Urban-Act
Integrated Urban Climate Action for Low-Carbon & Resilient Cities

Jiaxing City Low-Carbon Urban Planning Research Report

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Project description
Integrated Urban Climate Action for Low-Carbon and Resilient Cities (Urban-Act)

The Urban-Act project is implemented on behalf of the International Climate Initiative (IKI) of the Federal Government of Germany. Within the Federal Government, the IKI is anchored in the Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN).

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Preface

Climate change is a major global concern due to its direct impact on human survival and development. Actively and effectively addressing this issue not only meets the demands of global progress but is also a crucial prerequisite for achieving sustainable development.

Zhejiang Province is the birthplace of the development philosophy, "Lucid waters and lush mountains are invaluable assets." Improving ecological quality is of great significance in advancing the four-pronged development strategy: building a beautiful countryside, strengthening the ecological environment, promoting green economic growth, and nurturing a vibrant ecological culture. This plan aims to build a comprehensive understanding of the total amount, structure, and distribution of greenhouse gas emissions (GHGs) in Jiaxing City. It also seeks to provide strong technical support for creating low-carbon and climate-resilient plans and policies in response to climate change.

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1. Background

1.1 Macro-level background on green development

1.1.1 Macro context

At the General Debate of the 75th Session of the UN General Assembly held on September 22, 2020, Chinese President Xi Jinping announced that China "aims to have carbon emissions peak before 2030 and achieve carbon neutrality before 2060". The Report to the 20th National Congress of the Communist Party of China (CPC) emphasized the importance of green development and promoting harmony between humanity and nature. China is committed to actively and prudently pursuing the goals of reaching peak carbon emissions and carbon neutrality by promoting clean, low-carbon, and high-efficiency energy use and pushing forward the clean and low-carbon transition in industry, construction, transportation, and other sectors. More recently, the Third Plenary Session of the 20th CPC Central Committee reaffirmed this commitment, emphasizing steady progress toward green and low-carbon development and the continued implementation of targeted action plans to achieve peak emissions.

1.1.2 Planning background

To better address global climate change and promote international ecological cooperation, the Ministry of Natural Resources of China, in collaboration with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, jointly applied for the "Integrated Urban Climate Action for Low-Carbon and Resilient Cities (Urban-Act)" project under the International Climate Initiative (IKI) of the former Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection of Germany. The Urban-Act China Component aims to integrate climate change considerations and indicators into the territorial spatial planning system to enable better decision-making and resource allocation.

In response to global climate change, Jiaxing, as a pilot city, is exploring sustainable innovations to build a green, low-carbon, and circular ecological city by developing a dedicated low-carbon urban development plan within the territorial spatial planning framework.

1.2 Core concepts of climate change-responsive urban development

1.2.2 Planning objectives and main content

(1) Planning objectives

The objectives are to integrate climate change considerations into Jiaxing's territorial spatial planning, with a focus on the practical application and innovation of the concepts, strategies, indicators, and methods to address climate change. Additionally, the plan aims to support the development of a territorial spatial planning, monitoring, and evaluation system, and promote multi-level, cross-departmental coordination and communication to strengthen Jiaxing's capacity for low-carbon urban development.

(2) Main content

The plan focuses on analyzing Jiaxing's current carbon emissions and carbon sinks in terms of total amount, structure, spatial distribution, and historical changes and trends. Combined with carbon accounting methods and multi-scenario simulations for quantitative assessments, and aligned with Jiaxing's sponge city planning and development practices, the plan also explores spatial planning concepts, methodologies, content frameworks, indicator systems, and key strategies to support the city in achieving its "dual carbon" goals.

1.3 Identifying basic pathways

1.3.1 Planning scope and focus areas

The planned area includes all land and marine spaces within the administrative boundaries of Jiaxing City. This includes the **2 urban districts** of Nanhu and Xiuzhou, the **3 county-level cities** of Pinghu, Haining, and Tongxiang, and the **2 counties** of Jiashan and Haiyan. The total planned area covers 5,740 square kilometers. Based on the planning and baseline conditions, the focus is placed on the urban districts of Nanhu and Xiuzhou, totaling 986 square kilometers.

1.3.2 Planning principles

(1) Bottom-line thinking to safeguard territorial security. Throughout the planning process, the fundamental bottom line of ensuring both security and development is always upheld, with the aim to maintain the

city's resilience and adaptability in the face of external shocks and disasters. This principle supports the stable functioning of urban systems and the sustained development of the local economy and society.

(2) Innovative thinking to implement sustainable development philosophies. Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, the top-level design role of territorial spatial planning is leveraged to effectively implement the national and Zhejiang Province's "dual carbon" strategies within Jiaxing's spatial framework. By promoting both technological and institutional innovation, the plan seeks to drive economic growth, guide industrial restructuring, advance the circular economy, and foster more sustainable lifestyles among residents, injecting new momentum into the process of Chinese-style modernization.

(3) People-centered thinking to enhance urban quality. Seizing the opportunity brought by green transformation, the plan aims to promote high-quality urban development by improving the ecological environment, enhancing spatial quality, and shaping distinctive urban and rural landscapes to create a livable and attractive environment. It also emphasizes innovative approaches to urban development and maintenance, encouraging interdepartmental coordination to improve urban governance, ensure equitable public services across urban and rural areas, and raise the overall standard of urban living.

1.3.3 Technical roadmap

(1) Planning approach

The planning process is structured around 4 main phased tasks: comprehensive assessment (objective alignment), city-wide control plan (regional coordination), urban district control plan (detailed spatial control), and implementation mechanism (transmission mechanism). The proposed planning approach is illustrated in the following figure:

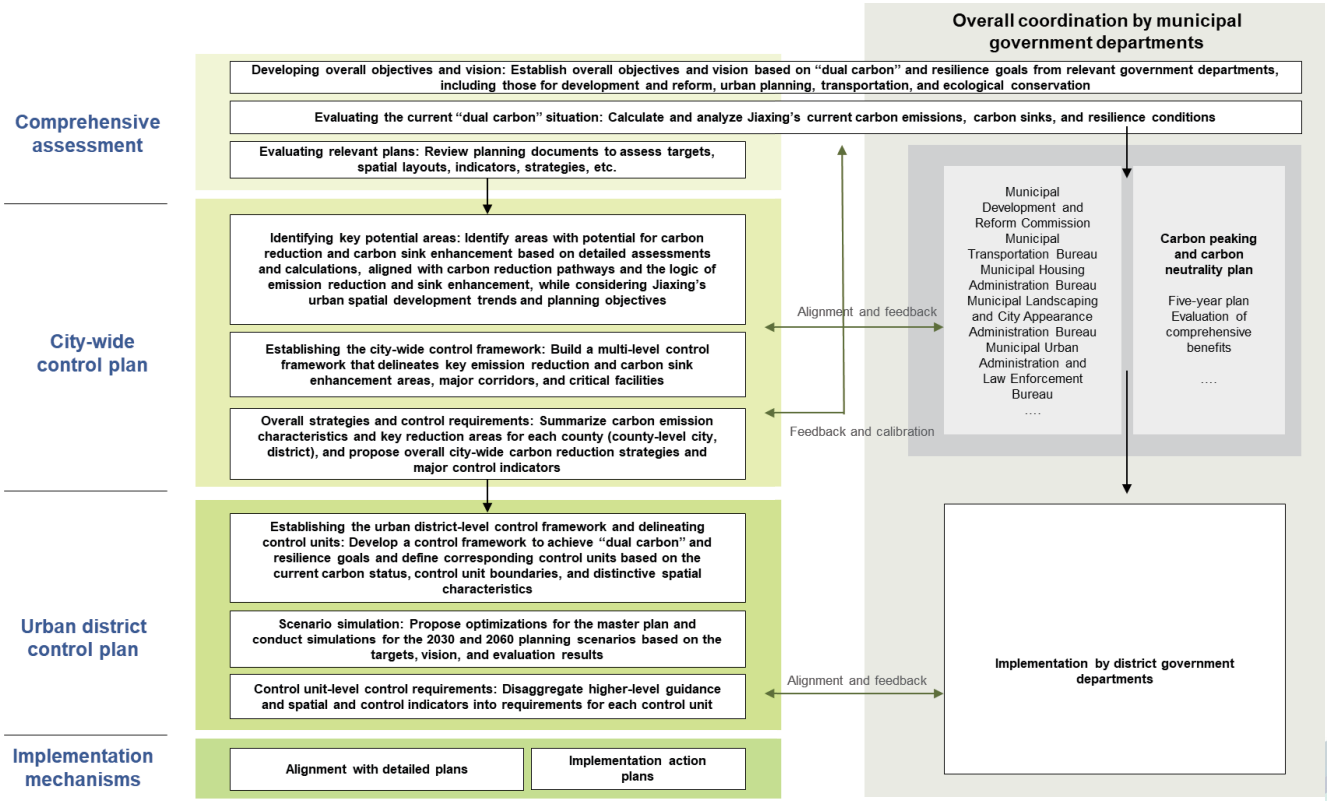

Figure 1-1: Technical roadmap
Source: SUPDRI

Developing the overall objectives and the vision to achieve the "dual carbon" goals. This involves analyzing national strategies and the requirements of the initiatives related to the Yangtze River Delta region and Jiaxing's master plan. The "dual carbon" goals from all sectors and departments in Jiaxing are compiled and benchmarked against both international and domestic best practices, as well as findings from preliminary pilot studies. These insights are then integrated to develop overall "dual carbon" goals aligned with the city's master plan vision.

Evaluating the current "dual carbon" situation. This involves analyzing current carbon emissions, carbon sinks, and their distribution patterns and classification characteristics to inform spatial zoning and classification under the "dual carbon" framework. It also includes evaluating Jiaxing's master plan and comparing it with the findings of the current-situation assessment to identify potential challenges in advancing low-carbon urban development. These insights will guide the key directions and strategic approaches for preparing the special plan.

Formulating an overall urban development strategy in the context of the "dual carbon" goals. Based on the above research and assessments, the plan develops overall guiding strategies, spatial strategies, and indicator frameworks. For key sectors, the plan proposes tailored low-carbon strategies and implementation pathways, with specific policy zones identified for applying spatial strategies, along with corresponding development guidelines and control requirements.

Establishing a planning control transmission system (including an indicator system). A control framework, comprising defined control units or zones, is developed based on the spatial layout outlined in the master plan. The framework also takes into account current distribution characteristics and aligns with the planning control units. The plan adopts a region-specific, categorized, and tiered approach to transmit upper-level control requirements. This includes clearly identifying key control elements, indicators, strategies, and expression methods tailored to different types of areas. For development control, control requirements are set for key stages such as preliminary land plot assessment, construction planning, design review, and project acceptance. The framework also provides recommendations for optimizing other special plans.

To ensure effective implementation, the plan establishes supporting mechanisms in alignment with core control indicators. These mechanisms include departmental performance evaluation and feedback, as well as assessment of implementation effectiveness.

(2) Multi-level control approach

The plan adopts a multi-level control approach in terms of content, scope, and level of detail. It is developed based on detailed calculations and assessments, aligned with carbon reduction pathways and disaster alleviation goals. It follows the logic of climate change response strategies while considering Jiaxing's urban spatial development trends and planning objectives. By identifying key potential areas, the plan establishes a multi-level control framework, supported by corresponding planning strategies and performance indicators. This framework is integrated with the broader local territorial spatial planning system, with clear pathways for implementation. A detailed overview of this approach is shown below:

		Data and basis	Calculation approach	Minimum scale	Control requirements
City-wide level	Counties (county-level cities, districts)	GHG inventories, statistical yearbooks, some data from relevant competent administrative departments	Calculation of carbon emissions by disaggregating indicators such as electricity and gas use, in accordance with GHG inventories	Counties (county-level cities, districts)	Control requirements and indicators for counties (county-level cities, districts)
	Key reduction areas	GHG inventories, statistical yearbooks, detailed data on some key reduction areas	Calculation of carbon emissions for key reduction areas, including transportation, buildings, and industry, based on activity levels and emission factors	Counties (districts), key regions	Structural control requirements and indicators for counties (districts) and key regions
Urban district level		Construction volumes, traffic volumes, industrial enterprise data, ecological land patches, stock volumes, etc.	Bottom-up approach across all sectors	Transportation analysis zones, land plots	Control requirements and indicators for delineated control units, transportation analysis zones, land plots, etc.

