Looking Back to Look Ahead

AN ANALYSIS OF PROVINCIAL 14TH FIVE-YEAR PLANS (2021-2025)

September 2024

Berkeley Law

California-China Climate Institute

Authors

Anni Dai, Jessica Gordon, Rixin Zhu, Fredrich Kahrl, Fan Dai

About the California-China Climate Institute

The California-China Climate Institute was launched in September 2019 and is a university of California-wide initiative housed jointly at UC Berkeley's School of Law and the Rausser College of Natural Resources. It is Chaired by Jerry Brown, former Governor of the State of California, and Vice-Chaired by the former Chair of the California Air Resources Board Mary Nichols. The Institute also works closely with other University of California campuses, departments and leaders. Through joint research, training and dialogue in and between California and China, this Institute aims to inform policymakers, foster cooperation and partnership and drive climate solutions at all levels.

Acknowledgements

This report and analysis were led by the California-China Climate Institute at the University of California, Berkeley. We appreciate the financial support of the Rockefeller Brothers Fund.

We would like to acknowledge the helpful comments from the following reviewers of this report: Xiaoqian Jiang (World Resources Institute), Yichao Gu (University of San Diego). We also thank for the data analysis supported by Qianhui Jin and Curtis Wong

Executive Summary

In September 2020, China announced "dual carbon" goals (双碳目标 | shuangtan mubiao) to peak its carbon emissions by 2030 and carbon neutrality by 2060. Meeting these goals will require a major transformation of China's energy system and changes throughout different sectors of the Chinese economy.

China has used five-year plans – vast undertakings involving hundreds of national and provincial government agencies – to orchestrate larger changes in its economy since its first such plan took hold in 1953. China's 14th five-year plan (2021-2025) provides a window on the country's pivot towards a lower carbon economy, but did not begin in time to incorporate China's dual carbon goals. As preparatory work gains momentum for the 15th five-year plan (2026-2030) – which will encompass China's 2030 carbon peaking goal – insights from the 14th five-year planning period can help to guide efforts.

This report examines policies and measures to mitigate and adapt to climate change in China's 14th five-year plans. The analysis covers national and provincial overall framework plans, as well as sector-specific plans for energy, transportation, buildings, industry, and environmental conservation. Drawing on successes and shortcomings of the 14th five-year plans, the report provides recommendations for enhancing how climate change mitigation and adaptation are incorporated into the 15th five-year planning cycle.

SIGNS OF PROGRESS, FRICTION, AND INNOVATION

The report highlights the significant progress made by China's national government and provincial governments in their 14th five-year plans, in terms of laying a foundation for reducing greenhouse gas (GHG) emissions and adapting to climate change in the coming decades. This foundation includes administrative changes, such as inter-agency coordination on policies to improve air quality and reduce GHG emissions, as well as policy changes to conserve ecosystems, sequester carbon, and facilitate climate adaptation (Section 2.2.2). This foundation also includes significant changes in industrial policy, including plans to massively expand renewable energy (Section 3.1) and implement low-carbon industrial transition strategies (Section 3.2). It also includes targets and strategies for greening the transportation (Section 3.4) and building sectors (Section 3.5).

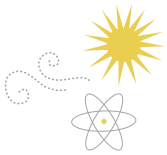
At a provincial level, efforts to lay this foundation were uneven. Perhaps contrary to perception, five-year planning in China is not a top-down process. The 14th five-year plans have reflected tension between national climate goals and various degrees of provincial alignment with them. Several provinces in China's northern regions have been clearly out of step with national goals for carbon intensity (Section 2.2.1), whereas other provinces have been on target for 2030 goals. All provincial FYPs have emphasized a low carbon transition for energy, buildings, industry, and transportation (Section 2.2.1, Sections 3.1-3.5). Some provinces have developed detailed plans for greening specific sectors, whereas other provinces have had limited detail or entirely lacked plans for some sectors (Sections 3.1-3.5).

Even so, the 14th five-year plans have shown how policy innovation and problem solving at the provincial level can trickle up to the national level. For instance, 11 provinces have developed plans for addressing and adapting to climate change in the 14th five-year planning cycle, even though China did not have a national framework for climate adaptation until 2022 (Section 2.2.2). Even for sectors where national government agencies did provide a high-level framework, provinces have developed strategies – for the electrification of heavy trucking in Shanxi, for example, or for efficient multi-modal transport systems in Jiangsu and Shanghai (Section 3.4) – that were tailored to their economic realities. The diversity of approaches in the 14th five-year plans illustrate that, as in the U.S., Chinese provinces serve as important laboratories for climate policy innovation.

KEY HIGHLIGHTS

China's national goals for reducing carbon dioxide (CO_2) emissions have historically been in intensity terms – i.e., CO_2 emissions per unit of GDP. Meeting China's dual carbon goals, however, will require absolute reductions in CO_2 emissions. Neither national nor provincial 14th five-year plans have incorporated absolute limits on emissions. Instead, the 14th five-year plans have continued the central government's historical preference for CO_2 intensity goals, which are set at 18% below the 2020 level by 2025, and 65% below the 2005 level by 2030 (Section 2.2.1).

Ultimately, reductions in CO_2 and other GHG emissions will come from changes in energy and land use in specific sectors. At a sectoral level, several themes have emerged in the 14th five-year plans.

 ENERGY SUPPLY	Provincial plans had a strong focus on renewable energy. The sum of provincial goals for solar and wind generation (1,236 GW) and hydropower (423 GW) by 2025 exceeded the national government's goals for solar and wind (1,200 GW by 2030) and hydropower (380 GW by 2025). There has been less clarity in provincial plans or national direction on how to transition away from China's historical reliance on coal. (Section 3.1.)
 INDUSTRY	Provincial plans for decarbonizing industry focused on energy efficiency, consistent with national goals (i.e., a 13.5% reduction in industrial energy intensity between 2020 and 2025). Some provinces have included strategies for low-carbon fuels and technologies such as hydrogen and carbon capture, utilization, and storage (CCUS). (Section 3.2.)
 TRANSPORTATION	Most (21) provinces have set targets for reducing CO_2 emissions from transportation that were close to the national government's 5% goal (i.e., a 5% reduction in CO_2 per passenger or per ton-kilometer by 2025, relative to the 2020 level). Electrification has been a common decarbonization strategy across provinces, but plans have diverged in their focuses and priorities. Seven provinces have developed specific plans for green transportation. (Section 3.3.)
 BUILDINGS	Nearly all (26) provinces have set goals for energy efficiency and onsite renewable energy consumption that were consistent with national goals (i.e., a 30% improvement in building energy efficiency and 8% onsite renewable energy consumption by 2025). Coastal provinces have been more ambitious in their goals. (Section 3.4.)
 NATURE-BASED SOLUTIONS	Nearly all (27) provinces have set targets for expanding forest coverage, with about half (15) establishing targets for wetland protection. (Section 3.5.)
 CLIMATE CHANGE ADAPTATION	Thirteen provincial climate adaptation plans have included strategies to enhance capabilities to monitor and assess climate-related risks, prioritize food security and climate-sensitive industries, and protect public health. (Section 3.6.)

RECOMMENDATIONS FOR THE 15TH FIVE-YEAR PLANNING CYCLE

Drawing on analysis of the 14th five-year plans and a review of successes and challenges in their implementation, this report outlines several recommendations for better incorporating climate change mitigation and adaptation into the 15th five-year planning cycle (Section 4).

Providing clear national guidance and coordination. Clear national guidance – perhaps in the form of a national framework for climate change mitigation and adaptation, combined with ongoing consultation and coordination with provincial agencies – would help to better align national and provincial goals, set expectations for which plans provinces should develop and what they should contain, and coordinate mitigation and technology strategies across provinces.

Setting provincial carbon caps. Total CO_2 emissions targets (i.e., caps, in million tons of CO_2 per year), specific to each province, would better align provincial planning with the dual carbon goals and encourage provinces to plan in more detail for meeting these targets.

Prioritizing provinces that are falling behind of the national "dual carbon" schedule. Several industrial provinces (i.e., Heilongjiang, Inner Mongolia, Liaoning, Ningxia, and Xinjiang) are not on track to meet 2030 carbon intensity goals. Challenges remain to adapt their industrial and economic growth models. These provinces could be prioritized for engagement, national investment, technical assistance, and demonstration projects during the 15th five-year plan.

Aligning climate policy with other environmental goals. An important step during the 14th five-year plans was the development of national frameworks to link air quality policies with GHG emission goals, and environmental conservation policies with carbon sequestration and adaptation programs. National government agencies could deepen these links in the 15th five-year plan by encouraging provincial agencies to undertake joint planning, providing methodological frameworks and technical support for multi-objective planning, and encouraging coordination between sectoral and environmental compliance plans.

Coordinating energy supply planning across regions. Provincial plans for energy supply will likely need to continue to prioritize cross-province coordination in the 15th five-year plans, through regional and national planning for energy transport networks and emerging electricity markets. In addition, clarity from national agencies on how coal will be regulated would assist energy supply planning efforts at the provincial level.

Accelerating industrial transformation. China's 15th five-year plans provide an opportunity to move beyond energy efficiency as the main strategy for reducing industrial GHG emissions by expanding new technologies (e.g., electrification, hydrogen, CCUS), new regulatory approaches (e.g., GHG emissions standards for carbon intensive industries, expanded cap-and-trade), new incentives, GHG reporting and disclosure tools, and "circular economy" concepts. Because provinces naturally want to protect their competitive industries, progress in reducing industrial GHG emissions will likely require national leadership and coordination.

Incentivizing green transportation and electrifying private vehicles. Provinces should consider developing green transportation plans to coordinate multi-modal green transportation development, including private vehicle electrification, and to deploy associated infrastructure. In addition, provinces and cities could further incentivize the decarbonization of the shipping and aviation activities by empowering the private sector, i.e., ports and airlines.

Promoting energy efficient buildings, green building materials, and onsite clean energy consumption via financial incentives and other means.

Diversifying how provincial progress is evaluated. Provinces face varied challenges in reducing GHG emissions due to differences in their natural resources and socioeconomic conditions. In the 15th five-year plan, national government agencies could develop a framework for goals and evaluation metrics tailored to the specific circumstances of different regions and/or individual provinces.

In the journey to achieve carbon neutrality, China and the U.S. have much to learn from each other in the coming years, as China develops and implements its 15th five-year plan. For instance, California's experience with GHG target setting, long-term planning for GHG emission reductions, and joint planning for air quality and GHG co-benefits can all provide important insights for Chinese government agencies. At the same time, U.S. federal and state agencies can learn from China's successes in electrifying transportation and its innovations in decarbonizing its industries. Furthering dialogue between China and the U.S. will help both countries consolidate their gains and strengthen their transition to lower carbon economies.

Table of Contents

List of Abbreviations	
CEADs	Carbon Emission Accounts & Datasets
FYP	Five-Year Plan
GHG	Greenhouse Gas
MEE	Ministry of Ecology and Environment
MNR	Ministry of Natural Resources
NbS	Nature-based Solutions
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NEV	New Energy Vehicles

1. Introduction

In 2020, China committed to peaking its carbon dioxide emissions by 2030 and reaching carbon neutrality by 2060.[1] Substantial climate endeavors are being made at subnational levels to achieve these goals. These efforts are laid out in China's social and economic five-year plan (FYP) framework, which outlines overarching targets, principles, and strategies across the economy on a rolling five-year basis. As we approach the end of the 14th FYP period (2021-2025), it is an opportune moment to analyze and reflect on these subnational climate plans and provide a baseline to anticipate China's climate ambitions during the 15th FYP period (2026-2030).

China's provinces exhibit significant economic, social, and ecological diversity, leading to varying interests and implementation timelines that may not always align with central government directives. Provinces are significant political and socioeconomic entities in governing cities, counties, townships and villages within their jurisdictions. Furthermore, provincial policies can cascade upward to shape national policies. For instance, Guangdong, particularly Shenzhen city, initiated a pilot program to disaggregate transmission and distribution fees from retail electricity prices.[2] Subsequently, the National Development and Reform Commission (NDRC) adopted this restructured pricing approach in nationwide energy reforms.[3] In this context, provinces can act as crucial testing grounds for innovation, functioning as "laboratories for experiments" in climate governance.[4] Therefore, provinces represent more than just lines on a map; they emerge as influential power centers significantly contributing to China's responses to climate change.

China's FYP system operates within a hierarchical and fragmented political structure. National FYPs establish priorities and targets for the entire economy, which are then followed by a multitude of sub-plans that are translated into a complex and interlocking web of detailed execution policies at all governmental levels.[5] Within this hierarchy, power is dispersed both horizontally and vertically. Regulators at equal authority levels might be tasked with separate or even competing missions, and the dynamic between central and local authorities evolves through power-sharing and bargaining rather than legal justification.[6] Hence, FYPs may not be seen as a "cohesive and unified blueprint," but rather as an ongoing process for information gathering and analysis to foster consensus-building and to shape policies and their implementation.[7] In the context of climate change, this "soft centralization"[8] refers to a distribution of authority to formulate climate-related FYPs across sectors and governmental levels. These FYPs only outline key indicators for climate targets, strategies, and significant projects, which are then realized through evolving implementation plans and measures.

METHODOLOGY AND STRUCTURE

For the purposes of this report, the term "province" includes all provincial-level jurisdictions in China: provinces, provincial-level municipalities, autonomous regions, and special administrative regions. Under this definition, 31 provinces are included, while Tibet Autonomous Region, Hong Kong Special Administrative Regions and Macao Special Administrative Regions are excluded due to their distinct planning systems or insufficient data availability.

This report examines a wide range of FYPs at both national and provincial levels: (a) the framework FYPs for economic and social development; and (b) sector-specific FYPs regarding energy, transportation, ecological protection, industrial development, and buildings. These FYPs are selected due to their

1 Xinhua News (2021).
2 NDRC (2024).
3 NDRC and NEA (2015).
4 Steven Callande (2023).
5 Heilmann and Melton (2013).
6 Zheng (2007).
7 Naughton (2013).
8 Mertha (2005).

significant impacts on carbon emissions and primary roles in crafting decarbonization efforts. As FYPs typically outline strategies to reach overarching targets in the given five-year period, this report thoroughly reviews key indicators, major projects, and notable implementation measures related to climate actions in the 14th FYPs.

In addition to the FYPs themselves, this report involves a comprehensive review of subsequent implementation plans and other government reports and announcements, along with official statistical data related to crucial climate indicators and metrics in the 14th FYPs. The goal here is to provide deeper insights into provincial climate plans across sectors in the 14th FYP cycle and inform the development of the 15th FYPs, as the NDRC just initiated research projects for designing them.[9]

To this end, the report begins by discussing the landscape of climate actions in Section 2 to provide an overview of the climate actions undertaken during the 14th FYP cycle. Section 3 then focuses on sectoral climate plans to demonstrate key climate targets and approaches for achieving targets in high-emitting sectors, as well as notable actions for climate change adaptation and nature-based solutions for climate mitigation. Finally, Section 4 concludes with recommendations drawn from insights gained during the 14th FYPs to enhance provincial climate actions in the upcoming 15th FYP cycle.

9 People's Daily (2023).

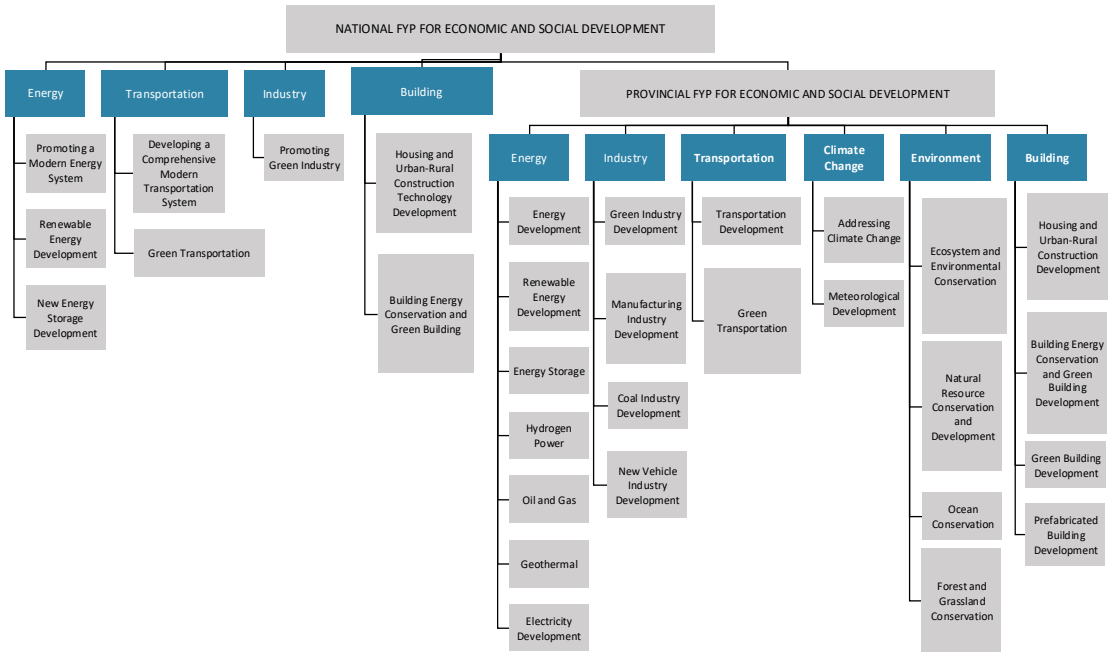
2. The Landscape of Provincial Climate Actions in the 14th Five-Year Plans

Since there is no single national FYP dedicated to addressing climate change, this section reviews provincial climate-related plans, which intersect across different layers of FYPs as well as different sectoral plans. Although the climate actions taken at various governmental levels deliver mixed messages, carbon emission reduction has become increasingly important both politically and administratively in the 14th FYP period. This section will explore these dynamics in the midst of a complex and ever-changing landscape.

2.1. CLIMATE CHANGE EFFORTS SCATTERED IN THE 14TH FYPS

Addressing climate change is not a singular or static challenge but rather a response to an evolving array of climate, environmental, and socioeconomic conditions. As illustrated in Figure 1, national FYPs give rise to a multitude of provincial FYPs, which outline sector-specific climate targets, strategies, and direct responses to mitigate climate change. As a result, climate plans are scattered across a range of industries and sectors, reflecting both the polycentric nature of climate change risks and China's fragmented power structure. Moreover, although Figure 1 illustrates central and provincial climate-related plans in separate vertical frames, national sectoral plans significantly shape provincial ones by setting overall targets and initiatives that provincial plans must follow in a given area. These plans together comprise an intricate and interlinked system through which regulators can contribute to climate change responses while serving economic, social, and environmental goals.

Figure 1: National and Provincial Climate-related 14th FYPs



Sources and notes: Names in blue indicate FYP categories, while those in gray refer to FYP names. Not every province has released each FYP.

