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THE DECARBONIZATION OF CHINA'S BUILDING SECTOR

Progress and Prospects

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EXECUTIVE SUMMARY

- **The building sector, accounting for almost 29% of China's carbon emissions in 2023, is pivotal to the country's climate efforts.**

With the world's largest building stock and ongoing rapid urbanization, China faces the dual challenge of accommodating increasing construction and energy demand while achieving its climate goals—peaking carbon emissions before 2030 and reaching carbon neutrality before 2060.

- **China's strategy to decarbonize its building sector has evolved over time, reflecting changing priorities in environmental governance and economic planning.**

After an early focus on reducing particle emissions to curb air pollution, policies priorities shifted to energy-saving. A new shift occured in 2021, with the official announcement of China's dual carbon commitment and the introduction of carbon intensity criteria. The first outlines of a path towards absolute caps on carbon emissions have been set in 2024.

- **The policy and regulatory frameworks are progressively taking into account the buildings' whole-life cycle.**

China is developing a comprehensive approach of the building sector decarbonization, introducing a wide range of actions similar to what more developed countries are doing. These include the development of low-carbon materials, an increased use of renewable energy, an emphasis on retrofitting over demolition and reconstruction, a push for digitalization and smart management systems, and the premises of a circular economy for building materials.

- **For the first time in 2023, the sector's total carbon emissions showed a slight decrease, which will hopefully be confirmed in the following years.**

The sector's total carbon emissions amounted to 3.6 billion tons in 2023, compared to 3.7 billion tons in 2021[1]. With the carbon emissions from the building sector slightly decreasing and the country's global emissions still increasing (reaching 12.6 billion tons in 2023[2]), the share of the building sector in China's global emissions decreased from 32% in 2021 to 28,6% in 2023. Data for 2024 and 2025 will confirm whether this is a stable trend, which would mean that the carbon peak goal, set for 2030, has already been reached.

[1] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025).

[2] https://www.iea.org/reports/co2-emissions-in-2023/energy-intensive-economic-growth-compounded-by-unfavourable-weather-pushed-emissions-up-in-china-and-india

- **While China seems to be on track to meet most of its 2025 targets[3], the building sector will need to step up its efforts to meet the 2060 neutrality goal.**

To reach carbon neutrality in 2060 as planned, China will need more ambitious targets in retrofitting, energy and carbon intensity, clean energy share, and in the decarbonization of steel and cement. The 15th Five-Year Plan, to be released early 2026 will be crucial to measure China's ambitions in the decarbonization of its building sector and the alignment of its upcoming policies with its neutrality target.

- **Implementation and monitoring challenges persist that slow down the country's building decarbonization process.**

While carbon emissions targets are being gradually integrated into policies and standards, the focus remains primarily on energy savings and China still lacks a comprehensive regulatory framework for carbon management. Existing standards and labels are not mature and operational, and do not yet encompass the full scope of decarbonization needs. Furthermore, the sector lacks a robust, validated methodology for calculating building-level carbon emissions, and a comprehensive national emissions database for building materials is still under development. Because of this, implementation remains an issue. Data reliability and transparency also pose significant hurdles, the current system relying heavily on self-reporting by enterprises and building managers, with limited third-party verification or audit mechanisms.

- **The implementation of important pilot programmes prepares for a strategic push, which could be a source of economic growth for the Chinese economy.**

China's building sector decarbonization is a make-or-break for the country's 2060 carbon neutrality trajectory. Pilot programmes are the opportunity to test implementation policies and to foster the development of technological solutions and business models. Indeed, China's building decarbonization efforts are catalyzing a wave of **technological advancement** and new companies with rising significance, both for achieving China's national climate targets and offering replicable solutions worldwide.

- **China's current regulatory momentum and the wave of new standards and policies are creating new opportunities for international cooperation and economic partnerships.**

International actors can contribute to the development of standardized methodologies for carbon calculation, reporting, and monitoring, as well as to the creation of certification and auditing capacities. Experience from Europe, such as that of the CRREM methodology, could inform China's efforts to build a robust carbon accounting framework. Promising areas for technical collaboration are emerging in building digitalization and smart monitoring (Building Information Modeling, BIM) to optimize energy use and emissions tracking. In materials, China is investing in R&D and has announced lower tariffs for select green products, creating openings for foreign companies with innovative technologies. Additionally, the country is exploring recycling and reuse of building materials, an area where international expertise is actively sought.

[3] According to many analysts (CREA, Climate Tracker, Carbon Brief), China will not meet its carbon intensity reduction target for 2025.

CHINA'S BUILDING SECTOR DECARBONIZATION TARGETS

2025 & 2030

NEW BUILDINGS

- **+ 20 million m²** ultra-low and near-zero energy consumption vs. 2023
- **100%** of new buildings to be green (basic grade) in urban areas
- **30%** of new buildings to be at least 1-Star Green Building Standard
- **30%** of new construction to be prefabricated (**40%** in 2030)

BUILDING RENOVATION

- **+ 200 million m²** energy-saving renovation vs. 2023
- **+30%** energy-saving rate in renovated urban residential buildings vs. 2023
- **+20%** energy-saving rate in renovated public buildings vs. 2023

BUILDING MATERIALS

- **80%** of iron and steel production capacity transformed to ultra-low emissions
- **30%** of cement kilns use alternative fuel
- **30%** of cement production capacity above energy efficiency benchmark
- **2%** decrease in energy consumption per ton of steel
- **3.7%** decrease in energy consumption per unit of clinker in cement products vs. 2020
- **300 million tons** of steel scrap resources used in iron and steel industry
- **800 million tons** of wastes used in cement industry
- **55%** of construction wastes to be reused

ENERGY MIX

- **55%** electricity share in buildings energy consumption (**65%** in 2030)
- **8%** renewable energy substitution rate in new buildings
- **50 million kW** installed capacity of photovoltaic power generation in new buildings
- **50%** rooftop photovoltaic installation for new public buildings and factories
- **100 million m²** of buildings equipped with geothermal energy
- **1.15 billion tons** equivalent coal cap for buildings operational energy consumption

ENERGY PERFORMANCE

Buildings

- **83%** energy efficiency in new buildings in cold climate zones
- **75%** energy efficiency in other zones
- **78%** energy efficiency in new public buildings

Equipement

- **60%** energy-efficient household refrigeration equipment
- **50%** energy-efficient lighting equipment

CARBON PERFORMANCE

- **7 kg CO_2/m²/year** reduction in carbon carbon intensity for new buildings vs. 2016
- **40%** reduction in carbon intensity for new buildings vs. 2016
- **53 million tons** reduction of carbon emissions from iron and steel production vs. 2024
- **13 million tons** reduction of carbon emissions from cement production vs. 2024
- **26 million tons** reduction of carbon emissions in building materials vs. 2024
- **5%** reduction of carbon emissions from electrolytic aluminum

