sink capacity	11.0	12.4	11.1	20.0
Policy Systems and Public Participation	Policy framework development and social participation	5.2	4.7	4.0	10.0

## 5. Summary

Eastern Regions, Pioneer Economies, Yangtze River Delta Integrated Development Belt, and Leading Regions for Low-Carbon Energy Transition showed high scores in carbon productivity, industry, and buildings, reflecting strong economic carbon output efficiency and end-use sector decarbonization. However, their power scores were generally low due to resource endowment constraints. Provinces in these categories should prioritize cross-regional energy coordination, low-carbon technology R&D and application, and improving social awareness to drive greener production patterns and lifestyles.

Central regions, Leading Economies, Yangtze River Economic Belt, and the Beijing–Tianjin–Hebei Coordinated Development Region posted relatively balanced sub-category scores with no pronounced weaknesses. These regions maintain medium-to-high scores in carbon productivity, industry, and environment; the priority going forward should be driving deep decarbonization in end-use sectors through technology innovation and institutional reform, while greening incremental power demand, providing replicable models of balanced transition for the country.

Western regions, Catching-Up Economies, Yellow River Basin Ecological Protection and High-Quality Development Zone, and Large Clean Energy Bases led in power and energy sub-categories, but had lower carbon productivity and industry scores due to weak industrial foundations. Provinces in these categories should focus on converting their green power endowments into high-quality local green growth, improve local consumption capacity, enhance industrial value-added, and transition from energy-rich provinces to green industrial powerhouses.

Northeastern regions, Developing Economies, and Key Energy Security Regions generally scored low in industry sub-category but excelled in environmental conditions and land use. These regions should focus on greening traditional industries, cultivating new green growth drivers, and better integrating energy development and ecological governance.

### III. Provincial Perspective: Performance and Typologies Across 30 Provinces

Provincial level regions are the primary actors in China's green and low-carbon efforts. Tracking progress at the provincial level enables evaluation of policy implementation at different stages, helps identify gaps in the transition, and provides transferable experience for other regions.

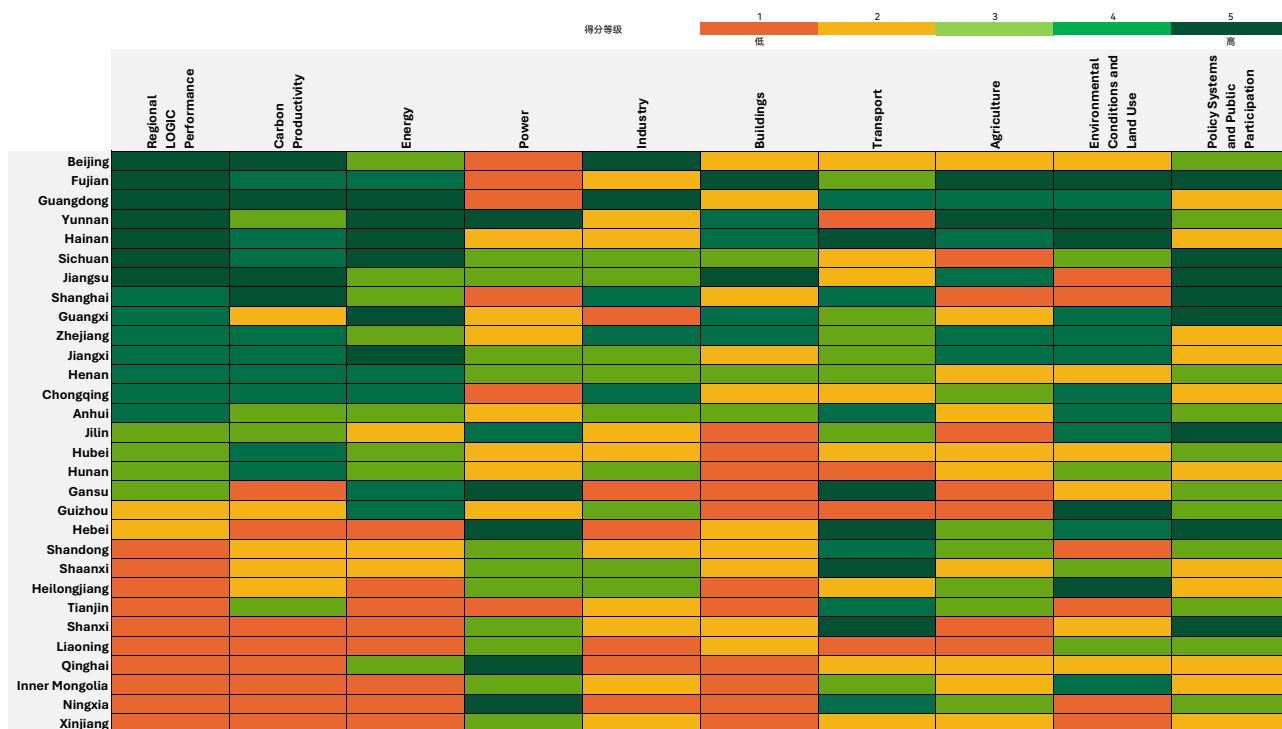
#### 1. 2022 Subnational LOGIC Performance Analysis

Subnational LOGIC scores across provinces reveal pronounced structural differences (see Figure 2). The five top-ranked provinces in 2022—Beijing, Sichuan, Guangdong, Fujian, and Yunnan—form the leading cohort of China's green and low-carbon transition. Notably, none of these provinces led across all sub-categories.

Beijing excelled in carbon productivity and industry, indicating that high-value-added industries are pillars for development. Sichuan, with its rich hydropower energies combined with a relatively sound policy system, scored high in energy and policy sub-categories. Guangdong showed strong momentum in energy and transport sub-categories, reflecting the leading role of a mega-province on energy consumption. Fujian scored high in buildings, agriculture, and policy, providing a model for integrated urban-rural green development. Yunnan stood out in power and environmental conditions, consistent with its designated role as a national clean energy base.

Green and low-carbon transition across provinces does not advance uniformly across all dimensions, and strengths and weaknesses coexist within each province's transition profile. Driving regional transition therefore cannot follow a one-size-fits-all approach; instead, it requires locally tailored responses.

Figure 2 | Subnational LOGIC Index and Sub-Category Scores for 30 Provinces



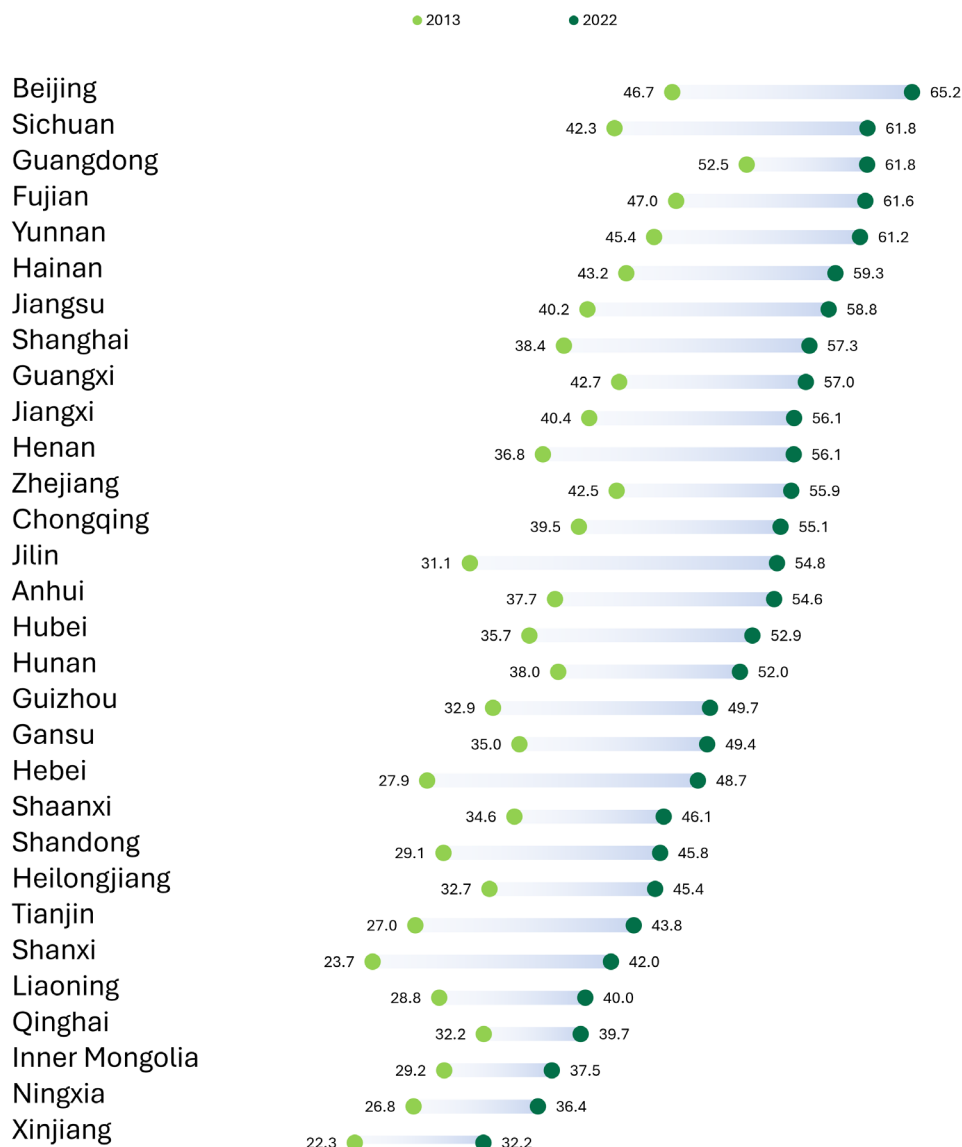
## 2. Subnational LOGIC Score Changes Across Provinces over a Decade

As shown in Figure 3, from 2013 to 2022, Subnational LOGIC scores rose across all 30 provinces, reflecting broad-based progress in green and low-carbon transition, but with significant differences in the pace and pathways of transition.

The fastest-transitioning provinces were Shanxi, Jilin, Hebei, Tianjin, and Shandong, with Subnational LOGIC index growth rates all exceeding 56%, demonstrating strong momentum. Among them, Shanxi (+78%) and Hebei (+75%) mainly benefited from significant progress in the decarbonization of the power system. As traditional energy and heavy industry bases, both regions accelerated transition from carbon-intensive power systems to cleaner generation by scaling up clean energy deployment and retrofitting coal-fired plants for operational flexibility.

Jilin (+76%), Tianjin (+62%), and Shandong (+57%) were mainly driven by significant improvements in carbon productivity, reflecting accelerating decoupling of economic output from carbon emissions.

**Figure 3 | Subnational LOGIC Score Changes for 30 Provinces (2013 vs. 2022)**



### 3. Ranking Changes for Key Provinces Over a Decade

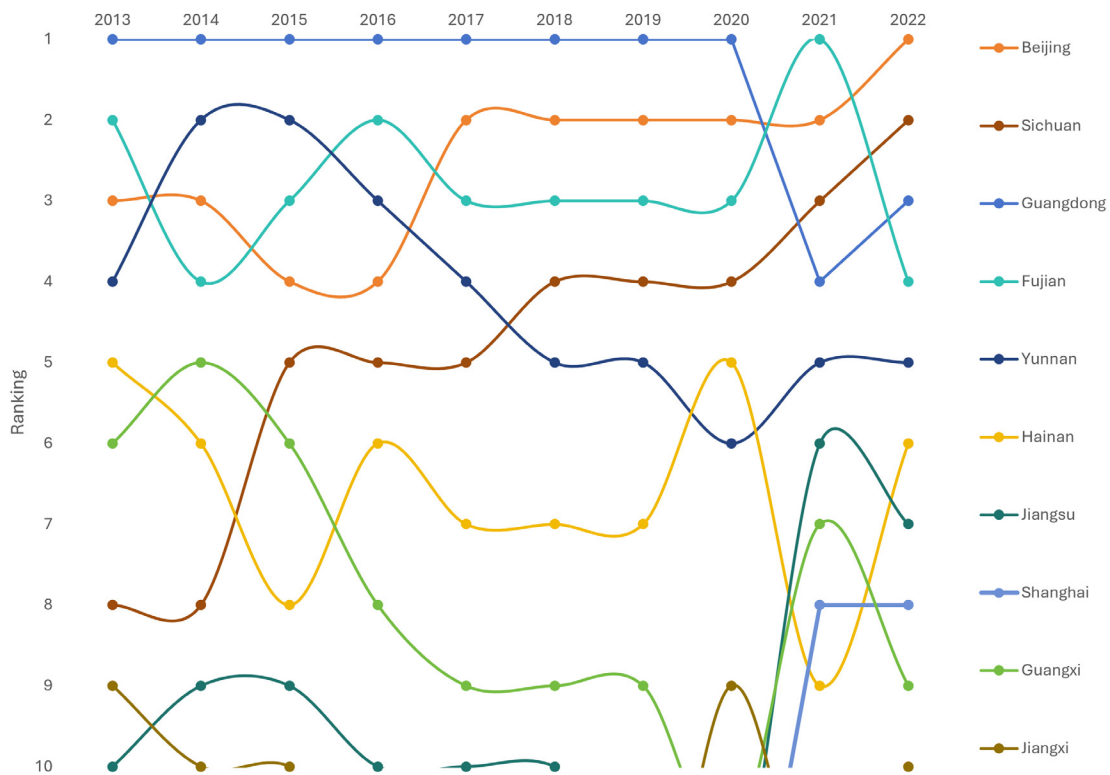
Figure 4 shows the annual ranking changes over the past decade for the 10 provinces with the highest Subnational LOGIC scores in 2022, revealing three patterns of evolution.

