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# NEAR-ZERO CARBON ZONES IN CHINA

## POLICY ROADMAP AND CASE STUDY

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### AN INTERNATIONAL EFFORT TO REDUCE CARBON EMISSIONS

Following the 2015 Paris Agreement, China committed to peaking emissions around 2030. Looking beyond its nationally determined contribution, China is taking practical actions to eliminate carbon emissions. As hubs of economic activity and technology innovation, cities are critical to achieving these near- and longer-term emissions reduction targets. In China, cities account for around 60% of CO<sub>2</sub> emissions. Critically, cities and other local governments are following the nation's lead by setting ambitious peaking and post-peaking emissions reduction targets. A critical component of achieving emissions reduction targets in China at both the national and local levels is the use of near-zero carbon demonstration zones. In the 13th Five-Year Plan for Controlling Greenhouse Gas Emissions, China committed to peaking CO<sub>2</sub> emissions by 2030 and highlighted near-zero carbon zones as one of the key policies to achieve reductions, including a specific call for 50 near-zero carbon zones by 2050.

The emphasis on zero-carbon districts in China parallels a broader global trend advancing the design and implementation of net-zero buildings and districts. Net-Zero Energy Coalition statistics indicate a significant increase in the number of net-zero building projects in recent years, with 6,000 net-zero buildings today, compared with 4,077 in 2016. Several net-zero carbon projects have been initiated outside of China that can both serve to inform and be informed by the China near-zero carbon demonstration projects. Ongoing net-zero projects include Hazelwood Green in Pittsburgh, United States; SMA x ECO TOWN Harumidai in Osaka prefecture, Japan; and the Bo01 district in Malmö, Sweden. Near-zero and net-zero carbon districts are critical to demonstrating at scale the integration of innovative clean energy technologies and new approaches or business models for financing the deployment of these technologies.

To support carbon-peaking goals, local governments in China have demonstrated leadership on implementing the national strategy by piloting near-zero carbon zones. Guangdong, Beijing, Shanxi, Yunnan, Shanghai, Zhejiang, and several other provinces and cities have proposed work plans for piloting near-zero carbon zones. Near-zero carbon zones are at the core of China's economic and energy transformation, supporting the national carbon peaking goals and city peaking actions through the following pathways:

- **Optimize the economic structure and find a new growth point.** As China's economy shifts from a high-speed growth stage to a high-quality development stage, it is urgent to that it transcend the current development mode, optimize the economic structure, and identify new opportunities to support growth. Near-zero carbon development is a concrete model for innovative, efficient, and quality-oriented development based on cultivating new industries, advanced business models, and city redevelopment. Implementing near-zero carbon development can, therefore, support the optimization of economic structures and encourage economic growth.
- **Adjust the energy structure and achieve cleaner energy consumption.** China's central government is advancing an ambitious agenda to grow a clean, low-carbon, safe, and efficient energy system. By 2020, nonfossil energy will account for 15% of total energy consumption and carbon emissions per unit of GDP will decrease 18% from 2015 levels, as specified by the National Development and Reform Commission and the National Energy Administration. Between 2011 and 2017, China's renewable energy capacity grew from 17.27% to 26.37% of total electricity generation. This energy transformation is critical to piloting near-zero carbon emission zones as advances in clean power supply provide a low-carbon source of on-site electricity. Near-zero carbon developments also play an important role in achieving the

broader clean energy and carbon emissions goals by demonstrating models and defining best practices and standards that can be scaled through the private sector and government policy.

- **Improve building standards and upgrade existing municipal infrastructure.** With China’s ongoing urbanization process, upgrading municipal infrastructure and promoting high-quality urban development are important to help better manage urban growth. The near-zero carbon zone projects demonstrate higher construction standards and promote energy efficiency improvements in existing buildings, promote renovation of old communities, improve the recreation areas of communities and surrounding areas, and spur upgrades of comprehensive service facilities. They also strengthen urban-rural integration by improving roads, water supply, power supply, information, logistics, flood control, and wastewater treatment facilities.