NON-QUANTIFIED TARGETS

- Development of calculation, reporting, monitoring and certification of carbon emissions and carbon footprint
- Favoring retrofitting over demolition and reconstruction
- Building digitalization, smart monitoring and BIM
- Low carbon materials R&D
- Recycling and reuse of building materials

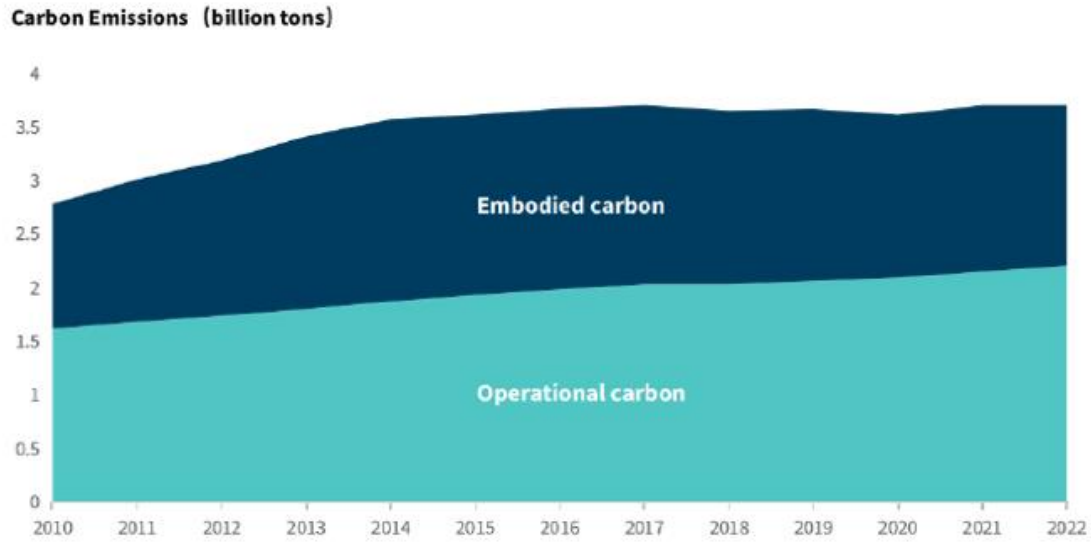
INTRODUCTION

In China, carbon emissions from the building sector accounted for almost 29% of the country's emissions in 2023. Since China, that same year, was responsible for slightly more than 30% of global carbon emission[4], this means that China's building sector alone represents 9% of the world's carbon emissions.

Decarbonizing this sector is therefore key not only for China's decarbonization pathway, but also to mitigate climate change at the global level.

Despite an early awareness of the need to reduce energy consumption and emissions, and noticeable achievements like the modernization of the district heating systems in Northern China's urban areas, China's efforts to decarbonize its building sector have yet to change gears to demonstrate full effectiveness. The country's operational emissions are still on the rise and the first time the sector's total emissions showed a slight decrease was in 2023 (reaching 3.6 billion tons compared to 3.7 in 2021[5]). In way of comparison, emissions from the building sector in France have been consistently decreasing since 2017 (except in 2021)[6].

Graph 1 – Evolution of Embodied and Operational Emissions



RMI Graphic. Source: Building Energy Research Center Tsinghua University, *Annual Report on Building Energy Efficiency Development in China 2024*

[4] JRC/IEA Report, GHG Emissions of all world countries, 2024. https://edgar.jrc.ec.europa.eu/report_2024?vis=ghgtot#emissions_table

[5] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025).

[6] Citepa, *Rapport Secten ed., 2024*, https://www.citepa.org/wp-content/uploads/2024/12/Citepa_Secten-2024.pdf

In order to reach its climate goals, with carbon emissions peaking before 2030 and the whole country being carbon-neutral before 2060, China has to step up its efforts to decarbonize its building sector.

This report presents China's actions targeting the sector and their evolution over the years. Its scope comprises all components of buildings (materials, construction, operation, renovation, destruction) and all kinds of buildings (residential, commercial, urban, rural). It remains at the building level, and does not delve into decarbonization strategies at the community, neighbourhood or village levels.

It takes stock of the country's past and current efforts, points out their accomplishments and limitations, and outlines venues for increased efficiency and international cooperation.

GLOSSARY

Carbon emissions: this expression is used throughout the paper to designate the sum of all greenhouse gas emissions (CO_2 and other GHG) converted in carbon equivalent. In the building sector, carbon emissions are divided into two categories: operational emissions and embodied emissions.

Operational emissions: carbon emissions associated with the energy used to operate and maintain the building. These emissions can in turn be divided into two categories: direct and indirect emissions.

Direct emissions (Scope 1): carbon emissions from on-site fuel combustion (for example gas used for cooking or heating). These can also be referred to as Scope 1 emissions.

Indirect emissions (Scope 2): carbon emissions stemming from the use of centralized energy sources (for example electricity from the grid, steam from district heating). These can also be referred to as Scope 2 emissions.

Embodied emissions (Scope 3): carbon emissions arising from the manufacturing and transportation of building materials and from the construction and disposal of buildings. These can also be referred to as Scope 3 emissions.

Carbon intensity: in the buildings, carbon intensity measures the amount of operational carbon emissions per floor area over a given period of time. It is usually expressed in kg carbon equivalent per square meter per year ($kgCO_2e/m^2/year$). It can also be expressed in kg carbon equivalent per person per year ($kgCO_2e/person/year$).

Energy intensity: how much energy a building uses per floor area over a given period of time. It is usually expressed in kilowatt-hours per square meter per year ($kWh/m^2/year$).

I - Buildings in China's decarbonization efforts

I.1 - China's building sector specificities

Before starting to describe the specificities of China's building sector, it should be noted that finding one's way in the different sources of data on related carbon emissions is not an easy task. China's data collection systems have greatly improved in recent years, and are currently being standardized in line with international practices, but they are not as developed and transparent as they can be in other countries, which raises the question of their international comparability. The Chinese sources consulted for this report are considered benchmark ones, but show some disparities – in particular: the data corpus of the *Building Energy Research Center* of Tsinghua University, of the *China Association of Building Energy Efficiency* and of *the National Bureau of Statistics.*

Getting building sector emissions data right is a complex task for all countries. But, as we will see in Part 4, standardised measurement methodologies underpinning norms and labels are still in development in China, resulting in data based on rougher estimations and modelling than other types of statistics. These forewarnings have implications for the monitoring of existing policies and for the overall assessment of the country's achievements in terms of decarbonization[7].