First, stable leaders: Guangdong, Beijing, Fujian, and Yunnan have consistently ranked at the top, with balanced and stable performance, serving as traditional green transition powerhouses;

Second, notable climbers: Sichuan steadily climbed from 8th in 2013 to 2nd in 2022; Jiangsu and Shanghai also achieved leapfrog advancement into the first tier, demonstrating strong transition acceleration. Guangxi experienced notable fluctuation with an initial decline followed by recovery;

Third, range-stable performers: Hainan and Jiangxi have remained within a relatively narrow range in the top national tier, reflecting a stable and resilient transition trajectory.

**Figure 4 | Ranking Changes for Top 10 Provinces by Subnational LOGIC Score (2013 vs. 2022)**



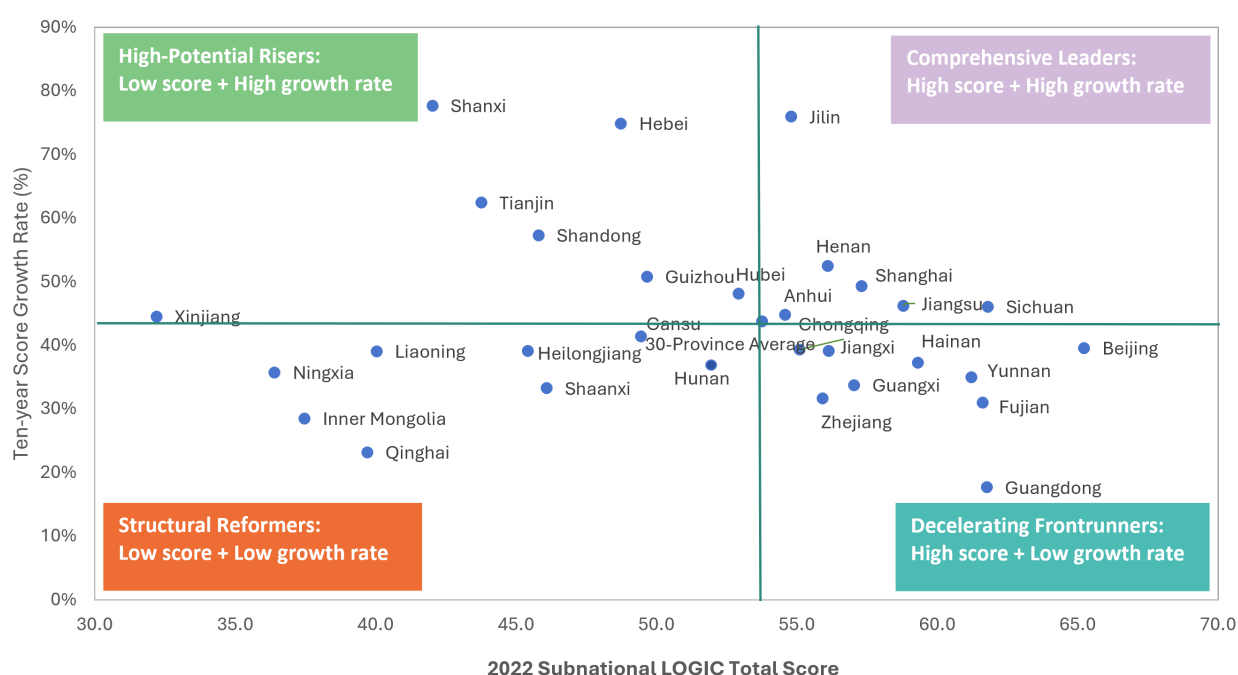
Note: Figure shows top 10 provinces in 2022.

### 4. Distribution of Transition Outcomes and Growth Rates Across 30 Provinces

Figure 5 uses the 2022 Subnational LOGIC score (horizontal axis) and ten-year score growth rate (vertical axis), with the 30-province average as the dividing threshold to sort 30 provinces into four quadrants, displaying the distribution of each province's transition speed and current level.

- Type 1: "Decelerating Frontrunners" provinces (fourth quadrant) are characterized by high scores and low growth rates, including Beijing, Yunnan, Fujian, Guangdong, Zhejiang, Hainan, and five other provinces (9 total). These provinces led in green and low-carbon transition, but slowing growth also reflects diminishing marginal returns.
- Type 2: "Comprehensive Leaders" provinces (first quadrant) are characterized by high scores and high growth rates, including Sichuan, Jiangsu, Shanghai, Jilin, and two other provinces (6 total). These provinces progressed rapidly over the decade and achieved significant outcomes in green and low-carbon transition.
- Type 3: "High-Potential Risers" provinces (second quadrant) are characterized by low scores and high growth rates, including Shanxi, Hebei, Shandong, Tianjin, and three other provinces (7 total). These provinces are mainly energy- and resource-rich or have well-developed heavy chemical industries, making the green and low-carbon transition more challenging; nevertheless, they have made rapid progress over the past decade.
- Type 4: "Structural Reformers" provinces (third quadrant) are characterized by low scores, and low growth rates, including Gansu, Heilongjiang, Shaanxi, Liaoning, and four other provinces (8 total). These provinces face the greatest transition pressure, constrained by economic development level and industrial or resource lock-in effects.

**Figure 5 | Provincial Green Development Typology Based on Score and Growth Rate**



Note: The legend shows the top 10 provinces in 2022.

## 5. Leading Provinces by Sub-Categories

Sub-category rankings reveal distinct provincial strengths across sectors.

In carbon productivity, Beijing, Shanghai, Guangdong, Jiangsu, and Chongqing scored highest, reflecting their high efficiency in creating economic value per unit of carbon emissions.

In energy, Hainan, Yunnan, Sichuan, Guangdong, and Guangxi stood out, reflecting significant results in optimizing energy consumption structure and advancing clean energy substitution.

In power, Qinghai, Yunnan, Gansu, Hebei, and Ningxia led, showing that these provinces have made notable progress in new energy power generation and a cleaner generation mix.

In industry, Beijing, Guangdong, Zhejiang, Shanghai, and Chongqing ranked high, indicating significant achievements in promoting green and low-carbon industrial transformation and upgrading.

In buildings, Jiangsu, Fujian, Hainan, Guangxi, and Yunnan led, demonstrating effectiveness in promoting green buildings and improving building energy efficiency.

In transport, Hebei, Hainan, Gansu, Shanxi, and Shaanxi demonstrated strong performance, pointing to progress in promoting new energy vehicles and transport energy efficiency management.

In agriculture, Fujian, Yunnan, Jiangxi, Zhejiang, and Hainan scored relatively high, suggesting advantages in promoting green agriculture technology and controlling agricultural carbon emissions.

**Table 10 | Top 10 Provinces in Major Sub-Categories**

Carbon Productivity			Carbon Emission										Environmental Conditions and Land Use			
Top 10			Energy		Power		Industry		Buildings		Transport		Agriculture		Environmental Conditions and Land Use	
Rank	Province	Score	Province	Score	Province	Score	Province	Score	Province	Score	Province	Score	Province	Score	Province	Score
1	Beijing	20.0	Hainan	17.6	Qinghai	8.2	Beijing	10.0	Jiangsu	3.1	Hebei	2.7	Fujian	1.5	Yunnan	13.5
2	Shanghai	18.0	Yunnan	17.1	Yunnan	6.3	Guangdong	6.8	Fujian	3.0	Hainan	2.5	Yunnan	1.3	Guizhou	13.4
3	Guangdong	16.7	Sichuan	17.0	Gansu	6.1	Zhejiang	5.8	Hainan	2.4	Gansu	2.3	Jiangxi	1.2	Hainan	13.2
4	Jiangsu	16.2	Guangdong	16.9	Hebei	6.0	Shanghai	5.2	Guangxi	2.3	Shanxi	2.2	Zhejiang	1.0	Jiangxi	13.1
5	Chongqing	15.8	Guangxi	16.6	Ningxia	5.5	Chongqing	4.8	Yunnan	2.0	Shaanxi	2.1	Hainan	1.0	Heilongjiang	13.0
6	Fujian	15.5	Jiangxi	15.3	Jilin	4.8	Jiangsu	4.5	Anhui	1.8	Guangdong	2.0	Guangdong	1.0	Hebei	12.9
7	Hunan	15.1	Fujian	15.0	Sichuan	4.7	Heilongjiang	3.9	Zhejiang	1.7	Shanghai	2.0	Hebei	1.0	Fujian	12.8
8	Zhejiang	14.9	Gansu	14.9	Henan	4.3	Jilin	3.8	Henan	1.2	Tianjin	1.8	Chongqing	1.0	Jilin	12.5
9	Hainan	14.7	Chongqing	14.8	Inner Mongolia	4.3	Sichuan	3.7	Sichuan	1.2	Ningxia	1.7	Ningxia	1.0	Guangxi	12.4
10	Jiangxi	14.6	Guizhou	14.4	Shandong	4.3	Guizhou	3.5	Jiangxi	1.1	Zhejiang	1.6	Shandong	1.0	Chongqing	12.4

## 6. Changes in the Distribution of Sub-Category Scores

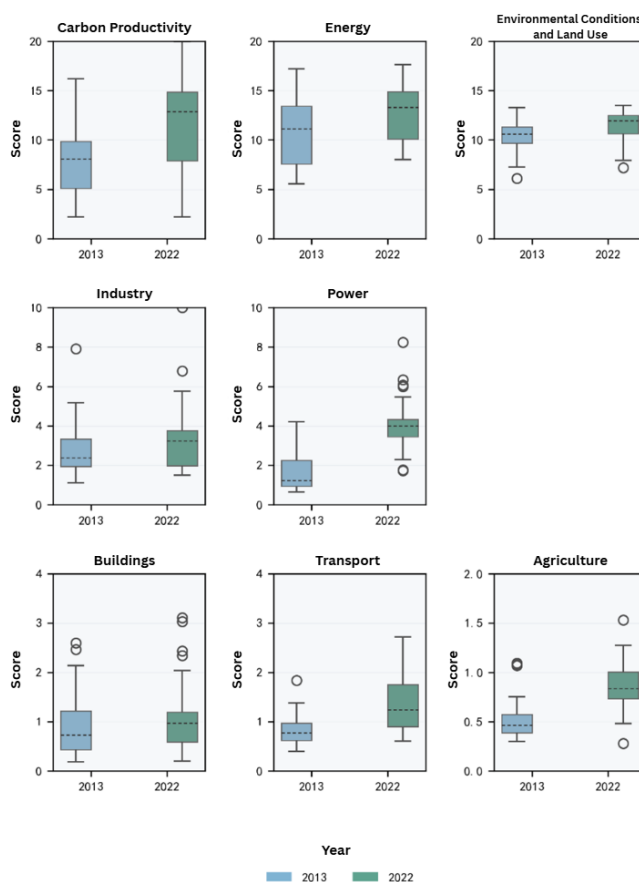
Figure 6 illustrates the uneven pace of green and low-carbon transition across sectors by comparing the distribution of sub-category scores in 2013 and 2022.

The median and upper bounds of score distributions in carbon productivity, energy, and power increased substantially, pointing to substantive nationwide progress over the past decade in improving the quality and efficiency of economic development and advancing energy revolution. Agriculture also recorded a noticeable improvement.

In buildings and transport, although overall scores increased, most provinces remained in the lower score range, indicating substantial room for further green transition in these two sectors.

The environmental conditions and land use scores distribution changed little, indicating that ecological governance and carbon sink capacity building require sustained investment and are unlikely to yield substantial improvement in the short term.

**Figure 6 | Distribution of Sub-Category Scores for 30 Provinces (2013 vs. 2022)**



*Note: The vertical axis represents the maximum possible score for each sub-category.*

## 7. Summary

Drawing on data spanning 2013 to 2022 across China's 30 provincial level regions, the Subnational LOGIC index shows that scores have improved across all provinces. This trend indicates that regional green and low-carbon transition has delivered tangible results and is entering a phase of broad-based acceleration.

The leading provinces (top five) in the 2022 Subnational LOGIC index each demonstrated distinctive advantages across sub-categories, with no single province holding an absolute lead across all indicators. This reveals that provinces have formed diverse green development models based on their resource endowments, industrial structures, and policy orientations, with no universal pathway.

Based on the distribution of Subnational LOGIC scores and growth rate changes across 30 provinces, all 30 provinces can be divided into four distinct categories. For different types of regions, differentiated policies can be adopted in the future: encouraging mechanism innovation to consolidate transition outcomes, or providing targeted support to fully unlock transition potential.

From sub-category performance, carbon productivity, energy, and power recorded substantive breakthroughs nationwide, emerging as the core drivers of green and low-carbon transition. In contrast, transport, buildings, and industry are the key areas for future deep transition, while ecological environment and land use follow a slower, more incremental improvement trajectory.