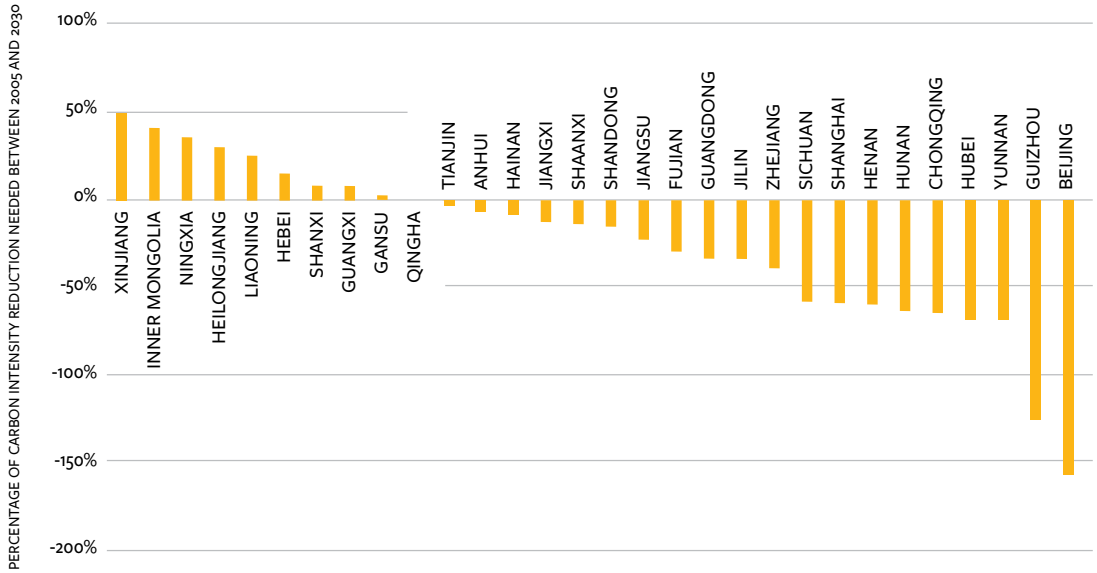
2.2. MIXED MESSAGES ON CARBON IN PROVINCIAL 14TH FYPS

This section provides an overview of the climate strategies outlined in the 14th FYPs, highlighting the mixed messages conveyed by the central and provincial governments in their climate responses. The central government took a cautious approach and set a modest national carbon intensity reduction target. Provinces varied significantly in their progress towards carbon peaking goals. Even so, a stronger link was forged between climate and environmental policy, as carbon reduction became a pillar of ecological and environmental conservation strategies.

2.2.1. CARBON INTENSITY REDUCTION TARGETS

China's goal to reach peak carbon emissions by 2030 will be addressed in the 15th FYP cycle (2025-2030). One useful indicator of China's ability to achieve absolute emissions reductions in the post-2030 period is current progress made towards reducing its carbon intensity in keeping with the national target, which calls for a 65% reduction below 2005 levels by 2030.[10] In the 14th FYP cycle, The National 14th Five-Year Plan for Social and Economic Development set an economy-wide benchmark of reducing carbon intensity by 18% below the 2020 level by 2025.[11] However, there is wide agreement that this target is modest and can be met even if overall carbon emissions increase.[12] This cautious approach may be driven by energy security concerns amid shifts in the global and domestic landscape. For example, Russia's invasion of Ukraine and persistent coal and electricity shortages in 2021 and 2022 complicated energy planning efforts and amplified calls for energy security.[13] These concerns have clouded China's trajectory for climate action and prompted a modest approach to setting national carbon targets.

Figure 2: Provincial Gaps in 2025 and 2030 Carbon Intensity, Based on 14th FYP Targets[14]

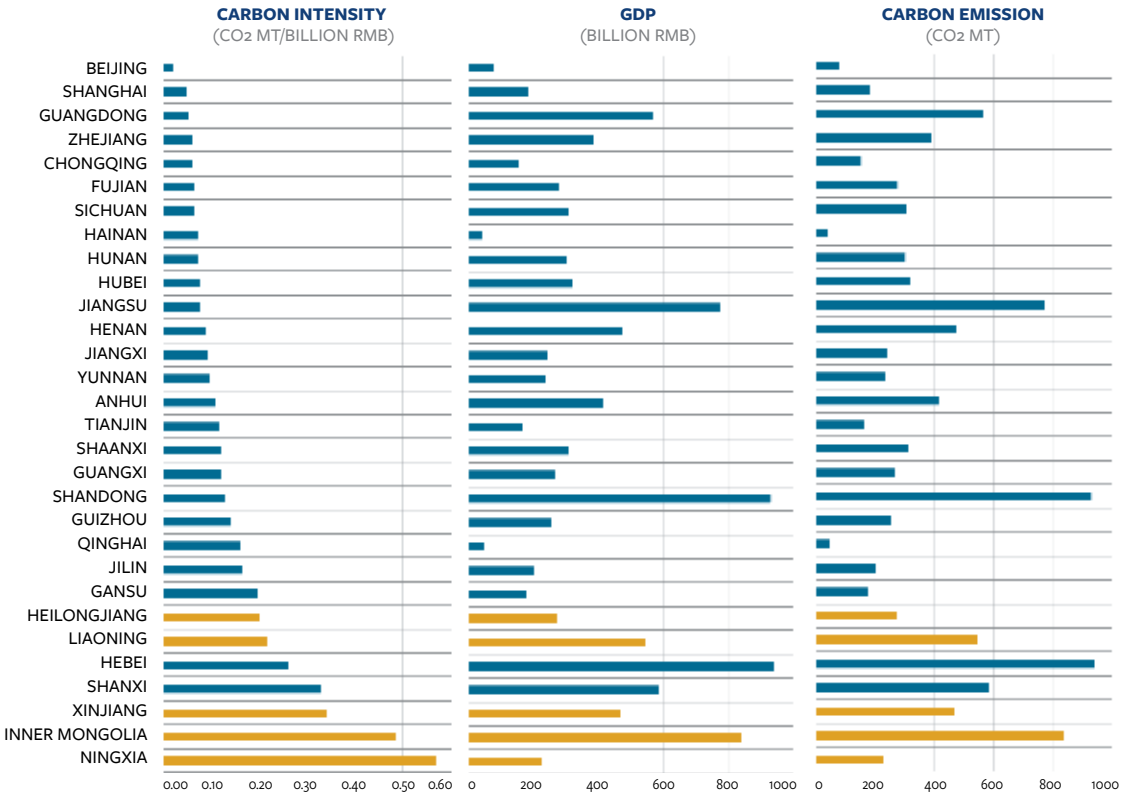


Sources and notes: The positive percentage indicates the amount that provinces will need to reduce carbon intensity to meet the 2030 carbon intensity goals, relative to their 2025 carbon intensity goals. The negative percentage represents provinces that will overachieve their 2030 carbon intensity goals by 2025. See Appendix A for a detailed description of how gaps were calculated. All data taken from China's National Bureau of Statistics and the Carbon Emission Accounts & Datasets (CEADs) for emerging economies.

10 State Council (2021a).
11 State Council (2021b).
12 Carbon Brief (2021).
13 Lushan (2022).
14 For provinces that do not specify targets, this analysis assumes an 18% carbon intensity reduction in line with national goals.

At the provincial level, significant disparities exist in terms of progress toward the 2030 carbon peaking goal. This goal is measured by a major indicator, the 2030 carbon intensity goal, which requires a 65% carbon intensity reduction below 2005 levels by 2030.[15] Figure 2 illustrates how much carbon intensity reduction is required for provinces to achieve the 2030 carbon intensity goal, relative to their 2025 carbon intensity goals based on 14th FYP targets. In this regard, Xinjiang, Inner Mongolia, Ningxia, Heilongjiang, and Liaoning fall short. For these provinces, large gaps must be filled in order to reach the 2030 carbon intensity goal, with carbon intensity reductions of over 25% or even up to 40% needed during the next five-year cycle. In contrast, Beijing has already reached the 2030 carbon intensity goal by 2025.[16]

Figure 3: Provincial Carbon Intensity, GDP, and Carbon Emissions in 2020[17]



Sources and notes: Provinces shown in orange lag in terms of progress towards 2030 carbon peaking goals, as shown in Figure 2. All data sourced from China's National Bureau of Statistics and the Carbon Emission Accounts & Datasets (CEADs) for emerging economies.

Hence, particular attention should be given to the provinces that are lagging behind, especially considering that they were also among the most carbon-intensive provinces in 2020, albeit with different attributes. As shown in Figure 3, for instance, Ningxia, aiming for a 16.5% reduction in carbon intensity in its 14th FYPs, had among the lowest GDP provinces in 2020, as well as relatively low carbon emissions. Its primary challenge therefore lies in bolstering economic growth without further increasing total carbon emissions, necessitating a green growth model to meet its carbon peaking goal. In contrast, Inner Mongolia, which is one of the highest carbon emitters combined with a low GDP in 2020, sets its carbon intensity reduction at the national target during the 14th FYP cycle. This target-setting might imply the underlying challenge faced by this coal-rich but undeveloped province in shifting towards a climate-friendly development path and away from an extractive industry-based economy.

15 State Council (2021a).
16 Beijing Government (2022).
17 Given that 2020 carbon intensity is the baseline for setting the 2025 targets, this report focuses on 2020 statistics to understand the differences between total carbon emissions and GDP that drive those lagging provinces for goal-setting.

Associated with carbon intensity targets, there is a notable absence of a defined cap on total carbon emissions in the 14th FYPs, despite the high expectations for one during the drafting period.[18] As a result, China's carbon emissions increased by 12% between 2020 and 2023, driven by an energy- and carbon-intensive response to the pandemic.[19] With GDP growth slowing down in the post-pandemic era, this trend of rising carbon emissions in absolute terms further deviates China from its carbon intensity target, which necessarily suggests a big leap in cutting carbon emissions to hit the 2025 goal in the remaining two years.[20]

Beyond the diverse interests that drive a mixed picture of target-setting for carbon intensity reduction, the target-setting dynamics also evolves profoundly due to greater flexibility as required to address tensions between central and provincial governments in adapting to a changing social and economic landscape, within this fragmented and hierarchical five-year planning system. This tension is prominent when considering the challenges observed in meeting energy intensity targets during the previous 13th FYP cycle (2015-2020). Although there is no official announcement regarding achieving energy intensity targets, it is highly likely that they were missed.[21] Specifically, in the northern region, Inner Mongolia, Shaanxi, and Ningxia encountered significant difficulties in reducing overall energy consumption by 2020 and their actual energy intensity increased.[22] In these provinces, the overly rapid approvals of numerous energy-intensive projects likely contributed to the difficulty in reaching the targets, which were deemed necessary to strategically ensure national energy security.[23] Moreover, these provinces, with access to cheap coal, have been inclined to increase energy consumption rather than prioritize energy efficiency measures. In particular, as relatively undeveloped provinces compared to coastal regions, they actively sought to attract energy-intensive industries that are less welcomed in coastal regions,[24] resulting in heavy and chemical industries increasingly contributing to their economic growth.[25] In the eastern and central regions, provinces were also under pressure to meet their energy consumption targets. For instance, Zhejiang had to inconvenience its residents by restricting power use to reach energy consumption control targets in 2020.[26]

2.2.2. USING DECARBONIZATION EFFORTS TO DRIVE BROADER ENVIRONMENTAL IMPROVEMENTS

In the 14th FYPs, environmental policies have evolved to prioritize carbon emission reductions, alongside efforts to improve air and water quality, protect and restore ecosystems, prevent soil pollution, and guard against hazardous waste risks.[27] A centerpiece of this strategy is coordinated governance,[28] where carbon reduction is used to bring other improvements along with it.[29] In the absence of a publicly released national 14th FYP for ecology and environmental protection, provincial FYPs demonstrate enhanced coordination in tackling climate change risks and environmental problems via two key avenues: (a) co-governance of greenhouse gas (GHG) emissions and major air pollutants; and (b) nature-based solutions (NbS) to deliver climate co-benefits.[30]

China's recent shift to a more integrated climate governance model enabled both of these avenues. In 2018, it established two new cabinet-level ministries: the Ministry of Ecology and Environment (MEE) and the Ministry of Natural Resources (MNR).[31] The MEE assumes a leading role in regulating climate

18 Baxter and Zhe (2019).
19 National Bureau of Statistics (2024); Myllyvirta (2024).
20 Myllyvirta (2024).
21 People's Daily (2020); Lushan (2021).
22 People's Daily (2020).
23 China Energy News (2021).
24 CGEP (2021).
25 People's Daily (2020).
26 China Energy News (2021).
27 Joe (2021).
28 Ministry of Ecology and Environment (2021).
29 The Paper (2021).
30 Ministry of Ecology and Environment (2021).
31 Xinhua News (2018).

risks and managing GHG emissions, having consolidated various environmental functions from other ministries.[32] This concentration of authority under the MEE underscores an increased recognition of coordinated governance in climate actions and environmental management in the policy-making arena. Moreover, with the MNR overseeing land use and planning,[33] these two ministries are able to implement a more consistent spatial planning system,[34] mapping out distinct urban, agricultural, and ecological zones with varying levels of development intensity tailored to specific purposes. In the 14th FYPs, this spatial planning system has manifested in two major programs: ecological conservation redlines[35] and a new network of nature reserves.[36] Within specific planned zones, ecological conservation redlines define areas in need of the strictest level of conservation, where no development activities are allowed. Many provincial FYPs establish nature reserves or parks to serve multiple environmental purposes and enhance carbon sequestration within designated zones.[37]

a. Co-control of GHG emissions and other air pollutants

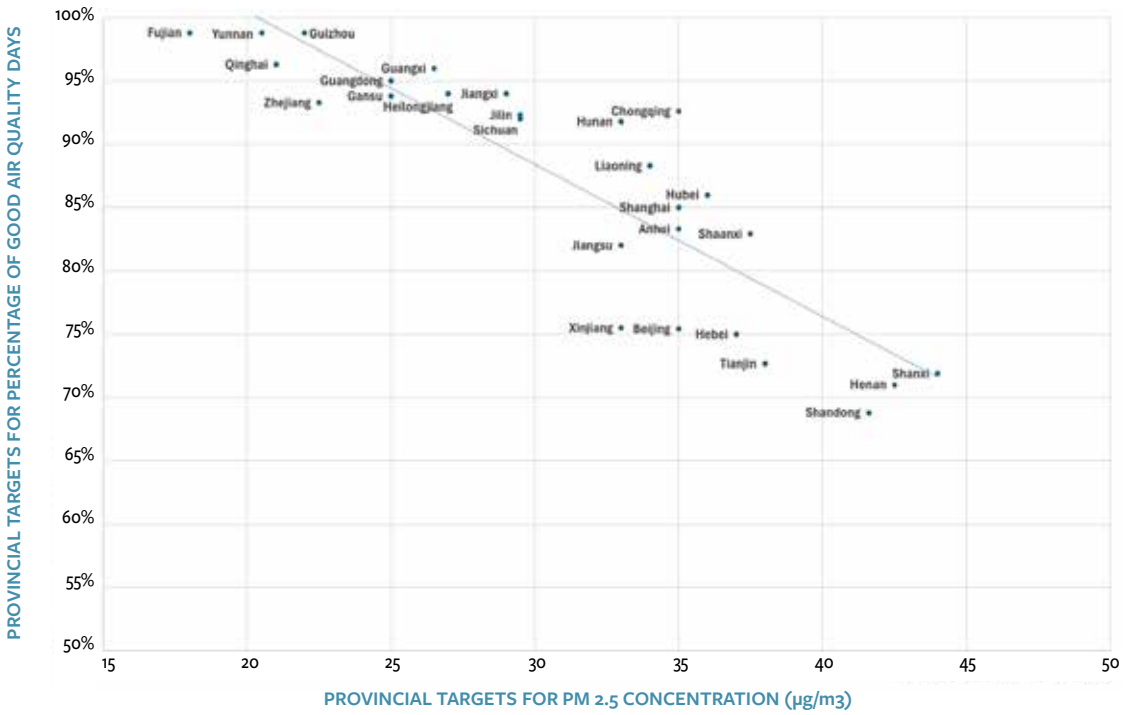
Despite significant improvements over the past decade, China's air quality still faces severe challenges. In 2020, for instance, 37% of China's 337 cities exceeded limits for particulate matter (PM 2.5), affecting 44% of its population.[38] Ozone pollution has also become increasingly severe. Between 2015 and 2020, the Jing-Jin-Ji region, the Yangtze River Delta, and Fenwei Plain experienced ozone increases of 24%, 18%, and 32%, respectively.[39] Climate change has worsened China's air quality. For instance, the effectiveness of the end-of-pipe treatment for pollutants has diminished[40] because climate change has both introduced additional air pollutants and weakened the atmospheric conditions necessary for dispersing them.[41] Hence, decarbonization efforts can drive significant air quality improvements.

In the 14th FYP cycle, GHG emissions and major air pollutants are being co-managed. The National 14th Five-Year Plan for Economic and Social Development introduced the idea of "synergizing the reduction of environmental pollution and carbon emissions" (协同推进减污降碳). The MEE, jointly with six other ministries, released the *Implementation Plan for Synergizing the Reduction of Pollution, Carbon Emissions, and Increased Efficiency*[42] to outline a coordinated plan to guide long-term actions. Subsequently, *Guiding Opinions on Coordinating and Strengthening Efforts to Address Climate Change and Environmental Protection*[43] aimed to incorporate climate change mitigation into the existing environmental monitoring system.

The National 14th Five-Year Plan for Economic and Social Development set targets for a 10% reduction in PM 2.5 concentration levels by 2025 from the 2020 level, as well as the elimination of heavily polluted days.[44] Provinces have translated these targets into two indicators: (a) the percentage of good air quality days (except Beijing, Fujian, Hainan, Inner Mongolia, Shandong, and Zhejiang); and (b) provincial PM 2.5 concentration levels. As shown in Figure 4, provinces in the bottom right (Shanxi, Henan, and Shandong) aim for modest targets for air quality, while provinces in the top left (Fujian, Yunnan, Guizhou, and Qinghai) set the most ambitious targets.[45]

32 Xinhua News (2018).
33 Ministry of Natural Resources (2023).
34 State Council (2019a).
35 State Council (2019b).
36 State Council (2019c).
37 Carbon sequestration secures carbon dioxide to prevent it from entering the Earth's atmosphere. This approach stabilizes carbon in solid or dissolved forms in terrestrial or ocean ecosystems so that it does not accumulate in the atmosphere and cause the Earth's surface to warm. See Carbon Sequestration (2021).
38 Chinese Academy of Environmental Planning (2021).
39 Chinese Academy of Environmental Planning (2021).
40 Lushan (2023).
41 Hong et al. (2019); Lushan (2023).
42 Ministry of Ecology and Environment et al. (2022).
43 Ministry of Ecology and Environment (2021).
44 Zhhjw News (2021).
45 Chinese Academy of Environmental Planning (2021).

Figure 4: Provincial 14th FYP Targets for PM 2.5 Concentrations and Good Air Quality Days



Efforts to synergize air pollution prevention and carbon reduction have also been translated into plans for numerous city clusters in several regions, including the "2+36" cities surrounding the Jing-Jin-Ji region (Beijing, Hebei, Shandong, Henan), the Yangtze River Delta (Shanghai, Jiangsu, Zhejiang, Anhui), and the Fenwei Plain (Shanxi and Shaanxi).[46] These plans go beyond traditional end-of-pipe control solutions to incorporate new strategies for clean energy and fuels, green transportation, and low-carbon industrial practices.[47] Achieving these targets has a long way to go, however. By the end of 2022, nearly a third of cities fell short of air quality standards[48] and the ratio of good air quality days continues to lag behind targets, as indicated in the NDRC's mid-evaluation report.[49]

b. A call for nature-based solutions

The 14th FYPs contain calls for synergy between climate action and ecosystem conservation and restoration efforts. This elevates the role of NbS in climate mitigation, with a focus on enhancing ecosystem carbon sequestration.[50] The MEE's *Guiding Opinions on Coordinating and Strengthening Efforts to Address Climate Change and Environmental Conservation*[51] entails improving ecosystem services through a more integrated monitoring, evaluation, and enforcement system.