## WHY NEAR-ZERO CARBON ZONES?

Central-government policymakers have been actively exploring pathways to achieve China’s climate goals while also supporting continued economic growth. City and regional low-carbon development have been commonly recognized as some of the most effective levers. Over the past decade, China’s low-carbon policy framework has strived to recognize and scale practices that are better than market average. As the latest national pilot program of a set of low-carbon policies, near-zero carbon zones emphasize a quantitative approach, aiming at deeper carbon reduction than “low” carbon and reducing carbon emissions to close to zero. Near-zero carbon zones have also been seen as innovative and advanced ways to achieve deeper CO<sub>2</sub> reductions.

In the process of exploring near-zero carbon models, cities and regions have begun to put forward the even more ambitious goal of net-zero carbon. Net-

zero carbon goals come with additional first costs and an extremely challenging economic payback. Even with successful small-scale pilots, net-zero carbon projects are difficult to replicate at scale. However, advancing net-zero projects is critical to expanding our understanding of integrated energy solutions and economic models that can be used to inform new approaches and best practices for near-zero projects, which are more readily scalable.

Finding the balance between cost and benefit is more urgent than ever. The near-zero carbon development concept is beginning to emerge and earn recognition from policymakers and the market. The near-zero carbon development model emphasizes cost-effectiveness. Instead of taking carbon emissions reductions as the only indicator, the near-zero carbon development model takes full consideration of costs and benefits. An ideal near-zero carbon goal should be able to reduce carbon emissions economically to close to zero. Referencing the new approaches and best practices of net-zero carbon development, which have helped push the boundaries of our knowledge and understanding of carbon reduction, near-zero carbon development can become more achievable and is ready to be scaled. China has been taking the leading role in exploring the near-zero carbon development model through a series of pilot projects.

### Meishan Near-Zero Carbon Definition

The near-zero carbon emission demonstration zone refers to the realization of high-quality economic development and a high level of ecological civilization, while achieving regional carbon emissions approaching zero, economic growth driven by emerging low-carbon industries, and energy consumption supplied by advanced near-zero carbon energy. The demand for construction and transportation is met by smart low-carbon technology, which lays a solid foundation for the long-term balance between source and sink (net-zero carbon).

## CASE STUDY: MEISHAN NEAR-ZERO CARBON DEMONSTRATION ZONE

Meishan is a “port-industry-city” integrated urban development zone in the southeastern part of Ningbo in Zhejiang province, with a total site area of 330 km<sup>2</sup>. Initially a small fishing village, Meishan has experienced rapid growth over the past decade. With approval from China’s State Council on February 24, 2008, Meishan became a national bonded port area. Since then, Meishan has been taking full advantage of its port status, successfully completing the cultivation of port functions and integration of the port areas and becoming an international port with a container throughput of 2.2 million 20-foot equivalent units (the standard measure of volume for shipping containers).

Since 2011, the development of the Meishan Bonded Port Area has spread to the surrounding area. The Meishan International Logistics Industry Cluster Area was formally established. This area includes not only traditional port services, but also value-added services such as agglomerate flow services, trade services, finance services, and more. In 2015, Meishan was officially recognized as Ningbo International Marine Ecological Science and Technology City, adding technology, culture, tourism, high-end research and development, and manufacturing functions to further deepen the integration of Meishan’s port, productive activities, and urban development.

### Ningbo Meishan Near-Zero Carbon Demonstration Zone

- A total site area of 330 km<sup>2</sup>
- Planned functions: port, warehousing, logistics, high-tech industries, residential, commercial, school, hospitals, tourism areas, etc.
- Climate zone: hot in summer and cold in winter, 4 months for summer and 4 months for winter, average annual temperature is 16.4°C. Average temperature gets to highest in July, which is 28.0°C, and gets to lowest in January, which is 4.7°C.