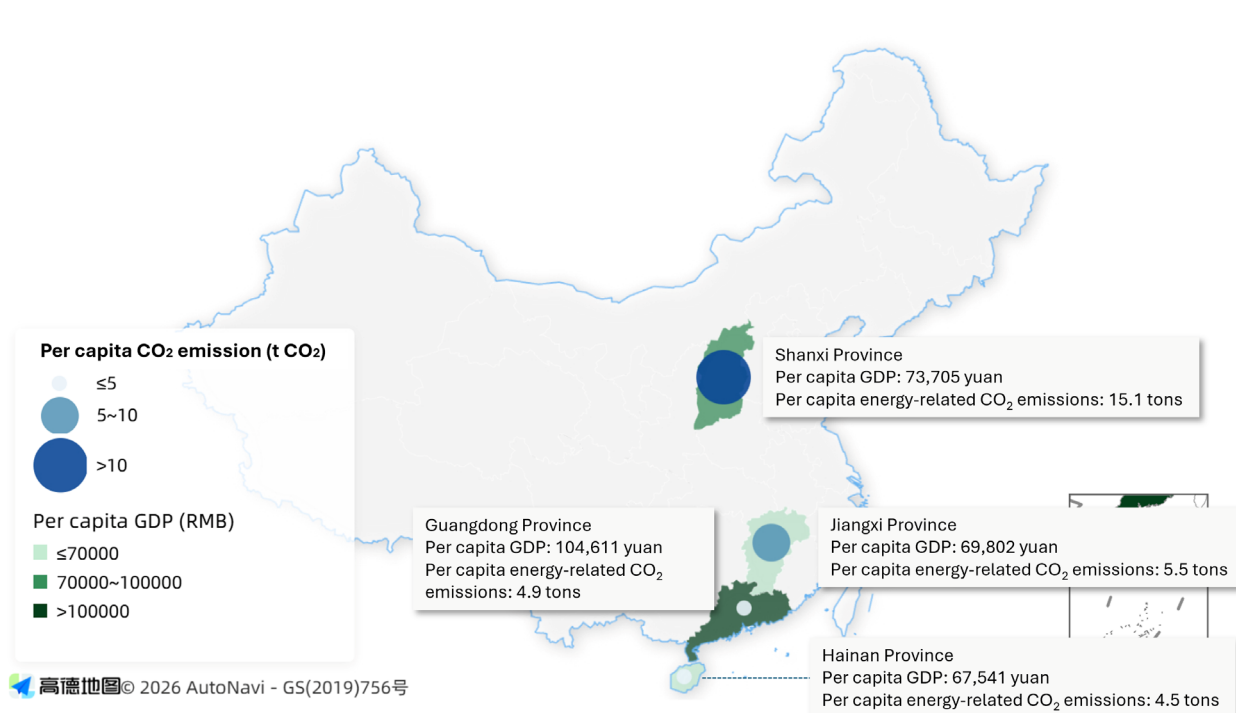
## IV. Case Studies of Key Regions

To explore the diverse pathways of green and low-carbon transition among China's provincial-level regions, this report selects Guangdong, Jiangxi, Shanxi, and Hainan for in-depth analysis on the basis of two main criteria:

First, economic development stage. The four provinces represent different tiers of development: Guangdong as a "Pioneer Economy", leading low-carbon development while maintaining high economic growth; Jiangxi as a "Leading Economy", demonstrating strong growth momentum and potential for green coordinated development; Shanxi as a "Catching-up Economy" and resource-rich region whose low-carbon transition can offer lessons for other provinces; and Hainan as a "Developing Economy", charting a path that balances ecological civilization with economic development. Together, these provinces can provide transferable insights for other provinces at similar stages.

Second, green and low-carbon transition outcomes. As shown in Figure 4 (Ranking Changes for Top 10 Provinces by Subnational LOGIC Score, 2013 vs. 2022), Guangdong, Jiangxi, and Hainan have consistently or periodically, ranked in the national top ten over the past decade. This indicates that, despite different provincial context, these provinces all exhibit green and low-carbon transition trends, and each province's pathway can serve as reference for provinces with similar conditions.

Figure 7 | Map of Case Study Provinces



Energy-related CO<sub>2</sub> emissions data is calculated by iGDP based on provincial energy balance sheets from China Energy Statistical Yearbook (electricity import and export emissions accounted for); Per capita GDP is in current price.

# Guangdong Province – Pioneer Economy

## Socioeconomic Overview

Guangdong is one of China's major provinces in terms of population and economic scale, consistently ranking first nationally in GDP. Along with rapid economic growth, its electricity and energy consumption are among the highest in the country.

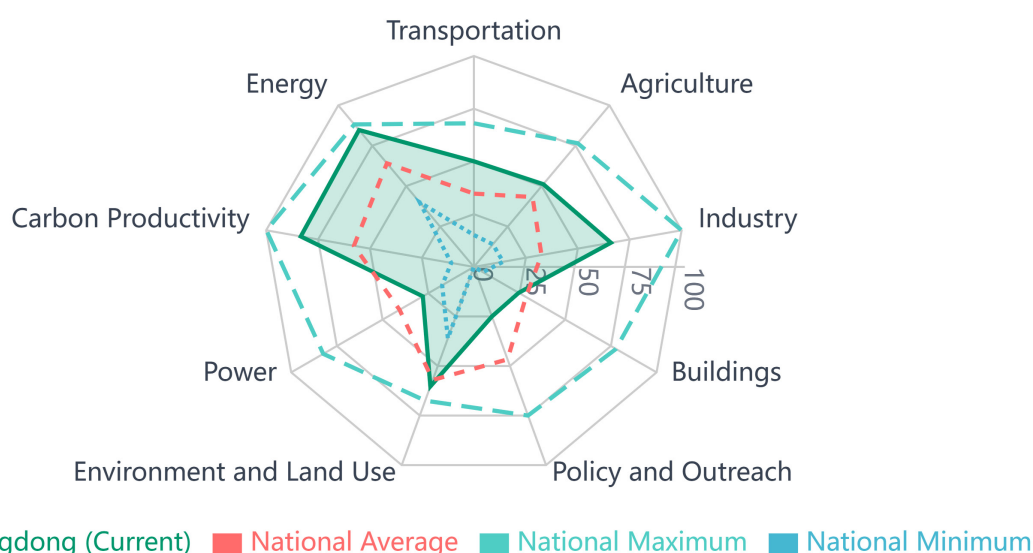
Currently, Guangdong has formed a modern industrial system anchored by modern services and supported by advanced manufacturing. In terms of industrial structure transformation, the share of tertiary sector has increased markedly, and the internal structure of the secondary sector has significantly optimized. Multiple trillion-yuan industrial clusters, including electronic information, green petrochemicals, and smart home appliances, have been cultivated. Emerging industries of strategic importance such as 5G and the digital economy have developed rapidly at a nationally leading scale.

In national strategy, Guangdong is positioned as a pioneer of reform and opening-up and leads the country in green and low-carbon development.

## Subnational LOGIC Performance Analysis

In 2022, Guangdong Province's total Subnational LOGIC score was 61.8, placing it in the first tier. As shown in Figure 8, Guangdong outperformed the provincial averages across multiple significant sub-categories and key areas including carbon productivity, energy, transport, agriculture, industry, and environmental conditions and land use; however, Guangdong still needs to strengthen its power sector low-carbon transition.

**Figure 8 | Guangdong's Overall Subnational LOGIC Performance in 2022**



Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/guangdong>

Table 11 presents Guangdong's Subnational LOGIC indicator scores and historical trends. Specifically, Guangdong performed well in carbon productivity and energy sub-categories, achieving full marks in recent years for carbon intensity per unit of GDP, non-fossil energy consumption share, and electrification rate. The high share of non-fossil energy consumption is mainly because Guangdong's energy consumption relies on local production and inter-provincial transfers, with local nuclear power generation share significantly above the national average. Additionally, roughly one-third of Guangdong's energy relies on inter-provincial transfers, primarily clean hydropower from west-to-east electricity transmission <sup>[2]</sup>, further greening its energy mix. In electrification, Guangdong's 40% electrification rate leads the country <sup>[3]</sup>, and Guangdong's building sector electrification rate reached 64% in 2020, contributing greatly to Guangdong's low-carbon transition.

In the power sector, Guangdong's 2022 power generation structure was still dominated by coal-fired power with a share of approximately 41%, and local renewable power generation share was low, resulting in low scores for the share of wind and solar installed capacity and carbon intensity per kWh of electricity.

Guangdong scored highly in carbon productivity. Currently, Guangdong's energy consumption per unit of GDP is only two-thirds of the national average. In 2020, Guangdong's carbon intensity ranked second lowest in the country, just above Beijing <sup>[4]</sup>. Guangdong's low energy and carbon intensity primarily benefit from industrial structure optimization and the shift toward cleaner energy sources, along with policy support. According to a non-exhaustive count by the CCNT team (see Table 12), since the start of the 14th FYP period, Guangdong has issued 77 "dual carbon"-related policies, reflecting its institutional exploration of low-carbon development to promote green and low-carbon transition.

**Table 11 | Subnational LOGIC Indicator Scores and Performance of Guangdong**

Category	Subnational LOGIC Indicator (Unit)	Value in 2022	2022 score/full score	Trends from 2013 to 2022
Carbon Productivity: 20%	<b>1 Carbon Productivity</b>		<b>16.7/20</b>	
	(-) Energy consumption per unit of GDP (tce/10,000 RMB, 2005 constant prices)	0.4	6.7/10	
	(-) Carbon emissions per unit of GDP (tCO2/10,000 RMB, 2005 constant prices)	0.7	10/10	
	<b>2 Energy</b>		<b>16.9/20</b>	
	(-) Per capita carbon emissions (tCO2/person)	4.9	3.6/5	
	(-) Per capita energy consumption (tce/person)	2.9	3.4/5	
	(+) Share of non-fossil energy in total primary energy consumption (%)	29%	5/5	
	(+) Share of electricity in final energy consumption (%)	46%	5/5	
	<b>3 Power</b>		<b>2.8/10</b>	
	(+) Share of wind and solar capacity in total power capacity (%)	17%	1.7/5	
Carbon Emissions: 50%	(-) Carbon emissions per unit of power generation (gCO2/kWh)	427.0	1.1/5	
	<b>4 Agriculture</b>		<b>1/2</b>	
	<b>Carbon Emissions: 50%</b>	0.1	0.4/1	
	(+) Agricultural output per worker (10,000 RMB/person)	7.7	0.6/1	
	<b>5 Industry</b>		<b>6.8/10</b>	
	(-) Carbon emissions per unit of industrial value-added (tCO2/10,000 RMB, 2005 constant prices)	0.3	3.2/5	
	(-) Revenue share of energy-intensive industries (%)	16%	3.6/5	
	<b>6 Transport</b>		<b>2/4</b>	
	(+) Share of electricity in final energy consumption in the transport sector (%)	5%	1/2	
	(-) Carbon emissions per unit of converted transport turnover (tCO2/t-km)	0.1	1/2	
Environmental Conditions and Land Use: 20%	<b>7 Buildings</b>		<b>1/4</b>	
	(-) Per capita residential building carbon emissions (tCO2/person)	0.3	0.5/2	
	(-) Public building carbon emissions per tertiary sector employee (tCO2/person)	0.4	0.5/2	
	<b>8 Environmental Conditions and Land Use</b>		<b>12.1/20</b>	
	(-) Per capita municipal solid waste collected (tons/person)	0.3	0.6/2	
	(-) Annual average PM2.5 concentration (µg/m³)	20.0	1.3/5	
	(+) Share of days with good or excellent air quality (%)	91%	3.7/4	
	(-) Daily per capita domestic water consumption (L/person-day)	252.6	0.5/2	
	(+) Share of local fiscal spending on energy conservation and environmental protection (%)	3%	1/2	
	(+) Forest coverage rate (%)	54%	5/5	
Policy Systems and Public Participation: 10%	<b>9 Policy Systems and Public Participation</b>		<b>2.5/10</b>	
	(+) Whether policy documents on fiscal support for the "dual carbon" goals have been issued	No	0/2.5	
	(+) Comparison of 14th FYP renewable energy targets vs. actual 13th FYP growth	Yes	2.5/2.5	
	(+) Whether a medium-to-long-term climate change adaptation action plan has been issued	No	0/2.5	
(+) Whether policies about promoting green consumption have been formulated	No	0/2.5		

Source: Institute for Global Decarbonization Progress

**Table 12 | Low-Carbon Policies Issued by Guangdong Since the 14th FYP (Selected)**

Action 	Region	Region Type	Published By	Year	Areas	Topics
Allocation Plan for Carbon Emission Allowance in Guangdong Province in 2025	Guangdong	Provincial	Guangdong Provincial Department of Ecology and Environment	2026	Green Economy	Carbon Pricing
Implementation Plan for the Development of Zero-Carbon Parks in Guangdong Province	Guangdong	Provincial	Guangdong Provincial Development and Reform Commission and other...	2025		Zero-Carbon Parks
Implementation Plan for Deepening Market-Oriented Reform of the Pricing System for New Energy to Promote High-Quali...	Guangdong	Provincial	Guangdong Provincial Development and Reform Commission,...	2025	Electricity	Renewable Energy
Notice on the Registration of Competitive Bidding for Mechanism Electricity under Incremental New Energy Project...	Guangdong	Provincial	Guangdong Provincial Development and Reform Commission,...	2025	Electricity	Renewable Energy
Work Plan for the Establishment of a Carbon Footprint Management System in Guangdong Province	Guangdong	Provincial	Guangdong Provincial Department of Ecology and Environment and...	2025		Carbon Footprint
Notice on Advancing Green and Low-Carbon Transition to Support the Development of Green Foreign Trade in...	Guangdong	Provincial	Guangdong Provincial Department of Ecology and Environment, China...	2025	Green Economy	
Allocation Plan for Carbon Emission Allowance in Guangdong Province in 2024	Guangdong	Provincial	Guangdong Provincial Department of Ecology and Environment	2025	Green Economy	Carbon Pricing
Climate Change Adaptation Action Plan for Guangdong Province (2025-2035)	Guangdong	Provincial	Guangdong Provincial Department of Ecology and Environment and...	2025		Climate Adaptation
Notice on Issuing the Implementation Rules for Provincial Key Manufacturing Special Funds (for Supporting New Energy...	Guangdong	Provincial	Guangdong Provincial Department of Industry and Information...	2024		Energy Storage
2024-2025 Action Plan for Energy Conservation and Carbon Reduction in Guangdong Province	Guangdong	Provincial	Guangdong Provincial People's Government	2024	Regional Strategy	

Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/guangdong>

### Box 1 | Traditional Wisdom and Modern Practice of Lingnan “Near-Zero Carbon” Buildings in Guangdong

Guangdong is deeply integrating traditional Lingnan architectural wisdom with modern green technologies, exploring near-zero carbon buildings with distinctive regional characteristics and high energy efficiency. This provides a model for low-carbon building transition in regions with hot summers and warm winters.