The 14th FYPs also focus on the quality and stability of ecosystems. One approach prioritizes restoration and conservation projects in critical ecosystems, thereby creating ecological buffer zones. Designated projects for ecosystem restoration are underway in the Qinghai-Tibetan plateau, the Yellow River[52] and Yangtze River basins,[53] the northeastern forest shelterbelt,[54] the northern sand-prevention

46 State Council (2023).
47 Wang Jinnan (2023).
48 The Paper (2023a).
49 NDRC (2023).
50 This type of carbon sequestration is to store carbon dioxide in vegetation such as grasslands or forests, as well as in soils and oceans. See CLEAR Center (2019); Ministry of Ecology and Environment (2021).
51 Ministry of Ecology and Environment (2021).
52 United Nations (n.d.).
53 Development Projects (n.d.).
54 Three-North Shelterbelt Program (n.d.).

belt, southern hilly mountain areas, and coastal zones.[55] Additionally, the 14th FYPs require better conservation and management practices for rivers, lakes, and wetlands, deforestation and afforestation efforts, combating desertification, addressing rocky desertification, and restoring grasslands and wetlands.[56] In addition, they establish nature reserves and nature parks, creating a comprehensive network of protected areas designed to serve multiple environmental purposes.[57]

Moreover, the 14th provincial FYPs recognize the necessity of balancing economic interests with ecosystem restoration and conservation efforts. The spatial planning system has been restructured to ensure that natural resources are managed to support ecosystem services and increase carbon sequestration. In this regard, the spatial planning system incorporates ecological considerations, utilizing ecological conservation redline and zoning plans to safeguard designated areas from development. It also assesses the status and distribution of various ecosystems, such as forests, wetlands, agricultural fields and other ecosystems, assigning them values that correspond to their ecological functions.[58] Furthermore, to maintain consistency in land use and planning, ecological conservation redlines are implemented to identify strict conservation areas, which ultimately aim to protect 25% of China's entire land area and 30% of the nearby ocean.[59] For instance, in Hainan's 14th FYP for ecology and environmental protection, it designates crucial coastal ecosystems (e.g., mangroves, seabeds, and wetlands) for its ecological conservation redline policy[60] and mandates restoration projects to enhance its ecosystem carbon sequestration capacity.

3. Provincial Sectoral Climate Actions

This section examines provincial FYPs pertaining to China's most carbon-intensive sectors, including energy, industry, transportation, and buildings. It also explores measures and plans aimed at climate adaptation and mitigation. Within these provincial FYPs, there is a broad spectrum of interpretations, with some aligning with national targets and others diverging. Despite regional disparities, the focus here is on discussing provincial climate targets, noteworthy initiatives, and prominent programs to illuminate the dynamics within each sector.

3.1. ENERGY

Under the umbrella of *The National 14th Five-Year Plan for Promoting a Modern Energy System*,[61] *The National 14th Five-Year Plan for Economic and Social Development*,[62] and *The National 14th Five-Year Plan for Renewable Energy Development*,[63] provincial FYPs in the energy sector center on developing specific resources including renewable energy, hydrogen power, energy storage, and geothermal power, as well as addressing energy conservation and carbon reduction. Major projects in provincial FYPs commonly emphasize seven key areas of energy development: large-scale clean energy zones, coastal nuclear power, offshore wind, long-distance electricity transmission systems, power system flexibility, oil and gas transport, and energy storage capacity.[64]

As a whole, provinces remain committed to prioritizing non-fossil fuels, advancing renewable energy integration, and constructing more flexible energy systems in line with the national goal of building

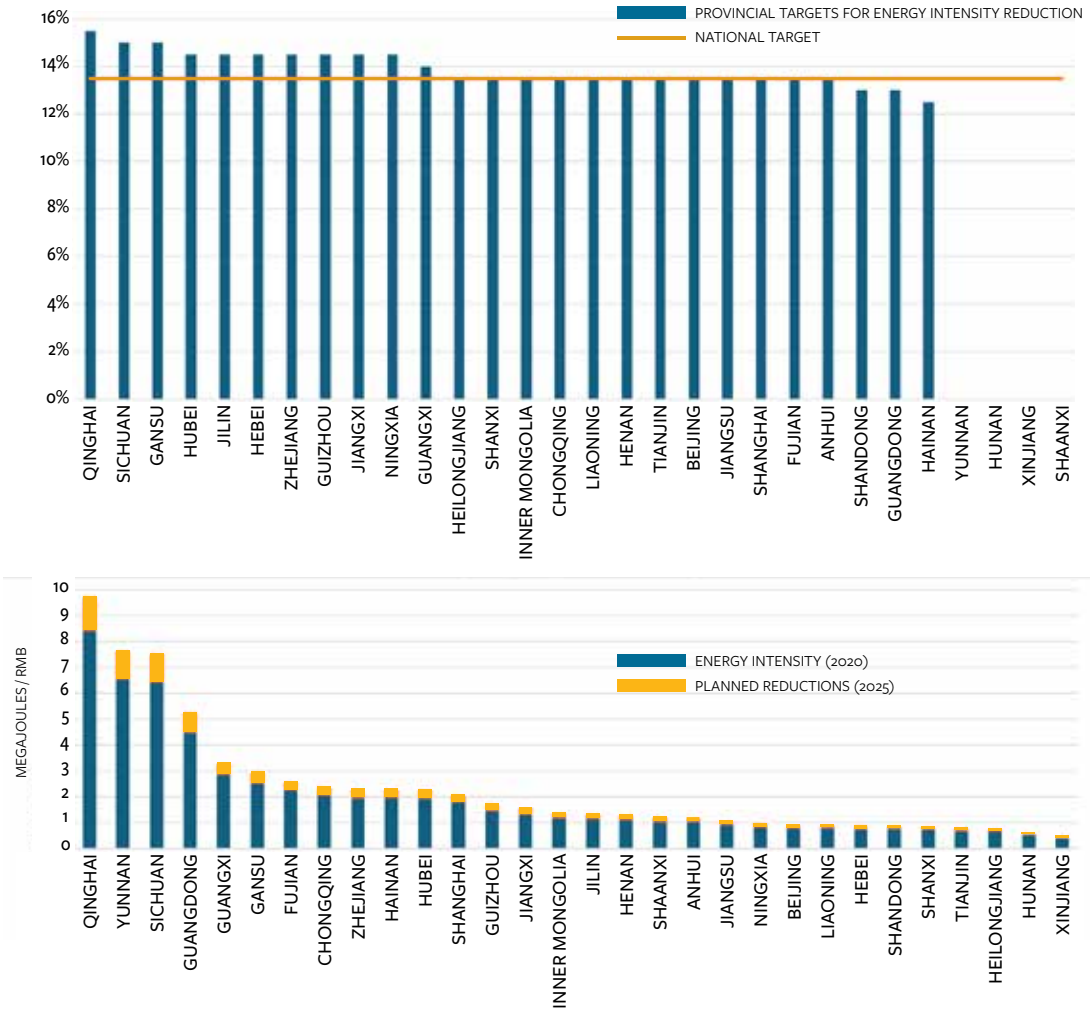
55 NDRC (2021b).
56 NDRC (2021b).
57 NDRC (2021b).
58 Ma (2018).
59 Jiang Xiaoping (2020); People's Daily (2017).
60 Hainan Department of Ecology and Environment (2021).
61 NDRC and NEA (2022).
62 State Council (2021a).
63 NDRC (2021a).
64 Carbon Brief (2021).

a "modern energy system."[65] Despite intentions to transition away from fossil fuels, provinces still prioritize coal as a "safety net" for stable energy supply or a baseload energy source. Due to both national energy security concerns and insufficient restrictions on coal investment, the 14th FYP period has proved to be a "window of opportunity" for new coal.

3.1.1. TARGETS FOR REDUCING ENERGY INTENSITY

The National 14th Five-Year Plan for Promoting a Modern Energy System sets a binding goal of reducing energy intensity by 13.5% below the 2020 level by 2025.[66] Provinces have either devised their own targets or aligned with the national goal, as illustrated in Figure 5. Accordingly, Shandong, Tianjin, and Inner Mongolia are aiming for the biggest reductions in energy intensity, while Guizhou, Guangxi, and

Figure 5: Provincial 14th FYP Targets for Energy Intensity Reduction



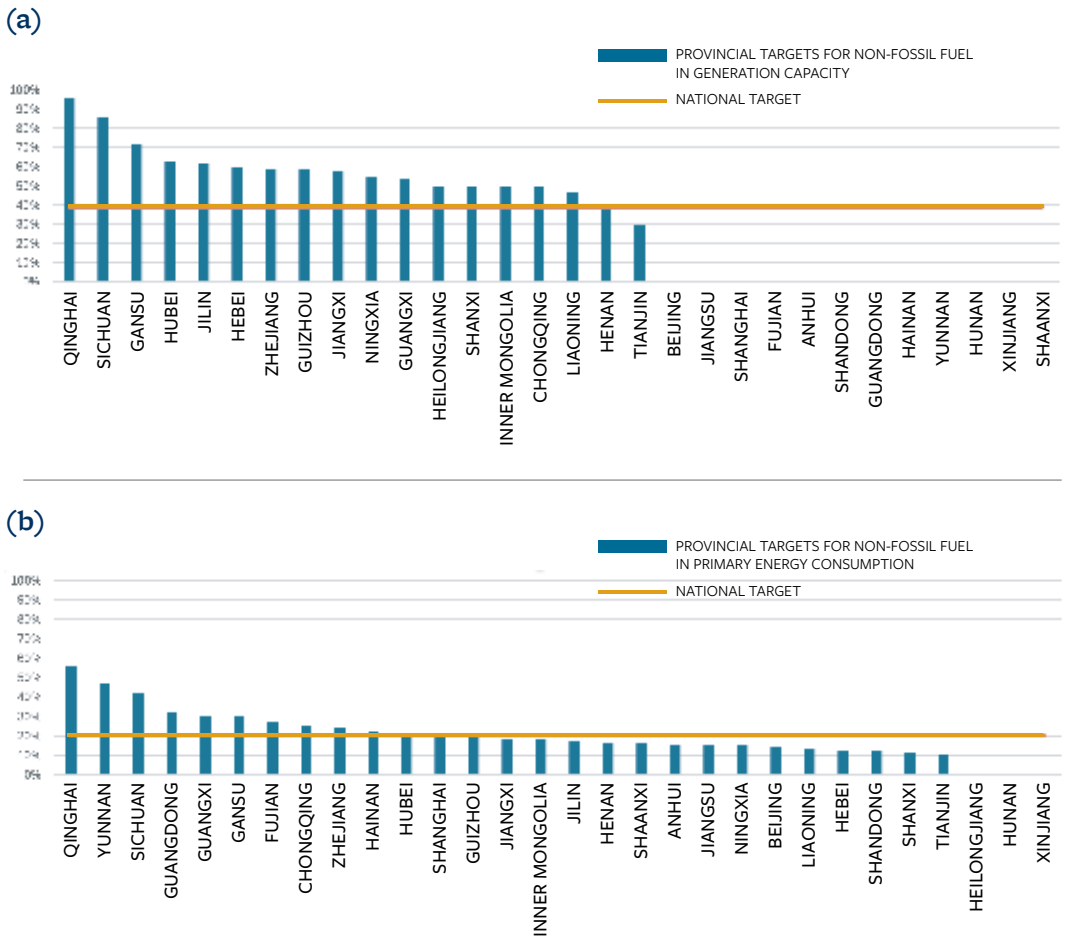
Sources and notes: Energy intensity is typically defined as the total amount of energy consumed per RMB of real GDP. China's energy data are from the China Energy Yearbook Editorial Board. Provincial GDP data are from China's National Bureau of Statistics. This report has converted from nominal to real GDP using a national GDP deflator for China from the World Bank's World Development Indicator series.

65 NDRC and NEA (2022).
66 NDRC and NEA (2022).

Gansu have set lower-than-national goals. Provinces with the highest energy intensity in 2020 – Ningxia, Shanxi, and Liaoning – are projected to remain the least energy-efficient regions in 2025.

According to the NDRC's mid-evaluation report, progress toward energy intensity reduction targets has slowed,[67] as energy intensity actually *increased* in 2023, marking the first annual rise since 2005.[68] For China to hit 2025 targets, absolute energy consumption must decrease over the next two years.[69] Faced with the imperative to accelerate national GDP growth, reaching energy intensity targets will be extremely challenging for provinces in the remaining years of the 14th FYP cycle. Consequently, the NDRC has summoned eight lagging provinces (Hubei, Shaanxi, Gansu, Qinghai, Zhejiang, Anhui, Guangdong, and Chongqing) to discuss enhanced actions for goal attainment.[70]

Figure 6: Provincial 14th FYP Targets for Non-fossil Fuels in (a) Generation Capacity and (b) Primary Energy Consumption



3.1.2. TARGETS FOR SHARES OF NON-FOSSIL FUELS

Two metrics are often employed to indicate clean energy deployment: (a) the share of non-fossil fuel in installed generation capacity; and (b) the share of non-fossil fuel in primary energy consumption. *The National 14th Five-Year Plan for Promoting a Modern Energy System* aims to raise the share of non-fossil fuel in generation capacity to 39% by 2025, and eighteen provinces have set related provincial

67 NDRC (2023).
68 Myllyvirta (2024).
69 Myllyvirta (2024).
70 Jiemian News (2024).

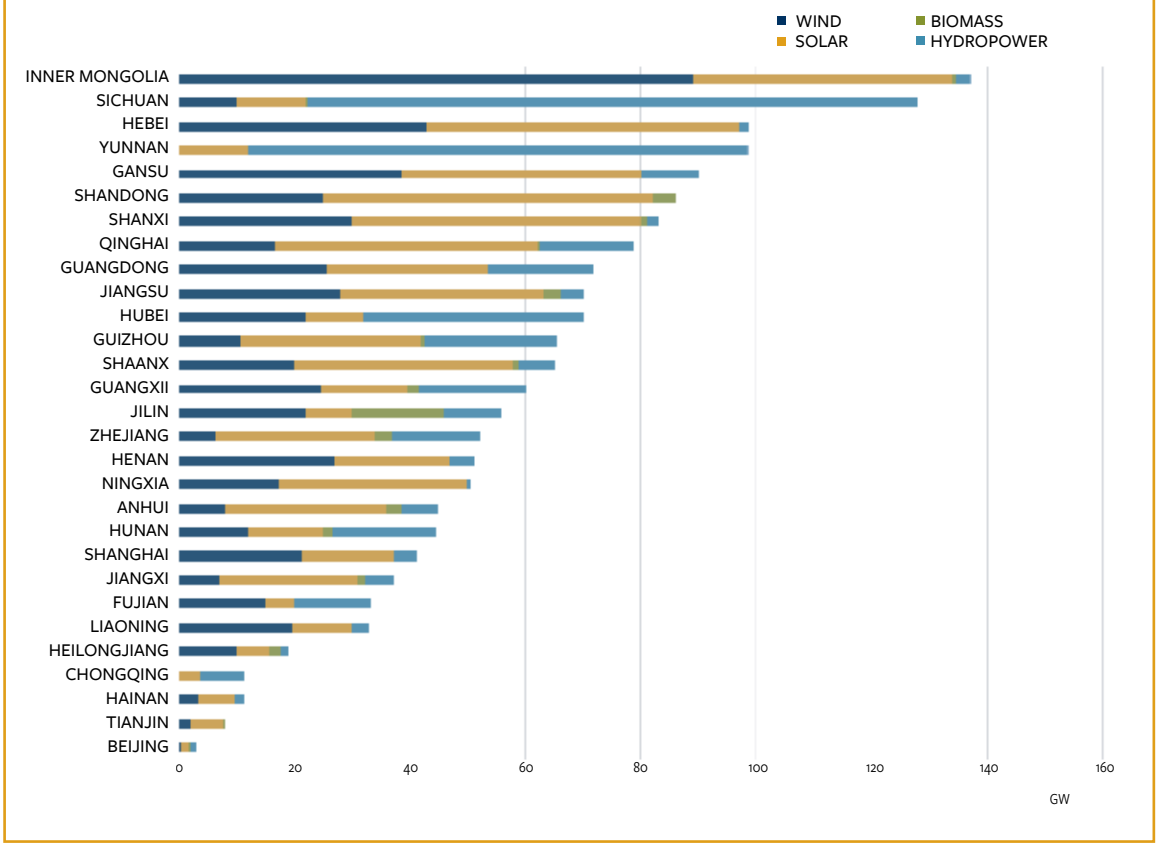
targets as shown in Figure 6. Sichuan, Qinghai, and Gansu aim for the largest shares of installed clean energy capacity, leveraging their abundant resources and advantages in building out large-scale clean energy zones.

In addition, *The National 14th Five-Year Plan for Promoting a Modern Energy System* sets a national target of increasing the share of non-fossil fuel in primary energy consumption to 20% by 2025. All provinces except Heilongjiang, Hunan, and Xinjiang have incorporated this target and half of provinces have set targets below the national level, with Qinghai, Yunnan, and Sichuan ranking among the most ambitious provinces. Qinghai stands out as the most ambitious province on both counts: it aims for non-fossil fuels to account for over half of its overall energy consumption and 90% of its installed capacity, with 70% of its electricity coming from wind and solar energy.[71]

3.1.3. ACCELERATING CLEAN ENERGY DEVELOPMENT WITH REGIONAL DIVERSITY

According to provincial plans, the collective capacity of installed renewable energy has significantly surpassed the national target. As illustrated in Figure 7, the planned combined capacity of solar and wind power by 2025 will exceed 1236 GW, surpassing China's 2030 carbon peaking goal of 1200 GW.[72]

Figure 7: Provincial 14th FYP Targets for Total Installed Renewable Energy Capacity in 2025



Sources and notes: Appendix B provides detailed descriptions of installed renewable energy capacities for each province. All data from provincial 14th FYPs for energy development. (Note: Xinjiang has no 14th FYP for energy development, and no numeric target for renewable energy could be found.)