Figure 1-2: Multi-level control approach
Source: SUPDRI

At the city-wide level, the plan focuses on the following key tasks: estimating carbon emissions based on GHG inventories and energy consumption data (e.g., electricity use); analyzing current carbon emissions, structures, and trends across the districts, county-level cities, and counties of Jiaxing; identifying key areas for carbon reductions in each district, county-level city, and county; evaluating their carbon reduction strategies within local spatial planning frameworks; and proposing planning control requirements and indicators at the district level.

At the urban district level, the main tasks include: calculating and verifying carbon emissions based on activity levels and emission factors (e.g., construction volumes, traffic volumes); running scenario simulations aligned with national spatial plans; conducting detailed spatial analyses; and developing unit-level planning control requirements and indicators.

2. Low-Carbon City Development Characteristics of Jiaxing

2.1 Baseline overview of Jiaxing City

2.1.1 Geographical conditions

Jiaxing City, located in northeastern Zhejiang Province and at the heart of the Hangzhou–Jiaxing–Huzhou Plain in the Yangtze River Delta, is a key city in the Yangtze River Delta region. The city is bordered by the East China Sea to the east, the Qiantang River to the south, Taihu Lake to the north, and the waters of Tianmu Mountain to the west. The historic Beijing–Hangzhou Grand Canal runs right through the city. Positioned at the intersection of the river, the lake, the sea, and the canal, Jiaxing serves as a strategic gateway along the southern corridor of Taihu Lake. It is less than 100 kilometers from cities such as Shanghai, Hangzhou, Suzhou, and Huzhou, giving it a distinct locational advantage. Jiaxing is especially renowned for its location between the famed "paradise cities" of Suzhou and Hangzhou. The city spans 92 kilometers from east to west and 76 kilometers from north to south. It covers a land area of 3,915 square kilometers, along with an additional 4,650 square kilometers of sea area.

2.1.2 Shallow, dish-shaped depression

Jiaxing has a generally flat and low-lying topography, with the lowest areas located in Xiuzhou District and the northern parts of Jiashan. It is home to over 200 hills, mainly scattered along the northern shores of the Qiantang River and Hangzhou Bay. Most of these hills are under 200 meters in elevation, with the highest point being Gaoyang Mountain, situated on the border between Haiyan and Haining. Jiaxing's terrain is defined by a shallow, dish-shaped depression near the edge of Taihu Lake, which generally slopes from southeast to northwest. Over thousands of years of human cultivation and development, the plain has been carved by a network of intersecting canals and waterways, creating a patchwork of farmland, water bodies, and other land uses. This landscape is often described as "six parts farmland, one part water, and three parts other land", with a three-dimensional terrain that supports mulberry cultivation on dry land, rice farming in paddy fields, and aquaculture in lakes and ponds. The landscape, heavily shaped by human activity, gives the area its distinctive water town character.

2.1.3 Dense network of rivers and waterways

Jiaxing is located in the Taihu Lake basin, which is part of the water system in the Hangzhou-Jiaxing-Huzhou Plain. Overall, it belongs to the Grand Canal water system, with only the southern part of Haining along the northern bank of the Qiantang River belonging to the Shangtang River system. Home to a vast number of rivers, lakes, and waterways, Jiaxing has a dense network. The total area of rivers and lakes within the city is 357.78 square kilometers (excluding the Qiantang River), with a total river length of 14,717 kilometers. This results in a water surface rate of 8.85%, making Jiaxing one of the regions with the highest water surface rate within the Taihu Lake basin. Key waterways include the Beijing–Hangzhou Grand Canal, Lanxi Lake, Taipu River, Hongqi Lake, Changshan River, Haiyan Lake, Yanguanxia River, Dushan'gan River, Pinghu Lake, Yanping Lake, and Shanghai Lake.

2.1.4 Climate and weather

Jiaxing is situated along the coast in a subtropical monsoon zone, resulting in a mild, humid climate with plenty of sunshine, rainfall, and distinct seasons. The city's average annual temperature is 15.9°C, with a record low of -12.4°C and a record high of 40.5°C. January sees the lowest average temperature at 3.6°C, while July experiences the highest average at 28.1°C. The city receives an average of 137–147 days of precipitation each year. Rainfall is distributed bimodally, with about 70–80% of it falling during two peak periods: June–July (the plum rain season) and August–October (the typhoon season). The highest evaporation rate occurs in July–August, while the lowest is observed during the winter months, influenced by factors such as temperature, wind speed, and humidity.

2.2 Review of relevant plans and policies

2.2.1 Upper-level plans

(1) Territorial Spatial Master Plan of Jiaxing City (2021–2035)

Spatial strategy: "Ecology First: Creating the Most Beautiful Region South of the Yangtze River". This strategy focuses on promoting comprehensive ecological restoration and strengthening land use regulations, with an emphasis on green and low-carbon principles.

Protecting ecological space to a high standard:

1) The mechanism for realizing the market value of ecosystem goods. The plan outlines the need to improve the evaluation mechanisms and accounting standards for the total market value of ecosystem goods in administrative regions and the specific market value of ecosystem goods in geographic units. By innovating property rights and promoting the flow of resources, the plan aims to strengthen market transaction systems for property rights such as forest rights, water rights, energy use rights, carbon emissions rights, and pollution discharge rights, thereby establishing a mechanism for the management and development of ecosystem goods.

2) The mechanism for achieving "dual carbon" goals. The plan specifies that key areas, such as natural parks like wetland parks and regions with dense public welfare and commercial forests, will be leveraged to create carbon sinks in the form of wetlands and forests throughout the city. It also aims to promote the large-scale use of clean energy sources, including solar, wind, and hydrogen power, while making the entire manufacturing industry both intelligent and eco-friendly.

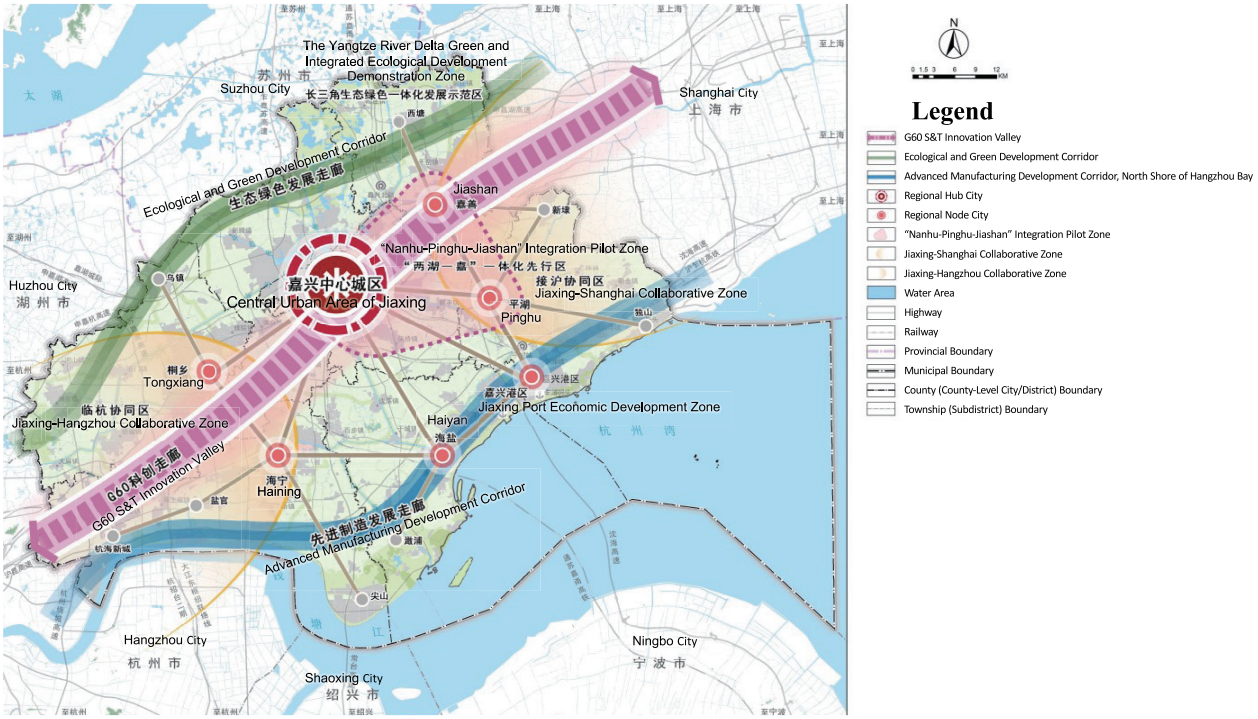

Figure 2-1: Overall territorial spatial layout of Jiaxing
Source: Territorial Spatial Master Plan of Jiaxing City (2021–2035)

Advancing sponge city development to enhance urban ecological benefits:

1) Strengthening the ecological security network. The plan envisions a distinctive ecological space shaped by the city's water-town character, focusing on enhanced governance of river ecological corridors. It also emphasizes improving water system connectivity to eliminate stagnant zones and advance sponge city development.

2) Implementing ecological restoration. According to the plan, the city is divided into 7 ecological restoration zones. The urban ecological restoration zone focuses on redeveloping inefficient urban land, promoting organic urban renewal, and advancing sponge city development alongside low-carbon, zero-waste urban growth. These efforts aim to continually improve land use efficiency and the overall quality of the urban environment.

3) Urban infrastructure planning:

In terms of the drainage system, the plan calls for the establishment of a secure and efficient network. It aims to achieve full coverage for sewage interception through a pipeline system and treatment facilities. To support Jiaxing's development as a sponge city, efforts will focus on improving the efficiency of the sewage collection network, enhancing the effectiveness of all treatment plants, and strengthening flood prevention and drainage systems.

Regarding major water conservancy infrastructure, the plan highlights the advancement of the Seawall Security Project, which includes coordinated efforts to upgrade seawall safety standards, enhance ecological conditions, and promote more integrated development. Additionally, the plan involves implementing the Plain High-Speed Waterway Project to boost the southward drainage capacity for the Hangzhou-Jiaxing-Huzhou region.

For flood and drainage prevention, the plan specifies better integration of the city's internal water system to optimize the overall flood prevention and drainage network. This includes directing water eastward into the Huangpu River, southward into Hangzhou Bay, and northward into the Taipu River, while fully utilizing the river network for water storage and regulation.

In the central urban area, the plan outlines efforts to enhance the city's ecological security as part of Jiaxing's sponge city development. This involves optimizing infrastructure in key urban areas such as High-Speed Rail New Town, Canal Bay New Town, and Airport Area.

(2) Special Plan for the Sponge City Development in Jiaxing's Urban Areas

The plan is organized into two levels: the urban districts and the central urban area of Jiaxing. At the urban district level, the focus is on establishing an ecological framework, while at the central urban area level, the plan primarily defines control indicators and proposes technical solutions. The central urban area is the primary focus of the plan.

The plan adopts a multi-dimensional approach that addresses the ecology, environment, resources, and security of water. It outlines tailored sponge city development strategies for both the urban districts and the central urban area, creating a systematic framework to advance the city's sponge city initiative.