- **China has the largest building stock in the world,** with an existing stock of 69 billion m² in 2023, and about 4 billion m² of new floor added every year (showing a very moderate slowing down)[8]. With ongoing urbanization (from 37,7% urbanization rate in 2001 to 67% in 2024, and a stable growth rate of around 0,8% for the past couple of years[9]) and rising living standards, the demand for building construction and energy use is still increasing. One of the country's challenges is to maintain a decoupling between the rise in the emissions on one side and the increase in the stock and the country's rising living standards on the other.

- **The structure of the carbon emissions from the building sector in China is slightly different from what most countries are experiencing.** Around 60% of emissions come from the operations of buildings (2.2 billion tons, including direct emissions from heating, cooking and hot water, and indirect emissions from electricity use and district heating - i.e. 19% of

[7] Furthermore, the experience of energy data reporting has shown that China's reporting system suffers from a systemic bias. Provincial and sub-provincial governments are responsible for compiling and reporting data to higher authorities. However, the "target responsibility system" means that the performance of local authorities is measured against targets set for them by the central government, after consultations. As the performance of officials is noted against their ability to meet set targets, local governments may therefore be tempted to alter the reported data to bring them in line with their targets. Due to this bias, the National Bureau of Statistics has revised its estimates of energy consumption several times over the past 20 years. This bias persists and might also alter carbon emission data.

[8] National Bureau of Statistics of China, https://www.stats.gov.cn/sj/ndsj/2024/html/E14-23.jpg

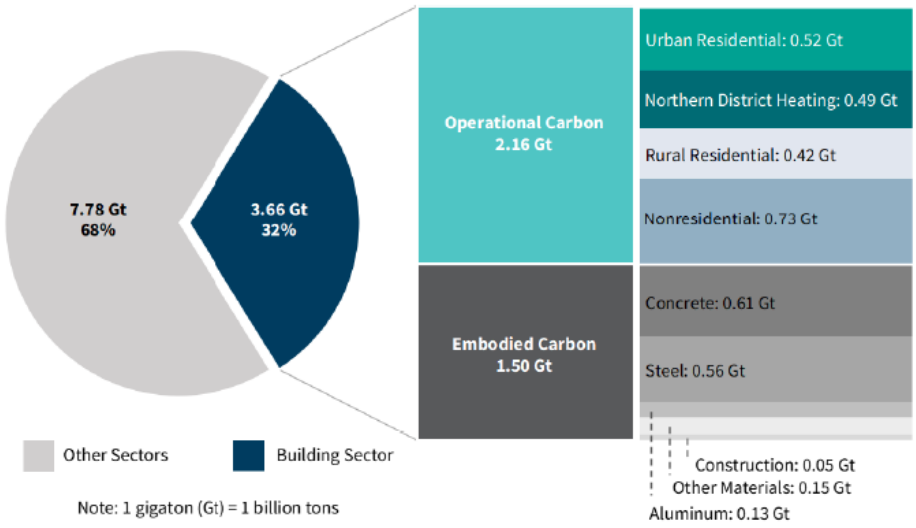
[9] National Bureau of Statistics of China, https://www.stats.gov.cn/english/PressRelease/202502/t20250228_1958822.html#:~:text=Solid%20progress%20was%20made%20in,at%20the%20end%20of%202023.

total national emissions vs. 27% global average), while 40% come from the materials, their production and transport, the construction and destruction of buildings (embodied carbon, 1.4 billion tons - i.e. 14% of total national emissions vs. 10% global average in 2021)[10] [11]. The larger embodied emissions are mostly due to the still ongoing urbanization process, shorter building lifespan and to the production processes of construction materials. The lower operational emissions partly come from the local standards of living, which are less energy-consuming (both per capita and per square meter) than in developed countries.

	Share of total building sector emissions in China	Share of total building sector emission, global average	Share of total emissions in China (2021 data)	Share of total emissions, global average (2021 data)
Operational emissions	60%	70%	19%	27%
Embodied emissions	40%	30%	14%	10%

Source: Building Energy Research Center of Tsinghua University, China Building Energy Efficiency Annual Development Research Report 2025.

Graph 2 - CO2 emissions breakdown from China's building sector in 2022



RMI Graphic. Source: International Energy Agency (IEA), **https://www.iea.org/reports/co2-emissions-in-2023/**; Building Energy Research Center Tsinghua University, *Annual Report on Building Energy Efficiency Development in China 2024*; Building Energy Research Center Tsinghua University, China Association of Building Energy Efficiency, *2023 China Building and Urban Infrastructure Carbon Emissions Report*

[10] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025).

[11] "Building Decarbonization in China: A State of Play", conference by Dr. Hu Shan, Building Energy Center, Tsinghua University, June 2024.

- **Regional and rural/urban disparities make for a building stock with strong local specificities** that the design and implementation of policies need to take into account. For example, standards for heating and ventilation differ from one region to another (five climate zones are officially recognized: severe cold region, cold region, hot-summer cold-winter region, hot-summer warm-winter region and temperate region). Different levels of development between rural and urban areas, and between Western and Eastern provinces, also create a variety of local conditions that influences both the characteristics of the building stock and the financing resources local governments, real estate companies and households can engage in decarbonization efforts.

- **While the real estate sector has been one of the engines of China's economic growth, it is currently experiencing a severe crisis** that led some big players into bankruptcy and left many others in a poor financial situation. This crisis is also impacting households, who put a lot of their savings in home ownership, and local governments, who have been dependent on land sales for revenue. The resulting financial constraints hinder the investments needed to decarbonize the building sector.

- **Low energy prices and low carbon prices in China are disincentives to reduce energy consumption and carbon emissions.** The market incentives that play well in other countries, through the EU's Emissions Trading System for example, are yet to reach their full efficiency in China.

I.2 - Historical perspective: changing drives, changing priorities

China's actions to decarbonize its building sector have evolved significantly over time, reflecting shifting priorities in environmental governance and economic planning. Early measures were in fact motivated by considerations other than carbon emissions but contributed to their reduction indirectly. They did, however, lay foundations for more targeted actions and continue to drive significantly China's decarbonization efforts.

- **Efforts to curb air pollution:** starting in the 2000s, early policies targeted the air pollution that plagued the country. Highly polluting industries such as iron and steel, cement and aluminium, were pointed out. Industrial policies were implemented aiming at reducing particle emissions in the production process of these raw materials.

⇒ Cf. Law on the Prevention and Control of Atmospheric Pollution (2000)[12].

- **Efforts to meet the growing demand of energy:** with China's rapid economic development from the 1990s on, the country's energy consumption skyrocketed. In order to meet this demand and curb the dependence on energy importations, two main lines of action were promoted. First, to produce more energy, including with the development of renewables that was accelerated in 2006. Second, emphasis was put on energy savings across all sectors of society. These broad objectives had implications for the building sector, with the issuance in 2006 of the Green Building Standard, also known as the Three-Star System, that focuses on the reduction of operational energy consumption and on the promotion of resource-saving practices.