71 Qinghai Government (2022).
72 State Council (2020).

Furthermore, hydropower capacity in provincial plans will reach over 423 GW by 2025, exceeding the national target of 380 GW.[73]

In keeping with regional disparities, provinces exhibit distinct priorities in clean energy development. In the western and northern regions, provinces designate large-scale clean energy zones as pillars to drive a clean energy transition in the 14th FYP cycle. These clean energy zones are situated in various regions including Xinjiang, the upstream of the Yellow River (primarily Qinghai), the Hexi Corridor (Gansu), North Hebei, the Song-Liao Plateau (including Heilongjiang, Jilin, and eastern Inner Mongolia), and the downstream of the Yellow River (primarily Henan and Shandong).[74]

As illustrated in Figure 7, Inner Mongolia has set the most ambitious target for combined wind and solar capacity (134 GW), while Gansu, Shandong, and Shanxi each plan to reach about 80 GW.75 Hebei, a northern industrial and manufacturing hub, has developed wind and solar capacity in Zhangjiakou to power the Winter Olympics and set a target of 97 GW by 2025.[76] Further, Shanxi and Inner Mongolia, renewable-rich provinces, continue to be powerhouses for serving regional and national demand, having added vast transmission networks and energy storage resources to serve the densely populated Jing-Jin-Ji (Beijing-Tianjin-North Hebei) metropolitan area. These strategic clean energy zones aim not only to advance cost-effective clean technologies, but also to vigorously reduce equipment and construction costs in industrial supply chains.[77]

Still, these clean energy zones encounter challenges from local conditions. For instance, in the Song-Liao Plateau, challenges arise in adapting the regional power grid to accommodate the rise of wind and solar power. The rigid system of dispatching traditional energy generators, combined with the presence of "must-run" combined heat and power (CHP) units, complicate renewable energy integration, particularly during winter when heating demand is highest.[78] Moreover, the aforementioned spatial planning system has exposed tensions between land use regulations governing agricultural and protected areas and the imperative to scale up large renewable projects.[79]

For China's eastern and southern regions – highly developed areas with substantial energy demand driven by economic growth – the challenge lies in maintaining a reliable energy supply while accelerating the clean energy transition. The strategy in these regions involves a push for distributed wind and solar power, particularly in industrial parks, large commercial properties, and data centers. This is complemented by specific plans for various energy storage technologies, referred to as "renewable energy plus storage."[80] Five large-scale offshore wind farms are planned in these regions: on the Shandong Peninsula, Yangtze River Delta (Jiangsu and Shanghai), Southern Fujian, Eastern Guangdong, and the Beibu Gulf (Guangxi).[81] As a result, coastal provinces are gearing up for offshore wind development. Guangdong aims to lead in offshore wind (OSW) installations, targeting a total capacity of 17 GW.[82] Meanwhile, Fujian, Jiangsu, Guangxi, and Zhejiang are all targeting OSW capacities ranging from 5 to 10 GW.[83] Shandong and Hainan are also actively pursuing OSW projects: Shandong plans for 35 GW of capacity by 2030, with 5 GW being added by 2025,[84] while Hainan has received approval from the National Energy Administration (NEA) to begin developing over 12 GW of OSW capacity in the 14th FYP cycle.[85] Nuclear power is also a significant component of the energy mix for some coastal provinces, with several nuclear projects scheduled to be completed by 2025.[86]

73 NDRC and NEA (2022).
74 NDRC (2021a).
75 Inner Mongolia Government (2022).
76 21st Century Business Herald (2021).
77 Mei et al. (2023).
78 Liaoning Government (2023).
79 Liaoning Government (2023).
80 Jiangsu Government (2022); Jiangsu Government (2022).
81 NDRC (2021a).
82 China Business Network (2023).
83 Wind Energy (2022).
84 Shandong Energy (2022).
85 China Energy News (2022).
86 These nuclear projects include the Hualong No.1 project, Guohe No.1 project, and a high-temperature gas-cooled reactor demonstration project. See NDRC and NEA (2022).

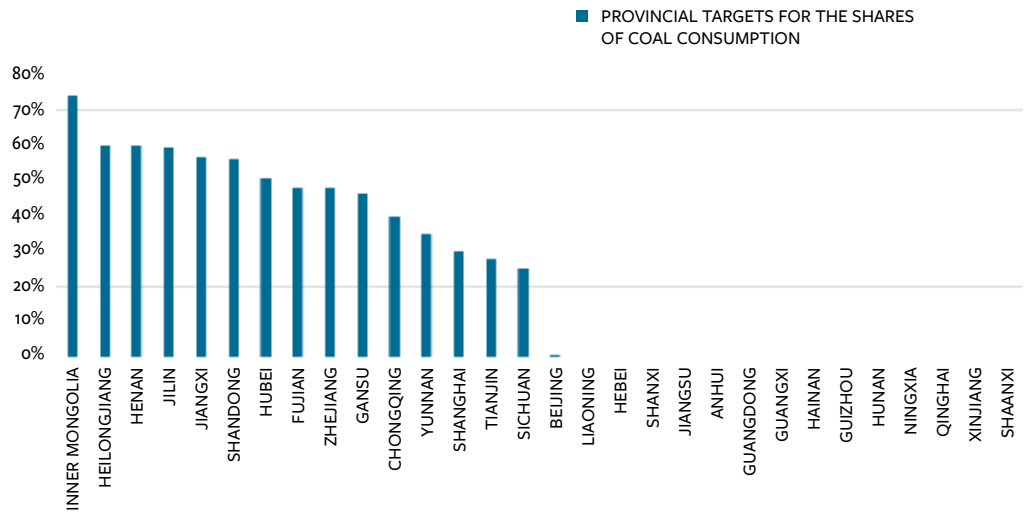
In the southwest region, Sichuan and Yunnan are at the forefront of China's hydropower development. These two provinces intend to develop hydropower zones totaling tens of millions of kilowatts with a combined capacity of over 190 GW (Figure 7), equivalent to 43% of China's total hydropower capacity.[87] However, this region experienced a historical decline in hydropower output from August 2022 to July 2023[88] due to record droughts, heatwaves, and low rainfall, significantly impacting national energy supply.[89] Hence, provincial plans in this region also prioritize solutions for seasonal capacity fluctuations by diversifying their energy mix, such as the "efficient, intelligent, and clean" use of coal in Yunnan.[90]

Driven by these large-scale clean energy zones, China has witnessed a substantial increase in clean energy installations in the post-pandemic period. Its solar, wind, and hydropower capacity added in 2023 alone is estimated to generate 423 terawatt-hours per year – equivalent to the total annual electricity consumption of France.[91] Moreover, the surge in clean energy installations has evidenced faster progress toward wind and solar targets than previously anticipated,[92] which may keep China's 2025 energy intensity targets within reach.[93]

3.1.4. A LACK OF CLARITY ON PHASING OUT COAL

In *The National 14th Five-Year Plan for Promoting a Modern Energy System*, energy security is portrayed as a matter of "mounting economic risk and a national security issue,"[94] which significantly influences how coal is approached in provincial plans. The wording about coal phaseout in provincial plans is vague. Fourteen provinces do not specify coal caps, as illustrated in Figure 8. Among the remaining sixteen provinces that do set caps, the shares of coal in the electricity mix vary significantly. Inner Mongolia, Heilongjiang, Jilin, and Henan anticipate coal to

Figure 8: Provincial 14th FYP Targets for the Shares of Coal Consumption



87 China Business Network (2023).
88 National Bureau of Statistics (2023).
89 Times (2023); Reuters (2022).
90 Yunnan Government (2023); Myllyvirta (2023).
91 Myllyvirta (2023).
92 Hedley (2024).
93 Myllyvirta (2024).
94 NDRC and NEA (2022).

contribute over 60% of their total electricity consumption,[95] while southwestern provinces with cleaner energy mixes expect a smaller coal share, such as Sichuan (25%)[96] and Yunnan (35%).[97] Shanghai, Beijing, and Tianjin have also set low coal caps (30%), possibly driven by strategic plans for using natural gas and geothermal energy.[98]

Despite almost all provinces expressing intentions to reduce coal consumption or control its increase, coal remains emphasized as a means of ensuring a reliable energy supply.99 Provincial 14th FYPs articulate two main approaches to dealing with coal: (a) upgrading coal-fired power units to operate in a cleaner and more efficient manner; and (b) retiring them from regular service for emergency use only. Notably, new coal capacity is still being introduced in China. For instance, new coal projects were approved in Shaanxi, Inner Mongolia, Shanxi, and Gansu between 2021 and 2023,[100] and China's People's Bank increased its refinancing quota to 300 billion yuan in support of coal utilization.[101] Consequently, there is a rush to secure permits for new coal among provinces. State-owned China Shenhua[102] and Inner Mongolia Energy Group[103] have highlighted their investments in building thermal power in Inner Mongolia, and Zhejiang's energy regulator officially emphasized seizing the opportunity to develop coal-fired power.[104] As a result, a total of 218 GW of new coal plants have been permitted since 2022, 89 GW of which had already started construction by the end of 2023.[105] Therefore, the 14th FYP period has seen an expansion of new coal, rather than new coal projects being "strictly controlled."[106]

The mixed messages around coal likely result from concerns about energy security and past power shortages that occurred while provincial energy plans were being drafted.[107] Generally, coal in China is considered a safety net to ensure a reliable energy supply, and coal-producing provinces like Shanxi lack coal consumption caps.[108] While the lack of clarity regarding coal's phaseout may not ultimately contradict the overall trend of reducing coal usage, it highlights the challenges faced by provinces that have relied on fossil fuels to stimulate regional economic growth and may be tempted to undertake new energy-intensive projects. The recent global rebound in carbon emissions is partly down to China's continued investment in coal, which has increased the risk of stranded assets and made the transition away from fossil fuels more complex and costly.[109]

3.2. INDUSTRY

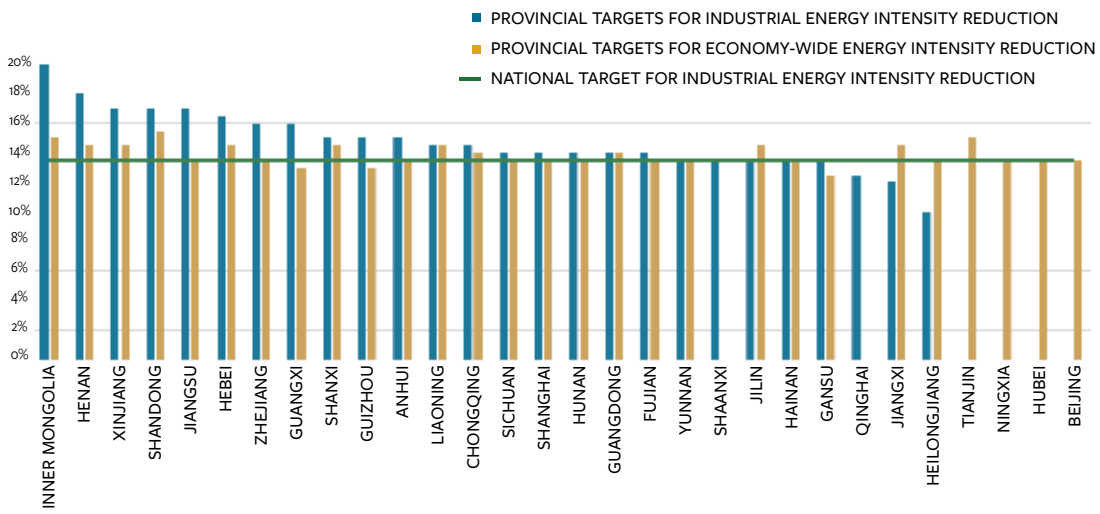
The industrial sector is a major source of China's carbon emissions, with the steel, cement and chemical industries all-consuming significant energy. [110] Guided by *The National 14th Five-Year Plan for Promoting Green Industry*, Hebei, Jiangxi, Sichuan, Yunnan and Gansu have devised provincial plans to facilitate the transition to low-carbon practices in the industrial sector. Some provinces have even outlined detailed FYPs for specific industrial segments, including manufacturing (Hebei, Fujian, and Hubei), low-carbon metallurgical development (Hubei), and new vehicle equipment (Jiangsu, Zhejiang, and Guangxi).

95 Inner Mongolia Government (2022a).
96 Sichuan Government (2022).
97 Yunnan Government (2023).
98 Beijing Government (2022); Tianjin Government (2022a); Shanghai Government (2022).
99 NDRC and NEA (2022).
100 The Paper (2023b); China Energy News (2023); Jiemian News (2022).
101 Xinhua News (2022).
102 Beijing News (2023).
103 State-owned Assets Supervision and Administration Commission of the State Council (2023).
104 NEA (2023).
105 Myllyvirta (2024).
106 NDRC and NEA (2022); Myllyvirta (2024).
107 Lushan 2022.
108 Shanxi Government (2022a); Shanxi Government (2022b).
109 IEA (2022).
110 Kahrl et al. (2023).

3.2.1. IMPROVING INDUSTRIAL ENERGY EFFICIENCY IN NORTHERN AND COASTAL REGIONS

The three largest coal-producing northern provinces, Shaanxi, Inner Mongolia, and Shanxi, collectively account for 70% of China's coal production.[111] With abundant access to energy resources, the northern region has evolved into a center for heavy industry that significantly contributes to China's overall carbon emissions. For instance, Hebei, the largest steel producer, surpassed Germany in total emissions in 2018, with coal-fired electricity accounting for 90% of its emission increase.[112] Shandong and Henan, the two leading aluminum-producing provinces,[113] and Inner Mongolia, known as the "energy hub" for its carbon-intensive metallurgy and coal chemicals industries, have the highest carbon emission rates per capita.[114] Eastern and southern coastal provinces also boast mature industries, supported by robust economic growth and substantial energy imports.[115]

Figure 9: Provincial 14th FYP Targets for Industrial and Economy-wide Energy Intensity



Guided by *The Implementation Plan for Carbon Peaking in the Industrial Sector*,[116] the national goal is to reduce industrial energy intensity by 13.5% below the 2020 level by 2025,[117] mirroring China's economy-wide target. As shown in Figure 9, all provinces other than Beijing, Tianjin, Ningxia, and Hubei have set industrial energy intensity targets. The largest national emitters, northern provinces (Inner Mongolia, Xinjiang, Henan, Hebei) and coastal provinces (Jiangsu, Shandong, and Zhejiang),[118] have set the most ambitious targets (16-20%). These targets are higher than their economy-wide energy intensity reduction targets, which indicate a concentrated effort in their industrial sector to achieve overall energy intensity reduction. In contrast, Jiangxi, Qinghai, and Heilongjiang opted for a less ambitious target (12% or 10%), below the national rate.

111 Zhang Yu (2021).
112 CGEP (2021).
113 CGEP (2021).
114 Jiang X (2021).
115 CGEP (2021).
116 Ministry of Industry and Information Technology et al. (2022).
117 Ministry of Industry and Information Technology et al. (2022).
118 Jiang X (2021).

3.2.2. COMMON APPROACHES TO PROMOTING GREEN PRACTICES

Table 1: Actions to Promote Green Industry in Four Provinces (Sichuan, Yunnan, Hebei, And Gansu)

AREA	APPROACH	ACTIONS AND NOTABLE PROGRAMS
INDUSTRY PRACTICES	▪ Optimize industrial land use ▪ Green transformation in traditional industries ▪ New green industry development	▪ Emphasize regional development built on local resources, conditions, and industrial foundations ▪ Key industries (e.g., steel, construction materials, petrochemicals, machinery, textiles, paper) undergo technological upgrades, equipment renewal, and transformation ▪ Develop new green industries, including new materials, energy storage, prosumer energy vehicles, ultra-low-energy consumption building materials, advanced materials, energy and chemical engineering, pharmaceuticals and health, aerospace
CARBON REDUCTION	▪ Develop low-carbon technologies ▪ Implement low-carbon demonstration projects	▪ Facilitate technical breakthroughs in clean and efficient utilization of fossil energy, energy storage, advanced hydrogen production and storage, carbon capture, utilization and storage (CCUS) ▪ Demonstration projects on hydrogen energy storage, near-zero emission power generation, large-scale CCUS
ENERGY EFFICIENCY	▪ Energy-saving technology upgrades ▪ Optimize energy use ▪ Industrial energy conservation management	▪ Reduce carbon in energy consumption and increase utilization efficiency ▪ Develop comprehensive plans for energy-saving technology upgrades in key industries such as steel, construction materials, and petrochemicals ▪ Reasonably control fossil energy consumption, guide natural gas consumption in an orderly manner
WATER EFFICIENCY	▪ Water resource management ▪ Water-saving technology upgrades ▪ Water treatment, recycling and reuse	▪ Sichuan introduces China's strictest water management system ▪ Upgrade high water-consuming industries, such as steel, petrochemicals, papermaking, non-ferrous metals, foods
RESOURCE UTILIZATION	▪ Resource recycling and utilization ▪ Industrial solid waste utilization	▪ Hebei introduces efficient utilization of recycled resources in manufacturing industries ▪ Yunnan emphasizes efficient development and utilization of mineral resources
GREEN PRODUCTION	▪ Focus on process steps with significant emissions of key pollutants in key industries ▪ Upgrade end-of-pipe treatment facilities	▪ Yunnan adopts clean production audit model
GREEN MANUFACTURING	▪ Green product design ▪ Creation of green factories ▪ Establishment of green industrial parks ▪ Development of green supply chains	▪ Sichuan intends to develop green standard system for manufacturing

The transition to low-carbon practices in the industrial sector extends beyond specific industries. The sector encompasses a wide array of industries, each with varying energy demands and requiring distinct decarbonization approaches. In this regard, provincial efforts are influenced by various factors such as national priorities, provincial-level industrial productivity, and comparative advantages.[119] Moreover, the sector's low-carbon transformation is directly or indirectly subject to regulations and/or standards in other sectors. For instance, in Jiangsu, energy efficiency programs for manufacturing facilities are directly regulated by environmental and technical standards mandated for low-carbon industrial parks.[120]

Moreover, provinces with existing FYPs for promoting green industries (Sichuan, Yunnan, Hebei, and Gansu) have adopted comprehensive approaches to the low-carbon transformation of the industrial sector, as illustrated in Table 2. They prioritize the efficient use of resources along with green transformations in major carbon-intensive industries and in energy consumption and production.

The resource-rich provinces - Shanxi, Inner Mongolia, and Anhui- have continued to follow a resource-driven industrial model, producing FYPs for the coal industry and for resource utilization.[121] In contrast, Jiangsu and Zhejiang leverage their strong industrial foundations to enhance the competitiveness of their new vehicle industries, emphasizing battery technology, industrial supply chains, core technology research, product design, and integration with other fields such as new infrastructure.[122]

3.3. TRANSPORTATION

At the national level, there are two primary plans for green mobility: *The National 14th Five-Year Plan for Developing a Modern Comprehensive Transportation System*[123] and *The National 14th Five-Year Plan for Green Transportation*.[124] Accordingly, all but two provinces (Xinjiang and Inner Mongolia) formulate FYPs for transportation, and seven provinces (Shanghai, Jiangsu, Tianjin, Shanxi, Guangxi, Jiangxi, Yunnan) develop FYPs specifically for green transportation.

3.3.1. DIVERSITY IN CARBON INTENSITY REDUCTION TARGETS

Variations in economic conditions and geographical factors shape provincial commitments to promoting clean transportation, which are reflected in the diversity of carbon reduction targets for transportation in provincial 14th FYPs. Following the national target of a 5% cut in carbon intensity by 2025 compared to the 2020 level,[125] twenty-one provinces have established transportation sector targets. As shown in Figure 10, Guangxi has demonstrated the most ambitious reduction goal (6%), while Shaanxi, Sichuan, Fujian, and Jiangsu have set lower targets (3%). About a third of provinces did not set a carbon intensity reduction goal for the transportation sector in their 14th FYPs.

Seven provincial FYPs for green transportation contributed much discussion on decarbonizing transportation in the 14th FYP cycle. With the exception of Yunnan, all of these provinces saw increased transportation sector carbon emissions between 2012 and 2019.[126] Among the seven FYPs for green transportation, Shanxi focuses on adopting electric heavy trucks and encourages large-scale industrial and mining enterprises to use greener transportation methods, such as railways and clean energy vehicles, for transporting coal, ore, coke, and other products.[127] In contrast, Shanghai and Jiangsu prioritize the development of multi-modal transportation systems to integrate railway and

119 Wu et al. (2019).
120 Suzhou Industrial Park Economic and Trade Development Bureau (2016).
121 Anhui Government (2022); Shanxi Government (2022c); Inner Mongolia Government (2022b).
122 Jiangsu Government (2021a); Zhejiang Government (2022).
123 State Council (2021c).
124 Ministry of Transportation (2021).
125 State Council (2021c).
126 World Resources Institute (2023).
127 Shanxi Government (2022d).