The plan outlines the spatial framework for the sponge city development in the urban districts, which features "one central urban area, five key zones, eight ecological corridors, and three lakes". Development in the outer areas of the central urban area will prioritize enhancing the water environment through low-impact development, improving water security through river dredging and clearing, improving water ecology through the ecological development and restoration of shorelines, and strengthening water resource protection by increasing rainwater reuse. Seven major sponge elements are planned across 5 key zones, such as the Northern Area, including sponge town development zones, shallow lake and wetland protection zones, and shallow lake landscape zones for storage and regulation.

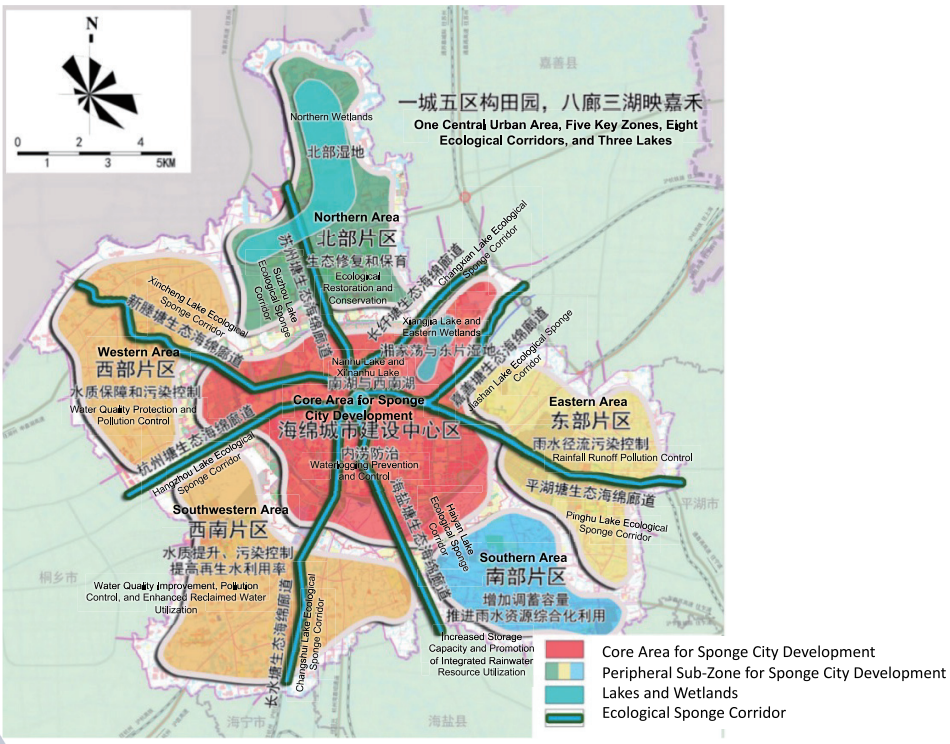

Figure 2-2: Spatial framework for the sponge city development in the urban districts
Source: Special Plan for the Sponge City Development in Jiaxing's Urban Areas

The plan outlines the spatial framework for the sponge city development in the central urban area, which includes "a network of two rings and six ecological corridors, a green city with five lakes and ten parks, and a sponge system consisting of three wedges and ten zones". The goal is to establish a city-level public sponge area in the central urban area, primarily composed of flood prevention and drainage channels, large wetlands and lakes, large municipal parks and green spaces, and suburban parks. This sponge area spans 5,443.06 hectares, comprising 1,462.94 hectares of water-based sponge and 3,980.12 hectares of green-space sponge, which make up 21.18% of the total central urban area.

The plan divides the central urban area into several control units, managed through a "one map, one table" approach. The map illustrates sponge city measures tailored to the characteristics of each land type, while the table provides a breakdown of indicators, including the core metric of annual runoff control rates, for each control unit to guide future control efforts.

(3) Urban Flood Prevention Plan of Jiaxing City (2021–2035)

Overall objectives: In line with the goal of "accelerating the development of Jiaxing as a key hub within the Yangtze River Delta urban cluster", and based on the framework outlined in the Territorial Spatial Master Plan of Jiaxing City (2021–2035) and the requirements of the Flood Prevention Standards, the plan aims to establish a flood prevention and drainage system that is tailored to Jiaxing's economic, social, water ecological, environmental, and urban development characteristics, and to enhance the city's flood prevention and drainage capacity in all aspects. According to the plan, the flood defense perimeter in the central urban area, High-Speed Rail New Town, and Airport Area will meet the 200-year flood protection standard and the 30-year drainage standard. Other areas will meet the 100-year flood protection standard and the 20-year drainage standard.

Short-term goals: By the end of 2027, the plan aims to build on existing flood prevention and drainage systems to strengthen flood prevention and drainage capacity in the central urban area. This will address key vulnerabilities in flood defense and improve overall standards by incorporating projects such as expanding the eastward section of the channel for the southward drainage of the Hangzhou-Jiaxing-Huzhou region. Construction will also begin on planned projects, including the flood defense perimeter in the central urban area, as well as projects in the Linhu Lake Area and the High-Speed Rail New Town in the Economic and Technological Development Zone.

Long-term goals: By 2035, Jiaxing aims to significantly enhance its overall flood prevention capacity through the development of a core flood control system and improved ability to divert floodwater to external waterways. The flood defense perimeter in the central urban area, High-Speed Rail New Town, and Airport Area will meet the 200-year flood protection standard and the 30-year drainage standard. Other areas will meet the 100-year flood protection standard and the 20-year drainage standard.

Future vision: By 2050, Jiaxing will have a fully developed flood prevention and drainage system that ensures flood safety, maintains high water quality, fosters a people-friendly and livable environment, and incorporates intelligent management. The entire city will meet or exceed the 200-year flood protection standard and the 30-year drainage standard.

(4) Water System Reconstruction Plan of Jiaxing City (2021–2035)

Based on a detailed analysis of reconstruction pathways, Jiaxing will, during the 14th Five-Year Plan period (2021–2025) and beyond, coordinate efforts in flood prevention and drainage, water resource optimization, water ecological and environmental improvement, digital transformation of water resource management, and the development of navigation, culture, tourism, and public recreation. In alignment with Jiaxing's actual circumstances, a comprehensive city-wide water system reconstruction will be implemented. This involves creating the "Jiaxing Water Network", made up of 4 interconnected sub-networks: a flood control and navigation network, a water resource allocation network, a clean water ecology network, and a digital water resource management network. The plan also emphasizes addressing flood prevention and drainage issues as well as improving the clean water ecology, with particular focus on strengthening the flood control and navigation network, and the clean water ecology network.

Through the reconstruction of river and lake systems, the social and ecological functions of these waterways will be enhanced, further highlighting the unique characteristics of the water towns south of the Yangtze River. The aim is to create a "new water town" that is resilient to both floods and droughts, featuring clear waters, green shores, beautiful landscapes, and a livable environment that benefits the people.

2.2.2 Relevant guiding documents

(1) Guidelines of Zhejiang Province for Preparing Greenhouse Gas Inventories (Trial)

This document provides guidance to relevant government departments across Zhejiang Province on how to prepare GHG inventories. It plays a crucial role in understanding the province's GHG emissions, formulating corresponding reduction strategies, and advancing the development of a low-carbon economy. The main content includes inventories of emission sources, GHG emissions and absorptions, as well as changes in both emission and absorption levels.

(2) Implementation Guidelines of the Zhejiang Provincial Committee of the Communist Party of China and the Zhejiang Provincial People's Government for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy (December 2021)

By 2025, Zhejiang will have established an initial framework for a green, low-carbon, and circular economy. Energy efficiency will see significant improvements in key regions and industries, with some sectors expected to peak in emissions ahead of schedule. A digital platform for dual-carbon management will have been completed and brought into operation. The province will have met the targets set by the central government for the reduction in energy consumption and carbon emissions per unit of GDP. Non-fossil energy will account for approximately 24% of total energy consumption, and forest coverage will reach 61.5%. These achievements will lay a solid foundation for Zhejiang's progress toward carbon peaking.

By 2030, the province will have made significant progress in the comprehensive green transformation of its economic and social development. Energy efficiency in key energy-consuming industries will reach advanced international levels, and a system for controlling total CO_2 emissions will be essentially in place. Energy consumption per unit of GDP will decrease significantly, and carbon emissions per unit of GDP will be reduced by more than 65% compared to 2005 levels. The share of non-fossil energy in total consumption will reach about 30%. Positive progress will also be made in the innovation and development of zero-carbon and carbon-negative technologies and industries. CO_2 emissions will peak, stabilize, and then begin to decline.

By 2060, Zhejiang will have fully established a green, low-carbon, and circular economy, a clean, low-carbon, safe, and efficient energy system, and a long-term mechanism for carbon neutrality. Energy efficiency will be at the advanced international level, and zero-carbon and carbon-negative technologies will be widely adopted. Non-fossil energy will account for over 80% of total energy consumption, and emissions of non-CO_2 GHGs, such as methane, will be effectively controlled. The province will successfully achieve its carbon neutrality goal, marking a new level of harmony between humanity and nature.

(3) Notice by the Zhejiang Provincial People's Government of Issuing the Comprehensive Work Plan for Energy Conservation and Emission Reduction for the "14th Five-Year Plan" Period (Zhejiang Provincial People's Government [2022] No. 21)

The main objective of this document is to establish a stronger policy mechanism for energy conservation and emissions reduction. By 2025, Zhejiang aims to reduce its energy consumption per unit of GDP by 14.5% compared to 2020 levels, while keeping total energy consumption within a reasonable range. Coal consumption is expected to decline by about 5% from 2020 levels.

For Jiaxing, the baseline target for reducing energy consumption intensity is 16%, with an incentive target set at 17%.

(4) The "14th Five-Year Plan" of Jiaxing City for Responding to Climate Change

By 2025, Jiaxing will significantly strengthen its capacity to respond to climate change, with major progress in GHG emissions control, climate adaptation, institutional and mechanism innovation, and technological advancement. The city will further increase the share of non-fossil energy in its energy mix, reduce carbon emissions per unit of energy consumed, and meet the targets set by the provincial government for energy consumption intensity and carbon intensity. It will also enhance carbon sink capacity and establish a preliminary low-carbon industrial and energy system, with a clear pathway toward green and low-carbon development.

Key tasks include: accelerating the green transformation of the industrial structure; promoting low-carbon energy use; strengthening energy conservation and emissions reduction in buildings; developing a low-carbon transportation system; advancing low-carbon, circular agriculture; enhancing support for low-carbon technological innovation; encouraging green and low-carbon lifestyles; increasing the carbon sink capacity of ecosystems; implementing climate adaptation actions; and improving climate change governance.

(5) Implementation Guidelines for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy (2023)

By 2025, Jiaxing will have established an initial framework for a green, low-carbon, and circular economy. Energy efficiency will improve significantly in key regions and industries, with some sectors expected to reach peak emissions. A series of distinctive application scenarios will be developed, gradually strengthening the city's foundation for achieving peak carbon emissions.

By 2030, the province will have made significant progress in the comprehensive green transformation of its economic and social development. Energy efficiency in key energy-consuming industries will reach advanced international levels, and a system for controlling total CO_2 emissions will be essentially in place. Energy consumption per unit of GDP will decrease significantly, and carbon emissions per unit of GDP will be reduced by more than 65% compared to 2005 levels. CO_2 emissions will peak, stabilize, and then begin to decline.

By 2060, Jiaxing will have fully established a green, low-carbon, and circular economy, a clean, low-carbon, safe, and efficient energy system, and a long-term mechanism for carbon neutrality. The city will successfully achieve its carbon neutrality goal.