[12] https://www.gov.cn/gongbao/content/2000/content_60224.htm

⇒ Cf. Renewable Energy Law (2005)[13].
⇒ Cf. Energy Conservation Law (2007)[14].
⇒ Cf. China's Green Building Standard (2006) and its evolution, Annex 1.

- **Efforts to upgrade the heavy industry while reducing overcapacities:** in the 2010s, the still ongoing fight against air pollution was reinforced by the need to reduce production overcapacities in sectors like cement, steel and glass. Obsolete and heavily polluting factories were shut down, which indirectly helped control the rise in embodied emissions stemming from building materials.

⇒ Cf. Guiding Catalogue for Industrial Structure Adjustment (2011).

- **Efforts to promote clean heating in the Northern Region:** the government introduced a plan in 2017 to reduce heavy smog in urbanized areas, encouraging the shift from coal to electricity, from coal to gas and clean coal replacement, supplemented with the development of renewables and waste-to-energy.

⇒ Cf. Clean Heating Plan in Winter in the Northern Region (2017-2021).

- **Efforts buttressed by international climate commitments:** with the signing of the Paris Agreement in 2015, China accelerated its decarbonization efforts. In the early 2020s, its updated NDC (Nationally Determined Contribution, October 28th, 2021) formalized China's Dual Carbon Commitment (peaking carbon emissions before 2030, becoming carbon neutral before 2060). In 2021, a wide range of texts detailing strategic orientations and means of action to decarbonize the whole economy were published, including the 14th Five-Year Plan (2021-2026), and the "1+N" Framework for Carbon Dioxide Peaking and Carbon Neutrality (from 2021 on). With the "Working guidance for carbon dioxide peaking and carbon neutrality in full and faithful implementation of the new development philosophy" as the main strategic document (the "1"), this framework is composed of a number of action plans formulated for different industries (the "N"), implementing the guidance provided by the "1". This marked a turning point: the Chinese government, which had previously focused its efforts mainly on energy and air pollution, began to develop a series of policy guidance documents with explicit decarbonization targets. For the building sector, this new orientation translated in 2022 into a series of legislations detailing the specific implementation of the Five-Year plan guidelines for the sector.

⇒ Cf. National overarching guidelines including decarbonization targets, Annex 2, table 1.
⇒ Cf. Implementation plans specifically targeting the building and construction sectors, Annex 3.

- **Efforts driven by international trade requirements:** international trade rules and in particular the EU's Carbon Border Adjustment Mechanism (CBAM), as well as international standards, may have catalysed sectoral decarbonization in China's export-exposed industries. The progressive inclusion of steel, cement and aluminium in China's national

[13]https://english.mofcom.gov.cn/Policies/LawsRegulations/art/2013/art_f1de59700ebd47c69367af1013f6daef.html
[14] https://english.mee.gov.cn/Resources/laws/envir_elatedlaws/201712/P020171212569843009546.pdf

carbon market partly responds to CBAM and has consequences on the country's building sector's embodied emissions.

⇒ Cf. Work Plan for Including the Iron and Steel, Cement, and Electrolytic Aluminium Industries in the National Carbon Emissions Trading Market (2025)[15].

I.3 - Current targets

Since 2021, China has been developing a comprehensive policy framework for the decarbonization of its building sector, addressing operational and embodied emissions, with explicit targets. Most of these are expressed in terms of carbon intensity, but first targets in terms of absolute reduction for operational emissions were set in 2021, and for the production of building materials, in 2024. Absolute caps are expected to be introduced in the next Five-Year Plan (2026-2030).

- **Operational emissions:** the 14th FYP set a target in January 2022 for the total primary and secondary energy consumption of building operations, to reach 1.15 billion tons equivalent coal by 2025. This target is not labelled in terms of operational carbon emissions, but the capping of emissions related to primary and secondary energy consumption de facto equals to capping operational emissions. A related standard for carbon emissions from buildings and construction, implemented since April 2022, also provides that in newly built residential and public buildings, carbon emission intensity should be reduced by an average of 40% on the basis of the energy-saving design standards implemented in 2016, or by at least 7kg CO_2/m^2/year.

⇒ Cf. 14th Five-Year Plan for Building Energy Conservation and Green Building Development (2022), Annex 3.
⇒ Cf. Chinese Standards and Main Foreign Standards Used in China, Annex 1.

- **Embodied emissions:** no target has been set for the reduction of embodied emissions as a whole. However, quantified targets have been set for the first time in 2024 for the production of building materials, thus indirectly impacting the amount of embodied emissions of buildings. The building material industry should reach energy savings of 10 million tons of standard coal and reduce carbon emissions by 26 million tons in the 2024-2025 period. In the iron and steel industry, from 2024 to 2025, carbon emission reduction should reach about 53 million tons. In the cement industry, 13 million tons of carbon emissions should be saved in the 2024-2025 period. By 2025, more than 80% of iron and steel production capacity should be transformed into ultra-low emission.

⇒ Cf. Special Action Plan for Energy Saving and Carbon Reduction in the Iron and Steel Industry (2024), Annex 4.
⇒ Cf. Special Action Plan for Energy Conservation and Carbon Reduction in the Cement Industry (2024), Annex 4.
⇒ Cf. Action Plan for Energy Conservation and Carbon Reduction during 2024-2025 (2024), Annex 2, table 2.
⇒ Cf. Promoting High-quality Development of the Steel Industry (2022), Annex 4.

[15] https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202503/W020250326367625819894.pdf

- **To support this new focus on carbon emissions, China is building up a system to measure, monitor and report carbon emissions.**

⇒ Cf. General Code for Energy Efficiency and Renewable Energy Application in Buildings (2021), Annex 1.
⇒ Cf. Requirements for enterprises on GHG emissions accounting and reporting (2023 and 2024), Annex 1.

- At the building level, carbon emission accounting standards for operational emissions are to be improved, paving the way for the inclusion of large-scale buildings (residential, public or commercial) into a carbon emission trading system.
⇒ Cf. 14th Five-Year Plan for Building Energy Conservation and Green Building Development (2022), Annex 3.

- In the raw materials industry, carbon emission accounting and monitoring mechanisms are being set up and improved, and carbon labelling certification is being implemented for key construction materials. Carbon emission benchmarks are expected to be issued along with quotas, but no target or time-frame is provided.
⇒ Cf. Work Plan for Accelerating the Establishment of a Dual Control System for Carbon Emissions (2024), Annex 2, table 2.
⇒ Cf. Special Action Plan for Energy Saving and Carbon Reduction in the Iron and Steel Industry (2024), Annex 4.
⇒ Cf. Implementation Plan for Carbon Peaking in the Industrial Sector (2022), Annex 4.
⇒ Cf. Chinese Standards and Main Foreign Standards Used in China, Annex 1.