Taking the Science and Innovation Building of the CSCEC 4th Engineering Bureau as an example, the project revives traditional techniques such as “cold lanes” and “arcade buildings” to substantially reduce energy consumption through natural ventilation and shading; it also innovatively applies horizontal photovoltaic curtain walls, high-efficiency refrigeration machine rooms, and intelligent management systems, achieving near-zero energy consumption in a supertall building. Its full lifecycle carbon management platform further integrates emissions reduction concepts throughout the design, construction, and operation processes, encouraging user participation.

According to the Guangdong Province 2024–2025 Energy Saving and Carbon Reduction Action Plan, over 3 million square meters of Lingnan-style ultra-low energy and near-zero energy buildings will be constructed by 2025. This case illustrates the implementation of the plan. Guangdong's experience demonstrates that policy guidance, technology innovation, and behavioural management are key to achieving green transition in the buildings sector.

Source: Lyu Yaning. (2025). “Breathing” Near-Zero Carbon Buildings in Lingnan: Where Traditional Culture and Modern Technology Coexist.

Available at: <https://hqttime.huanqiu.com/share/article/4OPEUY4qRk1>.<sup>[5]</sup>

## Key Areas for Strengthening Future Low-Carbon Development

According to iGDP's research based on Energy Policy Simulator (EPS) model, achieving the 2060 carbon neutrality goal will require Guangdong to address weaknesses in the power sector and strengthen the advantage of high electrification rate <sup>[2]</sup>.

- Strictly control thermal power development, gradually reducing the coal-fired share over the long term; at the same time, develop more local renewable energy (such as offshore wind and distributed solar photovoltaics), to reduce dependence on fossil energy and cope with uncertainties in inter-provincial power transfer;
- Improve end-use sector electrification:
  - Unlock the potential of renewable energy in industrial parks, build integrated energy systems for logistics combining solar, storage, and charging, and accelerate the deployment of low-carbon technologies in energy-intensive industries, and ensure the industrial sector achieves net zero by 2060;
  - Promote new energy vehicles, and advance R&D and application of new energy vehicles using hydrogen and other new energy sources in heavy-duty road transport, water transport, and maritime transport;
  - Promote Lingnan-style ultra-low energy buildings, raise energy efficiency standards for new buildings, and advance energy efficiency retrofits of existing buildings.

## Jiangxi Province – Leading Economy

### Socioeconomic Overview

Jiangxi Province, as an important province in China's central region, has in recent years maintained economic vitality while accelerating its low-carbon transition, supported by the development of a modern industrial system. This aligns with the national call for former revolutionary base areas to pursue high-quality development and for the central region to take the lead.

Jiangxi's economy is at a middle-range level nationwide, with GDP accounting for approximately 3% of the national total. Its per capita GDP and urbanization rate are both slightly below the national average; with population growth and accelerating urbanization, its energy consumption demand and carbon emissions continue to rise.

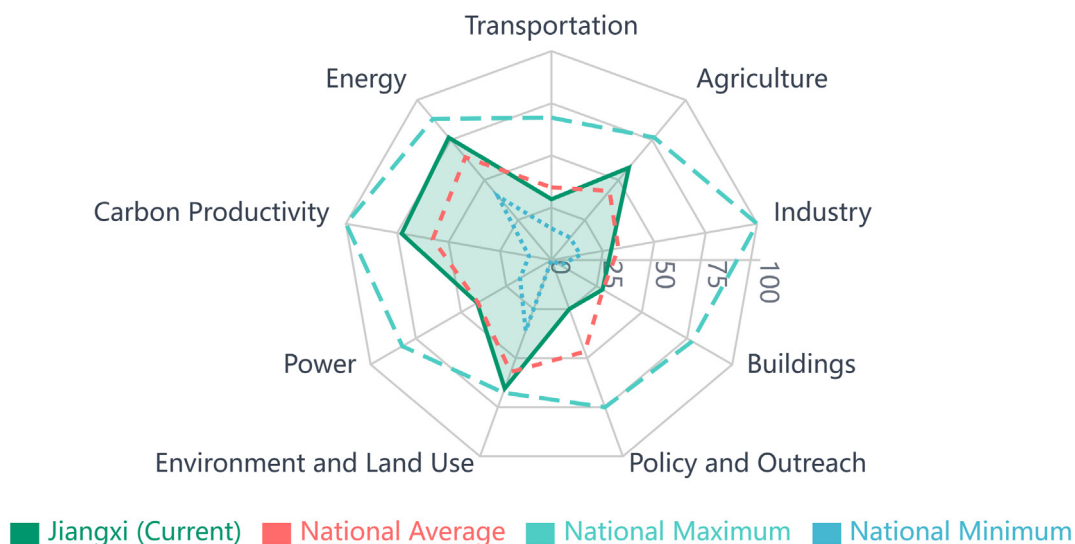
Currently, Jiangxi's economic structure is dominated by the tertiary sector and strongly supported by the secondary sector, with the tertiary sector gradually taking the lead in employment and economic growth. Among traditional industries, non-ferrous metal smelting and processing, electrical machinery and equipment manufacturing, and ferrous metal smelting and processing contribute most to GDP growth. In recent years, Jiangxi has been implementing the "1269" Action Plan for modernizing key manufacturing supply chains, with electronic information and non-ferrous metals designated as the two trillion-yuan priority industries, and equipment manufacturing, new energy, and eight others targeted at hundred-billion-yuan scale.

### Subnational LOGIC Performance Analysis

In 2022, Jiangxi Province's total Subnational LOGIC score was 56.1. As shown in Figure 9, Jiangxi's 2022 performance was significantly higher than the provincial averages in energy, agriculture, and environmental conditions and land use, while industrial and transport low-carbon transition still needs strengthening.

Table 13 presents Jiangxi's Subnational LOGIC indicator scores and historical trends. Jiangxi performed best in the carbon intensity per unit of GDP indicator under the carbon productivity sub-category, nearly achieving full score in 2022. According to the data from Jiangxi Development and Reform Commission, Jiangxi's carbon dioxide emissions per unit of GDP are at an excellent level nationwide <sup>[6]</sup>, and since the 18th National Congress, the province's energy consumption per unit of GDP has cumulatively decreased by 40% <sup>[7]</sup>, contributing to Jiangxi's high carbon productivity score.

**Figure 9 | Jiangxi's Overall Subnational LOGIC Performance in 2022**



Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/jiangxi>

Jiangxi also excelled in the share of electricity consumption in final energy consumption under the energy sub-category. As urbanization advances and industries transform, electrification levels across Jiangxi's sectors have continuously improved, driving Jiangxi's transition in the energy sub-category. In the environmental conditions and land use sub-category, a high share of days with good or excellent air quality and a forest coverage rate above the national average have helped Jiangxi achieve a relatively strong performance.

The industrial sector (including power generation) is Jiangxi's largest source of carbon emissions (including both direct and indirect emissions), accounting for 66% of total provincial carbon emissions; among these, energy-intensive industries such as steel and cement account for over two-thirds of total industrial energy consumption, with chemicals, petroleum coking, and non-ferrous metals combined accounting for 15%<sup>[8]</sup>. This resulted in a disadvantage in energy consumption per unit of industrial value-added and high energy intensity industry share, and lower scores in the industrial indicators.

In the transport sector, as Jiangxi's freight transport volume, especially road freight, has shown rapid growth in recent years<sup>[8]</sup>, carbon emissions per unit transport turnover are relatively high; the transport sector therefore requires further greening and low-carbon transition.

According to a non-exhaustive count by the CCNT team (see Table 14), since the start of the 14th FYP period, Jiangxi has issued 57 "dual carbon"-related policies, reflecting the province's ambition and action on energy saving and carbon reduction.

**Table 13 | Subnational LOGIC Indicator Scores and Performance of Jiangxi**

Category	Subnational LOGIC Indicator (Unit)	Value in 2022	2022 score/full score	Trends from 2013 to 2022
<b>Carbon Productivity: 20%</b>	<b>1 Carbon Productivity</b>		<b>14.6/20</b>	
	(-) Energy consumption per unit of GDP (tce/10,000 RMB, 2005 constant prices)	0.5	5/10	
	(-) Carbon emissions per unit of GDP (tCO2/10,000 RMB, 2005 constant prices)	1.3	9.6/10	
<b>Carbon Emissions: 50%</b>	<b>2 Energy</b>		<b>15.3/20</b>	
	(-) Per capita carbon emissions (tCO2/person)	5.5	3.2/5	
	(-) Per capita energy consumption (tce/person)	2.4	4/5	
	(+) Share of non-fossil energy in total primary energy consumption (%)	18%	3.5/5	
	(+) Share of electricity in final energy consumption (%)	34%	4.6/5	
	<b>3 Power</b>		<b>4.1/10</b>	
	(+) Share of wind and solar capacity in total power capacity (%)	32%	3.2/5	
	(-) Carbon emissions per unit of power generation (gCO2/kWh)	518.0	0.9/5	
	<b>4 Agriculture</b>		<b>1.2/2</b>	
	<b>Carbon Emissions: 50%</b>	0.1	0.6/1	
	(+) Agricultural output per worker (10,000 RMB/person)	6.4	0.5/1	
	<b>5 Industry</b>		<b>3.1/10</b>	
	(-) Carbon emissions per unit of industrial value-added (tCO2/10,000 RMB, 2005 constant prices)	0.6	1.5/5	
	(-) Revenue share of energy-intensive industries (%)	33%	1.7/5	
	<b>6 Transport</b>		<b>1.2/4</b>	
(+) Share of electricity in final energy consumption in the transport sector (%)	4%	0.8/2		
(-) Carbon emissions per unit of converted transport turnover (tCO2/t-km)	0.3	0.4/2		
<b>7 Buildings</b>		<b>1.1/4</b>		
(-) Per capita residential building carbon emissions (tCO2/person)	0.2	0.6/2		
(-) Public building carbon emissions per tertiary sector employee (tCO2/person)	0.4	0.5/2		
<b>Environmental Conditions and Land Use: 20%</b>	<b>8 Environmental Conditions and Land Use</b>		<b>13.1/20</b>	
	(-) Per capita municipal solid waste collected (tons/person)	0.1	1.4/2	
	(-) Annual average PM2.5 concentration (µg/m³)	27.0	0.9/5	
	(+) Share of days with good or excellent air quality (%)	92%	3.7/4	
	(-) Daily per capita domestic water consumption (L/person-day)	176.7	0.7/2	
	(+) Share of local fiscal spending on energy conservation and environmental protection (%)	3%	1.3/2	
(+) Forest coverage rate (%)	61%	5/5		
<b>Policy Systems and Public Participation: 10%</b>	<b>9 Policy Systems and Public Participation</b>		<b>2.5/10</b>	
	(+) Whether policy documents on fiscal support for the "dual carbon" goals have been issued	No	0/2.5	
	(+) Comparison of 14th FYP renewable energy targets vs. actual 13th FYP growth	Yes	2.5/2.5	
	(+) Whether a medium-to-long-term climate change adaptation action plan has been issued	No	0/2.5	
(+) Whether policies about promoting green consumption have been formulated	No	0/2.5		

Source: Institute for Global Decarbonization Progress

**Table 14 | Low-Carbon Policies Issued by Jiangxi Since the 14th FYP (Selected)**

Action	Region	Region Type	Published By	Year	Areas	Topics
Implementation Plan for Orderly Promoting the Development of Green Power Direct Connection in Jiangxi Province	Jiangxi	Provincial	Jiangxi Provincial Development and Reform Commission, Jiangxi...	2026	Electricity	Renewable Energy
Several Measures of Jiangxi Province to Promote the Construction of the National Voluntary Greenhouse Gas...	Jiangxi	Provincial	Jiangxi Provincial Department of Ecology and Environment and other...	2026	Green Economy	Green Finance
Work Plan for Promoting the High-Quality Development of Virtual Power Plants in Jiangxi Province	Jiangxi	Provincial	Jiangxi Provincial Energy Bureau	2026	Electricity	
Construction Plan for Zero-Carbon Parks in Jiangxi Province	Jiangxi	Provincial	Jiangxi Provincial Development and Reform Commission	2025		Zero-Carbon Parks
Measures for Accelerating Comprehensive Green Transformation of Economic and Social Development in Jiangx...	Jiangxi	Provincial	Jiangxi Provincial Committee of CPC, Jiangxi Provincial People's...	2025	Regional Strategy	
Implementation Opinions on Promoting Green and Low-Carbon Development of the Manufacturing Industry in Jiangxi Province	Jiangxi	Provincial	Jiangxi Provincial Department of Industry and Information Technolog...	2025	Industry	
Detailed Rules for Competitive Pricing Mechanisms for Incremental New Energy Projects in Jiangxi Province	Jiangxi	Provincial	Jiangxi Provincial Development and Reform Commission	2025	Electricity	Renewable Energy
Detailed Rules for Differential Settlement Mechanisms of the Sustainable Development Pricing System for New Energy in...	Jiangxi	Provincial	Jiangxi Provincial Development and Reform Commission	2025	Electricity	Renewable Energy
Implementation Plan for the Market-Oriented Reform of the Pricing System for New Energy in Jiangxi Province	Jiangxi	Provincial	Jiangxi Provincial Development and Reform Commission	2025	Electricity	Renewable Energy
Notice by the Jiangxi Provincial Development and Reform Commission on Supporting the Sound and Orderly...	Jiangxi	Provincial	Jiangxi Provincial Development and Reform Commission	2025	Electricity	Energy Storage

Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/jiangxi>

### Box 2 | Clean Energy Transition and Rural Revitalization in Jiangxi

As a national pilot zone for ecological civilization and a major agricultural province, Jiangxi leverages its abundant biomass energy and solar radiation resources to explore a comprehensive rural utilization pathway centred on “photovoltaics+” and biomass circular utilization, providing a transferable “Jiangxi model” for similar regions nationwide.