Figure 10: Provincial 14th FYP Carbon Intensity Targets for the Transportation Sector

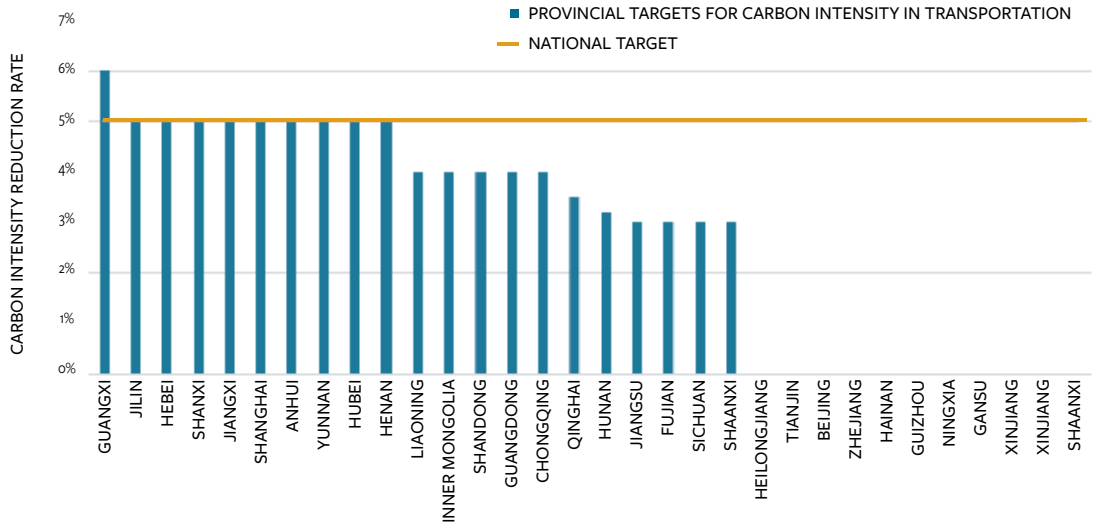


Table 2: Common Green Transportation Strategies in Provincial 14th FYPs

STRATEGY	APPROACH	ACTIONS AND NOTABLE PROGRAMS
CO-CONTROLLING AIR POLLUTION AND CARBON EMISSION	▪ More stringent carbon emission standards ▪ Address ship and port pollution	▪ Phase out diesel vehicles ▪ Improve emission inspection and monitoring systems ▪ Improve environmental testing and regulatory compliance systems
ELECTRIFICATION WITH RENEWABLE ENERGY	▪ Deployment of new energy vehicles (NEVs) and clean ships ▪ Expansion of charging facilities and stations	▪ Deployment of NEVs in bus, taxi, and logistics fleets ▪ Promotion of electric delivery trucks and hydrogen fuel cell vehicles ▪ Shore power systems at berths
UPGRADING GREEN INFRASTRUCTURE	▪ Green highways ▪ Green waterways ▪ Green ports	▪ Environmental protection throughout planning, construction, and operation processes ▪ Avoid environmentally sensitive areas ▪ Green land and ecosystem restoration along highways, waterways, and ports for carbon sinks
EFFICIENT USE OF RESOURCES	▪ Use and re-use of recycled and waste materials	▪ Reuse coal ash in Shanxi, Shaanxi, and Inner Mongolia ▪ Reuse steelmaking slag and waste materials from buildings in Hebei, Shandong, Jiangsu ▪ Recycle materials for building highways

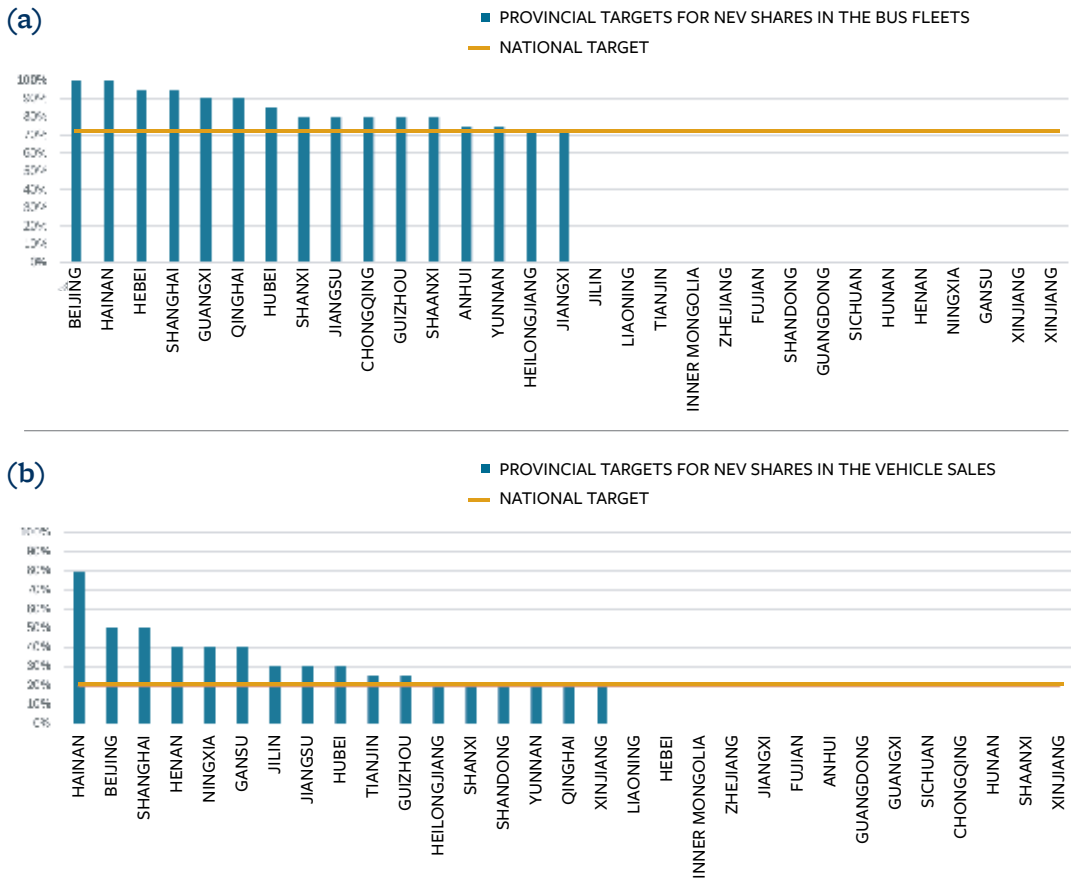
shipping systems, aiming to establish an international transportation center in Shanghai.[128] Jiangsu also aims to advance green freight delivery and implement smart logistics solutions.[129] Located in the northern Bohai Gulf region, Tianjin prioritizes the development of a green port equipped with low-carbon facilities and a shore power system.[130] In the southern Beibu Gulf region, Guangxi shares similar interests in building green ports, coupled with developing its inland green waterways.[131] Jiangxi, on the other hand, focuses on inland green waterway transportation and seeks to establish multi-modal transportation networks that integrate water and rail systems.[132]

128 Shanghai Government (2023); Jiangsu Government (2021b).
129 Jiangsu Government (2021b).
130 Tianjin Government (2022b).
131 Guangxi Government (2022).
132 Jiangxi Government (2021).

3.3.2. COMMON DECARBONIZATION STRATEGIES

All provinces signal a shift towards rail transportation and shipping for mid- and long-haul bulk transportation, moving away from traditional on-road freight. Moreover, they intend to integrate ecological preservation and restoration efforts into the planning and construction of highways and waterways. This restricts potentially damaging projects in ecologically sensitive regions while advancing sustainable land use practices and ecological restoration efforts. For instance, Shanxi's 14th FYP for green transportation prioritizes soil and water preservation in efforts to develop waterways in the Yellow River and highways near Taihang Mountain.[133] In summary, provinces have commonly approached decarbonization by introducing initiatives to promote electrification with clean energy, develop low-carbon infrastructure, reduce air pollution and carbon emissions, and enhance efficient use of resources, as outlined in Table 3.

Figure 11: Provincial 14th FYP Targets for NEV Shares in (a) Bus Fleets and (b) Vehicle Sales



3.3.3. ELECTRIFYING VEHICLE FLEETS

Electrifying vehicle fleets is a key strategy for reducing China's carbon emissions. The National 14th Five-Year Plan for Green Transportation outlines a goal to increase the share of new energy vehicles (NEVs)[134] in the public bus fleet to 72%.[135] All provinces actively promote clean public transit for daily

133 Shanxi government (2022).
134 In China, "new energy vehicles" (NEVs) refer to those with power systems that are completely or mainly driven by new energy sources. NEVs include plug-in hybrid electric vehicles, battery electric vehicles, and fuel cell electric vehicles. See International Council on Clean Transportation (2018).
135 State Council (2021c).

commuting, and 19 provinces have set NEV targets for bus fleets. Hainan, Liaoning, Shandong, and Hunan aim to electrify all new buses, while 16 provinces seek to increase the share of NEVs in bus fleets. Hainan and Beijing aspire to become 100% NEV bus regions, as illustrated in Figure 11. For the private sector, the national target is to boost NEV sales to 20% or more of total sales.[136] Hainan leads in setting NEV targets to comprise 80% of total vehicle sales, followed by Beijing and Shanghai at 50%.[137]

3.4. BUILDINGS

The National 14th Five-Year Plan for Energy Conservation and Green Building provides a framework for reducing emissions in the construction and building sectors, focusing on improving energy efficiency and using renewable energy for onsite consumption.[138] Subsequently, 26 provinces incorporate low-carbon initiatives to advance energy efficiency and green buildings. Nine provinces develop FYPs for urban and rural housing development featuring dedicated sections on green building practices, while 17 provinces specify FYPs for energy conservation and green buildings.

Table 3: Energy Efficiency and Green Building Strategies in Provincial 14th FYPs

STRATEGIES	ACTIONS			
DEMAND-ORIENTED STRATEGY	Increased energy efficiency of residential and public buildings	Increased scale of energy-saving retrofit buildings	Solar PV installations and geothermal energy applications in buildings	Increased scale of low-carbon or near-zero-carbon energy buildings and/or communities
TECHNOLOGY-ORIENTED STRATEGY	More stringent design standards for energy-efficient new buildings	Energy efficiency retrofits for existing residential buildings	Application of renewable energy and electrification in buildings	Energy efficiency initiatives and pilot programs
PROCESS CONTROL STRATEGY	Green designs following green building general code	Utilization of green materials and production methods	Standardized construction system	Smart and sophisticated management and operation
SUSTAINABLE OPERATION STRATEGY	Energy efficiency labeling system	Carbon emission monitoring and accounting systems	Deployment of energy management contracts	R&D in innovative new low-carbon technologies

Following the national target for achieving a 30% improvement in energy efficiency in buildings,[139] provincial FYPs have introduced two primary strategies: (a) implementing a green building standard for new construction, and (b) retrofitting existing buildings. For new buildings, nearly all provinces aim to use green building standards in new construction. For instance, Hainan and Inner Mongolia target 80% and 60%, respectively.[140] Notably, the term "green building" in China has a very broad definition, referring to structures that, over their entire lifecycle, maximize resource savings, protect the environment, reduce pollution, and provide residents with healthy, adaptable, and efficient use

136 Ministry of Transportation (2021).
137 Beijing Government (2022); Shanghai Government (2023).
138 Ministry of Housing and Urban-Rural Development (2022).
139 Ministry of Housing and Urban-Rural Development (2022).
140 China Briefing News (2022).

of space.[141] For existing building retrofit programs, targets are typically measured by the number of square meters of building area that have undergone retrofitting. Provinces along the eastern coast tend to be more ambitious with retrofits, but the success of these initiatives largely depends on the willingness of property owners to participate.

Moreover, following the national target of using renewable energy to reach at 8% of onsite consumption, provincial targets are generally consistent with the national rate, with eastern provinces tending to be more ambitious (10%). Furthermore, although provincial FYPs commonly emphasize rooftop solar for onsite consumption, this is customized based on specific geographic locations and resource availability. For instance, in Chongqing and Sichuan, near the Sichuan Basin, solar energy requirements are relaxed because the local solar resource is relatively poor. Instead, Chongqing is exploring alternative renewable resources such as geothermal energy.

Applying green building materials is another focus of decarbonization efforts in the building sector. *The General Code for Building Energy Conservation and Renewable Energy* identifies 51 types of green building materials,[142] including prefabricated components, steel-structure housing, and modern timber frame and masonry materials. Insulation materials used in northern China and ready-mixed concrete are also included,[143] while prefabricated buildings are given the most attention overall. At the provincial level, Anhui, Shanghai, and Yunnan have devised specific FYPs for developing prefabricated buildings. Provincial governments play crucial roles in promoting green building materials, partly due to national mandates and incentives for procuring green materials for public buildings.[144] Provinces also proactively develop design standards for green materials and ensure their application in new and retrofitted public buildings.[145]

3.5. CLIMATE CHANGE ADAPTATION

During the 14th FYP cycle, while no national FYP was developed for climate change adaptation, 11 provinces formulated their own FYPs for addressing it.[146] In 2022, China published *National Climate Change Adaptation Strategy 2035* to provide guidance on climate adaptation actions,[147] and Sichuan and Jilin then released their individual adaptation action plans.

3.5.1. REGIONAL DIFFERENCES IN CLIMATE IMPACTS

Adapting to climate change in China presents a multifaceted challenge due to the country's diverse climate and the variety of risks facing different regions. For instance, Jilin, in the northeast, has a climate adaptation plan and is experiencing a faster warming rate than the national average. While this warming could benefit the province's agriculture, it also increases the risks of summer flooding, wetland degradation, and permafrost vulnerability.148 Given the northeast's critical role in China's food security, Jilin's adaptation efforts prioritize farming and agriculture.149 Meanwhile, Inner Mongolia is grappling with increasing warming and drying trends that pose threats to the agriculture and livestock industries.150 Beijing is dealing with issues such as water scarcity, heavy rainfall and flooding, and

141 Ministry of Housing and Urban-Rural Development (n.d.).
142 Ministry of Housing and Urban-Rural Development (n.d.).
143 Xue et al. (2023).
144 Ministry of Housing and Urban-Rural Development and Ministry of Finance (2020).
145 State Administration for Market Regulation et al. (2019).
146 The 14th FYPs for Addressing Climate Change were developed by Inner Mongolia, Beijing, Jiangsu, Zhejiang, Jiangxi, Anhui, Shandong, Guangdong, Chongqing, Yunnan, and Ningxia.
147 Ministry of Ecology and Environment (2022).
148 Ministry of Ecology and Environment (2022).
149 Jilin Government (2023).
150 Inner Mongolia Government (2021).

the urban heat island effect.[151] Coastal areas, including Jiangsu, Zhejiang, Shandong, and Guangdong, contend with intensified typhoons, urban flooding, heat waves, and rising sea levels. Inland provinces, Hubei and Jiangxi, frequently experience droughts and floods, putting their lakes and wetlands at risk of ecological degradation and biodiversity loss.[152] Ningxia, in the northwest, is experiencing accelerated snow and ice melt, snowmelt flooding, and increased vulnerability of water resources and ecosystems.[153] Sichuan, Chongqing, and Yunnan face worsening winter and spring droughts, necessitating urgent water and soil conservation, desertification management, and biodiversity protection efforts,[154] especially considering the region's significance as an ecological barrier for the Qinghai-Tibet Plateau. Furthermore, major strategic regions including the Jing-Jin-Ji region, Yangtze delta zone, Greater Bay Area, and Yellow River Basin are typically vulnerable to multiple climate risks, which are exacerbated by their population, resource, environmental, and economic complexities.[155]

3.5.2. PROVINCIAL PLANS FOR CLIMATE ADAPTATION

In the 14th FYP cycle, addressing climate change is not uniformly integrated into provincial FYPs but there is much discussion about climate adaptation in regions with vulnerable climates, particularly coastal provinces and the southwest. While FYPs don't distinguish between adaptation and mitigation actions, they do reiterate the importance of carbon emission reduction across the energy, transportation, and industrial sectors as well as ecological and environmental protection as part of broader climate initiatives. Further, all provincial FYPs for addressing climate change include government-led adaptation strategies. These strategies center on proactively developing regulatory frameworks to adapt to climate impacts, advance climate-related technologies, and bolster capacities for reducing climate risks, as detailed in Table 4.

Provincial climate adaptation strategies focus on regulatory capacity building, which relies on developing monitoring and assessment systems for climate-related risks. Special attention is given to areas related to food security, as well as climate-sensitive industries such as agriculture and tourism. Plans also emphasize using all possible financial resources. Furthermore, as climate change introduces a layer of complexity at a time when provinces are already striving to improve healthcare systems and living standards, public health is viewed as integral to the broader process of climate adaptation.

Due to the diversity of regional climate impacts, provincial FYPs incorporate specific measures tailored to local context. Coastal provinces Jiangsu and Guangdong prioritize enhancing coastal climate resilience through marine ecosystem restoration initiatives, disaster responses, and warning systems. They commit to strict protection and regulation of marine ecological conservation redlines while bolstering risk assessment mechanisms for marine disasters and emergency events in vulnerable coastal areas, supported by enhanced monitoring and weather forecasting systems.[156] Meanwhile, Hubei and Anhui focus on measures concerning the preservation of lakes and reservoirs and challenges from rocky desertification and soil erosion.[157] They also address the tourism and transportation sectors, integrating extreme weather monitoring and warning systems into urban transportation planning and construction in disaster-prone areas, thereby enhancing emergency response capabilities.

In the west, Yunnan and Ningxia focus on ecologically vulnerable areas. Their adaptation efforts involve implementing restoration and protection projects in plateau lake basins, high-altitude mountain areas, rocky desertification regions, and abandoned mines.[158] Inner Mongolia seeks to develop adaptive

151 Beijing Government (2022d).
152 Jiangxi Government (2022); Hubei Government (2022).
153 Ningxia Government (2022).
154 Sichuan Government (n.d.); Chongqing Government (2022); Yunnan Government (2022).
155 Ministry of Ecology and Environment (2022).
156 Jiangsu Government (2022c); Guangdong Government (2022b).
157 Hubei Government (2022); Anhui Government (2023).
158 Ningxia Government (2022); Yunnan Government (2022).