2.3 Analysis of Jiaxing's current low-carbon profile

2.3.1 Characteristics of current carbon emission and carbon sink activities

(1) General approach

Based on the GHG inventory, carbon emissions and carbon sink activities are reorganized by spatial location. This enables the identification of key areas for planning, with emissions and sinks quantified for each specific area. This accounting covers 5 main categories: buildings, transportation, industry, ecology and agriculture, and waste management. 1) Carbon emissions from buildings refer to those resulting from energy consumption of buildings located on all types of construction land, excluding land designated for transportation, industry, and public utilities (except for land used for district heating). 2) Carbon emissions from transportation primarily account for emissions generated by vehicle operations. 3) Carbon emissions from industry include emissions resulting from both energy consumption and chemical or physical processes during industrial production. It covers emissions occurring on land used for mining and for public utilities such as electricity and heat production. 4) In the ecology and agriculture category, the focus is on carbon emissions and carbon sinks from different types of ecological land, including carbon sinks from forests and emissions from farmland and agricultural facility land. 5) Carbon emissions from waste management arise from landfill sites, incineration facilities, and household and industrial wastewater treatment facilities.

(2) Overall characteristics

The majority of carbon emissions in Jiaxing come from four key sectors: industry, buildings, transportation, and waste management. Industry accounts for approximately 73% of total emissions, followed by buildings at around 13%, transportation at 12%, and waste management at 2%.

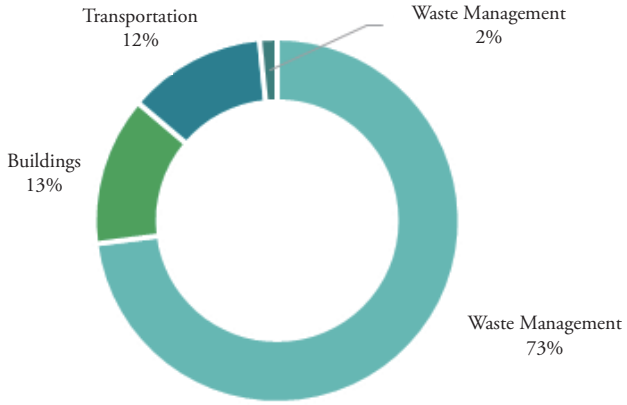

Figure 2-3: Composition of the carbon emissions of Jiaxing
Source: SUPDRI, based on collected materials

Trend analysis: The proportional contribution of each sector has remained relatively stable over time. However, the share from industry has gradually declined, the building sector has seen a steady increase, and transportation emissions have exhibited fluctuating trends. From 2013 to 2015, Jiaxing decommissioned small boilers (under 30 tons) and adjusted its energy mix, which led to reduced fossil fuel combustion and a decline in carbon emissions. Between 2016 and 2019, rising energy consumption in energy processing and conversion, along with a significant increase in oil product consumption, drove carbon emissions upwards. In 2020, reduced energy consumption due to the COVID-19 pandemic resulted in a substantial decrease in carbon emissions.

Spatial distribution: The districts, county-level cities, and counties of Jiaxing are categorized into three levels in terms of total carbon emissions. The highest level includes Tongxiang, Pinghu, and Haining; the intermediate level consists of Nanhu, Xiuzhou, and Haiyan; while Jiashan falls into the lowest level. In terms of carbon emission intensity, they are also divided into three levels: Tongxiang and Pinghu exhibit the highest intensity; Haiyan, Haining, and

Xiuzhou have the second-highest intensity; and Nanhu and Jiashan show the lowest intensity. Areas such as Pinghu, Tongxiang, and Haiyan exhibit both high total emissions and high emission intensity, indicating significant potential for further carbon reduction efforts.

(3) Characteristics of major sectors

Industry: The green transformation has been effective in the central urban area; however, surrounding traditional manufacturing sectors continue to exhibit high carbon emission intensity. The spatial distribution shows a pattern of lower emissions in the northern areas and higher emissions in the south, with high-intensity emission zones scattered relatively evenly across all the districts, county-level cities, and counties Notably, Jiaxing Port Economic Development Zone and Tongxiang are home to regions with extremely high carbon emission intensity. This is closely connected with Jiaxing's industrial structure and distribution characteristics. First, the city has a relatively low level of industrial development. Its dominant sectors are primarily labor-intensive, resource-heavy, and process-based traditional manufacturing, leading to high carbon emission intensity. Second, there is a lack of support and integration along the industrial chain. Businesses across the districts, county-level cities, and counties are geographically clustered within administrative boundaries, but there is limited connection between industries, as well as between upstream and downstream enterprises.

Figure 2-4: Distribution of the industrial land and dominant sectors of Jiaxing
Source: SUPDRI

Buildings: Total emissions continue to rise, with particularly rapid and extensive growth observed in the outer districts and counties. High carbon emission intensity is primarily concentrated in the core areas of urban clusters. Haining, Tongxiang, and Nanhu exhibit the highest levels of emissions, while Haiyan has the lowest.

Transportation: Short-distance travel and passenger transport by private cars account for a large proportion of carbon emissions, with a heavy reliance on fossil fuels. Travel patterns are dominated by short-distance trips and private car use for passenger transport, with strong connectivity between the districts, county-level cities, and counties in Jiaxing. Haining exhibits the highest total carbon emissions from transportation among all the districts, county-level cities, and counties in Jiaxing. Tongxiang, Jiashan, Nanhu, and Pinghu also exceed the city-wide average. Notably, Nanhu, Jiashan, and Haining demonstrate particularly high carbon emission intensity in the transportation sector.

Ecology and agriculture: Carbon sinks are more concentrated in the west and less so in the east, with forests being the primary contributors. Spatially, the distribution of carbon sinks follows a west-to-east decline. The areas with the highest carbon sink capacity are Haining, Tongxiang, and Xiuzhou. An analysis of land patches within current land use shows that areas with a higher proportion of forested land tend to have greater carbon sink capacity.

3. Vision for High-Quality Green Development

3.1 Overall objectives and vision

Jiaxing is a central city at the core of the Yangtze River Delta region. It is a national historical and cultural city, as well as an important hub for scientific and technological innovation and advanced manufacturing within the region. According to the master plan of Jiaxing, the city aims to establish a sustainable development model characterized by resource-efficient production spaces, livable and appropriately sized residential areas, and green, beautiful ecological zones. It also aims to modernize territorial spatial governance systems and capabilities, achieve socialist modernization goals to a high standard, and ultimately establish itself as a model city for common prosperity. Building on an evaluation of the current situation and integrating the planning goals of various relevant sectors, this plan outlines the following objectives and vision:

Transforming ecological advantages into economic and social strengths; highlighting the high-quality ecological features of the water towns south of the Yangtze River; promoting a green, low-carbon transformation of the economy and society; and becoming a demonstration area for high-quality, low-carbon development on the northern shore of Hangzhou Bay, and a model city for low-carbon development within the Yangtze River Delta urban cluster.

3.2 Overall strategy

To integrate the goals of addressing climate change into the territorial spatial planning system of Jiaxing, the plan outlines an overall strategy covering five key aspects:

Optimizing the energy mix and infrastructure support: Efforts will focus on transforming the energy system to make it more future-oriented, and balancing renewable energy sources with energy supply security.

Promoting green, low-carbon building technologies tailored to local conditions: To achieve carbon neutrality, the plan regulates the human-land relationship, optimizes land use in terms of function, scale, structure, and layout, and advances the green transformation of spaces during urban renewal, including the application of green building technologies.

Enhancing the optimization, agglomeration, and coordination of the city's industrial structure: The focus is on strengthening and optimizing industrial chains. Territorial spatial planning will be leveraged to promote the growth of strategic emerging industries and facilitate industrial transformation and upgrading. Efforts will also be made to strengthen the transformation of industrial land, compelling industry players to innovate technologically and adjust their industrial structures.

Advancing green upgrades to the transportation system: The focus is on improving the quality and coverage of public transportation services to encourage citizens to choose low-carbon travel options by strengthening research to optimize the layout of transportation networks. Studies will also be conducted on the spatial layout of multimodal transport to increase the share of rail-waterway intermodal transport.

Providing better habitats and enhancing ecological carbon sinks: Efforts will be made to improve the carbon sequestration capacity of ecological spaces by expanding forests and green spaces, and increasing the use of high-efficiency carbon-sequestering vegetation (such as trees and shrubs) and native plants. Comprehensive natural resource management will be implemented to enhance the carbon sink capacity and promote agricultural emission reductions.

3.3 Guidelines for Jiaxing's counties (county-level cities, districts)

Based on the city-wide spatial control framework, the plan summarizes carbon emission characteristics and key reduction areas for each county (county-level city, district), and then proposes preliminary carbon reduction strategies and major control indicators tailored for each county (county-level city, district).

Table 3-1: Control recommendations for each county (county-level city, district)
Source: SUPDRI

District/ county	Area (km2)	Current carbon emissions Main characteristic	Key carbon reduction areas	Major carbon reduction strategies	Recommended major control indicators
Xiuzhou	547.8	High share of industrial carbon emissions	Industry, energy	Transform industrial enterprises Optimize energy mix	Reduction rate of energy consumption per unit of GDP Share of non-fossil energy in total consumption Reduction rate of carbon emissions per unit of GDP
Nanhu	439.1	Concentrated heat-related carbon emissions	Buildings, transportation	Increase the number of green and low-carbon buildings Adjust energy mix	Reduction rate of carbon emissions per unit of GDP Share of green and zero-energy-consumption buildings Share of public transport of total travel modes Share of clean energy vehicles
Tongxiang	727.5	Major industrial sectors being high-energy-consuming and high-emission industries ("two-high" industries)	Industry, energy	Adjust industrial structure Reduce the number of enterprises in "two-high" industries	Reduction rate of carbon emissions per unit of GDP Reduction rate of energy consumption per unit of GDP Share of non-fossil energy in total consumption Share of low-carbon, high-efficiency industries
Haining	862.8	The highest carbon reduction by renewable energy use in Jiaxing	Industry, transportation	Adjust industrial structure Optimize energy mix	Reduction rate of carbon emissions per unit of GDP Share of public transport of total travel modes Share of green passenger/freight transport Share of clean energy vehicles
Haiyan	595.7	Carbon emissions mainly from the tertiary sector and residential activities	Buildings	Make use of the advantages of nuclear power Adjust industrial structure	Reduction rate of carbon emissions per unit of GDP Household waste recycling rate Comprehensive utilization rate of construction waste
Pinghu	557.5	Increase of the share of "two-high" industries	Industry, transportation	Adjust industrial structure Reduce the number of enterprises in "two-high" industries	Reduction rate of carbon emissions per unit of GDP Share of low-carbon, high-efficiency industries Share of public transport of total travel modes Share of green passenger/freight transport
Jiashan	507.0	Carbon emissions dispersed across multiple sectors	Buildings, energy	Leverage the "dual demonstration" initiatives to develop new-energy, low-carbon, and high-efficiency industries	Reduction rate of energy consumption per unit of GDP Share of non-fossil energy in total consumption Share of green and zero-energy-consumption buildings

Furthermore, at the city-wide level, detailed planning strategies are outlined for various sectors.

4. Continuously Optimizing the Energy Mix and Infrastructure Support

4.1 Baseline assessment

Currently, Jiaxing's energy supply is heavily dependent on externally supplied fossil fuels, resulting in low self-sufficiency. GHG emissions from energy activities include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), with CO_2 accounting for approximately 95%. In terms of carbon emissions from energy activities across different sectors, the energy industry contributes 63.7%, with electricity production being the primary source of emissions within the sector.