In recent years, Jiangxi has issued multiple plans setting targets for the comprehensive utilization of crop straw and the share of non-fossil energy consumption, positioning rural energy transition as an important pathway. In terms of practical innovation: Guangchang County and Yugan County have used barren hills and rooftops to develop photovoltaics, increasing village collective income by over 300,000 yuan per year; Xunwu County has built photovoltaic power stations on abandoned mines while also developing wind and hydropower, achieving 100% clean electricity substitution; Suichuan County has introduced biomass briquette enterprises, using three drivers including policy, technology, and market to build a straw collection, storage, and transportation network, reducing open burning of crop straw.

Jiangxi's case demonstrates the multiple benefits of rural energy transition in reducing emissions, raising income, and improving livelihoods.

Source: He Guijin et al. (2025). *Jiangxi's Integrated Clean Energy Use in Rural Areas: A Path to Dual Carbon Goals*. Available at: <https://mp.weixin.qq.com/s/vEGGUR9GhkvXARV8eZ-d3A> [9]

## Key Areas for Strengthening Future Low-Carbon Development

According to iGDP's research based on Energy Policy Simulator (EPS) model, to achieve carbon peaking by 2030 and carbon neutrality by 2060, Jiangxi still needs to address its weakness in low-carbon industry and fully leverage its renewable resource potential, specifically:

- During the 15th FYP, Jiangxi should prioritize low-carbon industrial development by optimizing its industrial structure, implementing the manufacturing supply chain modernization plan, achieving early peaking of total coal and oil consumption, and applying equivalent or reduced carbon substitution requirements to new, rebuilt, or expanded dual-high industrial projects;
- Developing renewable electricity and scaling up local wind, solar, and pumped storage capacity; additionally, low-carbon electricity is related to low-carbon transition in end-use sectors like industry, for example, in Jiangxi's copper smelting sector, carbon emissions can be further reduced by 2060 with the support of clean electricity;
- Accelerate the development of rail–water intermodal transport and new energy-powered freight transport and facilitate modal shifts of bulk cargo from road to rail and waterways; promote new energy trucks and clean energy technologies to further decarbonize the transport sector.
- Jiangxi has a large stock of buildings with significant untapped rooftop solar potential; additionally, with its hot summers and cold winters, Jiangxi has considerable geothermal resources; it is recommended to focus on clean energy supply for public buildings and large-scale deployment of solar photovoltaic in rural areas.

## Shanxi Province – Catching-Up Economy

### Socioeconomic Overview

Shanxi is a typical coal-rich region, with its economic development below the national midpoint and per capita GDP below the national average. Currently, Shanxi's economic growth and energy-related CO<sub>2</sub> emissions have yet to be decoupled, and the provincial economy remains highly dependent on coal, with non-fossil energy accounting for a relatively small share of the energy mix. In recent years, Shanxi's wind and solar photovoltaic power developed rapidly, though both still trail the national average considerably.

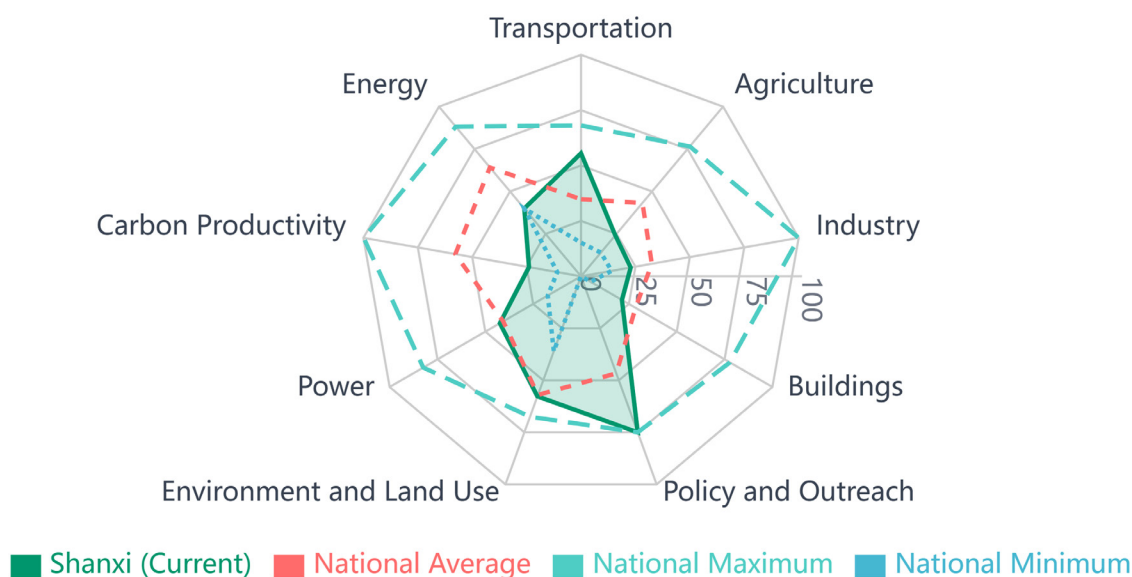
Shanxi's industrial structure is dominated by the secondary sector, with a robust heavy industrial foundation and high coal dependence. Heavy industries represented by mining, steel, chemicals, and coking are the economic pillars, making Shanxi's economic growth closely tied to the coal market. In recent years, Shanxi has also been facilitating industrial transformation, with multiplying industrial robot and photovoltaic cell output and rapidly growing revenue in industries including advanced metal materials, advanced equipment manufacturing, aerospace, and new energy equipment <sup>[10]</sup>.

As a coal energy base and an important electricity-exporting province, Shanxi bears important responsibility for national energy security. At the same time, as a key region of the Yellow River Basin Ecological Protection and High-Quality Development Strategy, Shanxi is working to explore a carbon emissions reduction pathway suited to its own reality while aligning with national strategy.

### Subnational LOGIC Performance Analysis

Shanxi Province's total Subnational LOGIC score in 2022 was 42. As shown in Figure 10, Shanxi's 2022 overall performance was significantly better than the provincial averages in the transport, policy system and social awareness sub-categories, while carbon productivity, energy, and transport still need strengthening.

Figure 10 | Shanxi's Overall Subnational LOGIC Performance in 2022



Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/shanxi>

Table 15 presents Shanxi's indicator scores and historical trends. Shanxi scored poorly in per capita CO<sub>2</sub> emissions and non-fossil energy consumption. This is because its local energy consumption structure is coal-dominated, with coal consumption accounting for 80.56% of total primary energy consumption in 2022 and non-fossil energy consumption share only 9.8%. Additionally, in 2022, Shanxi's energy consumption and carbon intensity per unit of GDP were 2.3 and 3 times the national average, respectively, leading to low scores in carbon productivity.

The industrial sector is Shanxi's second-largest source of carbon emissions, accounting for 41%, just below the power sector. Shanxi's energy consumption is highly concentrated in traditional industries represented by steel, chemicals, coking, and coal mining, resulting in low scores for the industrial indicators.

With strong policy support, diesel heavy-duty trucks used for short-haul transport in Shanxi's coal mining area are being replaced by electric heavy trucks <sup>[11]</sup>; in the passenger transport sector, public charging stations now cover all county-level areas, supporting the rapid growth of new energy vehicle adoption <sup>[12]</sup>. Together, these developments helped Shanxi achieve a relatively leading position in the green and low-carbon transition of the transport sector.

In terms of policy system and social awareness, Shanxi has committed to combining carbon peaking and carbon neutrality strategic goals with local resource and industrial characteristics to achieve low-carbon transition. As shown in Table 16, since the "14th FYP," Shanxi has issued a series of policy plans that set out the direction and key tasks for carbon peaking.

**Table 15 | Subnational LOGIC Indicator Scores and Performance of Shanxi**

Category	Subnational LOGIC Indicator (Unit)	Value in 2022	2022 score/full score	Trends from 2013 to 2022
<b>Carbon Productivity: 20%</b>	<b>1 Carbon Productivity</b>		<b>4.8/20</b>	
	(-) Energy consumption per unit of GDP (tce/10,000 RMB, 2005 constant prices)	1.6	1.7/10	
	(-) Carbon emissions per unit of GDP (tCO2/10,000 RMB, 2005 constant prices)	3.9	3.1/10	
<b>Carbon Emissions: 50%</b>	<b>2 Energy</b>		<b>8/20</b>	
	(-) Per capita carbon emissions (tCO2/person)	15.2	1.2/5	
	(-) Per capita energy consumption (tce/person)	6.3	1.5/5	
	(+) Share of non-fossil energy in total primary energy consumption (%)	9%	1.8/5	
	(+) Share of electricity in final energy consumption (%)	26%	3.5/5	
	<b>3 Power</b>		<b>4.2/10</b>	
	(+) Share of wind and solar capacity in total power capacity (%)	33%	3.3/5	
	(-) Carbon emissions per unit of power generation (gCO2/kWh)	504.0	0.9/5	
	<b>4 Agriculture</b>		<b>0.5/2</b>	
	<b>Carbon Emissions: 50%</b>	0.3	0.2/1	
	(+) Agricultural output per worker (10,000 RMB/person)	3.4	0.3/1	
	<b>5 Industry</b>		<b>2.4/10</b>	
	(-) Carbon emissions per unit of industrial value-added (tCO2/10,000 RMB, 2005 constant prices)	1.7	0.5/5	
	(-) Revenue share of energy-intensive industries (%)	29%	1.9/5	
	<b>6 Transport</b>		<b>2.2/4</b>	
(+) Share of electricity in final energy consumption in the transport sector (%)	9%	1.6/2		
(-) Carbon emissions per unit of converted transport turnover (tCO2/t-km)	0.2	0.6/2		
<b>7 Buildings</b>		<b>0.9/4</b>		
(-) Per capita residential building carbon emissions (tCO2/person)	0.3	0.4/2		
(-) Public building carbon emissions per tertiary sector employee (tCO2/person)	0.5	0.5/2		
<b>Environmental Conditions and Land Use: 20%</b>	<b>8 Environmental Conditions and Land Use</b>		<b>11.5/20</b>	
	(-) Per capita municipal solid waste collected (tons/person)	0.1	1.3/2	
	(-) Annual average PM2.5 concentration (µg/m³)	38.0	0.7/5	
	(+) Share of days with good or excellent air quality (%)	75%	3/4	
	(-) Daily per capita domestic water consumption (L/person-day)	118.8	1/2	
	(+) Share of local fiscal spending on energy conservation and environmental protection (%)	4%	1.7/2	
(+) Forest coverage rate (%)	21%	3.9/5		
<b>Policy Systems and Public Participation: 10%</b>	<b>9 Policy Systems and Public Participation</b>		<b>7.5/10</b>	
	(+) Whether policy documents on fiscal support for the "dual carbon" goals have been issued	Yes	2.5/2.5	
	(+) Comparison of 14th FYP renewable energy targets vs. actual 13th FYP growth	No	0/2.5	
	(+) Whether a medium-to-long-term climate change adaptation action plan has been issued	Yes	2.5/2.5	
(+) Whether policies about promoting green consumption have been formulated	Yes	2.5/2.5		

Source: Institute for Global Decarbonization Progress

**Table 16 | Low-Carbon Policies Issued by Shanxi Since the 14th FYP (Selected)**

Action 	Region	Region Type	Published By	Year	↓ Areas	Topics
Implementation Plan for Accelerating the Green and Low-Carbon Energy Transition and...	Shanxi	Provincial	People's Government of Shanxi Province	2026	Energy	Hydrogen Non-CO2 Emissions
Action Plan for Implementing Large-Scale Equipment Renewals and Consumer Goods Trade...	Shanxi	Provincial	Shanxi Provincial Development and Reform...	2026	Green Economy	
Implementation Opinions for Accelerating Energy Sci-Tech Innovation to Support Energy Transition...	Shanxi	Provincial	People's Government of Shanxi Province	2026	Energy	
Measures for Promoting the Development of the Private Economy in the Energy Sector in Shanxi...	Shanxi	Provincial	Shanxi Provincial Energy Bureau, Shanxi Developme...	2025	Energy Green Economy	
Implementation Plan for Promoting High-Quality Development by Supporting Virtual Power Plants'...	Shanxi	Provincial	Shaanxi Provincial Development and Reform...	2025	Electricity	
Notice on Toll Subsidies for Hydrogen-Powered Trucks on Shanxi Provincial Highways (Trial)	Shanxi	Provincial	Shanxi Provincial Development and Reform...	2025	Transport	Hydrogen
Notice on Launching Pilot Construction of Product Carbon Footprint Management System	Shanxi	Provincial	Shanxi Provincial Department of Ecology and...	2025		Carbon Footprint
Work Plan for the Construction of Carbon Inclusive Public Participation and Mechanism in Shanxi...	Shanxi	Provincial	Shanxi Provincial Department of Ecology and...	2025	Green Economy	Carbon Pricing Behavioral Change
Action Plan for the Hydrogen Energy Industry Chain in Shanxi Province (2025)	Shanxi	Provincial	Shanxi Provincial Development and Reform...	2025	Energy	Hydrogen
Action Plan for Accelerating the Comprehensive Green Transition of Economic and Social...	Shanxi	Provincial	People's Government of Shanxi Province	2025	Regional Strategy	

Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/shanxi>

### Box 3 | Methane Reduction and Energy Transition in Coal-Rich Regions

As a coal-producing region with annual production exceeding 1 billion tonnes, Shanxi prioritizes the utilization of low-concentration coal mine gas. Leveraging policy support, economic incentives, and technology R&D, the utilization rate increased from 33.5% in 2010 to 48% in 2023, contributing to an annual methane emission reduction of 1.95 million tonnes.