## Setting an Ambitious Goal

Following comprehensive technical and economic analysis and benchmarking against leading international cities, Meishan has released ambitious quantitative near-zero carbon goals. By 2030, Meishan's total carbon emissions will be at 2017 levels with a four times higher GDP and a three times larger population; per capita carbon emissions will be kept below 1 ton; in the long term, Meishan will achieve carbon neutrality around 2050 (EXHIBIT 1).

With these clear goals, Meishan further analyzed the carbon reduction potential in each sector. The result of the scenario analysis and energy system simulation demonstrated that significant carbon reduction potential exists on both the energy consumption side and energy supply side. Through a feasibility analysis of technical and policy measures, the emissions reduction potential of the industry, building, transportation, and power sectors can be further quantified, supporting Meishan's development strategy and action plan to achieve near-zero carbon targets (EXHIBIT 2).

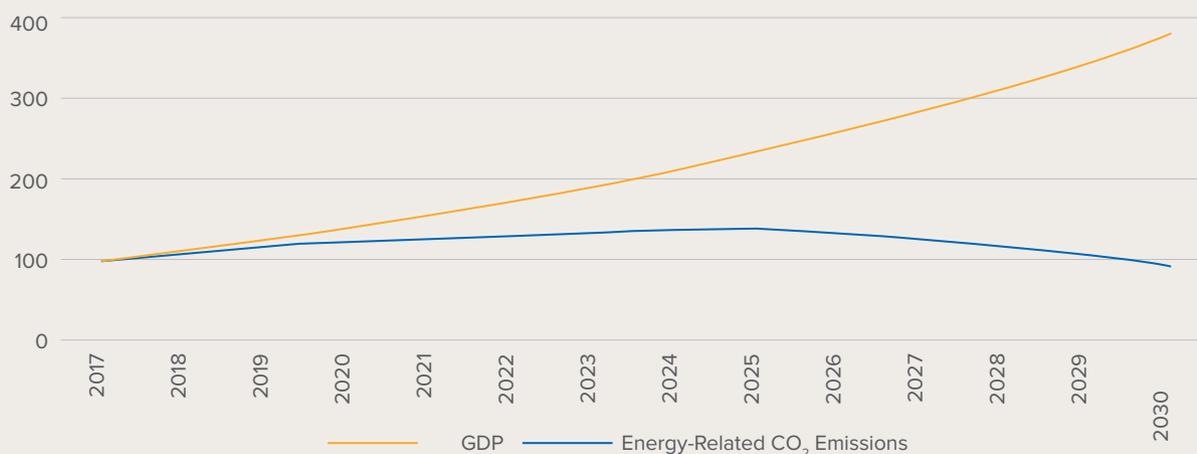
## Highlights of the Meishan Pilot

From planning to implementation, innovation is the spirit of the pilot project. Meishan has set up innovative solutions in the following areas: (1) government coordination and leadership, (2) planning methodology, (3) policy design, (4) business models, and (5) fiscal policy. All these innovations ensure that Meishan is positioned to achieve a world-leading, best-in-class urban development, setting new international standards of zone-level development with ambitious carbon goals. The following list explains the specific mechanisms implemented in Meishan:

- The “port-industry-city” integrated development model emphasizes the synergy of port development, productive activities, and urban development. Integrated development plays a crucial role in strengthening Meishan's position as the core area of Ningbo's “Belt and Road” Comprehensive Experimental Zone, facilitating the establishment of the Meishan free-trade port and supporting Meishan as the gateway of Zhejiang province's opening to the world. The integrated

### EXHIBIT 1

Meishan's GDP and CO<sub>2</sub> Emissions Trend from 2017 to 2030 under Near-Zero Carbon Scenario



development model will serve as the new growth engine for regional development by further promoting synergy of the existing port logistics and high-tech industries, advancing the urban functions provided by city development.