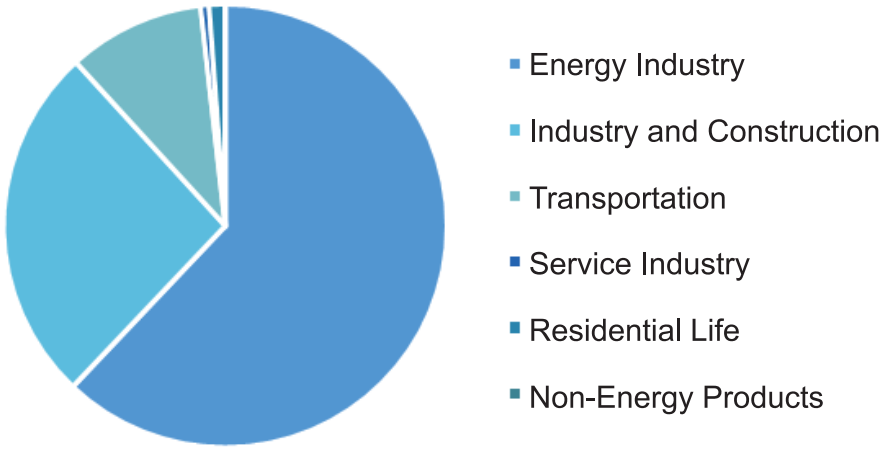

Figure 4-1: Share of carbon emissions from energy activities by sector (2022)
Source: SUPDRI

Furthermore, from a spatial utilization perspective, the marine space of Jiaxing is currently highly developed, with offshore wind farms approaching saturation due to limited spatial resources. Future growth will, therefore, rely on breakthroughs in deep-sea wind power development. As a result, non-fossil fuel energy is expected to be dominated by distributed PV generation.

In summary, Jiaxing's current energy mix—particularly in electricity production—is relatively low-carbon, with non-fossil fuel sources primarily consisting of PV energy. The main source of carbon emissions is CO_2 generated by fossil fuel power plants.

Therefore, from a territorial spatial planning perspective, the core strategies for the energy sector are: first, continuously optimizing the energy mix to further reduce carbon emissions from energy production; and second, promoting the optimization and enhancement of energy infrastructure to ensure adequate spatial capacity for facilities.

4.2 Continuously optimizing the energy mix

First, increasing the share of non-fossil fuel power generation. Jiaxing's advantages in the development of the PV sector should be fully leveraged, with a focus on promoting distributed PV systems.

Wind power development in the near term will primarily focus on distributed wind power and upgrading existing wind farms to improve generation efficiency. In the longer term, achieving progress and breakthroughs in deep-sea wind power development will be crucial.

Second, promoting the low-carbon transformation of fossil fuel generation. To ensure a secure energy supply, fossil fuel power generation will remain an important source of power. Therefore, it is of vital importance to drive the low-carbon transformation of fossil fuel generation. Specific strategies include increasing the share of high-efficiency natural gas power generation and promoting the

low-carbon transformation of coal-fired power plants. This can be achieved through process improvements and the increased application of carbon capture, utilization, and storage (CCUS) technologies in power plants, among other measures.

4.3 Promoting the optimization and improvement of energy infrastructure

Spatially, Jiaxing currently hosts 3 major centralized power generation bases, including the Jiaxing Power Plant and offshore wind farms, with their locations already established. The primary focus now is on securing land for key energy corridors.

At the city-wide level, this mainly involves securing land for essential electricity and natural gas corridors. Given the increasing share of non-fossil fuels, particularly the expansion of distributed PV systems, it is both crucial and urgent to develop a new power system that can accommodate a high proportion of distributed energy. Therefore, at the system or regional level, it is essential to advance a new integrated source-network-load-storage power system. This includes optimizing the layout of energy storage facilities, promoting the construction of integrated energy stations tailored to local conditions, and expanding the application of smart grids.

5. Promoting Sustainable and Efficient Industrial Development

5.1 Baseline assessment

The industrial and construction sectors are the primary contributors to Jiaxing's CO_2 emissions, with key industries including chemicals, textiles, chemical fibers, non-metallic materials, and paper manufacturing.

From 2010 to 2022, GHG emissions from Jiaxing's industrial processes generally followed a pattern of increase, decrease, and eventual stabilization. Between 2010 and 2016, emissions peaked in 2014, followed by a significant drop in 2015 and 2016. This reduction was largely due to cost factors and Jiaxing's policy of closing down small and scattered enterprises. Local companies reduced their self-produced cement clinker output and mainly relied on external suppliers. The closure of the Zhejiang Qijia Cement Plant in 2015 also contributed to a significant decline in cement production emissions. From 2016 to 2020, carbon emissions from industrial processes remained relatively stable, with a slight upward trend, and saw a small increase from 2021 to 2022. This increase was primarily driven by a rise in plate glass production within the city in 2022, which led to higher emissions from that sector.

The industrial spatial layout of Jiaxing is relatively dispersed, with dominant industries showing some degree of homogenization compared to neighboring cities and counties. In terms of average tax per mu (1 mu = 0.067 hectares), Jiaxing ranks relatively low, reflecting the underutilization of land resources.

Regarding the distribution of industrial carbon emission intensity, chemical industries and related sub-industries are the leading contributors in the two coastal county-level cities and one coastal county. This distribution aligns with the Advanced Manufacturing Development Corridor. In the urban districts, the leading contributors to carbon emissions are more diverse and have higher added value. These industries include electronics, agricultural and sideline product processing, and general equipment manufacturing. This distribution aligns with the characteristics of the G60 S&T Innovation Valley. In recent years, Jiashan County has phased out several high-energy-consuming and high-emission industries, while also fostering emerging strategic industries. As a result, the county's industrial carbon emissions are comparatively low.

In the Economic and Technological Development Zone, the share of carbon emissions from industries above the designated size is lower than that of society-wide electricity consumption, suggesting that the zone is in a later stage of industrialization or post-industrialization. High-tech enterprises are less developed, and the green, low-carbon transformation of sectors like transportation and construction will be key pathways for future carbon reduction. In the central urban area, industrial carbon emissions account for less than 60% of the carbon emissions from society-wide electricity consumption, indicating a relatively smaller industrial scale and effective green, low-carbon transformation. In contrast, the peripheral areas show slower progress in green transformation and urgently need industrial upgrades.

5.2 Advancing industrial cluster coordination and green industrial transformation

Efforts will be made to reinforce the strategy of "phasing out poorly managed, polluting small enterprises, addressing issues of spatial fragmentation, promoting clustering development, and upgrading industries". This includes the development of a series of green industrial parks. These parks will undergo comprehensive, circular economy–oriented transformations, becoming hubs for clustered enterprises, eco-friendly industries, and platform-based services. Furthermore, efforts will be made to optimize spatial planning, enhance infrastructure, restructure industries, improve ecological and environmental protection, and foster operational management innovation within the parks. This approach aims to achieve circular production for enterprises, create synergistic industry clusters, maximize resource efficiency, and ensure the harmless treatment of "three wastes" (waste water, waste gas, and waste solid materials).

Mechanisms related to differentiated urban land use taxes, land use, energy use, sewage management, and finance will be further refined to compel low-efficiency, high-energy-consuming enterprises to either upgrade or exit the market.

Based on current industrial models, traditional industries will undergo iteration and upgrades to expand the layout of strategic emerging industries and high-end manufacturing. Efforts will be made to achieve deeper integration and clustered transformation of industries. For the industrial sectors in the urban districts of Xiuzhou and Nanhu, the transformation will be strengthened with a focus on enhancing the marginal productivity of labor.

5.3 Shifting from an extensive to an intensive economic development model

Industrial land control will be strengthened through the use of control lines. This involves optimizing the resource-efficient use of industrial land, ensuring that the quantity remains consistent while improving its quality. By 2035, the concentration of industrial land within the parks should stay within the defined boundaries of the industrial land control line, while the proportion of non-industrial land within these areas will be tightly regulated. Efforts will also be made to strictly manage industrial projects located outside the control line, phasing out low-efficiency, scattered, and disorganized industrial land, and guiding industrial projects toward clustering within designated industrial parks.

Additionally, steps will be taken to accelerate the elimination of outdated processes characterized by high energy consumption, high carbon emissions, and low production capacity. This includes encouraging enterprises to calculate the carbon footprint of each production process, develop targeted low-carbon production routes, and actively promote the research, development, and application of green materials across the entire product lifecycle.

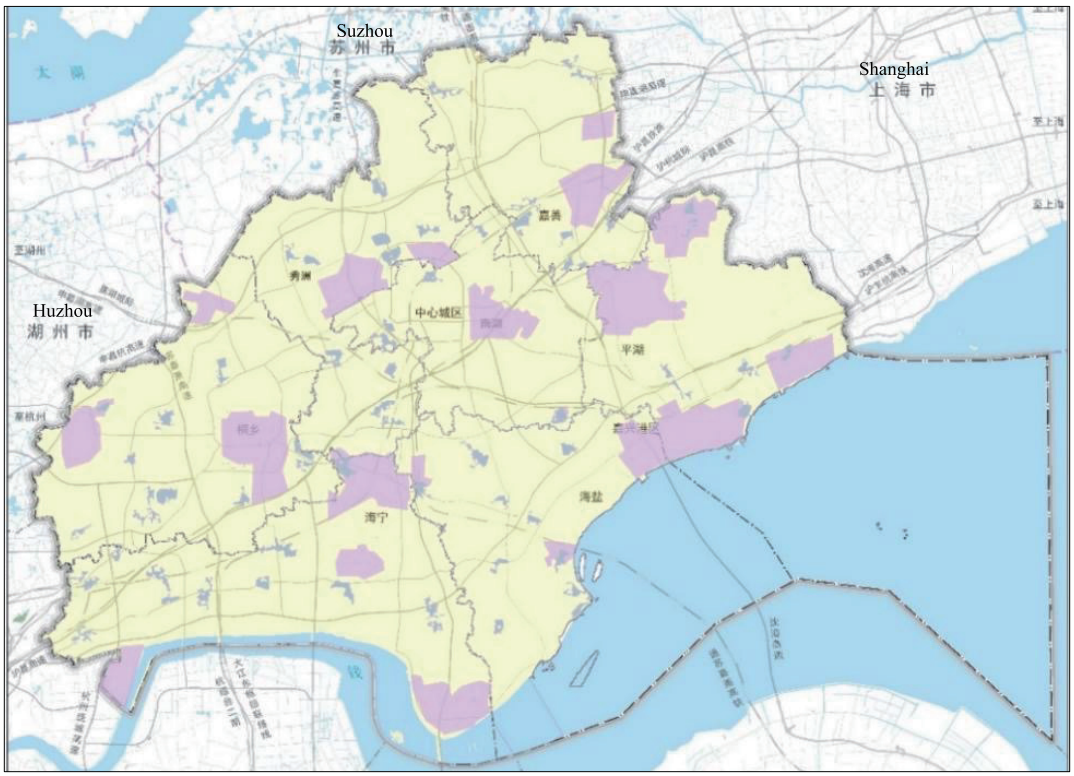

Figure 5-1: Industrial carbon reduction zones across Jiaxing
Source: SUPDRI

6. Advancing Green Upgrades to the Transportation System

6.1 Baseline assessment

Gasoline and diesel are the primary energy sources consumed by Jiaxing's transportation sector, with vehicle fuel consumption in road transport being the largest contributor. The transportation industry is the second-largest emitter of fossil fuel combustion emissions in the city, after the industrial sector.

Transportation emissions have fluctuated, showing cycles of increase and decrease. As the living standards of residents improved and the logistics industry rapidly developed, gasoline and diesel consumption saw a significant rise, followed by a period of stability after 2019.