Table 4: Climate Adaptation Strategies in Provincial 14th FYPs

STRATEGY	APPROACH	ACTIONS AND NOTABLE PROGRAMS
NATURE-BASED ADAPTATION	▪ Water management ▪ Forestry adaptation ▪ Adaptation of ecologically vulnerable areas	▪ Strict water use management, with caps on total consumption and intensity ▪ Climate-adaptive technologies for tree species improvement ▪ Enhance forest resilience to risks such as fire, pest disasters, etc. ▪ Restore and protect desertification and rocky desertification regions, reservoirs, abandoned mines, etc. ▪ Build national parks
URBAN ADAPTATION	▪ Enhance resiliency of energy infrastructure ▪ Develop flood control and drainage facilities ▪ Ensure urban lifeline systems	▪ Enhance resilience of critical urban facilities in buildings, transportation, water supply and drainage, and energy to extreme weather ▪ Pilot programs on climate-adaptive cities and "sponge cities" to absorb flooding ▪ Energy infrastructure construction, such as grid construction and natural gas supply assurance, for energy security ▪ Flood control and drainage engineering systems ▪ Water supply facility upgrades ▪ Urban green roof projects
INDUSTRY ADAPTATION	▪ Sustainable practices in agriculture and food production ▪ Climate-resilient tourism	▪ Smart agriculture through efficient, climate-adaptive technologies ▪ Build climate-adaptive industrial parks ▪ Tourism infrastructure construction and project design for risk resilience and conservation of cultural and natural heritage
CLIMATE RISK RESPONSES	▪ Disaster prediction and early warning systems ▪ Disaster prevention and relief systems	▪ Meteorological prediction and early warning systems for climate change monitoring, impact assessment, and response ▪ Enhance meteorological and emergency response capabilities
PUBLIC HEALTH	▪ Synergies between climate change adaptation and public health	▪ Disease prevention and control related to climate change ▪ Enhance public health under extreme climate conditions ▪ Emphasis on vulnerable populations ▪ Conduct health risk assessments
GOVERNANCE	▪ Regulatory improvements ▪ Financial management ▪ Enhanced coordination efforts	▪ Build carbon market, issue carbon bonds, and incentivize carbon finance ▪ Promulgate climate directives and regulations ▪ Build platform for carbon data disclosure

infrastructure to enhance disaster resilience for its livestock sector.[159] Strategic areas like the Greater Bay Area prioritize measures related to resistance, recovery, and management of impacts from typhoons, storms, heavy rainfall, and urban flooding. They aim to coordinate monitoring, warning, and emergency response efforts for sea-level rise, typhoons, and marine disasters; construct comprehensive disaster

159 Inner Mongolia Government (2021).

prevention and relief systems for flood and typhoons, based on data and information sharing; and establish coastal buffers.[160]

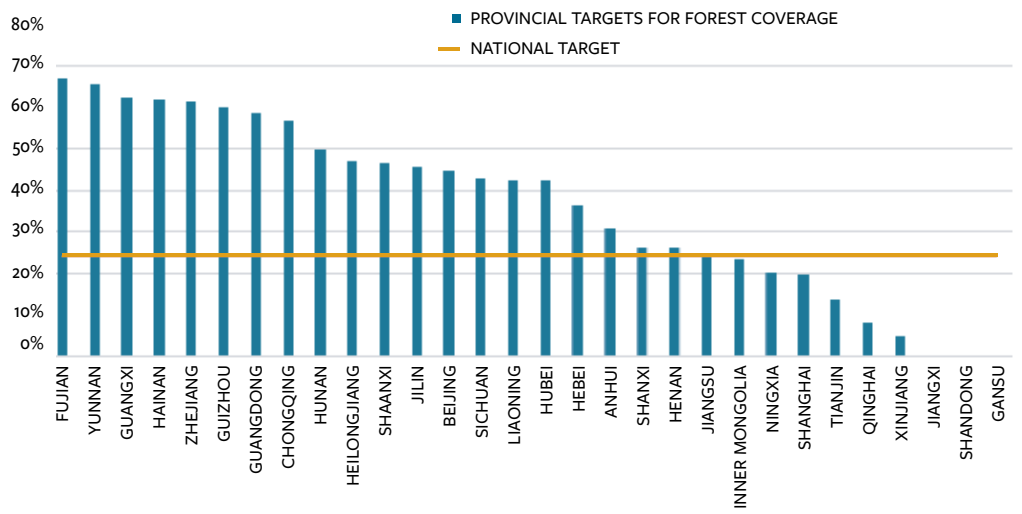
While there has traditionally been a strong emphasis on tactical responses to climate change and disaster relief efforts, there are growing calls for the planning system to develop long-term strategies for rebuilding communities and enhancing climate resilience for the next two to three decades.[161] Because awareness and action remain limited at the grassroots level, specific national plans may be necessary to guide local actions on risk management and emergency response. This dynamic highlights the importance of combining top-down and bottom-up approaches in the planning process, integrating information from all levels to ensure effective policy decisions and local implementation.

3.6. NATURE-BASED CLIMATE SOLUTIONS

The concept of nature-based solutions (NbS) emerged in 2008, in acknowledgement of the crucial role that biodiversity and ecosystem services can play in mitigating climate change.[162] The International Union for Conservation of Nature, an early advocate, defines NbSs as actions that seek to protect, sustainably manage, and restore natural or modified ecosystems to effectively address societal challenges while providing benefits for human well-being and biodiversity.[163] While NbS lacks a consistent framework for implementation, it is frequently mentioned as a tool for climate adaptation and mitigation via ecosystem conservation and restoration projects. In the 14th FYP cycle, all provinces have developed FYPs for ecology and environmental protection, some of whose actions or projects fall under the NbS category. Additionally, certain ecosystem protection and preservation measures outlined in provincial FYPs for climate adaptation can be considered as NbSs.

NbS measures can be categorized into four groups: climate mitigation, biodiversity conservation, water security, and sustainable cities.[164] Provincial FYPs for ecology and environmental conservation recognize ecosystems' role in carbon sequestration and focus on ecosystem restoration initiatives

Figure 12: Provincial 14th FYP Targets for Forest Coverage

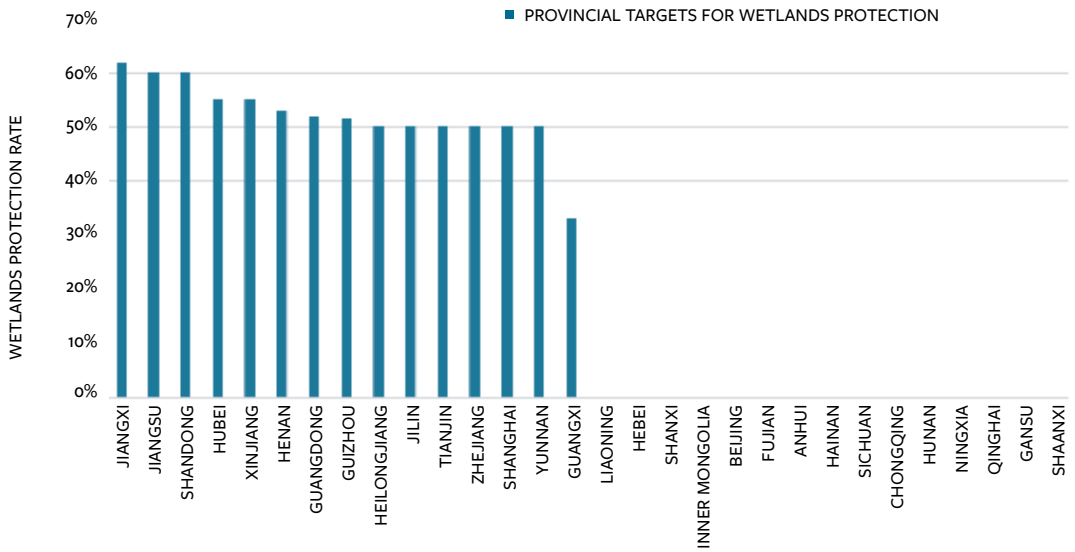


160 Guangdong Government (2022b).
161 Xia (2023).
162 Yu and Mu (2023).
163 IUCN (n.d.).
164 Yu and Mu (2023).

and the expansion of green spaces. These initiatives emphasize forests and wetlands, with provinces aiming to increase forest coverage in two ways: reforestation (converting land back into forest) and afforestation (planting new forests). Beyond mitigating climate impacts, these initiatives also safeguard watersheds and combat desertification.[165] As shown in Figure 12, based on the national target for increasing forest coverage to 24.1%, regions with higher population densities and provinces in the northwest with extensive grasslands and deserts have moderate expectations for forest coverage. Fujian, Yunnan, and Guangxi, located in hilly areas, exhibit the highest expectation of forest coverage.

Wetlands constitute another vital ecosystem in China's NbS portfolio. As shown in Figure 13, wetland protection is prioritized primarily in provinces in the northern plains and the middle and lower reaches of the Yangtze River in eastern China. In general, provinces aim to safeguard more than half of total wetland areas. Coastal wetlands in the east and southeast are particularly prioritized as natural buffers against climate-related risks, contributing to a holistic ecosystem restoration initiative spanning both marine and terrestrial environments.[166] Meanwhile, inland wetlands near lakes and rivers have been integrated into broader ecological restoration efforts related to water resource management.[167]

Figure 13: Provincial 14th FYP Targets for Wetlands Protection



Moreover, strategies for biodiversity conservation are grounded in ecosystem restoration, habitat rehabilitation, and ecological conservation redline programs that protect ecologically vulnerable areas and biodiversity hotspots.

Although NbS is not explicitly mentioned in policies to enhance China's water security, water-related ecological restoration efforts, such as the River and Lake Chief system,[168] align with the NbS concept.[169] For example, the NDRC has prioritized ecosystem function and integrity as the foundation for managing aquatic environments in key river basins.[170] Northern provinces often grapple with water scarcity, while other regions contend with water pollution; as a result, each province outlines measures to enhance water quality, reduce water pollution, and manage water resources sustainably. Further, China has

165 Kahrl et al. (2023).
166 Jiangsu Government (2021c).
167 Hubei Government (2021).
168 State Council (2016).
169 UN Environment Programme (2019).
170 NDRC (2021c).

introduced the River and Lake Chief system to help manage its water resources. It involves ecological restoration projects in key river basins and ecological engineering for treating water pollution, as well as implementing a national regulatory framework with local leaders to enable both bottom-up reporting and top-down supervision on water issues.[171]

Major cities are embarking on a sustainable city strategy, with the "sponge city" program at its core.[172] This initiative is designed to bolster urban resilience against water-related disasters and includes sustainable practices such as rain gardens, green roofs, permeable pavement, and urban renovation projects, all of which enhance cities' water absorption capabilities.

In the absence of a national plan for NbS, provinces have adopted context-specific actions tailored to their ecosystems and local conditions. But given the interconnected nature of ecosystems, implementing NbS strategies often requires collaboration across provincial boundaries and may fall under the jurisdiction of different ministries and sectors. This "implementation gap" speaks to the importance of leveraging existing regional coordination mechanisms and enhancing cross-sectoral collaboration in China.

4. Looking Ahead: Conclusions and Recommendations for the 15th FYPs

China is off course to meet its carbon intensity target and requires a large reduction in 2024 and 2025 to achieve it by the end of the 14th FYP cycle. In response, the central government has highlighted its commitment to tightening controls on carbon and energy intensity.[173] If provinces fail to do so, drastic measures – such as industrial shutdowns and power cuts, which 10 provinces experienced at the end of the 13th FYP cycle, in 2020 and 2021 – may be taken.[174]

This dilemma arises in part from the very design of the 14th FYP system. As this report makes clear, mixed messages have been conveyed by different levels of government and across sectors. In the absence of a definitive national climate roadmap, provincial progress on climate has predictably been mixed.

This section offers recommendations for China's 15th FYPs based on lessons learned from surveying the breadth of economy-wide and sectoral climate actions contained in the 14th FYPs, as well as the real-world implementations and impacts of those actions.

4.1. PROVIDING CLEAR NATIONAL GUIDANCE AND COORDINATION

There is no national-level FYP to address climate change mitigation and adaptation in the 14th FYP cycle. Hence, in the upcoming 15th FYP cycle, there is a clear opportunity to release an overarching framework to guide provinces in developing their own specific plans tailored to local contexts. Clear national guidance – perhaps in the form of a national framework plan, combined with ongoing consultation and coordination with provincial agencies – would better align national and provincial goals, set clear expectations for which plans provinces should develop and what they should contain, and coordinate mitigation and technology strategies across provinces.

Additionally, this process will support a more robust integration of adaptation and mitigation strategies and increase attention to adaptation actions across the country. In the 14th FYP cycle, nearly half of provinces have embraced proactive government-led strategies to adapt to climate change. Despite

171 Yu and Mu (2023).
172 State Council (2015).
173 NDRC (2023).
174 Michal et al. (2024).

differing climate risks among regions that lead to distinct focuses among provinces, all strategies intend to build disaster risk management, along with nature-based, industrial, and urban climate adaptation actions. Coastal provinces have had more robust discussions of climate adaptation planning, due both to their unique vulnerability[175] to climate change and their appetite for advancing technology-based adaptation methods. Provinces have also acknowledged the ability of ecosystems to help mitigate climate risks, implementing NbS actions including forest and wetland preservation and, in urban areas, the sponge city program. These integrated efforts should continue to be prioritized.

4.2. SETTING PROVINCIAL CARBON CAPS

For the 15th FYP period, provinces should outline definitive plans for achieving economy-wide carbon emission targets. This would better align provincial planning with a national climate roadmap for meeting 2030 and 2060 goals and encourage provinces to perform more detailed planning for how they would meet these targets. In particular, provinces with abundant fossil fuel resources, such as Shanxi and Shaanxi, should consider formulating comprehensive energy development FYPs with clear metrics for implementing carbon caps and evaluating outcomes of decarbonization efforts, which were absent in the 14th FYP cycle.

Carbon caps do not necessarily require binding limits on emissions. An alternative approach, for instance, might be to tie each province's progress toward its carbon cap to national funds, investment projects, or other incentives. Provincial carbon caps could be calculated using existing CO_2 intensity targets or a national CO_2 emission reduction trajectory; would be easier to monitor than CO_2 intensity targets; and could be integrated with China's emerging cap-and-trade system. Hence, the goal should be to manifest a clearer blueprint for China's efforts to control total carbon emissions, not just carbon intensity. An absolute carbon target is being explored: Inner Mongolia has indicated its intention to place dual caps on carbon intensity and total carbon emissions during the 15th FYP cycle,[176] and more provinces are expected to follow.

4.3. PRIORITIZING PROVINCES THAT ARE FALLING BEHIND

Recognizing the varying pace of climate progress across provinces in the 14th FYP cycle, more attention should be given to provinces that are falling behind. These provinces – including Xinjiang, Ningxia, Inner Mongolia, Heilongjiang, and Liaoning – face considerable challenges in defining strategies to balance local economic growth with decarbonization efforts. During the 15th FYP cycle, provinces must accelerate efforts to transition to cleaner development models with national support including investment, technical assistance, and demonstration projects.

4.4. ALIGNING CLIMATE POLICY WITH OTHER ENVIRONMENTAL GOALS

The 14th FYPs include more concerted efforts to address climate change, including ecosystem protection and restoration measures and air quality. The 15th FYPs should build upon this momentum and incorporate environmental initiatives that transcend provincial borders and sectoral domains. For example, provincial FYPs could identify co-benefits of major pollutant reductions from GHG emissions policies, including for public health, or vice versa.

Moreover, an overarching linkage between ecological conservation and climate action was missing

175 Stanway (2023).
176 Inner Mongolia Government (2023).

during the 14th FYP cycle. National government agencies could deepen integrated environmental and climate planning in the 15th five-year plan by encouraging provincial agencies to undertake joint planning, providing methodological frameworks and technical support for multi-objective planning, and encouraging coordination between sectoral and environmental compliance plans.

4.5. COORDINATING ENERGY SUPPLY PLANNING

In the 14th FYP cycle, renewable energy installation has been prioritized, as reflected by efforts to develop vast clean energy zones. Hence, in the 15th FYP cycle, the integration and utilization of installed renewable energy should be a centerpiece – something the 14th FYPs have already started to build toward, in accordance with *The National 14th Five-Year Plan for Promoting a Modern Energy System*. The 15th FYPs must proceed with complementary planning at both central and provincial governmental levels. For instance, provinces might consider developing specific FYPs for energy storage, diversifying their renewable energy mix, and optimizing planning for energy transport networks and emerging electricity markets.

Importantly, the role of coal – as a supporting resource for grid stability, rather than a mainstay of power generation – should be reinforced in the 15th FYP cycle. Energy security concerns have led to new coal additions in the 14th FYP cycle, and while this does not necessarily indicate a reversal of the clean energy transition, it does reveal a temptation to continue relying on coal, which has driven China's economic growth for decades. In the end, China's continued dependence on coal will make its transition away from fossil fuels more complicated and costly. While 14th FYPs indicate a diminishing role for coal, provinces have continued to show their enthusiasm for building new coal projects. Given China's profound historical reliance on coal, the 15th FYP cycle must include clearer, firmer, and stricter caps on coal consumption to definitively catalyze the construction of a modern, optimized energy system.

4.6. ACCELERATING INDUSTRIAL TRANSFORMATION IN NORTHERN PROVINCES

Transitioning the industrial sector to low-carbon practices requires significant structural transformation in the northern industrial heartlands. This represents a dramatic and enduring shift in approach towards a developmental paradigm that promotes local economic growth while advancing climate objectives.

For the upcoming 15th FYP cycle, provinces must continue formulating sector-specific regulations both within and beyond the industrial sphere. For instance, provinces should, at minimum, designate more stringent GHG emission standards. In particular, Hebei, Inner Mongolia, Henan, and Shanxi should set carbon intensity thresholds for carbon-intensive industries such as steel, construction materials, and petrochemicals. Moreover, coal-rich provinces including Shanxi, Inner Mongolia, and Anhui should explore cleaner use of coal and financial incentives for energy-efficient equipment at facilities.

In addition, provinces can leverage financing programs to advance the structural transformation of industry. The goal here is to overcome barriers to low-cost capital so firms can finance a full transition to low-carbon production methods. Financing toolkits may incorporate a variety of programs such as co-lending, aggregation, loan guarantees, and bond sales, which can also be combined with other policies such as tax credits and/or subsidies for clean production.

Another centerpiece for the 15th FYP cycle is to strengthen policy for a "circular economy." For instance, provinces may build networks for sorting, recycling, and reusing waste materials – similar to Hebei and Yunnan's programs for reusing minerals and recycling resources in manufacturing processes during the 14th FYP period.

What is missing in provincial FYPs is the disclosure of GHG emissions in the industrial sector, where only Yunnan has released an audit model for clean production. Hence, in the 15th FYP cycle, provinces should mandate GHG emission disclosure for the full production process, starting with firms located in green industrial parks, and apply green design standards for products.

4.7. INCENTIVIZING GREEN TRANSPORTATION AND ELECTRIFYING PRIVATE VEHICLES

Looking ahead to the 15th FYP cycle, transportation decarbonization will have a large impact on carbon peaking goals. Provinces should first consider formulating green transportation plans to guide the low-carbon transformation of shipping, aviation, and on-road freight, given that only five provinces have such plans now. Moreover, provinces may consider including the transportation sector into China's national carbon market. For instance, Shanghai has incorporated the shipping sector into its regional carbon market.

Provinces should accelerate a shift towards rail and shipping and away from on-road freight for their mid- and long-distance bulk transportation needs. To enable this shift, the 15th FYP cycle must emphasize the planning and construction of necessary infrastructure while taking into account sustainable land use practices.

Electrifying vehicles and upgrading related infrastructure should be another priority here. Some 14th FYPs contain enhanced actions for public vehicle fleets, such as Beijing and Hainan's FYPs aiming for the electrification of all buses. Electrifying private vehicles is also necessary and can be accomplished through different policies, such as raising targets for NEV market shares and adopting sales mandates for commercial vehicles.

4.8. PROMOTING BUILDING ENERGY EFFICIENCY, GREEN MATERIALS, AND ONSITE CLEAN ENERGY CONSUMPTION

In the building sector, the 15th FYPs should continue to improve energy efficiency by promoting low-carbon building retrofits and urban renewal programs. While provinces generally emphasize energy efficiency in new buildings, Hainan and Inner Mongolia should enhance their energy efficiency actions and apply green building standards. Provinces should also introduce more ambitious energy efficiency standards for existing buildings and support retrofit programs through financial incentives and other means in the 15th FYPs.