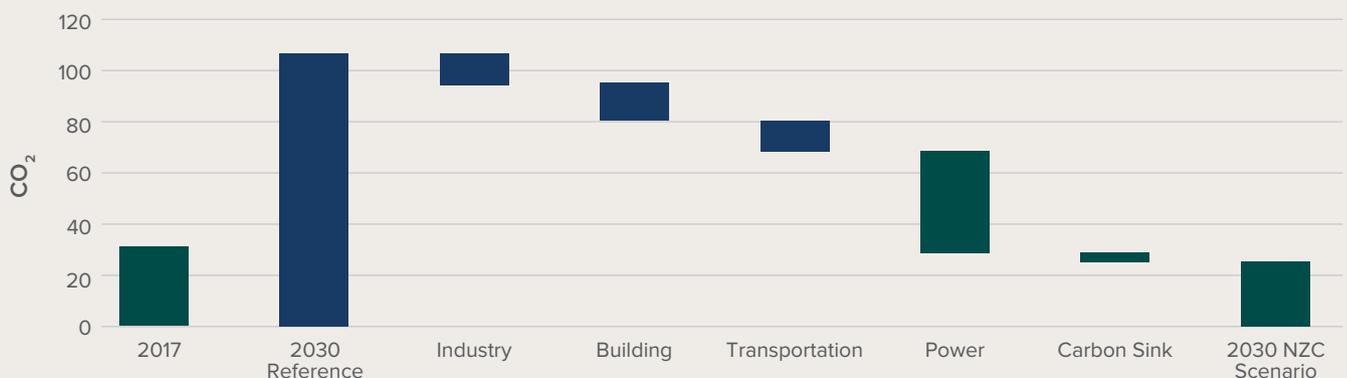
- The integrated energy service provider (IESP) model** is a business model that allows stakeholders to share the risk and return of delivering a more efficient and economical energy system. In the case of Meishan, a joint effort between the local government and the State Grid electric utility ensures the implementation of the IESP model, with a scope of work covering integrated energy planning, decarbonization of the power system, integrated utilization of energy, distributed energy resources, market-based trading, and the construction of a smart grid. The IESP business model will make full use of Meishan’s abundant renewable energy resources, supporting Meishan to become the “Zhejiang Province Green Energy Island.”
- The life-cycle assessment (LCA) building code** represents a higher standard when setting up decarbonization goals in the buildings sector, supporting Meishan to achieve 74% reduction in buildings-sector emissions. Instead of focusing only on operational emissions, the LCA building

code promotes a whole-process near-zero carbon concept. It requires the establishment of life-cycle management for near-zero carbon buildings and the refinement of relevant standards and guidelines throughout the construction of a near-zero carbon building. The LCA building code covers all stages of near-zero carbon buildings, from establishment of a project to final operational adjustments.

- The smart port system (Index)** helps to promote the use of clean energy and the construction of a near-zero carbon port. Specific actions include gradually electrifying container trucks, improving the coordination of mass-transit railway transportation, and constructing high-voltage, on-dock power charging stations (achieving full coverage of all berths in Meishan’s main container terminal). With the smart port system, both the energy efficiency and port logistic efficiency of Meishan port will be improved.
- The intercity light rail** connects Meishan to the central city of Ningbo, promoting greener mobility solutions for tourists and daily commuters. By establishing a new line, Meishan will not only support the development of tourism, but also contribute to the regional connectivity plan of railroads and regional economic development.

## EXHIBIT 2

Waterfall Chart of Each Sector's Carbon Reduction Contribution for Meishan under Near-Zero Carbon Scenario



## SEVEN THINGS TO DO TO DEVELOP A NEAR-ZERO CARBON ZONE



The development of each near-zero carbon zone is unique, but they all share some general characteristics. Through the examination of the development of world-leading near-zero carbon zones, it's not difficult to see that most near-zero carbon construction follows a general procedure, from the initial stages to final implementation, to ensure the project can achieve its carbon-reduction goal.