6.2 Strengthening city-wide multimodal public transportation systems

Passenger transport is the largest contributor to carbon emissions within the transportation sector, offering substantial potential for reduction. High carbon emission intensity is concentrated in the central urban area and key activity areas across Jiaxing's districts and counties, which corresponds to the widespread use of private motor vehicles. City-wide efforts should focus on strengthening public transportation infrastructure construction and increasing the share of green travel.

Given Jiaxing's locational advantage and urban expansion, the city aims to become the first in the province to integrate three public transportation networks: urban, urban-rural, and intercity. A coordinated public transportation system will also be established, featuring multi-layered rail transit and modern tramways as the backbone, conventional buses as the foundation, and taxis, water buses, and public bicycles as supplementary options. This integrated system will meet the travel needs of Jiaxing, its neighboring cities, the city's clusters, and the various spatial levels within those clusters.

6.3 Developing multimodal transport to increase the share of rail-waterway intermodal transport

Efforts will focus on improving the quality and efficiency of rail-waterway intermodal transport, with the goal of shifting more bulk goods from road transport to rail-waterway options. Leveraging Jiaxing's extensive ship lanes, a multimodal transport hub will be developed, centered around Jiaxing Port. The aim is to increase the share of ship-to-ship container transfers and boost the volume of rail-sea intermodal transport.

Additionally, significant improvements will be made to the city's sea-river intermodal transport infrastructure, including the preliminary establishment of the "one hub, eight cargo distribution and transport channels, and ten logistics channels" framework. However, the relatively low navigability of some inland river sections limits the effectiveness of sea-river intermodal transport, necessitating further improvements. According to the plan, an overall layout for inland navigation will be developed, featuring "six connections, four high-efficiency container terminals, five intermodal transport options, and one network". By 2030, Jiaxing Port's cargo distribution and transport through sea-river intermodal routes are expected to exceed 30%.

7. Promoting Green, Low-Carbon Building Technologies Tailored to Local Conditions

7.1 Using buildings to drive renewable energy applications

The use of renewable energy in newly constructed civil buildings will be expanded. When designing building structures, renewable energy facilities and equipment will be integrated seamlessly, ensuring aesthetic harmony with both the building and its surroundings. Based on Jiaxing's strong foundation in PV applications, efforts will also focus on promoting the large-scale development of distributed PV systems. For public buildings, priority will be given to adopting the building-integrated photovoltaics (BIPV) technology. For residential buildings, efforts will focus on actively promoting the BIPV technology, solar thermal power systems, and high-efficiency air-source heat pump water heating technology.

The optimization of energy use in existing public buildings will be actively promoted. Efforts will be made to enhance green and diversified energy supply systems, increase the level of electrification in energy use, and promote the adoption of low-carbon energy sources for all buildings. As part of green, low-carbon renovation projects for public institutions (fully or primarily government-funded), large-scale solar PV systems will be actively promoted. Education, healthcare, sports, and other existing civil buildings will be encouraged to integrate solar PV systems during renovations where feasible. The industrial cluster effect of Jiaxing's Xiuzhou PV Town will be fully leveraged to promote the application of solar PV systems in existing building renovations.

Exploration will be conducted on the utilization of other renewable energy sources. This includes promoting the application of ground-source heat pump technology in new buildings based on local conditions, water-source heat pump technology in areas with abundant surface or seawater, tubular daylighting technology in areas where natural light cannot meet lighting standards, and the use of waste heat or residual heat from buildings or nearby buildings.

7.2 Promoting green buildings and applying green, low-carbon technologies

7.2.1 Improving green, low-carbon standards for new buildings

Energy-saving, green, and low-carbon design standards will be implemented. This includes the implementation of the Design Standard of Zhejiang Province for Energy Efficiency in Public Buildings, the Design Standard of Zhejiang Province for Energy Efficiency in Residential Buildings, and the Green Building Regulations of Zhejiang Province. These standards will guide the orderly and steady development of buildings with ultra-low and near-zero energy consumption. Additionally, pilot projects for office buildings of governmental departments, public buildings (fully or primarily government-funded), and future communities will serve as demonstration projects for Jiaxing. All new civil buildings within urban construction zones (excluding self-built houses by rural residents and areas under special provisions in this plan) will adhere to the mandatory one-star green building standard, aiming for full coverage of green buildings. For office buildings of government departments and public buildings (fully or primarily government-funded), the mandatory standard will be two-star green buildings or higher.

Exploration will be conducted on key carbon reduction technologies in buildings. This includes exploring ultra-low energy consumption technologies suitable for Jiaxing and promoting the adoption of ultra-low energy building technologies and products. The goal is to effectively reduce the construction costs of ultra-low energy buildings and support the development of the entire industrial chain for such buildings.

Efforts will also focus on strengthening oversight of energy-saving and low-carbon buildings. This involves enhancing carbon emission assessments, improving post-construction energy efficiency evaluations, and implementing building energy consumption monitoring for civil buildings. The aim is to achieve a closed-loop management system for building carbon reduction and energy efficiency throughout the entire process.

7.2.2 Promoting energy efficiency improvements in existing buildings

Public buildings are encouraged to conduct energy-saving renovations. This includes encouraging government office buildings and fully or primarily government-funded public buildings to take the lead in implementing energy-saving renovations, while promoting the adoption of new energy-efficient technologies and products to improve overall energy performance. Other public buildings will also be encouraged to implement energy-saving renovations, phase out low-efficiency, high-energy-consuming products, and enhance the energy performance of equipment within existing buildings.

All new civil construction projects in the city are encouraged to meet high-star-level green building standards to increase the number of buildings that achieve high-star green building certifications.

7.2.3 Advancing urban ecological progress

The greening of buildings will be promoted based on local conditions, including wall, roof, fence, and balcony greening. These efforts aim to fully utilize building facades and roof spaces, thereby enhancing their carbon sink capacity.

The spatial layout of urban green spaces will be optimized. This involves accelerating the development of green areas and parks at key nodes and the construction of greenways to create a green, low-carbon city.

Efforts to advance regional sponge city development will be stepped up. This includes the active construction of sponge city infrastructure such as green roofs, vegetated swales, bioretention systems, porous pavements, and ecological green spaces. These efforts will improve local rainwater storage, infiltration, and utilization, while enhancing the overall efficiency of water resource management.

7.3 Strengthening awareness campaigns and adopting a low-carbon lifestyle

Energy-saving efforts will be promoted in the building sector and among key energy-consuming organizations to encourage green, low-carbon energy use behaviors. This includes advocating for the purchase and use of energy-efficient equipment and increasing the proportion of green products procured by government departments.

Awareness campaigns will also be strengthened to promote a simple, moderate, green, low-carbon, and healthy lifestyle and life philosophy. These campaigns will focus on opposing wasteful energy use in buildings, advocating for the use of clean and renewable energy, and fostering the development of green, low-carbon energy use patterns in building operations.

8. Providing Better Habitats and Enhancing Ecological Carbon Sinks

8.1 Baseline assessment

Based on an analysis of the current land use structure and intensity of areas used as carbon sinks, and considering requirements such as the "three zones delineated by three lines for land use" policy and land zoning in territorial spatial planning, three types of carbon sink functional zones are defined: core anchor zones, key maintenance zones, and potential enhancement zones. Each type of zone is governed by specific control measures tailored to its role.

The plan designates areas with high carbon sink intensity within ecological conservation areas and ecological control areas as core anchor zones. Strict land use regulations and ecological restoration efforts will be enforced in these zones to ensure the stability and quality of ecosystems in these critical ecological spaces. Areas with moderate carbon sink intensity in ecological conservation areas, ecological control areas, farmland protection areas, and rural development areas are designated as key maintenance zones. In line with national and provincial regulations, including the "three zones delineated by three lines for land use", these areas will be enhanced through measures like afforestation, wetland restoration, and adjustments to planting structures to boost vegetation coverage and carbon sink capacity. Areas within urban development zones, marine development zones, and other protected use zones, where current carbon sink intensity is low or where improving carbon sink capacity in the short term is difficult, are designated as potential enhancement zones. These areas are vital for increasing both blue and green carbon sinks and for mitigating climate change.

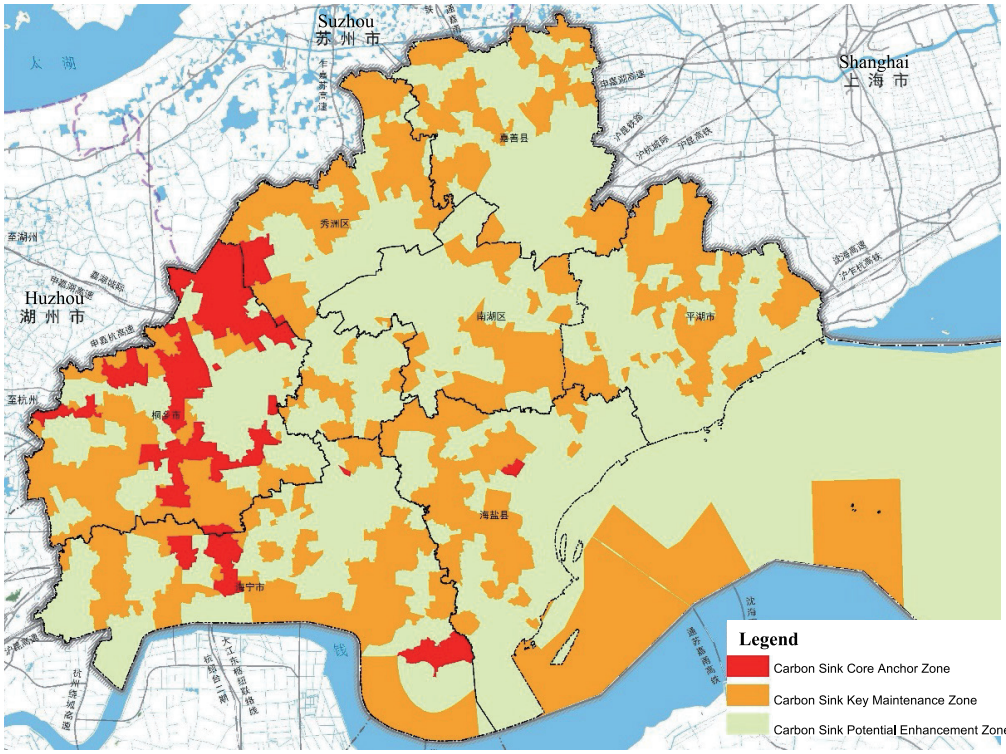

Figure 8-1: Zoning plan of the ecological carbon sinks in Jiaxing
Source: SUPDRI

8.2 Planning strategies

(1) For core anchor zones

The strategy focuses on strictly adhering to ecological conservation redlines to ensure the protection of critical ecological spaces. It prioritizes nature-based solutions for the integrated governance of mountains, rivers, forests, farmlands, lakes, and grasslands, with stringent land use controls. Additionally, major ecological restoration projects will be undertaken to enhance the carbon sink capacity of soils, vegetation, and water bodies in a holistic manner.

(2) For key maintenance zones

Aligned with the natural geographic patterns and their evolution principles within these zones, the strategy emphasizes the role of ecosystems—such as forests, wetlands, grasslands, and oceans—as carbon sinks. It also focuses on reconstructing and restoring degraded ecosystems to enhance their overall carbon sink capacity. While ensuring food security and a stable supply of key agricultural products, the strategy includes measures like implementing crop-livestock production systems for carbon reduction, promoting organic and ecological farming techniques, and encouraging biological and soil carbon sequestration to strengthen agricultural carbon sinks. In addition, comprehensive territorial spatial management will be prioritized to improve the ecological quality of these zones and restore and enhance carbon sink capacity in rural areas.