- For building material and equipment, a carbon footprint management system is to be set up in line with international standards. By 2027, it should target 100 key products, with the aim of including 200 products by 2030. Among the key products, many are related to the building sector: iron and steel, cement, glass, electrical and electronic appliances.
⇒ Cf. Implementation Plan for the Establishment of a Carbon Footprint Management System (2024), Annex 4.

II - Reducing operational emissions: the historical core of building decarbonization

II.1 - Same tools, new ambitions

Operational emissions can be reduced by using two levers: energy savings and a greener energy mix.

- **Reducing energy consumption**

Energy consumption in buildings generates operational emissions: direct ones from heating and cooking, and indirect ones from the use of centralized energy sources like electricity from the grid.

The reduction of energy consumption is one of the historical drives of China's decarbonization efforts and remains a focus of its current action. This makes sense as operational emissions account for about 60% of the building sector total emissions, and as households and property operators will cooperate easily to measures helping them lower their energy bill.

To reduce operational emissions, China has set ambitious targets for <u>new constructions</u>. By 2025, all newly constructed buildings in urban areas should reach at least the basic grade of the country's Green Building Standard, and newly-built ultra-low and near-zero energy consumption buildings should have increased by 20 million square meters compared to 2023.
⇒ Cf. Action Plan for Carbon Dioxide Peaking before 2030 (2021), Annex 2, table 1.
⇒ Cf. Opinions on accelerating the comprehensive green transformation of economic and social development (2024), Annex 2, table 2.
⇒ Cf. Action Plan for Energy Conservation and Carbon Reduction during 2024-2025 (2024), Annex 2, table 2.

New buildings are also being given increasingly demanding energy-efficiency targets. The "General Code for Energy Efficiency and Renewable Energy Application in Buildings", issued in 2021, provides that the energy saving rate of new residential buildings should reach 75% in cold zones, 65% in other zones, and 72% for all public buildings. One year later, in July 2022, the "Implementation Plan for Carbon Peaking in Urban and Rural Construction" sets a stricter long-term target for 2030, when new buildings' energy efficiency is due to reach 83% in cold climate zones, 75% in other zones and 78% for new public buildings.
⇒ Cf. General Code for Energy Efficiency and Renewable Energy Application in Buildings (2021), Annex 1.
⇒ Cf. Implementation Plan for Carbon Peaking in Urban and Rural Construction (2022), Annex 3.

The **gradual introduction of energy consumption caps for new buildings, expressed in** kWh/m²/year, has been announced but no quantified targets have been provided yet. Once these are released, they'll make international comparisons easier, most countries expressing their targets in kWh/m^2/year (as does the DPE system in France for example).
⇒ Cf. Working Guidance for Carbon Dioxide Peaking (2021), Annex 2, table 1.

<u>The existing building stock</u> is the target of energy-saving measures to be implemented as part of renovation work. In 2025, energy saving rates of renovated residential and public buildings should have increased by 30% and 20% respectively compared to 2023. More than 350 million square meters of buildings should have undergone energy-saving renovation between 2022 and 2025.

⇒ Cf. Action Plan for Energy Conservation and Carbon Reduction during 2024-2025 (2024), Annex 2, table 2.
⇒ Cf. 14th Five-Year Plan for Building Energy Conservation and Green Building Development, (2022), Annex 3.

Existing buildings are also expected to reduce their energy consumption by upgrading their equipment: the proportion of energy-efficient products in household refrigeration equipment should reach 60% by 2025, and 50% for lighting equipment. Building equipment and home appliances are also specifically targeted for upgrades and trade-ins.
⇒ Cf. Action Plan for Energy Conservation and Carbon Reduction during 2024-2025 (2024), Annex 2, table 2.
⇒ Cf. Action Plan to Promote Large-Scale Equipment Upgrades and Trade-Ins of Consumer Products (2024), Annex 4.

In addition to these traditional tools to reduce operational emissions, China now also increasingly uses **smart building technologies and Building Information Modeling** (BIM) to better control the energy consumption of buildings from the early design phase on. No quantified targets are being set, but these technologies are widely promoted.
⇒ Cf. 14th Five-Year Plan for the Development of Construction Industry (2022), Annex 3.

- **Electrification and greening the energy mix**

Electrification and greening the energy mix is the second lever contributing to reducing operational emissions. Since 2021, measures have been adopted to change the energy consumption structure of buildings by promoting electric conversion, low-carbon (natural gas and nuclear) and renewable energies.
⇒ Cf. Working Guidance for Carbon Dioxide Peaking (2021), Annex 2, table 1.

Increasing the share of electricity in buildings' energy consumption is one of the leverages promoted by China to reduce its operational emissions. The target set for electricity consumption was to reach 55% of energy consumption in buildings by 2025, compared to 30,3% in 2021[16]. This electrification of energy consumption is designed to reduce the share of fossil fuel consumption in buildings: oil, natural gas and coal still accounted for 35% of the energy consumption of buildings in 2021. However, since 58 % of China's electricity production still comes from coal[17], the efficiency of this measure is limited in terms of decarbonization.
⇒ Cf. 14th Five-Year Plan for Building Energy Conservation and Green Building Development (2022), Annex 3.

[16]https://1p5ndc-pathways.climateanalytics.org/countries/china/sectors/buildings#:~:text=Decarbonising%20the%20building%20sector,up%2035%25%20of%20the%20mix.
[17] https://carboncredits.com/china-sets-clean-energy-record-in-early-2025-with-951-tw/

Increasing the share of renewable energy used in the buildings is another leverage. According to official targets, the renewable energy substitution rate in urban buildings should reach 8% by 2025. Two main sources of renewable energy are promoted:
i) photovoltaic power, with the target of having photovoltaic coverage of roofs for 50% of new public buildings and factories, and a total installed capacity of 50 million kilo-watts in new buildings by 2025. The spread of rooftop photovoltaic panels is part of a strategy to develop buildings able to produce, store and consume their own electricity locally. Known as PEDF buildings (Photovoltaic - Energy storage - Direct current - Flexible loads), they increase energy flexibility and avoid peak grid loads. They are one of the experimentation axes China has been developing to reduce operational emissions.
ii) geothermal energy with a target of 100 million square meters of buildings equipped by 2025.
These measures are driving the local demand for the industrial production of solar panels and heat pumps.
⇒ Cf. 14th Five-Year Plan for Building Energy Conservation and Green Building Development (2022), Annex 3.
⇒ Cf. Action Plan for Carbon Dioxide Peaking before 2030 (2021), Annex 2, table 1.
⇒ Cf. Implementation Plan for Carbon Peaking in Urban and Rural Construction (2022), Annex 3.
⇒ Cf. Action Plan for Promoting High-Quality Development of the Heat Pump Industry (2025).