Shanxi was the first to issue provincial level regulations on clean and efficient coal utilization, requiring high-gas mines to be equipped with gas utilization facilities; it also established quantitative targets for coal mine gas extraction and utilization in the Implementation Plan for Carbon Peaking in the Coal Industry of Shanxi Province. Additionally, Shanxi uses fiscal subsidies to improve the economic viability of coal mine gas utilization projects. Since the establishment of the national voluntary greenhouse gas emission reduction trading market, Shanxi has encouraged private enterprises to participate in gas-fired power generation projects through mechanisms such as energy performance contracting (EPC) and build-operate-transfer (BOT) models, thereby facilitating the integration of low-concentration coal mine gas projects into the carbon market.

In this context, multiple projects have been launched, including the Sihe Coal Mine project integrating low-concentration gas power generation with waste heat recovery, the Fusheng Coal Mine project utilizing 6.8% concentration gas for direct combustion heating, and the Yuanxiang Coal Mine project combining thermal storage oxidation with combined heat and power (CHP) supply, showing that emissions reduction and economic benefits can be mutually achieved.

Source: Liu Jie, Qin Yan, Liu Yu & Chen Meian. (2025). Methane Emission Reduction in Coal Regions: The Experience of Shanxi, China. Available at: <https://mp.weixin.qq.com/s/kUcQVMmBG7eFKP8ihy4Ckw><sup>[13]</sup>

## Key Areas for Strengthening Future Low-Carbon Development

According to iGDP's research based on Energy Policy Simulator (EPS) model, Shanxi Province's emissions reduction pathways in energy and industry play an important role in achieving the 2060 carbon neutrality goal, specifically:

- Promote renewable energy while controlling coal power expansion; from 2030 to 2045, wind and solar photovoltaic power will gradually replace coal power as the main energy source;
- Continue to reduce the capacity and share of coal power; by mid-century, gas-fired power capacity from unconventional natural gas is expected to continue increasing, partly replacing coal-fired power as a flexible peaking resource, while also contributing to the reduction of coal mine methane emissions.
- In addition to optimizing the industrial structure, it is necessary to establish and improve policy frameworks covering industrial electrification and hydrogen substitution (particularly in energy-intensive industries), industrial energy efficiency improvement, and low-carbon technologies such as carbon capture, utilization, and storage (CCUS).

## Hainan Province – Developing Economy

### Socioeconomic Overview

Hainan has a relatively small economy, with GDP accounting for less than 1% of the national total and per capita GDP below the national average. Hainan's energy consumption is correspondingly modest, accounting for only about 0.5% of the national total. Hainan has a relatively diversified energy structure, with similar shares of coal, crude oil, natural gas, and primary electricity consumption, and a coal consumption share well below the national average.

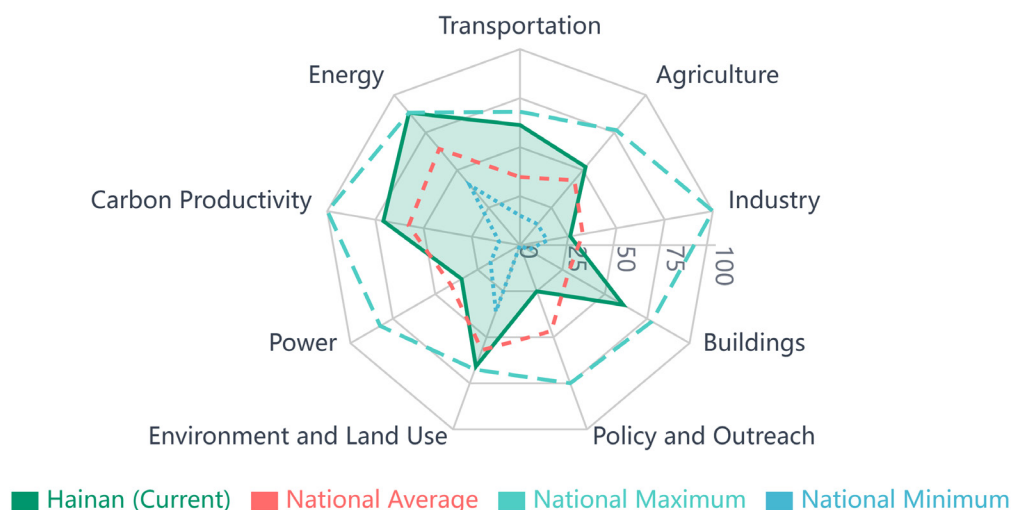
In terms of industrial structure, Hainan is dominated by the tertiary sector (60.8%), with the primary and secondary sectors accounting for similar shares. It has an industrial system underpinned by tourism, modern services, high-tech industries, and high-efficiency tropical agriculture. Currently, Hainan Province is at a critical juncture of rapid socioeconomic development and transformation. With the official commencement of customs-closure operations of the Hainan Free Trade Port, the province is expected to maintain robust economic growth, driven by strong demand for maritime and aviation transport, presenting both distinct opportunities and challenges for emissions reduction.

Hainan, as a national pilot zone for ecological civilization, a free trade port, and the largest special economic zone, is committed to building a "clean energy island" and "low-carbon island," aiming to forge a transition path that breaks from the traditional "develop first, govern later" model, serving as a showcase for the construction of Beautiful China.

### Subnational LOGIC Performance Analysis

Hainan Province's 2022 total Subnational LOGIC score was 59.3, placing it in the first tier. As shown in Figure 11, Hainan's overall performance exceeded the provincial averages in multiple sub-categories: energy, carbon productivity, transport, and buildings. Industry and power, however, remained areas requiring further improvement.

**Figure 11 | Overall Subnational LOGIC Performance of Hainan in 2022**



Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/hainan>

Table 17 presents Hainan's indicator scores and historical trends. Sub-category wise, Hainan scored near maximum in 2022 in both carbon emissions per unit of GDP under the carbon productivity sub-category and electrification level under the energy sub-category. Benefiting from a relatively clean power mix and a service-sector-dominated economy, Hainan's carbon intensity per unit of GDP ranks among the lowest nationally. With nuclear power as the primary non-fossil power source for local power generation and clean energy accounts for a relatively high share of installed capacity, the province's carbon emissions baseline is relatively low. Compared with provinces dominated by heavy industry, Hainan has a service sector accounting for a high share of its economy, characterized by strong output and low emissions, thereby further enhancing its carbon productivity.

In electrification, Hainan is the first province in China to set a 2030 target for phasing out the sale of gasoline and diesel vehicles. Hainan currently leads the country in both new energy vehicle ownership and adoption rate, and rapid electrification in the transport sector helps increase the share of electricity in final energy consumption. Recently, China's first green methanol bunkering operation for a container ship was completed in Hainan, facilitating the country's low-carbon transition in the shipping sector <sup>[14]</sup>. In addition, the electrification level of Hainan's building sector is also high<sup>[15]</sup>, contributing to Hainan's excellent performance in the energy sub-category. Hainan also leads nationally in the low-carbon transition of the building sector, with the share of prefabricated building area in new construction area ranking second nationally <sup>[16]</sup>. Meanwhile, public institutions are also improving their energy efficiency.

Although Hainan has set out a target of building a "clean energy island," thermal power still accounted for 64% of local power generation in 2022, pushing up the power sector's carbon emissions per kWh and leading to poor performance in the low-carbon transition of power. Additionally, the combined share of wind, hydropower, and solar power generation in Hainan was only 8% in 2022 power generation <sup>[16]</sup>, pointing to enormous room to expand both new energy installed capacity and generation output.

In the industrial sector, Hainan's manufacturing industry is anchored by industries including petrochemical new materials, medical equipment and device manufacturing, oil and gas exploration, food industry, and modern seed industry. Unlike other provinces, Hainan's carbon emissions of the industrial sector are relatively low, at only 19% in 2022, though its electrification rate remains significantly below its potential <sup>[17]</sup>.

Table 17 | Subnational LOGIC Indicator Scores and Performance of Hainan

Category	Subnational LOGIC Indicator (Unit)	Value in 2022	2022 score/full score	Trends from 2013 to 2022
<b>Carbon Productivity: 20%</b>	<b>1 Carbon Productivity</b>		<b>14.2/20</b>	
	(-) Energy consumption per unit of GDP (tce/10,000 RMB, 2005 constant prices)	0.6	4.3/10	
	(-) Carbon emissions per unit of GDP (tCO2/10,000 RMB, 2005 constant prices)	1.2	9.9/10	
<b>Carbon Emissions: 50%</b>	<b>2 Energy</b>		<b>17.6/20</b>	
	(-) Per capita carbon emissions (tCO2/person)	4.5	3.9/5	
	(-) Per capita energy consumption (tce/person)	2.4	4.1/5	
	(+) Share of non-fossil energy in total primary energy consumption (%)	24%	4.7/5	
	(+) Share of electricity in final energy consumption (%)	41%	5/5	
	<b>3 Power</b>		<b>3.4/10</b>	
	(+) Share of wind and solar capacity in total power capacity (%)	21%	2.1/5	
	(-) Carbon emissions per unit of power generation (gCO2/kWh)	345.0	1.3/5	
	<b>4 Agriculture</b>		<b>1/2</b>	
	<b>Carbon Emissions: 50%</b>	0.2	0.3/1	
	(+) Agricultural output per worker (10,000 RMB/person)	8.5	0.7/1	
	<b>5 Industry</b>		<b>2.4/10</b>	
	(-) Carbon emissions per unit of industrial value-added (tCO2/10,000 RMB, 2005 constant prices)	0.7	1.2/5	
	(-) Revenue share of energy-intensive industries (%)	43%	1.3/5	
	<b>6 Transport</b>		<b>2.5/4</b>	
(+) Share of electricity in final energy consumption in the transport sector (%)	2%	0.5/2		
(-) Carbon emissions per unit of converted transport turnover (tCO2/t-km)	0.0	2/2		
<b>7 Buildings</b>		<b>2.4/4</b>		
(-) Per capita residential building carbon emissions (tCO2/person)	0.1	1.6/2		
(-) Public building carbon emissions per tertiary sector employee (tCO2/person)	0.3	0.8/2		
<b>Environmental Conditions and Land Use: 20%</b>	<b>8 Environmental Conditions and Land Use</b>		<b>13.2/20</b>	
	(-) Per capita municipal solid waste collected (tons/person)	0.3	0.7/2	
	(-) Annual average PM2.5 concentration (µg/m³)	12.0	2.1/5	
	(+) Share of days with good or excellent air quality (%)	99%	3.9/4	
	(-) Daily per capita domestic water consumption (L/person-day)	242.8	0.5/2	
	(+) Share of local fiscal spending on energy conservation and environmental protection (%)	2%	1/2	
(+) Forest coverage rate (%)	57%	5/5		
<b>Policy Systems and Public Participation: 10%</b>	<b>9 Policy Systems and Public Participation</b>		<b>2.5/10</b>	
	(+) Whether policy documents on fiscal support for the "dual carbon" goals have been issued	Yes	2.5/2.5	
	(+) Comparison of 14th FYP renewable energy targets vs. actual 13th FYP growth	No	0/2.5	
	(+) Whether a medium-to-long-term climate change adaptation action plan has been issued	No	0/2.5	
(+) Whether policies about promoting green consumption have been formulated	No	0/2.5		

Source: Institute for Global Decarbonization Progress

**Table 18 | Low-Carbon Policies Issued by Hainan Since the 14th FYP (Selected)**

Action 	Region	Region Type	Published By	Year	Areas	Topics
Planning Outline for the Comprehensive Multi-dimensional Transportation Network of Hainan Province	Hainan	Provincial	Hainan Provincial Committee of CPC, Hainan Provincial People's...	2026	Transport	
Notice on Launching the Construction of Zero-Carbon Parks in the Hainan Free Trade Port	Hainan	Provincial	Hainan Provincial Development and Reform Commission	2025		Zero-Carbon Parks
Implementation Measures for Energy Conservation Review and Carbon Emission Assessment of Fixed Asset...	Hainan	Provincial	Hainan Provincial Development and Reform Commission	2025	Green Economy	
Implementation Plan for Deepening Market-Oriented Reform of the Pricing System for New Energy in Hainan...	Hainan	Provincial	Hainan Provincial Development and Reform Commission	2025	Electricity	Renewable Energy
Work Plan of Hainan Province for Deepening the Construction of a "Zero-Waste Island" (2025–2030)	Hainan	Provincial	Hainan Provincial Department of Ecology and Environment	2025	Regional Strategy	Waste
Construction Plan for a Low-Carbon Island in Hainan	Hainan	Provincial	Hainan Provincial People's Government	2025	Regional Strategy	
Work Plan for Accelerating the Establishment of the Carbon Footprint Management System for Hainan Free Trade Por...	Hainan	Provincial	Hainan Provincial Development and Reform Commission and...	2025		Carbon Footprint
Developing a Strategic Plan to Forge a New Chapter of Hainan's Beauty on Its Renewed Journey and Setting an...	Hainan	Provincial	Hainan Provincial Committee of CPC, Hainan Provincial People's...	2024	Cross-sector Action	
Implementation Plan for Promoting Large-scale Equipment Renewal and Trade-in of Consumer Goods in Hainan...	Hainan	Provincial	Hainan Provincial People's Government	2024	Industry, Green Economy	
The Medium- and Long-Term Plan for the Development of Hydrogen Energy Industry in Hainan (2023-2035)	Hainan	Provincial	Hainan Provincial Development and Reform Commission and...	2024	Energy	Hydrogen

Source: Institute for Global Decarbonization Progress. Carbon Neutrality Tracker (CCNT). Available at: <https://ccnt.igdp.cn/en/actions-tracker/details/hainan>

#### Box 4 | Battery-Swap Heavy Trucks and Green Freight in Hainan

Drawing on the natural advantages of its closed island geography and its policy commitment to ban the sale of fossil fuel vehicles by 2030, Hainan has pioneered the large-scale deployment of battery-swap heavy trucks, offering a transferable model for low-carbon transition in heavy-duty freight transport.