(3) Potential enhancement zones

The strategy takes into account factors such as the stage of urban development, industrial structure, population size, and resource endowments to optimize the urban spatial form and scale. It focuses on promoting green buildings and low-carbon transportation options to reduce emissions, strengthening green space development to increase the area of urban green spaces and urban greening coverage, and implementing marine ecological restoration projects to protect marine biodiversity. The strategy also includes strengthening carbon sink estimation, assessing carbon sequestration potential, and advancing research into carbon sequestration and storage technologies.

(4) Tapping into the carbon sink potential of marine ecosystems

The strategy emphasizes advancing the reconstruction of marine habitats as carbon sinks and further implementing fisheries enhancement programs. It also focuses on restoring fishery resource populations in aquatic areas, maintaining aquatic biodiversity and ecological balance, and promoting the sustainable development of aquatic environments. These actions will significantly enhance the carbon sink capacity of marine fisheries.

(5) Strengthening the agricultural carbon sink system

In collaboration with universities such as Zhejiang University and research institutes like the China National Rice Research Institute, research projects focused on developing an agricultural carbon sink system are being conducted. The emphasis is on establishing monitoring and accounting standards for rice carbon sinks. Efforts will also be made to accelerate the transition from theoretical research to practical pilot programs, along with organizing and implementing agricultural carbon sink pilot projects.

9. Territory Planning Control in the Urban Districts Aligned with the "Dual-Carbon" Goals

9.1 Control and optimization strategies for the urban districts

The focus of territorial planning control in the urban districts lies in practicality and detailed implementation. Therefore, in alignment with city-wide control requirements, the strategies emphasize the delineation of control policy zones and corridors, while closely integrating urban renewal with development planning. This includes delineating key control areas and important corridors. Key control areas include green building renewal zones, new green transformation zones, PV potential development zones, key maintenance zones for carbon sinks, potential enhancement zones for carbon sinks, public transportation priority zones, and slow traffic priority zones. Important corridors and facilities include green transportation corridors.

In line with the control framework for the urban districts, the following key strategies are proposed:

9.1.1 Transitioning to green transportation for short-distance travel

The urban districts of Jiaxing account for the highest transportation-related carbon emissions across the entire city, with emissions particularly concentrated in the central urban area. Therefore, based on the spatial distribution of transportation-related carbon emissions, a strategic approach is needed to optimize the transportation system layout and leverage the role of public transit and slow traffic in reducing carbon emissions. Given the short-distance travel patterns within the urban districts, efforts should focus on strengthening the construction of greenways and other non-motorized transportation infrastructure to create a favorable environment for slow-traffic users. This includes prioritizing the development of a robust branch road network to create a dense grid of narrower streets and optimizing cross-sections of roads to improve the right of way for slow traffic At present, the road network ratio in Jiaxing's central urban area is 0.05:1:0.76:1.27 for expressways, main roads, secondary roads, and branch roads, respectively. The relatively low proportion of branch roads indicates a need to further optimize the road network hierarchy.

Transportation-related carbon emission control zones within Jiaxing's urban districts are delineated in line with the current distribution of carbon emissions and travel patterns.

(1) Slow traffic priority zones: These mainly consist of the ancient Jiaxing city area within the city moat, which is home to a concentration of cultural and historical attractions. The main objective is to establish dedicated slow traffic spaces. This involves creating open, shared areas for pedestrians and cyclists, comprehensively upgrading slow traffic infrastructure, and exploring the feasibility of establishing car-free zones in select locations where conditions allow.

(2) Public transportation priority zones: In the central urban area, policies prioritizing public transportation will be actively implemented. Efforts will focus on optimizing the transit network to ensure broad coverage and high accessibility. Dedicated lanes for public transit vehicles will be strategically planned to guarantee their right of way, and traffic signal systems will be adjusted to give them priority. The goal is to enhance the overall competitiveness of public transportation. By 2030, Jiaxing aims to increase the share of motorized public transportation in the central urban area to 40% and to achieve a 96% customer satisfaction rate for public transportation services.

(3) Green transportation corridors: The current core public transportation network is fragmented and lacks connectivity. To address this, efforts will focus on accelerating the development of a robust, well-connected core public transit system, ensuring seamless transfers between conventional bus services and rail transit. Additionally, differentiated public transportation services will be introduced to meet the diverse travel needs of residents.

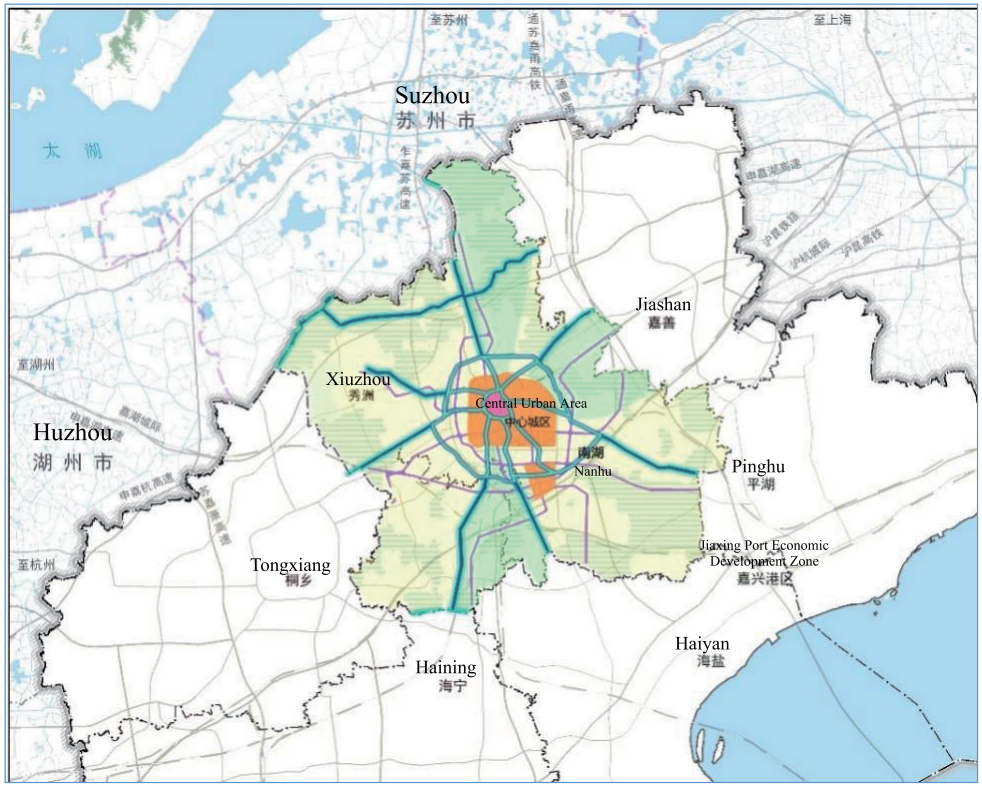

Figure 9-1: Zoning plan for transportation-related carbon reduction in Jiaxing's urban districts
Source: SUPDRI

9.1.2 Promoting green, low-carbon upgrades in the building sector

(1) Identifying priority areas for planning. Based on relevant planning documents and market analysis, the plan identifies key areas for new development and urban renewal within the urban districts. Key development areas include: High-Speed Rail New Town, Canal Bay New Town, Tian'ehu Area, Yaojiadang Area, and Xiangjiadang Area. Key urban renewal areas include: Old Town, the Electronic Control Factory area along the Intermediate Ring Road, North Jiaxing, East Jiaxing, Minfeng-Yejin Area, the wholesale markets for grain, oil, fruits, and vegetables along Tongxiang Avenue near the Third Ring Road, the automobile trade center north of Changshui Road, and the industrial park north of Dongsheng Road.

(2) Focusing on key areas for carbon reduction in buildings. Supported by Jiaxing's strength in the PV industry, efforts will be made to promote the large-scale development of distributed PV systems. The plan, based on local solar resources and building conditions, identifies zones with potential for distributed PV development.

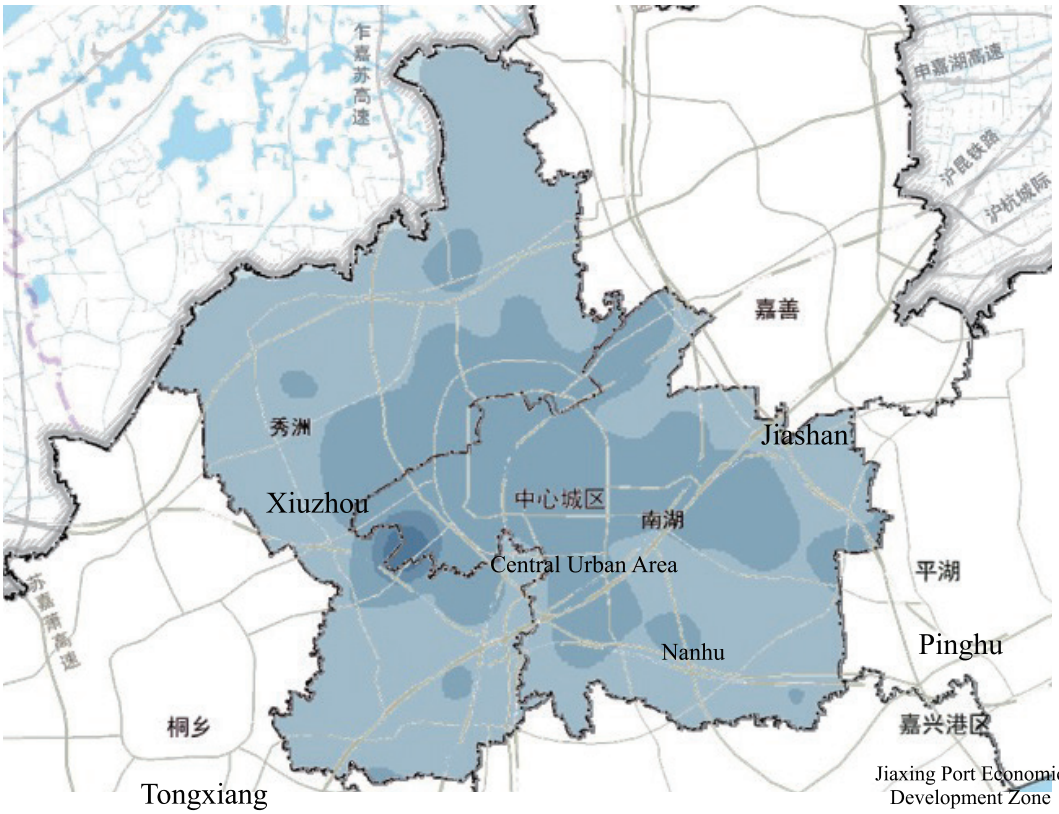

Figure 9-2: Zones with PV potentials in Jiaxing's urban districts
Source: SUPDRI

(3) Advancing steady progress in establishing policy zones. Aligned with relevant policies on priority areas for planning, distributed PV development potential, and green buildings, the plan delineates policy zones to guide green and low-carbon building upgrades.

Green building renewal zones: Public buildings are encouraged to lead energy-saving renovations. Efforts will also focus on promoting energy use system optimization technologies for existing public buildings and adopting new energy-saving technologies and products.

New green transformation zones: New buildings are encouraged to achieve ultra-low or near-zero energy consumption. Pilot projects for office buildings of governmental departments, fully or primarily government-funded public buildings, and future communities will serve as demonstration projects for Jiaxing.

PV potential development zones: Priority will be given to adopting the BIPV technology. For residential buildings, efforts will focus on actively promoting the BIPV technology, solar thermal power systems, and high-efficiency air-source heat pump water heating technology.

9.1.3 Implementing a zero-waste city initiative

The waste sector includes both solid waste and wastewater. In terms of solid waste, Jiaxing has already achieved zero landfill for household waste. As a result, the primary source of GHG emissions is now CO_2 from waste incineration. The plan identifies CO_2 from incineration as a continuing major source of GHG emissions.