II.2 - Still on the rise

In 2023, operational emissions increased slightly at 2.2 billion tons[18]. The rise is slowing down, though, and at a regular pace: +6% per year between 2006-2010, +4.4% per year during 2011-2015, +2.7% per year during 2016-2020[19]. Since the 12th Five-Year Plan (2011-2015), operational emissions have been growing at a slower pace than energy consumption. In 2022, the energy consumption in buildings operation increased by 5.29% compared to the previous year, while in the same timeframe, operational emissions only grew by 2.66%[20].

China's operational emissions are low compared to the US and other countries, reflecting China's living standards and way of life. For instance, per capita electricity consumption in the building sector in China is still only 1/6 of the US and 1/3 of France's[21]. In 2020, China's

[18] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025).
[19] China Association of Building Energy Efficiency and Chongqing University, *Research Report on Carbon Emissions in the Field of Rural and Urban Development in China, 2024* (in Chinese). https://cmsfiles.zhongkefu.com.cn/cmsossjianzhujieneng/upload/file/20250120/1737310863233732.pdf
[20] China Association of Building Energy Efficiency and Chongqing University, *Research Report on Carbon Emissions in the Field of Rural and Urban Development in China, 2024* (in Chinese). https://cmsfiles.zhongkefu.com.cn/cmsossjianzhujieneng/upload/file/20250120/1737310863233732.pdf
[21] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025).

operational carbon emissions intensity, whether per capita or per floor area, was lower than the then global average (1.5 t/cap and 31 kg/m² vs. 35kg/m²).

The rise in operational emissions, driven by higher living standards, urbanisation and development, could have been worse : it has been contained by government policies leading to the better energy efficiency of new buildings and retrofitted ones, and by a growing share of renewable both in the country's electricity production (24.2% in 2022[22]) and in the buildings' energy mix (11.6% wind and solar power in the residential energy consumption[23]).

Indirect emissions from heating are still increasing, reaching 450 million tons in 2023, compared to 430 million tons in 2021[24]. Rising living standards and a growing demand for residential heating are driving these emissions up. However, an improved energy efficiency in Northern district heating contains the rise: between 2003 and 2023, the energy consumption for district heating dropped from 26.7 kg carbon equivalent per square meter to 12.9 kg/m² and while the total area covered by district heating tripled between 2003 and 2023, the energy consumption for heating only doubled.

Indirect emissions from electricity consumption keep rising at a quick pace, reaching 1.35 billion tons in 2023, compared to 1.24 billion tons in 2021[25]. This increase is driven by rising living standards (more electric appliances like air-conditioning, more demand for connectivity for example) leading to a steady rise in electricity use. This is also the consequence of national policies pushing for the electrification of energy consumption in buildings.

Direct emissions from rural and urban cooking and from heating boilers peaked around 2015 and decreased sharply in recent years. In 2023, they accounted for 420 million tons, compared to 510 million tons in 2021. This decrease is mostly due to the vast campaigns "from coal to electricity" and "from coal to gas" that China has been implementing since 2013. Originally designed to curb air pollution, these campaigns have had a clear impact on direct carbon emissions. In Northern urban areas, the promotion of district heating has also contributed to this reduction in direct emissions.

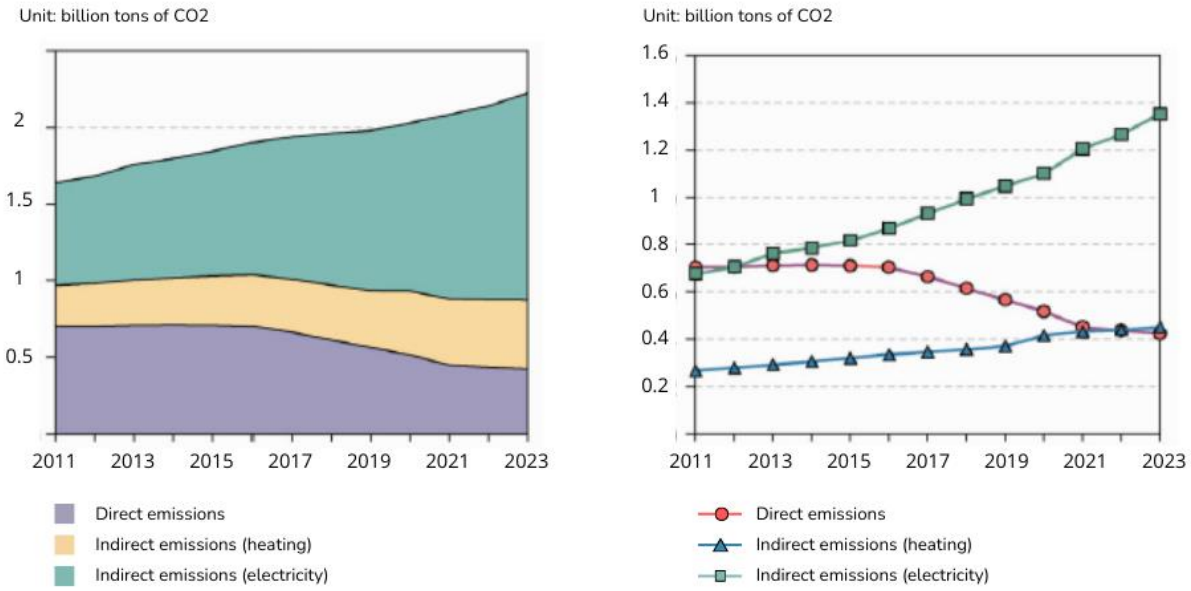
[22] IEA, Energy Transitions Indicators, https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser?country=CHN&fuel=Electricity%20and%20heat&indicator=ETISharesInPowerGen

[23] IEA Data services, https://www.iea.org/countries/china/efficiency-demand#how-does-the-residential-sector-in-china-use-energy

[24] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025) ; Building Energy Research Center of Tsinghua University, *China Building Energy and Emission Yearbook 2023.*

[25] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025) ; Building Energy Research Center of Tsinghua University, *China Building Energy and Emission Yearbook 2023.*

Table 1: China building sector's operational emissions, 2011-2023.



Source: Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025)

III - Reducing embodied emissions: harnessing new levers

III.1 - Towards a more comprehensive approach of embodied emissions

Cement, glass and steel have been early targets of decarbonization efforts due to their highly polluting production processes and they remain a focal point of China's decarbonization policies. But they no longer are the only entry point to tackle embodied emissions: the whole life-cycle of buildings is progressively taken into account, as in most developed economies. **A broad range of actions is currently being promoted, revealing a comprehensive approach to embodied emissions, and a shift of focus from energy consumption and intensity to carbon intensity.**

- **Reducing the carbon and environmental footprint of raw materials:**

The decarbonization of cement and steel started in the early 2000s. It has a direct impact on the decarbonization of the building sector, since buildings are large users of steel and cement (respectively 24% and around 56% of total steel and cement consumption in 2023[26][27]).