The 15th FYPs must also prioritize the construction phase, focusing on building materials including green insulation systems in northern China as well as prefabricated buildings. In this regard, provincial governments can play a pivotal role in standardizing and procuring green materials and providing funding for materials research and development.

Finally, the 15th FYPs must address onsite energy consumption. Provinces should further expand buildings' use of onsite renewable energy, for example by deploying rooftop solar panels in provinces with abundant solar resources (e.g., Shandong) and exploring other renewable resources as available (e.g. geothermal power in Chongqing).

4.9. DIVERSIFYING PROVINCIAL PROGRESS EVALUATION METRICS AND GOALS

Regarding the FYP planning system, there is no clear legal wording that defines the hierarchy between provincial FYPs for social and economic development (省级十四五经济与社会发展规划) and specific plans crafted by central ministries (中央专项规划). This lack of clarity in authority levels within a fragmented planning structure leads to insufficient guidance for provinces in interpreting national plans into their own actions in a given sector. A common approach in the 14th FYP cycle has been to select certain provinces or cities as testing grounds for low-carbon pilot projects, for the purpose of enhancing national expertise in climate policy-making despite project-level inconsistencies (e.g., targets, approaches, and/or indicators) and provincial disparities in economic development, industrial structure, resource endowments, and capacity. This approach is likely to continue in the 15th FYP cycle. However, challenges remain in data disclosure and evaluation methods for pilot projects to ensure a broadly evidence-based and effective policy-making process.

In both the FYP planning process and the plans themselves, normative values, such as equity among provinces, must be acknowledged in the 15th FYPs. Due to geological and socioeconomic diversity and the varied roles designated by Beijing, provinces face different tasks that ultimately affect their available resources for achieving carbon goals. To mitigate disparities from this underlying equity issue, the 15th FYP cycle should explore evaluation and/or monitoring approaches that incorporate diverse metrics. This equity concern also highlights the importance of aggregating provincial efforts to generate optimized outcomes collectively. Provinces with advanced climate change mitigation techniques and strategies, such as China's coastal provinces, can materially assist the climate action capacities among northern provinces and elsewhere if they are guided to share their knowledge and best practices.

References

1. 21st Century Business Herald. (2021, July 20). 21 provinces have already released their "14th Five-Year Plan" energy plans, with keywords such as multi-energy complementarity and integration of major base projects emerging as crucial focuses. https://finance.china.com.cn/industry/energy/20210720/5611256.shtml

2. Anhui Government. (2022, March 30). Anhui's 14th FYP for coal industry development. https://coal.in-en.com/html/coal-2618030.shtml

3. Anhui Government. (2023, January 6). Anhui's 14th FYP for addressing climate change. https://m.bjx.com.cn/mnews/20230106/1281383.shtml

4. Beijing Government. (2022a, November 30) The Beijing Carbon Peaking Implementation Plan. https://www.ndrc.gov.cn/fggz/hjyzy/tdftzh/202211/t20221130_1343045.html

5. Beijing Government. (2022b, August 3). Beijing's 14th Five-Year Plan for Energy Development. http://fgw.beijing.gov.cn/fgwzwgk/zcgk/ghjhwb/wnjh/202204/P020220426362073075921.pdf

6. Beijing Government. (2022c, May 7). Beijing's 14th FYP for transportation. https://www.beijing.gov.cn/zhengce/zhengcefagui/202205/t20220507_2704320.html

7. Beijing Government. (2022d, August 9). Beijing's 14th FYP for addressing climate change and energy conservation. https://sthjj.beijing.gov.cn/bjhrb/index/xxgk69/zfxxgk43/fdzdgknr2/zcfb/hbjfw/2022/325892550/index.html

8. Beijing News. (2023, May 5). China Shenhua: Capital expenditure in the next three years will continue to focus mainly on thermal power construction. https://finance.sina.com.cn/jjxw/2023-05-05/doc-imysttks3392734.shtml

9. Carbon Sequestration. (2021, August 21). UC Davis. https://www.ucdavis.edu/climate/definitions/carbon-sequestration

10. CarbonBrief. (2021, March 12). Q&A: What does China's 14th 'five year plan' mean for climate change? https://www.carbonbrief.org/qa-what-does-chinas-14th-five-year-plan-mean-for-climate-change/

11. CGEP, C. |. (2021, November 22). Gatekeepers of the Transition: How Provinces Are Adapting to China's National Decarbonization Pledges. Center on Global Energy Policy at Columbia University SIPA | CGEP. https://www.energypolicy.columbia.edu/publications/gatekeepers-transition-how-provinces-are-adapting-china-s-national-decarbonization-pledges/

12. China Briefing News. (2022, November 18). China's Green Building Materials Sector: Policies and Opportunities. https://www.china-briefing.com/news/chinas-green-building-materials-sector-policies-and-investment-opportunities/

13. China Business Network. (2023, December 3). Sudden Change in Situation: From "Abandoning Water" to "Power Shortages" Sichuan and Yunnan Simultaneously Deploy Measures to Ensure Energy Security. https://m.yicai.com/news/101917409.html

14. China Business Network. (2023, December 3). The situation has taken a sharp turn: From "excess water discharge" to "power shortage," Sichuan and Yunnan simultaneously deploy measures to ensure energy security. https://m.yicai.com/news/101917409.html

15. China Energy News. (2021, January 22). Multiple regions repeatedly exceed standards, revealing extensive loopholes in energy consumption "dual control". http://mp.weixin.qq.com/s?biz=MjM5NTI4MTIyMg==&mid=2657879297&idx=1&sn=6ccb57ad3d94f1c8ebec39309ab6832f&chksm=bd6245288a15cc3e938b27e92c50d4a406ba8c17f74dbd46a4bdd7bb2ab404c4a395f9fc19e5#rd

16. China Energy News. (2022, March 9). Hainan restarts offshore wind power. https://news.bjx.com.cn/html/20220309/1208984.shtml

17. China Energy News. (2023, November 22). Two coal mine projects in Gansu Province have obtained approval from the NDRC, with a total planned annual production capacity of 13 million tons. https://www.china5e.com/news/news-1161374-1.html

18. Chinese Academy of Environmental Planning. (2021, December 24). Executive Summary on the Strategies for Air Pollution Prevention and Control in Efforts to Co-Address GHGs Control during the 14th Five-year Plan Period. https://www.efchina.org/Attachments/Report/report-cemp-20220305-3/%E5%9B%BD%E5%AE%B6%E6%B0%94%E5%80%99%E5%8D%8F%E5%90%8C%E7%9A%84-%E5%8D%81%E5%9B%9B%E4%BA%94-%E5%A4%A7%E6%B0%94%E6%B1%A1%E6-%9F%93%E9%98%B2%E6%B2%BB%E7%AD%96%E7%95%A5%E7%A0%94%E7%A9%B6-%E4%BA%8C%E6%9C%9F-%E7%A0%94%E7%A9%B6%E6%91%98%E8%A6%81.pdf

19. Chongqing Government. (2022, April 26). Chongqing's 14th FYP for addressing climate change. https://sthjj.cq.gov.cn/zwgk_249/zfxxgkml/zcwj/qtwj/202205/t20220513_10712793.html

20. CLEAR Center. (2019, September 20). What is Carbon Sequestration and How Does it Work? | https://clear.ucdavis.edu/explainers/what-carbon-sequestration

21. Development Projects: Yangtze River Protection and Ecological Restoration Program - P171644. World Bank. Retrieved February 25, 2024, from https://projects.worldbank.org/en/projects-operations/project-detail/P171644

22. Fredrich Kahrl, Jessica Gordon, Fan Dai and Jie Han. (November 2023). Tracking Subnational Progress Toward Carbon Neutrality in the U.S. and China. https://ccci.berkeley.edu/sites/default/files/Tracking%20Progress-ExecSummary.pdf

23. Guangdong Government. (2022a, March 17). Guangdong's 14th FYP for energy development. https://www.gd.gov.cn/zwgk/wjk/qbwj/yfb/content/post_3909371.html

24. Guangdong Government. (2022b). Guangdong's 14th FYP for addressing climate change. https://gdee.gd.gov.cn/attachment/0/494/494368/3977041.pdf

25. Guangxi Government. (2022, January 24). Guangxi's 14th FYP for green transportation. http://jtt.gxzf.gov.cn/zfxxgk/fdzdgk/zcfg/gfxwj/t11330982.shtml

26. Hainan Department of Ecology and Environment. (2021, July). Hainan's 14th Five-Year Plan for Ecologcial Development. http://www.sanya.gov.cn/sanyasite/hnzmghnzc/202107/edc36eefd4644a79a4507fa89327c4e8/files/a204056e75874ca3b9180ae8b3167740.pdf

27. Hedley, N. (2024, January 18). China will hit 1,200GW wind and solar targets this year, IEA says. The Progress Playbook. https://theprogressplaybook.com/2024/01/18/china-will-hit-1200gw-wind-and-solar-target-this-year-iea-says/

28. Heilmann, S., & Melton, O. (2013). The Reinvention of Development Planning in China, 1993–2012. Modern China, 39(6), 580–628. https://doi.org/10.1177/0097700413497551

29. Hong, C., Zhang, Q., Zhang, Y., Davis, S. J., Tong, D., Zheng, Y., Liu, Z., Guan, D., He, K., & Schellnhuber, H. J. (2019). *Impacts of climate change on future air quality and human health in China*. Proceedings of the National Academy of Sciences, 116(35), 17193–17200. https://doi.org/10.1073/pnas.1812881116

30. Hubei Government. (2021, December 21). Hubei's 14th FYP for ecology and environment protection. http://www.hubei.gov.cn/zfwj/ezf/202112/t20211221_3925769.shtml

31. Hubei Government. (2022, October 14). Hubei's 14th FYP for addressing climate change. https://sthjt.hubei.gov.cn/fbjd/zc/zcwj/sthjt/ehf/202210/t20221021_4359677.shtml

32. IEA. (2022, March 8). Global CO_2 emissions rebounded to their highest level in history in 2021—News. IEA. https://www.iea.org/news/global-co2-emissions-rebounded-to-their-highest-level-in-history-in-2021

33. Inner Mongolia Government. (2021, November 15). Inner Mongolia's 14th FYP for addressing climate change. http://fgw.nmg.gov.cn/ywgz/jndt/202111/t20211117_1953435.html

34. Inner Mongolia Government. (2022, February 28). Inner Mongolia's 14th FYP for energy development. https://www.nmg.gov.cn/zwgk/zfxxgk/zfxxgkml/202203/t20220304_2012787.html

35. Inner Mongolia Government. (2022b, February 15). Inner Mongolia's 14th FYP for coal industry development. http://www.coalchina.org.cn/index.php?m=content&c=index&a=show&catid=39&id=136490

36. Inner Mongolia Government. (2023, December 27). Notice on Issuing the Work Plan for the Pilot Transformation of Inner Mongolia's Energy Consumption Dual Control to Carbon Emission Dual Control and the Key Points of Work in 2024 by the General Office of the People's Government of Inner Mongolia Autonomous Region. https://www.ndrc.gov.cn/fggz/hjyzy/tdftzh/202401/t20240125_1363658.html

37. International Council on Clean Transportation. (2018). China's New Energy Vehicle Mandate Policy. https://theicct.org/sites/default/files/publications/China-NEV-mandate_ICCT-policy-update_20032018_vF-updated.pdf

38. IUCN. Nature-based Solutions. Retrieved December 13, 2023, from https://www.iucn.org/our-work/nature-based-solutions

39. Jiang X. (2021). Six pictures to help you understand China's per capita carbon emissions. https://wri.org.cn/insights/data-viz-6-graphics-per-capita-emissions-china

40. Jiang Xiaoping. (2020, May 22). The area of China's ecological protection red line accounts for approximately 25% of the country's land territory. CCTV.com https://sannong.cctv.com/2020/05/22/ARTIbgwffu4PX1w8gxQEcK6z200522.shtml

41. Jiangsu Government. (2021a, November 6). Jiangsu's 14th FYP for New Energy Vehicle Industry Development. http://www.jiangsu.gov.cn/art/2021/11/24/art_46144_10124132.html

42. Jiangsu Government. (2021b, September 8). Jiangsu green transportation. https://jtyst.jiangsu.gov.cn/art/2021/9/15/art_77131_10014617.html

43. Jiangsu Government. (2021c, September 28). Jiangsu's 14th FYP for ecology and environment protection. https://www.jiangsu.gov.cn/art/2021/10/29/art_46144_10091249.html

44. Jiangsu Government. (2022a, July 11). Jiangsu's 14th FYP for renewable energy development. https://fzggw.jiangsu.gov.cn/art/2022/7/11/art_83783_10531644.html

45. Jiangsu Government. (2022b, August 8). Jiangsu's 14th FYP for energy storage. https://fzggw.jiangsu.gov.cn/art/2022/8/8/art_83783_10566543.html

46. Jiangsu Government. (2022c, April 6). Jiangsu's 14th FYP for addressing climate change. https://sthjt.jiangsu.gov.cn/art/2022/4/6/art_83554_10404733.html

47. Jiangxi Government (2021). Jiangxi's 14th FYP for green transportation. https://xjq.nc.gov.cn/xjqrmzf/xjbmgfxwj9/202205/5ccce2d2ea2a4c17bf61d352daf0d81a.shtml

48. Jiangxi Government. (2022, January 25). Jiangxi's 14th FYP for addressing climate change. http://www.jiangxi.gov.cn/art/2022/1/25/art_5423_3844505.html; Hubei government. (2022, October 14). Hubei's 14th FYP for addressing climate change.

49. Jiemian News. (2022, February 22). The total investment is nearly 32.5 billion yuan. China has approved five coal mine projects this year. https://m.jiemian.com/article/7130487.html

50. Jiemian News. (2024, January 3). The implementation progress of the 14th Five-Year Plan has passed the halfway mark, but energy consumption and carbon emission targets are lagging behind. https://www.ideacarbon.org/news_free/61302/?pc=pc

51. Jilin Government. (2023, September 15). Jilin's action plan on climate change adaptation. https://xxgk.jl.gov.cn/zcbm/fgw_98007/xxgkmlqy/202309/t20230925_8804218.html

52. Joe, C.S. (2021, March 25). 14th Five Year Plan: China's carbon-centred environmental blueprint. China Dialogue. https://chinadialogue.net/en/climate/14th-five-year-plan-china-carbon-centred-environmental-blueprint/

53. Liaoning Government. (2023, July 5). Liaoning 14th five-year plan for energy development. https://www.ln.gov.cn/web/zwgkx/lnsrmzfgb/2022n/qk/2022n_dsqq/szfbgtwj/00492D1A9B324E6BA9776EBF8CFA294C/index.shtml

54. Lushan, H. (2021, March 15). 'Without a carbon cap, you can't provide strong support for a carbon peak.' China Dialogue. https://chinadialogue.net/en/energy/can-controlling-energy-use-drive-chinas-green-transition-during-the-next-five-years/

55. Lushan, H. (2022, June 23). China's Five Year Plan for energy: One eye on security today, one on a low-carbon future. China Dialogue. https://chinadialogue.net/en/climate/chinas-five-year-plan-for-energy-one-eye-on-security-today-one-on-a-low-carbon-future/

56. Lushan, H. (2023, November 14). How climate change complicates China's 'battle for blue skies.' China Dialogue. https://chinadialogue.net/en/pollution/how-climate-change-complicates-chinas-battle-for-blue-skies/

57. Ma, T. (2018, March 14). China reshapes ministries to better protect the environment. China Dialogue. https://chinadialogue.net/en/pollution/10502-china-reshapes-ministries-to-better-protect-environment/

58. Mei, D., Weil, M., Prasad, S., O'Malia, K., & Behrsin, I. (2023). A Race to the Top China 2023: China's quest for energy security drives wind and solar development. https://globalenergymonitor.org/report/a-race-to-the-top-china-2023-chinas-quest-for-energy-security-drives-wind-and-solar-development/

59. Mertha, A. C. (2005). China's "Soft" Centralization: Shifting Tiao/Kuai Authority Relations. The China Quarterly, 184, 791–810.

60. Michal Meidan, Anders Hove, & Yan Qin. (2024, February). China's policy pendulum shifts back toward environmental protection, but will bureaucracy get in the way? Oxford Institute for Energy Studies. https://www.oxfordenergy.org/publications/chinas-policy-pendulum-shifts-back-toward-environmental-protection-but-will-bureaucracy-get-in-the-way/

61. Ministry of Ecology and Environment, National Development and Reform Commission, Ministry of Industry and Information Technology, Ministry of Housing and Urban-Rural Development, Ministry of Transport, Ministry of Agriculture and Rural Affairs, National Energy Administration. (2022, June 13). The Implementation Plan for Synergizing the Reduction of Pollution, Carbon Emissions, and Increased Efficiency. https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202206/t20220617_985879.html

62. Ministry of Ecology and Environment. (2021, January 11). Guiding Opinions on Coordinating and Strengthening Efforts to Address Climate Change and Environmental Protection. https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202101/t20210113_817221.html

63. Ministry of Ecology and Environment. (2022, May 10). National Climate Change Adaptation Strategy 2035. https://www.gov.cn/zhengce/zhengceku/2022-06/14/content_5695555.htm

64. Ministry of Housing and Urban-Rural Development & Ministry of Finance. (2020, October 13). Notice Regarding Expanding the Scope of Implementation of Policies to Promote the Improvement of Building Quality through Government Procurement Support for Green Building Materials. https://gks.mof.gov.cn/guizhangzhidu/202210/t20221024_3847589.htm

65. Ministry of Housing and Urban-Rural Development. (2022, March 1). The 14th Five-Year Plan for Energy Conservation and Green Building. https://www.gov.cn/zhengce/zhengceku/2022-03/12/content_5678698.htm

66. Ministry of Housing and Urban-Rural Development. GBT 50378-2014 Green Building Evaluation Standard.

67. Ministry of Industry and Information Technology, NDRC, MEE. (2022, July 7). The Implementation Plan for Carbon Peaking in the Industrial Sector. https://www.gov.cn/zhengce/zhengceku/2022-08/01/content_5703910.htm

68. Ministry of Natural Resources. (2023, March 23). Notice from the Ministry of Natural Resources Regarding Strengthening the Work of Detailed Land Use Planning. https://www.gov.cn/zhengce/zhengceku/2023-03/25/content_5748273.htm

69. Ministry of Transportation. (2021, October 29). The 14th FYP for Green Transportation. https://www.gov.cn/zhengce/zhengceku/2022-01/21/content_5669662.htm

70. Myllyvirta, L. (2023, November 13). Analysis: China's emissions set to fall in 2024 after record growth in clean energy. Carbon Brief. https://www.carbonbrief.org/analysis-chinas-emissions-set-to-fall-in-2024-after-record-growth-in-clean-energy/

71. Myllyvirta, L. (2024, February 22). Analysis: Record drop in China's CO_2 emissions needed to meet 2025 target. Carbon Brief. https://www.carbonbrief.org/analysis-record-drop-in-chinas-co2-emissions-needed-to-meet-2025-target/

72. National Bureau of Statistics (2023 July). Energy production in the first half year of 2023. https://www.stats.gov.cn/sj/zxfb/202307/t20230715_1941272.html

73. National Bureau of Statistics. (2024, January 18). Energy supply security, strength, and effectiveness accelerate the process of green and low-carbon transformation. https://www.stats.gov.cn/sj/sjjd/202401/t20240118_1946697.html