By the end of 2025, Hainan's heavy truck electrification rate had risen to 36.1%, with over 2,000 battery-swap heavy trucks in operation and 37 battery-swap stations built and commissioned, providing broad coverage of the island's trunk roads and key industrial parks. Under the Hainan Province New Energy Vehicle Battery-Swap Mode Application Pilot Implementation Plan, individual pilot vehicles are eligible for subsidies of up to 4 million yuan. In addition, Hainan has advanced electrification across typical use cases, including cement mixer trucks and port short-haul transport, through a combination of measures: promoting vehicle-battery separation business models to lower market entry barriers, and leveraging off-peak electricity pricing to reduce energy costs.

Challenges remain, however, in scaling battery-swap heavy trucks: connector standards are not yet unified, construction costs remain high, and battery weight reduces effective payload capacity. Other port cities may draw on Hainan's experience by prioritizing the battery-swap model in closed or fixed-route settings, advancing the development of local battery-swap standards in parallel, and exploring battery asset management and green finance instruments to ease investment pressure.

Source: Lyu Yaning. (2026). Hainan Provides a Practical Model for the Promotion and Application of Battery-Swap Heavy Trucks. Available at: [https://mp.weixin.qq.com/s/ws56w\\_eMr5VA5A8UET5fDw](https://mp.weixin.qq.com/s/ws56w_eMr5VA5A8UET5fDw)<sup>[18]</sup>

### Key Areas for Strengthening Future Low-Carbon Development

According to iGDP's research based on Energy Policy Simulator (EPS) model, Hainan Province should formulate phased and sector-specific pathways for its low-carbon transition in support of key goals, including building a low-carbon island and achieving carbon neutrality. Key actions include:

- Accelerate development of non-fossil power generation, especially offshore wind power generation, and promote integrated offshore wind-to-hydrogen, ammonia, and methanol production and refuelling demonstration projects; reduce energy consumption and carbon emissions amid the accelerated electrification of end-use sectors in the future;
- Hainan leads the country in road transport electrification. With fossil fuel vehicle sales restrictions in place, continued grid decarbonization, the ongoing rollout of zero-emission vehicles (including battery electric and hydrogen fuel cell vehicles), and structural modal shifts from road to waterway and rail, the transport sector's overall emissions reduction contribution is expected to approach 10%;
- Deep emissions reduction in the industrial sector requires greater emphasis on electricity substitution in energy-intensive industries such as petrochemicals. In addition, it is crucial to explore use cases and viable business models for technologies such as high-temperature heat pumps and electric boilers;
- There is a strong foundation for building sector electrification, but due to Hainan's tropical climate and development of high-efficiency tropical agriculture, demand for cooling in the province is expected to grow further. Therefore, promoting green cooling, raising building energy efficiency standards, and driving appliance upgrades are important for low-carbon transition of the building sector.

# Appendix 1: Subnational LOGIC Methodology

The Regional Low-Carbon and Green Index for China ( “Subnational LOGIC” ) focuses on key dimensions of the green and low-carbon transition. It covers 30 provinces<sup>1</sup>, spans 2013–2022, and comprises 26 indicators (22 quantitative and 4 qualitative) in 4 categories and 9 sub-categories (see Table A1-1).

**Category 1: Carbon Productivity (Sub-Category 1, Weight 20%):** Evaluates the quality of green development of regional economies, reflecting the cultivation of new productive forces and industrial greening through two indicators: energy consumption per unit of GDP and carbon emissions intensity.

**Category 2: Carbon Emissions (Sub-Category 2–7, Combined Weight 50%):** As the core of the Subnational LOGIC system, it covers the six major areas of energy, power, industry, buildings, transport, and agriculture, reflecting national progress in energy revolution, industrial upgrading, and sectoral decarbonization.

**Energy (Sub-Category 2, Weight 20%):** Assesses decarbonization of the energy system, with four indicators: per capita carbon emissions, per capita energy consumption, electricity consumption share, and non-fossil energy share.

**Power (Sub-Category 3, Weight 10%):** Measures progress toward a power system centred on new energy, with two indicators: wind and solar capacity share, and carbon emissions per unit of power generation.

**Industry (Sub-Category 4, Weight 10%):** Reflects green and low-carbon industrial transformation and upgrading, with two indicators: carbon emissions per unit of industrial value-added, and revenue share of energy-intensive industries.

**Buildings (Sub-Category 5, Weight 4%):** Assesses energy efficiency and the level of decarbonization in building operation, with indicators for per capita residential building carbon emissions and public building carbon emissions per tertiary sector employee.

**Transport (Sub-Category 6, Weight 4%):** Reflects the smart and low-carbon transition of the transport sector, with two indicators: share of electricity in final energy consumption in the transport sector and carbon emissions per unit of converted transport turnover.

**Agriculture (Sub-Category 7, Weight 2%):** Measures the low-carbon transition and efficiency improvement in the agriculture sector, with indicators for carbon emissions per unit of agricultural value-added and agricultural output per worker.

**Category 3: Environmental Conditions and Land Use (Sub-Category 8, Weight 20%).** Focuses on ecological governance and carbon sink capacity, covering six indicators: forest coverage rate, share of days with good or excellent air quality, annual average PM2.5 concentration, municipal solid waste safe disposal rate, daily per capita domestic water consumption, and share of local fiscal spending on energy conservation and environmental protection.

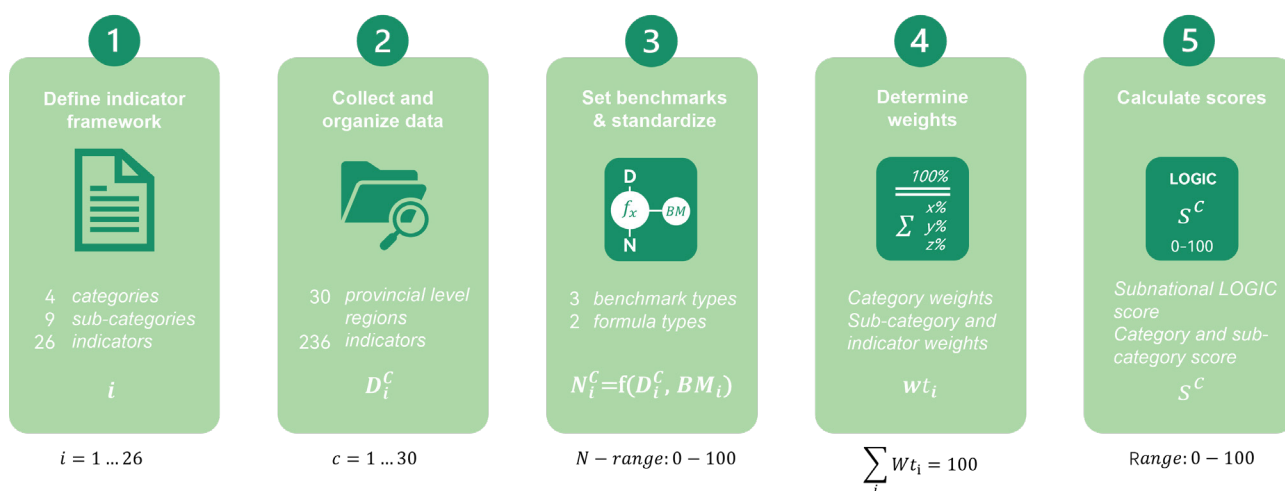
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<sup>1</sup> There are 31 provincial-level administrative units (provinces, autonomous regions, and municipalities) nationally. Due to data availability, Xizang Autonomous Region is not included in this report.

**Category 4: Policy Framework and Public Participation (Sub-Category 9, Weight 10%).** Evaluates provincial government's policy framework and social participation in green and low-carbon transition through four qualitative indicators: whether policy documents on fiscal support for the “dual carbon” goals have been issued; comparison of 14th FYP renewable energy targets vs. actual 13th FYP growth; whether a medium-to-long-term climate change adaptation action plan has been issued; and whether policies about promoting green consumption have been formulated.

The Subnational LOGIC index is constructed in five steps: first, define the indicator framework; second, collect and organize data and determine regional scope; third, establish benchmark values and standardize raw data; fourth, determine weights for different categories and indicators; and finally, calculate the Subnational LOGIC score for each region (see Figure A1-1).

**Figure A1-1 | Subnational LOGIC Index Construction — Five-Step Methodology**



Subnational LOGIC is guided by five principles: practicality of the methodology, ensuring calculation methods are simple, direct, and scientific; indicator relevance, fully reflecting national green and low-carbon strategies and subnational actions; result comparability, enabling cross-regional comparisons and time-series analysis; data availability, ensuring indicators are universally applicable and publicly available; and international compatibility, maintaining consistency with domestic and international statistical standards as much as possible to facilitate result comparison.

Benchmark values are determined using three approaches: international best-practice values in areas such as annual average PM2.5 concentration and per capita domestic water consumption; national medium-to-long-term target values or forecast values, such as carbon emissions per unit of GDP, non-fossil energy share, and forest coverage rate, as well as indicators highly correlated with "dual carbon" goals; and for indicators lacking international or domestic leading values, the benchmark is calculated as the average of the top three provinces, adjusted by a coefficient, with the positive indicator benchmark set at 1.2 times the top-3 average and the negative indicator benchmark at 0.8 times.

Differentiated methods are applied for data standardization according to indicator type. Positive indicators (higher values indicate better performance):  $f(D_i^c, BM_i) = \frac{D_i^c}{BM_i} \times 100$ ; negative indicators (lower values indicate better performance):  $f(D_i^c, BM_i) = \frac{BM_i}{D_i^c} \times 100$ . If the actual value exceeds the benchmark value, a score of 100 is assigned. Policy indicators use binary scoring: “yes” scores 100, “no” scores 0.

Weight assignment was updated on the basis of "China's Cities Transitioning Toward Energy Sustainability, and Pursuing Early Peaking of Carbon Emissions: 2017 results from the 'China LOGIC' city index," incorporating findings from national carbon neutrality pathway research<sup>2</sup>, latest policy developments, and expert opinions. Weights for the four major categories are: carbon productivity 20%, carbon emissions 50%, environmental conditions and land use 20%, and policy systems and public participation 10%. Under the carbon emissions category, six sub-categories are weighted according to their sectoral carbon emissions share in 2030: energy 20%, power 10%, industry 10%, transport 4%, buildings 4%, agriculture 2%. Indicators within the same sub-category are equally weighted, with minor adjustments for individual indicators based on importance.

A higher Subnational LOGIC score represents better performance, with a perfect score of 100 and a minimum of 0. The maximum score for each sub-category and indicator is calculated by multiplying its weight by 100. The Subnational LOGIC score equals the sum of all indicator scores, and each indicator score equals the standardized value of that indicator multiplied by the indicator weight. The formula is:

$$\text{LOGIC Score}^c = \sum_i S_i^c = f(D_i^c, \text{BM}_i) \times \text{Wt}_i$$

Where:  $c$  represents the sample province (1–30);  $i$  represents the indicator (1–26);  $S_i^c$  is the score of the  $i$ -th indicator for province  $c$ ;  $D_i^c$  is the original value of the  $i$ -th indicator for province  $c$ ;  $\text{BM}_i$  is the benchmark value of the  $i$ -th indicator;  $\text{Wt}_i$  is the weight assigned to the  $i$ -th indicator.

## Appendix 2: Regional Classification

### By Economic-Geographic Region

The National Bureau of Statistics divides China's economic regions into four major areas: eastern, central, western, and northeastern:

- Eastern: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan;
- Central: Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan;
- Western: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang;
- Northeastern: Liaoning, Jilin, and Heilongjiang

### By Economic Development Stage

The economic development stage dimension focuses on the underlying characteristics of economic and social structure. This report refers to the comprehensive indicator approach for assessing China's regional industrialization process proposed by Chen Jiagui et al. to classify provinces by economic development stage, with calculations also referencing methods by Huang Qunhui, Sun Jiuwen, and others. Based on a composite assessment of five variables—per capita GDP

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2 Institute for Global Decarbonization Progress (iGDP). 2024. "Report Summary: Energy Transition Pathways Supporting China's Carbon Neutrality." Beijing: iGDP. Available at: <http://www.igdp.cn/wp-content/uploads/2024/11/2024-11-13-IGDP-Report-Summary-Energy-TransitionPathways-Supporting-China-Neutrality-Based-on-EPS.pdf>

(2022)<sup>2</sup>, shares of the primary, secondary, and tertiary sectors, share of manufacturing value-added in total industrial value-added, resident population urbanization rate, share of primary sector employment—the 30 provinces are divided into four groups: Pioneer Economy, Leading Economy, Catching-Up Economy, and Developing Economy.

The classification and indicators are as follows:

**Table A2-1 | Classification and Characteristics of Provincial Economic Development Stages**

Province Category	Count	Provinces	Per Capita GDP (2010 Constant USD)	Urbanization Level	Industrial Structure
Pioneer Economy	6	Beijing, Shanghai, Tianjin, Jiangsu, Zhejiang, Guangdong	16,117-28,129	73%-85%	Tertiary sector 51–80%; Primary sector <5%
Leading Economy	9	Fujian, Shandong, Henan, Hunan, Chongqing, Anhui, Jiangxi, Hubei, Liaoning	10,668-18,858	57%-73%	Tertiary sector 47–55%; Secondary sector below 45%
Catching-Up Economy	8	Hebei, Shanxi, Inner Mongolia, Sichuan, Shaanxi, Jilin, Ningxia, Qinghai	9,059-14,841	55%-70%	Tertiary and secondary sectors each 40–55%; Primary sector <13%
Developing Economy	7	Guangxi, Hainan, Yunnan, Xinjiang, Gansu, Guizhou, Heilongjiang	6,869-10,209	50%-70%	Secondary sector 20–46%; Tertiary sector 40–60%; Primary sector 13–23%

- Provinces classified as Pioneer Economies have per capita GDP levels comparable to high-income countries, with industrial structures dominated by the service sector and a relatively low share of agriculture. Their urbanization rates are also comparable to those of developed countries.
- Provinces classified as Leading Economies have similar levels of per capita GDP to those of Pioneer Economies but differ in industrial structure and urbanization rate. In Leading Economies, the service sector accounts for around 50% of the economy, and the urbanization rate is slightly below that of Pioneer Economies but above the national average.
- Provinces classified as Catching-Up Economies generally have per capita GDP above the national average. The service and industrial sectors each account for about 40%–50% of GDP, reflecting a relatively balanced development between the secondary and tertiary industries, while agriculture accounts for less than 10%.
- Provinces classified as Developing Economies generally have a relatively high share of the primary sector (13%–22%), with the secondary sector accounting for a smaller share than the tertiary sector and remain in the intermediate stage of industrialization. Their urbanization rates range from approximately 50% to 76%.