The focus has been put on several aspects:

[26] https://www.bhp.com/news/bhp-insights/2024/07/visualised-chinas-steel-demand-through-time
[27] https://www.mordorintelligence.com/industry-reports/china-cement-market

- **Improving energy efficiency and reducing energy consumption in the cement and steel industries**: by the end of 2025, 30% of cement industries should be above an energy-efficiency benchmark. By 2025, the energy consumption per ton of steel is to be reduced by 2% compared to 2021, and the consumption per unit of clinker cement products is to be reduced by 3.7%. The use of alternative fuels is also encouraged, and should reach 10% in the cement industry.
⇒ Cf. Action Plan for Energy Conservation and Carbon Reduction during 2024-2025 (2024), Annex 2, table 2.
⇒ Cf. 14th Five-Year Plan: Action Plan for the Development of the Raw Materials Industry (2021), Annex 4.
⇒ Cf. Implementation Plan for Carbon Peaking in Urban and Rural Construction (2022), Annex 3.
⇒ Cf. Special Action Plan for Energy Conservation and Carbon Reduction in the Cement Industry (2024), Annex 4.
⇒ Cf. Implementation Plan for Carbon Peaking in the Industrial Sector (2022), Annex 4.

- Cement, steel and aluminium are being included in China's ETS system, with a test-phase from 2024 to 2027.
⇒ Work Plan for Expanding the National Carbon Emissions Trading Market (March 2024)[28].

- **Green concrete, alternative cement and low-carbon steel** are promoted, with an emphasis on R&D for low-carbon building materials.
⇒ Cf. 14th Five-Year Plan for the Development of the Construction Industry (2022), Annex 3.
⇒ Cf. Implementation Plan for Carbon Peaking in the Building Materials Industry (2022), Annex 4.
⇒ Cf. Promoting High-quality Development of the Steel Industry (2022), Annex 4.
⇒ Cf. Special Action Plan for Energy Conservation and Carbon Reduction in the Cement Industry (2024), Annex 4.
⇒ Cf. Implementation Plan for Sci-Tech Supporting Carbon Peaking and Carbon Neutrality (2022), Annex 4.

- **Control of the total production volume of building materials and capping of cement clinker production capacity** at 1.8 billion tons per year. These measures are also a way to curb the overcapacity experienced by the cement industry, partly due to China's real estate crisis[29].
⇒ Cf. Implementation Plan for Carbon Peaking in Urban and Rural Construction (2022), Annex 3.
⇒ Cf. Special Action Plan for Energy Conservation and Carbon Reduction in the Cement Industry (2024), Annex 4.

[28] https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202503/W020250326367625819894.pdf
[29] https://www.globalcement.com/news/item/18686-update-on-china-april-2025

- **Promoting a circular economy approach in raw materials industries:**

The development of a circular economy for building materials has recently been added to China's toolbox: **construction wastes** have to be controlled, the recycling of materials and the use of solid wastes as raw materials are encouraged. Some quantified targets have been set in 2022 and 2024: building wastes at new construction sites should be less than 300 tons per 10.000 square meters; by the end of 2025, the cement industry should use 800 million tons of wastes as raw material; by 2030, 55% of construction wastes should be reused.
⇒ Cf. Implementation Plan for Carbon Peaking in Urban and Rural Construction (2022), Annex 3.
⇒ Cf. 14th Five-Year Plan for the Development of the Construction Industry (2022), Annex 3.
⇒ Cf. Promoting High-quality Development of the Steel Industry (2022), Annex 4.
⇒ Cf. Special Action Plan for Energy Conservation and Carbon Reduction in the Cement Industry (2024), Annex 4.

- **Encouraging prefabricated buildings and components…**

The use of **prefabricated buildings** is currently promoted as a new lever to reduce material waste, transportation-related emissions, and to optimize energy efficiency in the production. In 2025, they should represent more than 30% of the new urban constructions built that year, and up to 40% in 2030.
⇒ Cf. 14th Five-Year Plan for the Development of the Construction Industry (2022), Annex 3.
⇒ Cf. 14th Five-Year Plan for Building Energy Conservation and Green Building Development (2022), Annex 3.
⇒ Cf. Implementation Plan for Carbon Peaking in Urban and Rural Construction (2022), Annex 3.

- **... and retrofitting.**

Retrofitting is now favoured over demolition and reconstruction, and the gross floor area is to be limited in urban areas. This shift, first mentioned in 2021 plans, has been reasserted in a 2023 circular issued by MOHURD[30], promoting the "retain, renovate and destroy" concept (留改拆) over the "destroy, build and retain" one (拆改留) that prevailed during the country's construction boom of the past decades.
⇒ Cf. Working Guidance for Carbon Dioxide Peaking (2021), Annex 2, table 1.
⇒ Cf. 14th Five-Year Plan for the Development of the Construction Industry (2022), Annex 3.

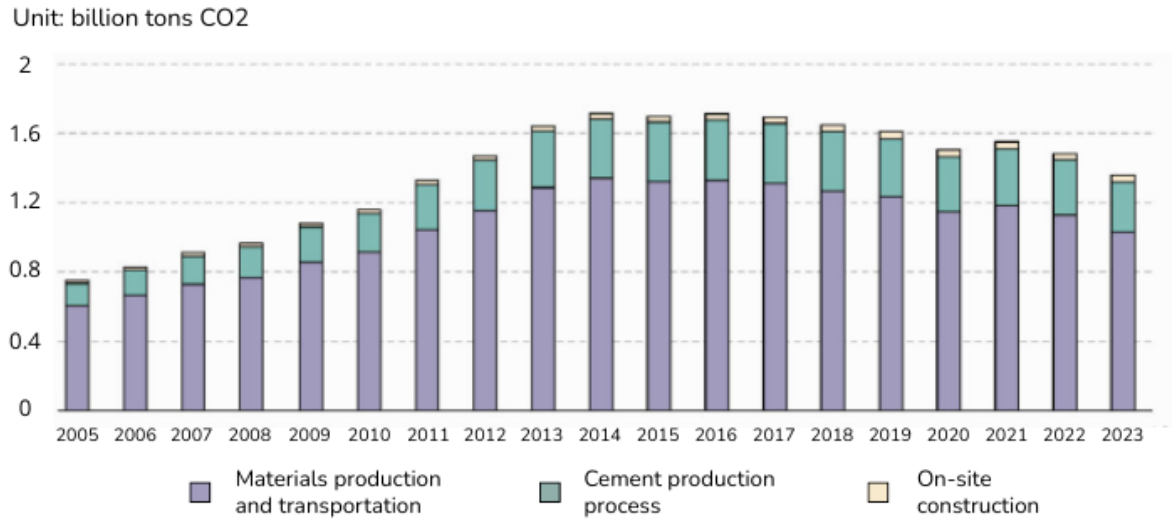
III.2 - Peak and Decrease

In 2023, embodied emissions receded to 1.4 billion tons, compared to 1.5 billion tons in 2021[31]. They had in fact already peaked around 2016 and slowly decreased since then, except in 2021 due to a post-Covid rebound in building construction. While the decrease in

[30] MOHURD, 住房城乡建设部关于扎实有序推进城市更新工作的通知 (Circular of the Ministry of Housing and Urban Development on Promoting Urban Renewal in a Solid and Orderly Manner), July 5th, 2023. https://www.gov.cn/zhengce/zhengceku/202307/content_6891045.htm
[31] Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025) ; Building Energy Research Center of Tsinghua University, *China Building Energy and Emission Yearbook 2023.*

2023 might be partly conjunctural and linked to the current real estate crisis, the trend seems steady.