As for wastewater, CH_4 from industrial sources currently accounts for a significant share of emissions. With ongoing economic growth and industrial expansion, the plan identifies both CH_4 and N_2O as continuing major sources of GHG emissions from the wastewater sector.

Therefore, to reduce GHG emissions from waste, the first core strategy is to cut down waste generation at the source. Specifically, this includes:

Implementing a zero-waste city initiative to improve the resource utilization rate of solid waste. Efforts will focus on promoting resource recovery from sludge, construction waste, and hazardous materials, while also integrating the two recycling networks for scrap materials and household waste to improve recycling rates.

Promoting the reduction of household waste at the source. This will be supported by fully implementing waste sorting programs and accelerating the development of a comprehensive waste collection and disposal system that serves all sectors of society. Moreover, efforts should be made to encourage a green, low-carbon lifestyle by reducing secondary packaging and promoting the use of recyclable and reusable materials.

Advancing industrial water saving. This includes advancing a green industrial transformation by reducing water-intensive industries in alignment with the city's broader industrial transformation goals. Furthermore, industrial enterprises will be encouraged to adopt water-saving technologies and wastewater recycling, leading to a reduction in water consumption and then wastewater discharge.

The second core strategy is to promote synergy between pollution reduction and carbon reduction by enhancing waste-to-energy conversion at the terminal disposal stage of waste. Specifically, this includes:

Encouraging the development of resource recycling-based industrial parks, where the resource recycling rate will be improved by facilitating the collaborative disposal of different types of waste.

Strengthening waste-to-energy conversion at large-scale terminal disposal facilities, such as household waste incineration and wastewater treatment plants. This involves exploring the co-treatment of incineration and sludge in suitable areas, increasing waste heat recovery rates at incineration plants, and piloting wastewater heat recovery projects. The goal is to improve overall waste-to-energy conversion at these large-scale facilities, ultimately reducing carbon emissions.

9.1.4 Boosting vegetation coverage and greenery

(1) Increasing green coverage and forested areas: Vegetation coverage will be expanded through afforestation and reforestation of barren mountains and land. Efforts will focus on effectively enhancing the carbon sink capacity of vegetation by implementing greening initiatives within and around Jiaxing's urban districts, increasing the area of afforested spaces, and making targeted improvements to forest and wetland quality.

Developing urban green spaces: This includes strengthening the construction and renovation of public green spaces in urban parks and pocket parks to increase the overall urban green coverage rate. Efforts will focus on promoting the development of parks within Jiaxing's urban districts, constructing and renovating pocket parks, and expanding the service radius of urban green spaces. This will enhance the city's carbon sink capacity while providing citizens with more recreational green areas.

Constructing ventilation corridors: Through scientific planning and thoughtful layout, emphasis will be placed on the planning and construction of large wedge-shaped green spaces during green space development. Additionally, the connectivity and openness of green spaces will be strengthened to create a more complete and efficient ventilation corridor network. Focus will be on ecological protection and landscape design, enhancing the ecological functions and visual appeal of these corridors through strategic vegetation planting and landscaping elements.

(2) Enhancing carbon sink capacity

Forestry carbon sinks: Jiaxing will work to enhance its forestry carbon sink capacity as part of a scientifically driven forest quality improvement initiative targeting millions of hectares. This includes steadily advancing the transformation and upgrading of designated forest land through sound forest management and silvicultural practices to improve both forest health and carbon sink capacity.

Farmland carbon sinks: The carbon sink capacity of farmland will be boosted through the development of high-standard farmland and initiatives to improve soil health. Technologies such as conservation tillage, the application of organic fertilizers, and straw incorporation will be promoted. In addition, the reuse of livestock manure as a resource will be strengthened to further enhance the carbon sequestration potential of farmland.

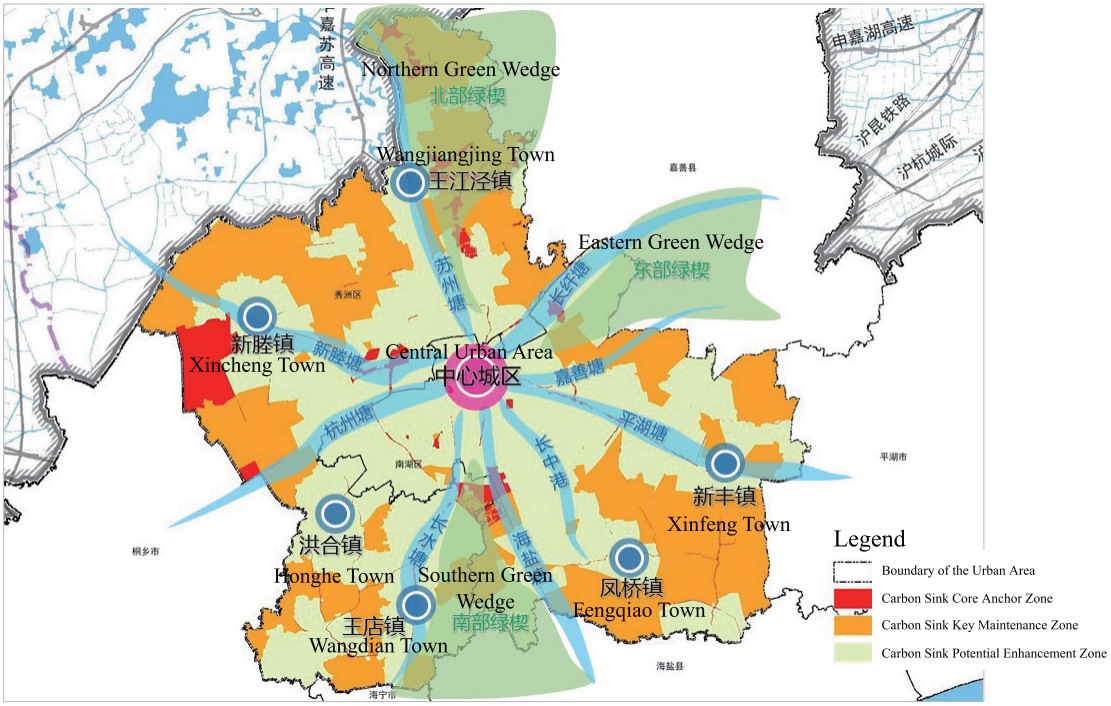

Figure 9-3: Zoning plan for carbon sink activities in Jiaxing's urban districts
Source: SUPDRI

Key control indicators include: area of per capita parks and green spaces (m2); coverage of parks, green spaces, and plazas within a 5-minute walk (%); area of green and open spaces (km2); minimum reserved area of water spaces (km2); proportion of river corridors meeting Class III water quality standards (%); and proportion of major river corridors and lakes meeting Class II water quality standards (%).

9.2 Scenario simulation of the plan for the urban districts

Table 9-1: Key indicators for the peak carbon year
Source: SUPDRI

Indicator		Target
Socio-economic indicators	GDP growth rate	Average annual growth of 6.8% during the 14th Five-Year Plan period; Average annual growth of 5.5% during the 15th Five-Year Plan period (2026–2030)
Three key energy-related indicators	Reduction rate of energy consumption per unit of GDP	Reduction of 16% during the 14th Five-Year Plan period; Reduction of 16% during the 15th Five-Year Plan period
Carbon intensity control indicators	Reduction rate of carbon emissions per unit of GDP	Reduction of 24% during the 14th Five-Year Plan period; Reduction of 22% during the 15th Five-Year Plan period

9.3 Methods and requirements for delineating control units

At the urban district level, the method of delineating control units is adopted with detailed transmission. Building on the spatial control framework for addressing climate change, and integrating relevant planning efforts and existing foundations, control units are delineated with an area of about 3 to 5 square kilometers, fully aligned with existing control units.

The delineation also considers the spatial distribution of carbon emissions and climate disaster risks, while maintaining connectivity with existing control units and special policy zones. To address climate change and support low-carbon city development goals, control indicators are established across five categories: buildings, transportation, industry, waste management, and ecology and environment.

Table 9-2: Some indicators for the control units in the urban districts
Source: SUPDRI

Category	Indicator	Xiuzhou District		
		Xinjia Administrative Zone		
		XZ-XJ001	XZ-XJ002	.....
Buildings	Reduction in carbon emission intensity from building operations (kg CO2/sqm)	8.0	8.0	
	Certification level / share of green buildings in new buildings (%)	50%	50%	
	Ratio of PV panel area to gross floor area in new buildings (%)	2.5%	3.0%	
	Energy savings rate based on building design (%)	75%	75%	
	Certification level of green buildings	Three-star	Three-star	
	Electrification rate of building energy use (%)	60%	60%	
Transportation	Share of green travel (%)	70%	70%	
	Accessibility of public transportation / rail transit stations (%)	80%	80%	
Industry	Energy consumption per unit of industrial added value (tons/RMB 10,000)	0.3	0.3	
	Recycling rate of industrial surplus energy (%)	40%	40%	
Waste	Comprehensive utilization rate of solid waste (%)	90%	90%	
	Wastewater reuse rate from centralized wastewater treatment facilities (%)	100%	100%	
	Per capita waste generation (kg/person·day)	‹ 0.8	‹ 0.8	
	Per capita domestic water consumption (liters/ person·day)	‹ 110	‹ 110	

Category	Indicator	Xiuzhou District		
		Xinjia Administrative Zone		
		XZ-XJ001	XZ-XJ002	.....
Ecology and environment	Forest coverage rate (%)	15%	13%	
	Area of per capita parks and green spaces (m2/person)	18	20	
	Wetland conservation rate (%)	75%	75%	
	Annual runoff control rate (%)	75%	75%	
	Ecological shoreline retention rate of river and lake systems (%)	70%	70%	

10. Supporting Mechanisms

10.1 Policy guidance and support

This includes developing and improving relevant policies to clearly define the objectives and pathways for building climate-adaptive cities; and providing policy guidance and financial support to encourage cities to fully integrate climate change considerations into urban planning, development, and governance.

10.2 Technological innovation and application

This includes promoting technological innovation and its application in areas such as green buildings, low-carbon transportation, and renewable energy; enhancing the climate resilience of urban infrastructure while reducing GHG emissions; and increasing resource allocation for climate change-related projects to ensure the effective implementation of adaptation and mitigation measures.

10.3 Social participation and awareness

This includes strengthening climate change education and public awareness campaigns to increase public understanding and engagement, fostering a social atmosphere of broad participation in addressing climate change.

11. Summary

The planning process is structured around 4 main tasks: comprehensive assessment (objective alignment), city-wide control plan (regional coordination), urban district control plan (detailed spatial control), and implementation mechanism (transmission mechanism). The process includes the following aspects: developing the overall objectives and the vision for Jiaxing to achieve the "dual carbon" and resilience goals; evaluating the current "dual carbon" and resilience situations; formulating an overall urban development strategy in the context of the "dual carbon" and resilience goals; establishing a multi-level planning control transmission system (including an indicator system); and providing supporting mechanisms to ensure effective implementation.

The plan adopts a multi-level control approach in content, scope, and level of detail, based on the key aspects and characteristics of the two levels: city-wide and urban district. The plan is developed based on detailed calculations and assessments, aligned with carbon reduction pathways and disaster risk reduction goals. It takes into account Jiaxing's urban spatial development trends and planning objectives, and identifies key areas for carbon reduction and carbon sink enhancement, establishing a multi-level control framework. City-wide control focuses on regional coordination by setting planning control requirements and indicators for the district level. Urban district-level control emphasizes detailed implementation, with planning control requirements and indicators specified at the unit level. This framework is integrated with the broader local spatial planning system, with clear pathways for implementation.

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