2 Per capita GDP uses the average of exchange rate and PPP methods, deflated to 2010 RMB constant prices using GDP deflators, combined with 2010 RMB/USD exchange rate, and further adjusted using the purchasing power parity between RMB and USD.

## By National Major Regional Development Strategy

National top-level design, namely major regional development strategies—not only provides directional guidance to regions but also shapes differentiated transition pathways through policy, funding, and technical support. Since the 18th National Congress of the CPC, the Central Committee of the Party has proposed new major regional development strategies including Beijing-Tianjin-Hebei Coordinated Development, Yangtze River Economic Belt Development, Yangtze River Delta Integrated Development, and Yellow River Basin Ecological Protection and High-Quality Development. These major national regional development strategies have injected strong momentum into coordinated regional development and significantly influenced the performance of the green and low-carbon transition in these regions.

- The Yangtze River Delta Integrated Development Belt is one of China's most economically active, open, and innovation-driven regions, covering 4 provinces: Shanghai, Jiangsu, Zhejiang, and Anhui.
- The Beijing-Tianjin-Hebei Coordinated Development Region covers Beijing, Tianjin, and Hebei.
- The Yangtze River Economic Belt covers 11 provinces/municipalities: Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Yunnan, and Guizhou.
- Yellow River Basin's Ecological Protection and High-quality Development Plan covers 9 provinces/autonomous regions through which the Yellow River mainstream and tributaries flow: Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shanxi, Shaanxi, Henan, and Shandong.

## By Regional Energy Development Positioning

The 14th Five-Year Plan for a Modern Energy System identifies three types of regional energy development priorities: Large Clean Energy Bases, Leading Regions for Low-Carbon Energy Transition, and Key Energy Security Regions <sup>[7]</sup>.

- Large Clean Energy Bases cover: Yunnan-Guizhou-Sichuan-Tibet, Qinghai hydro-wind-solar integrated development, Jinsha River upper and lower reaches, Yalong River Basin, and Yellow River upper reaches clean energy bases; the Yellow River "several-bend" arc, Hexi Corridor, Xinjiang clean energy bases; and others.
- Leading Regions for Low-Carbon Energy Transition include: Beijing-Tianjin-Hebei and surrounding areas, Yangtze River Delta region, Guangdong-Hong Kong-Macao Greater Bay Area and surrounding areas, and other central and eastern regions.
- Key Energy Security Regions involve Hubei, Hunan, and Jiangxi, northeastern China, and other regions.

**Table A2-2 | Regional Classification Summary**

Province	Economic Development Stage	Economic-Geographic Region	National Regional Strategy	Energy Positioning
Beijing	Pioneer Economy	Eastern	Beijing-Tianjin-Hebei Coordinated Development	Leading Region for Low-Carbon Energy Transition
Sichuan	Catching-Up Economy	Western	Yangtze River Economic Belt	Large Clean Energy Base

Province	Economic Development Stage	Economic-Geographic Region	National Regional Strategy	Energy Positioning
Guangdong	Pioneer Economy	Eastern	—	Leading Region for Low-Carbon Energy Transition
Fujian	Leading Economy	Eastern	Yangtze River Economic Belt	Leading Region for Low-Carbon Energy Transition
Yunnan	Developing Economy	Western	Yangtze River Economic Belt	Large Clean Energy Base
Hainan	Developing Economy	Eastern	—	Leading Region for Low-Carbon Energy Transition
Jiangsu	Pioneer Economy	Eastern	Yangtze River Delta Integrated Development Belt & Yangtze River Economic Belt	Leading Region for Low-Carbon Energy Transition
Shanghai	Pioneer Economy	Eastern	Yangtze River Delta Integrated Development Belt & Yangtze River Economic Belt	Leading Region for Low-Carbon Energy Transition
Guangxi	Developing Economy	Western	—	Key Energy Security Region
Jiangxi	Leading Economy	Central	—	Key Energy Security Region
Henan	Leading Economy	Central	—	Leading Region for Low-Carbon Energy Transition
Zhejiang	Pioneer Economy	Eastern	Yangtze River Delta Integrated Development Belt & Yangtze River Economic Belt	Leading Region for Low-Carbon Energy Transition
Chongqing	Leading Economy	Western	Yangtze River Economic Belt	Large Clean Energy Base
Jilin	Catching-Up Economy	Northeastern	—	Key Energy Security Region
Anhui	Leading Economy	Central	Yangtze River Delta Integrated Development Belt & Yangtze River Economic Belt	Leading Region for Low-Carbon Energy Transition
Hubei	Leading Economy	Central	Yangtze River Economic Belt	Key Energy Security Region
Hunan	Leading Economy	Central	Yangtze River Economic Belt	Key Energy Security Region
Guizhou	Developing Economy	Western	Yangtze River Economic Belt	Key Energy Security Region

Province	Economic Development Stage	Economic-Geographic Region	National Regional Strategy	Energy Positioning
Gansu	Developing Economy	Western	Yellow River Basin Ecological Protection and High-Quality Development Zone	Large Clean Energy Base
Hebei	Catching-Up Economy	Eastern	Beijing-Tianjin-Hebei Coordinated Development	Leading Region for Low-Carbon Energy Transition
Shaanxi	Catching-Up Economy	Western	Yellow River Basin Ecological Protection and High-Quality Development Zone	Large Clean Energy Base
Shandong	Leading Economy	Eastern	—	Leading Region for Low-Carbon Energy Transition
Heilongjiang	Developing Economy	Northeastern	—	Key Energy Security Region
Tianjin	Pioneer Economy	Eastern	Beijing-Tianjin-Hebei Coordinated Development	Leading Region for Low-Carbon Energy Transition
Shanxi	Catching-Up Economy	Central	Yellow River Basin Ecological Protection and High-Quality Development Zone	Large Clean Energy Base
Liaoning	Leading Economy	Northeastern	—	Key Energy Security Region
Qinghai	Catching-Up Economy	Western	Yellow River Basin Ecological Protection and High-Quality Development Zone	Large Clean Energy Base
Inner Mongolia	Catching-Up Economy	Western	Yellow River Basin Ecological Protection and High-Quality Development Zone	Large Clean Energy Base
Ningxia	Catching-Up Economy	Western	Yellow River Basin Ecological Protection and High-Quality Development Zone	Large Clean Energy Base
Xinjiang	Developing Economy	Western	—	Large Clean Energy Base

# References

- [1] Hu, M., Yang, L., Cannan, A., Zhang, J., Ohshita, S., Chen, M., Li, A., Wang, Y., Liu, S., Fridley, D., Khanna, N., & Zhou, N. 2018. "China's Cities Transitioning Toward Energy Sustainability, and Pursuing Early Peaking of Carbon Emissions: 2017 results from the 'China LOGIC' city index." Beijing: iGDP. Available at: <https://www.igdp.cn/wp-content/uploads/2023/01/2018-10-24-IGDP-Report-EN-China-LOGIC-Report.pdf>
- [2] Li, X., Liu, Z., Liao, C., et al. 2025. "Medium- and Long-Term Outlook for Low-Carbon Transition in Guangdong—Using EPS Modeling." Research report.
- [3] China Electricity Council. 2025. "China Electrification Annual Development Report 2025 (Summary)." Beijing: China Electricity Council. Available at: <http://www.ceia.eea.tsinghua.edu.cn/hyxx/981c5d5d7a414451b08bdbe5a02ab58c.htm>
- [4] Pearl River Environmental Report. 2021. "Guangdong's Carbon Intensity Ranked Second Lowest in the Country in 2020." Available at: [https://sthjj.gz.gov.cn/hbyd/zjhjb/content/post\\_7797786.html](https://sthjj.gz.gov.cn/hbyd/zjhjb/content/post_7797786.html)
- [5] Lyu, Y. 2025. "Lingnan 'Breathing' Near-Zero Carbon Buildings: Where Traditional Culture and Modern Technology Coexist." Huanqiu Shibao. Available at: <https://hqttime.huanqiu.com/share/article/4OPEUY4qRk1>
- [6] China News. 2024. "Jiangxi's Digital Economy Value Added Expected to Exceed 1.2 Trillion Yuan in 2023." Available at: <https://tradeinservices.mofcom.gov.cn/article/szmy/hydt/202401/160882.html>
- [7] Jiangxi Provincial Development and Reform Commission. 2022. "Jiangxi: Using Green Development as a Guide to Fully Advance Energy Saving and Carbon Reduction Work." Available at: [https://www.ndrc.gov.cn/xwdt/ztl/2022qgjncz/dfjnsj/202206/t20220612\\_1327149.html](https://www.ndrc.gov.cn/xwdt/ztl/2022qgjncz/dfjnsj/202206/t20220612_1327149.html)
- [8] Yuan, Y., Yang, L., Li, X., et al. 2025. "Medium-to-Long-Term Outlook for Low-Carbon Transition in Jiangxi—Developing 'Dual Carbon' Pathways Using EPS Modeling." iGDP. Available at: <https://www.igdp.cn/wp-content/uploads/2025/08/Medium-and-Long-Term-Outlook-for-Low-Carbon-Transition-in-Jiangxi.pdf>
- [9] He, G., Chen, W., Liu, S., et al. 2026. "Jiangxi's 'Dual Carbon' Practice of Comprehensive Rural Clean Energy Utilization | ACTION 2035." Available at: <https://mp.weixin.qq.com/s/vEGGUR9GhkvXArV8eZ-d3A>
- [10] Shanxi Provincial Government. 2026. "Government Work Report—Delivered at the 5th Session of the 14th Shanxi Provincial People's Congress on February 2, 2026." Available at: [http://www.liulin.gov.cn/zwdt/ssyws/202602/t20260209\\_2015153.shtml](http://www.liulin.gov.cn/zwdt/ssyws/202602/t20260209_2015153.shtml)
- [11] China Transportation News. 2026. "Double Breakthrough in Carbon Reduction and Greening of Transport." Available at: [https://www.mot.gov.cn/xinwen/jiaotongyaowen/202604/t20260415\\_4203693.html](https://www.mot.gov.cn/xinwen/jiaotongyaowen/202604/t20260415_4203693.html)
- [12] Shanxi Economic Daily. 2025. "Remarkable Results in Domestic Demand Expansion Strategy in '14th FYP'—Shanxi: Dual Drive of Investment and Consumption Unleashing New Economic Vitality." Available at: [https://tjj.shanxi.gov.cn/tjgz/sxyw/202512/t20251209\\_10009952.shtml](https://tjj.shanxi.gov.cn/tjgz/sxyw/202512/t20251209_10009952.shtml)
- [13] Liu, J., Qin, Y., Liu, Y., Chen, M., et al. 2026. "Methane Reduction in Coal-Resource Regions: Shanxi Experience | ACTION 2035." Available at: <https://mp.weixin.qq.com/s/kUcQVMmBG7eFKP8ihy4Ckw>

- [14] Hainan Provincial Department of Ecology and Environment. 2025. "Hainan Province's Policies and Actions on Climate Change: 2025 Annual Report." Available at: [https://hnsthb.hainan.gov.cn/ywdt/zwdt/202511/t20251113\\_3970516.html](https://hnsthb.hainan.gov.cn/ywdt/zwdt/202511/t20251113_3970516.html)
- [15] Song, M., Wu, D., Yang, L., et al. 2025. "Medium-to-Long-Term Outlook for Low-Carbon Transition in Hainan— Exploring 'Dual Carbon' Pathways Using EPS Modeling." Beijing: iGDP. Available at: <https://www.igdp.cn/wp-content/uploads/2025/11/2025-11-IGDP-Report-CN.pdf>
- [16] Hainan Daily. 2025. "Province's Carbon Dioxide Emissions Per Unit of GDP Have Continued to Decline Since 2005." Available at: <https://www.hainan.gov.cn/hainan/5309/202511/4861a151788d40ff99d64c5e4ad7105a.shtml>
- [17] Song, M. 2025. "ACTION 2035 | Research on Hainan Province's Low-Carbon Transition Pathway, Road Map Toward 'Low-Carbon Island'." Available at: <https://mp.weixin.qq.com/s/Pt5E1xub8OlcNldPu7rBbw>
- [18] Lyu Yaning. 2026. Hainan Provides a Practical Model for the Promotion and Application of Battery-Swap Heavy Trucks. Available at: [https://mp.weixin.qq.com/s/ws56w\\_eMr5VA5A8UET5fDw](https://mp.weixin.qq.com/s/ws56w_eMr5VA5A8UET5fDw)



The Institute for Global Decarbonization Progress (iGDP), established in Beijing in 2014, is a non-profit think tank dedicated to promoting green and low-carbon development. Since its inception, iGDP has provided policy-relevant analytical insight on China's green and low-carbon practices in view of the global climate challenge. iGDP serves decision makers, practitioners, and investors by promoting scientifically grounded energy and climate change mitigation solutions through interdisciplinary, systematic, and empirical research. iGDP collaborates with a wide variety of stakeholders to foster dialogue on green, low-carbon, and sustainable development, providing forward-looking analysis and developing knowledge products with a global perspective.

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