74. Naughton, B. (2013). The Return of Planning in China: Comment on Heilmann–Melton and Hu Angang. Modern China, 39(6), 640–652. https://doi.org/10.1177/0097700413498847

75. NDRC and NEA. (2015, November 26). Notice from the National Development and Reform Commission and the National Energy Administration on Issuing Supporting Documents for Electricity System Reform. https://www.ndrc.gov.cn/xxgk/zcfb/tz/201511/t20151130_963509.html

76. NDRC and NEA. (2022, January 29). The 14th Five-Year Plan for Promoting a Modern Energy System. https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202203/t20220322_1320016.html

77. NDRC. (2014, November 4). The NDRC is carrying out pilot reforms of electricity transmission and distribution prices in Shenzhen City. https://www.ndrc.gov.cn/fzggw/jgsj/jgs/sjdt/201411/t20141104_1109875.html

78. NDRC. (2021a, October 21). The 14th Five-Year Plan for Renewable Energy Development. https://www.ndrc.gov.cn/xwdt/tzgg/202206/t20220601_1326720.html

79. NDRC. (2021b, December 25). Interpretation of the Outline of the 14th Five-Year Plan: Enhancing the Quality and Stability of Ecosystems. https://www.ndrc.gov.cn/fggz/fzzlgh/gjfzgh/202112/t20211225_1309713.html

80. NDRC. (2021c, December 31). The 14th FYP for Water Governance in Key River Basins. https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202201/t20220111_1311768.html

81. NDRC. (2023, December 26). Mid-term Evaluation Report on the Implementation of the National 14th Five-Year Plan for Economic and Social Development. https://www.ndrc.gov.cn/fzggw/wld/zsj/zyhd/202312/t20231227_1362958.html

82. NEA. (2023, October 27). Zhejiang Energy Regulatory Office Conducts On-Site Research at Guoneng Beilun Power Plant. https://www.nea.gov.cn/2023-10/27/c_1310747699.htm

83. Ningxia Government. (2022, January 17). Ningxia's 14th FYP for addressing climate change. https://www.chndaqi.com/news/331633.html

84. People's Daily. (2017, January 9). Eleven provinces delineate marine ecological red lines. http://www.xinhuanet.com/politics/2017-01/09/c_1120272704.htm

85. People's Daily. (2020, November 25). China's unit GDP energy consumption is 1.5 times the world average, with energy consumption exceeding the standard in many regions. http://energy.people.com.cn/n1/2020/1125/c71661-31943213.html

86. People's Daily. (2023, December 18). The National Development and Reform Commission (NDRC) initiates preliminary research for the "15th Five-Year Plan." http://finance.people.com.cn/n1/2023/1218/c1004-40141715.html

87. Qinghai Government. (2022, February 21). Qinghai's 14th FYP for energy development. http://www.qinghai.gov.cn/xxgk/xxgk/fd/ghxx/202203/t20220309_189260.html

88. Reuters (2022, August 26). Explainer: The power crunch in China's Sichuan and why it matters. https://www.reuters.com/world/china/power-crunch-chinas-sichuan-why-it-matters-2022-08-26/

89. Shandong Energy. (2022, February 23). Shandong Province's First Grid-Parity Offshore Wind Power Project Approved. https://news.bjx.com.cn/html/20220223/1205943.shtml

90. Shanghai Government. (2022, April 17). Shanghai's 14th FYP for energy development. https://www.shanghai.gov.cn/nw12344/20220515/b0a5838d0ae944619d8559fd95b66bf1.html

91. Shanghai Government. (2023, January 6). Shanghai's 14th FYP for green transportation. https://jtw.sh.gov.cn/zxzfxx/20230206/d1d7a90fb65745db82ae94bba4a8cb6c.html

92. Shanxi Government. (2022a, December 15). Shanxi's 14th FYP for energy conservation and carbon reduction. https://www.shanxi.gov.cn/zfxxgk/zfxxgkzl/fdzdgknr/lzyj/szfwj/202212/t20221229_7699838.shtml

93. Shanxi Government. (2022b, June 22). Shanxi's 14th FYP for economic and social development. https://fgw.sxxz.gov.cn/jjdt/202106/t20210622_3647159.html

94. Shanxi Government. (2022c, August 16). Shanxi's 14th FYP for industrial resource utilization and development. https://gxt.shanxi.gov.cn/zcwj/wjfb/202208/t20220819_6964542.shtml

95. Shanxi Government. (2022d, July 6). Shanxi 14th FYP for green transportation. https://jtyst.shanxi.gov.cn/zwgk/gkml/ghjh/ghjjd/202207/t20220706_6590499.shtml

96. Sichuan Government. (2022, May 15). Sichuan's 14th FYP for energy development. https://www.sc.gov.cn/10462/zfwjts/2022/3/4/f09dbec42f7349589d042145437004a6.shtml

97. Sichuan Government. Sichuan's action plan on climate change adaptation. https://sthjt.sc.gov.cn/sthjt/c23101804/2023/4/21/8ab8f80c86bd4c1e8af7e6ad885b2ad1.shtml

98. Stanway, D. (2023, February 20). China provinces top list of world's most climate-vulnerable regions—Data. Reuters. https://www.reuters.com/world/china/china-provinces-top-list-worlds-most-climate-vulnerable-regions-data-2023-02-20/

99. State Administration for Market Regulation, Ministry of Housing and Urban-Rural Development, & Ministry of Industry and Information Technology. (2019, October 25). Notice of Three Ministries on Issuing the Implementation Plan for Green Building Materials Product Certification. https://www.gov.cn/xinwen/2019-11/08/content_5450047.htm

100. State Council. (2015, October 16). Guiding Opinions of the General Office of the State Council on Promoting the Construction of Sponge Cities. https://www.gov.cn/zhengce/content/2015-10/16/content_10228.htm

101. State Council. (2016, December 11). Opinions on Fully Implementing the River Chief System. https://www.gov.cn/gongbao/content/2017/content_5156731.htm

102. State Council. (2019a, May 23). Several Opinions on Establishing a Territorial Spatial Planning System and Supervising its Implementation. https://www.gov.cn/gongbao/content/2019/content_5397679.htm

103. State Council. (2019b, November 1). Guiding Opinions on Coordinating the Planning and Implementation of Three Control Lines in Territorial Spatial Planning. https://www.gov.cn/zhengce/2019-11/01/content_5447654.htm

104. State Council. (2019c, June 26). Guiding Opinions on Establishing a Nature Reserve System with National Parks as the Main Component. https://www.gov.cn/zhengce/2019-06/26/content_5403497.htm

105. State Council. (2020. December 14). In 2030, China's wind and solar PV installed capacity will exceed 1.2 billion kilowatts. http://www.scio.gov.cn/ztk/dtzt/42313/44537/44544/Document/1695088/1695088.htm

106. State Council. (2021a, March 11). The National 14th Five-Year Plan for Economic and Social Development and 2035 Long-Term Objectives for 2035. https://www.gov.cn/xinwen/2021-03/13/content_5592681.htm

107. State Council. (2021b, October 25). Notice of the State Council on Issuing the Action Plan for Peak Carbon Emissions by 2030. https://www.gov.cn/zhengce/content/2021-10/26/content_5644984.htm

108. State Council. (2021c, December 9). The 14th FYP for Developing a Modern Comprehensive Transportation System. https://www.gov.cn/zhengce/content/2022-01/18/content_5669049.htm

109. State Council. (2023, November 30). Notice from the State Council on Issuing the "Action Plan for Continuous Improvement of Air Quality." https://www.mee.gov.cn/zcwj/gwywj/202312/t20231208_1058492.shtml

110. State-owned Assets Supervision and Administration Commission of the State Council. (2023, May 9). Inner Mongolia Energy Group Achieves a "Flying Start" in the First Quarter. http://www.sasac.gov.cn/n16582853/n16582893/c27863659/content.html

111. Steven Callander: How to Make States "Laboratories of Democracy." (2023, December 4). Stanford Graduate School of Business. https://www.gsb.stanford.edu/insights/steven-callander-how-make-states-laboratories-democracy

112. Suzhou Industrial Park Economic and Trade Development Bureau. (2016, February 22). Assessment Scheme for Key Energy-Consuming Units in Suzhou Industrial Park on Energy Conservation, Consumption Reduction, and Low-Carbon Development Goals. https://sme.sipac.gov.cn/epservice/techsub/Apps/sme/index.php?s=/Home/PolicySearch/policydetail/id/110679/query_value1//orderway//i/3

113. The Paper. (2021, January 13). Ministry of Ecology and Environment: Coordination in Controlling Greenhouse Gas and Pollutant Emissions with "Carbon Reduction" as the Key Focus. https://www.thepaper.cn/newsDetail_forward_10773511

114. The Paper. (2023a, September 25). Ministry of Ecology and Environment: Many cities still fail to meet air quality standards, and overall, they have not yet escaped the influence of meteorological factors

115. The Paper. (2023b, April 11). The NDRC approved two coal mine projects with a total investment of 17.7 billion yuan, located in Shaanxi and Shanxi provinces. https://m.thepaper.cn/kuaibao_detail.jsp?contid=3287960&from=kuaibao

116. Three-North Shelterbelt Program | Department of Economic and Social Affairs. https://sdgs.un.org/partnerships/three-north-shelterbelt-program

117. Tianjin Government. (2022a, February 19). Tianjin's 14th FYP for energy development. https://fzgg.tj.gov.cn/zwgk_47325/zcfg_47338/zcwjx/fgwj/202203/t20220311_5827375.html

118. Tianjin Government. (2022b, April 20). Tianjin's 14th FYP for green transportation. https://jtys.tj.gov.cn/ZWGK6002/ZCWJ_1/WZFWJ/202209/t20220902_5976828.html

119. Times, G. (2023, June 26). More new-energy projects operational in China to meet power consumption demand—Global Times. Retrieved February 23, 2024, from https://www.globaltimes.cn/page/202306/1293197.shtml

120. Tom Baxter & Yao Zhe. (2019, August 7). The 14th Five Year Plan: What ideas are on the table? China Dialogue. https://chinadialogue.net/en/climate/11434-the-14th-five-year-plan-what-ideas-are-on-the-table/

121. UN Environment Programme. (2019). NBS Good Practice: River and Lake Chiefs. https://wedocs.unep.org/xmlui/handle/20.500.11822/29435

122. United Nations. The Yellow River Ecological Corridor Program | Department of Economic and Social Affairs. https://sdgs.un.org/partnerships/yellow-river-ecological-corridor-program

123. Wang Jinnan. (2023, December 23). Continue to deepen the battle for blue skies and build a beautiful China with clear blue skies, white clouds, and twinkling stars. https://www.mee.gov.cn/zcwj/zcjd/202312/t20231223_1059761.shtml; State Council 2023

124. Wind Energy. (2022, July 8). Statistics on the Scale Targets for Offshore Wind Power Development in Various Regions of China's '14th Five-Year Plan. https://m.bjx.com.cn/mnews/20220708/1239729.shtml

125. World Resources Institute. (2023). "Numbers" Episode 07 | How Much Do We Know About Carbon Emissions in the Provincial Transportation Sector in China? https://wri.org.cn/insights/datalogue-Ep07-China-provincial-level-transportation-carbon-emissions

126. Wu, Y., Zhu, X., & Groenewold, N. (2019). The determinants and effectiveness of industrial policy in china: A study based on Five-Year Plans. China Economic Review, 53, 225–242. https://doi.org/10.1016/j.chieco.2018.09.010

127. Xia, Z. (2023, September 19). Analysis: China's northern floods show need for climate adaptation strategy. China Dialogue. https://chinadialogue.net/en/climate/china-northern-floods-show-need-for-climate-adaptation-strategy/

128. Xinhua News. (2018, March 13). Briefings on the State Council's Institutional Reform Plan. https://news.sina.com.cn/c/nd/2018-03-13/doc-ifyscsmv0505118.shtml

129. Xinhua News. (2021, September 22). Opinions of the Central Committee of the Communist Party of China and the State Council on Fully, Accurately, and Comprehensively Implementing the Peak Carbon Emissions and Carbon Neutrality. https://www.gov.cn/zhengce/2021-10/24/content_5644613.htm

130. Xinhua News. (2022, May 4). The central bank increased the special re-lending quota by 100 billion yuan to support coal development and enhance coal reserve capabilities. https://www.gov.cn/xinwen/2022-05/04/content_5688593.htm

131. Xue Lulu, Zhou Weiqi, Wu Xiaohan, & Li Jiang. (2023). How much carbon emissions are there in the transportation sector at the provincial level in China? https://wri.org.cn/insights/datalogue-Ep07-China-provincial-level-transportation-carbon-emissions

132. Xue, S., Na, J., Wang, L., Wang, S., & Xu, X. (2023). The Outlook of Green Building Development in China during the "Fourteenth Five-Year Plan" Period. International Journal of Environmental Research and Public Health, 20(6), 5122. https://doi.org/10.3390/ijerph20065122

133. Yongnian Zheng. (2007). De Facto Federalism in China | Series on Contemporary China (world). https://www.worldscientific.com/doi/epdf/10.1142/6230

134. Yu, R., & Mu, Q. (2023). Implementation progress of Nature-based Solutions in China: A global comparative review. Nature-Based Solutions, 4, 100075. https://doi.org/10.1016/j.nbsj.2023.100075

135. Yunnan Government. (2022, November 30). Yunnan's 14th FYP for addressing climate change. https://www.ideacarbon.org/news_free/58559/?pc=pc

136. Yunnan Government. (2023, January 4). Yunnan's 14th FYP for green energy development. https://www.yn.gov.cn/zwgk/zfxxgkpt/fdzdgknr/zcwj/zfxxgkptyzbf/202304/t20230421_258004.html

137. Zhang Yu. (2021, April 20). Where does China's "carbon" come from? http://finance.sina.com.cn/zl/china/2021-04-20/zl-ikmxzfmk7891284.shtml

138. Zhejiang Government. (2022, May 7). Zhejiang's 14th FYP for new vehicle industry development. http://www.zj.gov.cn/art/2021/4/22/art_1229505857_2270250.html

139. Zhhjw News. (2021, December 23). Determining the Targets for Improving Air Quality during the 14th Five-Year Plan. http://www.zhhjw.org/a/qkzz/zzml/202112/js/2021/1223/13102.html

APPENDIX A: Data for Figure 2 regarding provincial carbon intensity levels for 2005, 2020, 2025 and 2030, along with the percentage gap each province must close to reach 2030 carbon peaking.

PROVINCES	PROVINCIAL 14TH FYP TARGETS for carbon intensity reduction	2005 CARBON INTENSITY	2020 CARBON INTENSITY	2025 CARBON INTENSITY (calculated by provincial 14th FYP targets)	2030 CARBON INTENSITY (calculated by the indicator to reach 65% reduction compared to the 2005 level by 2030)	% GAP TO REACH 2030 CARBON INTENSITY TARGET value = (2025 carbon intensity - 2030 carbon intensity) / 2025 carbon intensity
XINJIANG	18%	0.4010	0.3383	0.2774	0.1403	49%
INNER MONGOLIA	18%	0.6825	0.4866	0.3990	0.2389	40%
NINGXIA	16%	0.8920	0.5710	0.4797	0.3122	35%
HEILONGJIANG	18%	0.3323	0.2003	0.1642	0.1163	29%
LIAONING	18%	0.3851	0.2175	0.1783	0.1348	24%
HEBEI	18%	0.5233	0.2608	0.2139	0.1832	14%
SHANXI	18%	0.7110	0.3270	0.2682	0.2488	7%
GUANGXI	18%	0.2642	0.1212	0.0994	0.0925	7%
GANSU	18%	0.4518	0.1959	0.1606	0.1581	2%
QINGHAI	12.50%	0.3983	0.1592	0.1393	0.1394	0%
TIANJIN	18%	0.2817	0.1156	0.0948	0.0986	-4%
ANHUI	18%	0.2760	0.1093	0.0896	0.0966	-8%
HAINAN	18%	0.1860	0.0723	0.0593	0.0651	-10%
JIANGXI	19.50%	0.2445	0.0937	0.0754	0.0856	-13%
SHAANXI	18%	0.3204	0.1191	0.0976	0.1121	-15%
SHANDONG	18%	0.3490	0.1278	0.1048	0.1221	-17%
JIANGSU	18%	0.2186	0.0753	0.0617	0.0765	-24%
FUJIAN	18%	0.1931	0.0632	0.0519	0.0676	-30%
GUANGDONG	20.50%	0.1556	0.0510	0.0405	0.0545	-34%
JILIN	18%	0.5166	0.1637	0.1342	0.1808	-35%
ZHEJIANG	18%	0.1964	0.0598	0.0491	0.0687	-40%
SICHUAN	18%	0.2364	0.0634	0.0520	0.0827	-59%
SHANGHAI	18%	0.1728	0.0462	0.0379	0.0605	-60%
HENAN	18%	0.3282	0.0873	0.0716	0.1149	-60%
HUNAN	18%	0.2802	0.0728	0.0597	0.0981	-64%
CHONGQING	18%	0.2368	0.0610	0.0501	0.0829	-66%
HUBEI	18%	0.2925	0.0738	0.0605	0.1024	-69%
YUNNAN	18%	0.3806	0.0960	0.0787	0.1332	-69%
GUIZHOU	18%	0.7505	0.1415	0.1161	0.2627	-126%
BEIJING	18%	0.1288	0.0214	0.0175	0.0451	-157%

APPENDIX B: **Calculations for Figure 7 regarding provincial targets for installed renewable energy during the 14th FYP period. Xinjiang is excluded, as it lacks specific renewable energy goals.**

PROVINCE	TOTAL INSTALLED CAPACITY BY 2025 (GW)	WIND (GW)	SOLAR (GW)	BIOMASS (GW)	HYDRO-POWER (GW)
SUBTOTAL	**1699.76**	**554.85**	**680.77**	**40.66**	**423.48**
INNER MONGOLIA	137.02	89	45	0.6	2.42
SICHUAN	127.97	10.03	12.1	0.29	105.55
HEBEI	98.82	43	54	N/A	1.82
YUNNAN	98.53	28,81	11.93	N/A	86.6
GANSU	90.2	38.5	41.7	N/A	10
SHANDONG	86	25	57	4	N/A
SHANXI	83.24	30	50	1	2.24
QINGHAI	78.85	16.5	45.8	0.12	16.43
GUANGDONG	71.7	25.6	28	N/A	18.1
HUBEI	70	22	10	N/A	38
JIANGSU	70	28	35	3	4
GUIZHOU	65.45	10.8	31	0.85	22.8
SHAANXI	65	20	38	1	6
GUANGXI	60.3	24.5	15	2.2	18.6
JILIN	56	22	8	16	10
ZHEJIANG	52.17	6.41	27.5	3	15.26
HENAN	51.08	27	20	N/A	4.08
NINGXIA	50.42	17.5	32.5	N/A	0.42
ANHUI	44.9	8	28	2.7	6.2
HUNAN	44.5	12	13	1.5	18
SHANGHAI	41.12	21.5	15.7	N/A	3.92
JIANGXI	37.3	7	24	1.2	5.1
FUJIAN	33.43	15.1	5.02	N/A	13.31
LIAONING	32.81	19.81	10	N/A	3
HEILONGJIANG	19	10	5.5	2.2	1.3
CHONGQING	11.49	N/A	3.7	N/A	7.79
HAINAN	11.25	3.3	6.4	N/A	1.55
TIANJIN	8.05	2	5.6	0.45	N/A
BEIJING	3.16	0.3	1.32	0.55	0.99