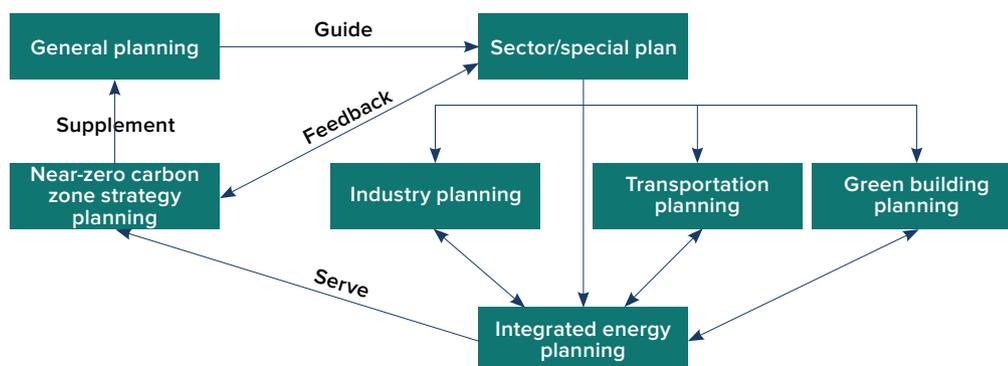
### Establishing a Comprehensive Policy Framework

Establishing a comprehensive policy framework sets the foundation for the future success of a near-zero carbon zone. The regional policy framework should include clear targets, quantitative indicators, general guidance, and detailed available fiscal support. Moreover, establishing the link between municipal and regional policy frameworks and specific project development should not be overlooked.

- Ningbo was the first city in China to propose a quantitative city carbon peaking target. The construction of the Ningbo Meishan Near-Zero Carbon Demonstration Zone is listed as an important action item in Ningbo's city peaking action plan. Quantitative goals set by the Ningbo Meishan Near-Zero Carbon Emission Zone Demonstration Project include achieving near-zero carbon emissions in 2030 with per capita emissions below 1 TCO<sub>2e</sub>, reducing the energy intensity per unit of GDP to 0.04 tons of coal equivalent per 10,000 RMB, and having renewable energy account for nearly 70% of power generated and more than 90% of total power consumed.
- Hundreds of cities around the world are committed to 100% renewable energy, such as Portland, USA; Vancouver, Canada; Hokkaido and Fukushima, Japan; Sydney and Canberra, Australia; Malmö, Sweden; and Agadir, Morocco.

### EXHIBIT 3

Innovative Planning Process of Near-Zero Carbon Zone



- Association of Southeast Asian Nations members have released a 2050 renewable goal of 23% renewables for their energy supply. Further consideration is needed to strengthen the goal's coordination with Southeast Asia's rapid urbanization and economic development, tackling the challenge of meeting rising demand with a secure, affordable, and sustainable energy solution.

### Forming Cross-Sector Collaboration

Collaboration across the buildings, transportation, industry, and power sectors ensures the achievement of whole-system carbon reduction. Unlike building-level development, zone-level development covers not only the buildings sector, but also the energy, industry, and transportation sectors. Such development requires in-depth coordination and collaboration across sectors. Yet carbon reduction patterns in each sector are different; in terms of emissions sources, integrated energy supply management has proven to be an effective way to reduce overall carbon emissions.

### Adopting an Innovative Planning Process

An innovative planning process (EXHIBIT 3) is a prerequisite for implementing whole-system solutions. An innovative planning process proposes to front-load whole-system strategic planning, conduct technical-economic analysis to support decision-making, and set a roadmap and goals before the urban planning document is completed. It is important to select quantitative targets from a near-zero carbon zone roadmap and include them in urban planning documents and also select targets

that can be used for sector-based planning. A complete planning document is subject to review by policymakers, planners, and engineers and is then reiterated based on their comments.

- As a complement to the master plan, the near-zero carbon strategic plan is made with full consideration of the region's development status and technical and economic studies. The near-zero carbon strategic plan clarifies the objectives of the near-zero carbon zone and specific sector targets with the support of quantitative analysis. Relevant policy recommendations are proposed based on the plan.
- The objectives of the strategic plan will be expressed as specific indicators and included in the master planning, and the relevant indicators will be used to further guide the sector-based planning, including industrial spatial planning, transportation network planning, green building planning, and integrated energy planning. It is important to carefully coordinate all sector-based planning to reflect the systematic nature of the regional energy system as a whole.

### Exploring Innovative Methodologies

Innovative analytical tools (EXHIBIT 4) are the basis for quantitative analysis for regional development. The energy system analysis tools are developed based on energy modeling that demonstrates the balance between energy supply and consumption, and are also based on the collection of data needed to carry out a relevant scenario analysis. The energy model

#### EXHIBIT 4

Regional Energy System Analysis Tool Framework



## Introduction of Zero Emission Reinventing Operator

ZERO (Zero Emission Reinventing Operator), based on LEAP (Long-Term Energy Alternative Planning), is a model developed for analyzing the pathways for greenhouse gas emissions reduction. It simulates the process of converting primary energy to secondary energy and to different forms for end use. The model uses detailed techniques to describe the process of energy flow and logistics that can be used for both service-oriented and scenario-oriented analyses to estimate energy savings—and emissions reduction—potential in specific target years.

should be able to analyze the difference between the business-as-usual scenario and the near-zero carbon scenario based on an analysis of regional economic development, future economic goals, the status of renewable energy resources, and historical energy consumption. The goal of adopting an innovative energy model is to ensure quantitative targets that are both economically and technically feasible and are tailored to meet local needs.

### Coordinating with Local Policies

The construction of a near-zero carbon zone is a complex process that involves all levels of government and covers all sectors in daily operations; coordinating high-level planning with local policies is often critical to implementation. The general steps to ensure efficiency in coordination include (1) releasing the targets and goals of the near-zero carbon zone, and releasing the construction plan; (2) integrating carbon-related targets into sector-based planning to balance development needs and carbon emissions—reduction efforts; and (3) utilizing local funds to support the near-zero carbon zone through promoting public–private partnerships and other market-based innovative financing mechanisms.

## Introducing an Innovative Business Model

The general principle of constructing a near-zero carbon zone is to use the most cost-effective way to achieve carbon-reduction targets and introduce an innovative business model as a pathway to achieve cost-effectiveness. An integrated energy service provider model is one of the innovative business models frequently discussed in this context. The IESP model is an innovative business model that stands out in the new era of power reform. The goal of an IESP is to resolve the contradiction between an energy-saving business and a power-retailing business. It creates a new form of power industry enterprise and enables all levels of governments and power grid companies to share both risks and returns and create a comprehensive system that covers energy planning, investment, construction, and operation, and assists in achieving the carbon-reduction goal.

### Creating a Project Library and Technology List

A project library and technology list are policy tools to better support implementation by clarifying the technical and economical roadmap of the near-zero carbon zone. A project library identifies the key projects within a development zone, including information about schedules, scopes, stakeholders, and fiscal conditions. A project library is an important tool to coordinate a large-scale, complex project that requires cross-institutional collaboration. The technology list provides technical support for the entities that implement projects, demonstrating clear technical selection criteria and setting priorities to enhance project delivery. Moreover, a technology list provided by an unbiased, independent third party is crucial for more effective procurement guidance.

### Future Outlook

This insight brief introduces China's near-zero carbon zone national pilot program and summarizes insights from a leading national pilot candidate.

Exploring new mechanisms to develop near-zero carbon zones is a continuous effort in China. The urban development model of near-zero carbon zones is setting a new international standard for best practice and has the potential to be scaled in China and beyond. With the Belt and Road Initiative, China is starting to play a leadership role to scale its best practices, and insights into the near-zero carbon zone have great potential to support rapid urbanization in cities along the region of the Belt and Road Initiative. The near-zero carbon zone of China has absorbed best practices from the developed world and, more importantly, has created leapfrog solutions through local innovation. As China sets itself on the path of establishing a revolutionary new growth model of ecological civilization, near-zero carbon zones can serve as the foundation for future exploration of a more comprehensive, whole-system approach that aligns carbon reduction with other sustainability goals.

## GET INVOLVED

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in the United States in Basalt and Boulder, Colorado; New York City; the San Francisco Bay Area; Washington, D.C.; and in Beijing, People's Republic of China.

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