Table 2: China building sector's embodied emissions, 2005-2023.



Source: Building Energy Research Center of Tsinghua University, 中国建筑节能年度发展研究报告 2025 (China Building Energy Efficiency Annual Development Research Report 2025)

The decrease in embodied emissions is driven by the country's long-term efforts to decarbonize the production of building materials, and in particular cement and steel. It should be mentioned though that there is still room for improvement, in particular in the cement industry: according to a recent IFC report, China's production of cement remains the most carbon intensive one in the world [32] and decarbonization targets for cement productions are not being met (cf. below).

More recent policies encouraging retrofitting, as well as the curbing of large-scale projects that consume more building material and energy during the construction process, should also contribute to a further reduction of embodied emissions in the coming years.

IV - Challenges and Venues for Improvement

IV.1 - Trajectory to neutrality : setting more ambitious targets

China is about to meet most of the targets set for its building sector in 2025 (cf. Table 3). Available recent data issued by official Chinese sources tend to demonstrate that most requirements in terms of new buildings standards, of energy saving retrofitting, of energy

[32] International Finance Corporation, *Building Green - Sustainable Construction in Emerging Markets*, 2023. https://www.ifc.org/content/dam/ifc/doc/2023/building-green-sustainable-construction-in-emerging-markets.pdf

mix greening and carbon performance of building operations are already met or will probably be by year-end. The decarbonization of building materials seems less successful, especially for the cement industry that clearly lags behind its targets.

Table 3: 2025 building sector decarbonization targets vs. current status

Category	Target (2025)	Current Available Data	Status
New Buildings	+20 million m^2 ultra-low/near-zero energy consumption buildings vs. 2023	~ 11 million m^2 reported in key pilot cities and regions by mid-2025; national statistics not yet published.	Probably on track
	100% urban new buildings at "basic grade" green building standard	94% in 2023; key cities near 100%[33].	Nearly achieved
	30% new buildings above 1-Star green standard	31% nationwide in 2024[34]	Achieved
	30% new construction prefabricated	32% nationwide (2024)[35]	Achieved
Building Renovation	+200 million m2 energy-saving retrofit vs. 2023	116 million m^2 added in 2023[36]; no national data for 2024.	Probably on track
Building materials - Steel	80% steel capacity with ultra-low emissions	591 Mt of steelmaking capacity reached ultra-low emissions benchmark by April 2025, with an additional 169 Mt partially achieved (total production	Probably on track

[33] https://www.yuzhehe.com/p/what-are-chinas-green-buildings-and
[34] http://www.mohurd.gov.cn/zcjd/202409/t20240920_289888.html
[35] https://www.vzkoo.com/read/20250604e3e677373ddfb4c68c3798d9.html
[36] https://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/202411/W020241106685054014098.pdf

		capacity around 1 billion tons)[37]	
	2% decrease in energy use per ton of steel	-0,16% in first half of 2024; very small year-on-year monthly decreases in 2025[38]	Probably behind
	53 Mt CO2 reduction (steel + iron) vs. 2024	Regular year-on-year monthly increases in 2025[39]	Behind
Building materials - Cement	30% production above energy efficiency benchmark	33-36% in some provinces, no nationwide data	Partial / Behind
	10% alternative fuel consumption in cement kilns	5% by the end of 2024[40]	Probably behind
	3.7% decrease in energy use per clinker unit vs. 2020	~ 3% decrease by the end of 2023[41]	Probably on track
	13 Mt CO2 reduction cement production vs. 2024	No official data for 2025 but massive production reduction will probably reduce emissions	Lack of national data
Recycling	300Mt steel scrap used in iron and steel industry	~ 210 Mt in 2024, year-on-year decrease in Q1 2025[42]	Probably behind
Energy mix in Buildings	55% electricity share of building energy	54% in 2024[43]	Nearly achieved
	50 GW photovoltaic capacity in new	36 GW of rooftop PV installed in 2025	Probably achieved

[37] https://gmk.center/en/news/chinas-steel-sector-aims-to-achieve-ultra-low-emissions-by-the-end-of-2025/

[38] https://www.chinadaily.com.cn/a/202409/04/WS66d854b1a3108f29c1fca292.html and articles by GMK Center on Chinese steel market https://gmk.center/en/tag/china/

[39] Articles by GMK Center on Chinese steel market https://gmk.center/en/tag/china/

[40] https://finance.sina.com.cn/roll/2024-12-19/doc-inczyxct6815494.shtml

[41] https://www.ccement.com/news/content/48422743301465001.html

[42] https://www.recycling-magazine.com/2025/05/27/release-of-16th-edition-of-world-steel-recycling-in-figures/ and https://www.bir.org/en/members-area/world-mirrors/mirrors-ferrous/1000042329-world-steel-recycling-in-figures-january-march-2025-update

[43] https://www.21jingji.com/article/20250125/herald/2665a23f81be41210e817addbb0a2e9a.html

	buildings	first quarter alone[44]	
	100 million m^2 of buildings equipped with geothermal energy	+60 million m^2 by the end of 2024 for Sinopec only[45]	Lack of national data, but probably on track

But despite these progresses, the sector is not on track to reach its 2060 carbon neutrality goals (cf. table 4). According to Climate Action Tracker[46], "China's emissions intensity in residential and commercial buildings needs to be reduced by at least 65% in 2030, 90% in 2040, and 95–100% in 2050 below 2015 levels, while energy intensity needs to be reduced by at least 20% in 2030, 35–40% in 2040, and 45–50% in 2050 compared to 2015 levels." China is far from meeting its carbon intensity targets in the building sector[47]. **Further efforts will be needed for the sector to become carbon neutral, including absolute capping to fully decorrelate economic growth and emissions increases.**

Table 4: Main current vs. required targets to reach China's climate goals

Category	Current target	Required target for 2030 peak / 2060 neutrality
Annual building stock renovation rate	< 1%	2.5% to 3.5%
Annual new ultra-low and near-zero energy consumption buildings	+10 million m^2/year	+50 million m^2/year
Annual carbon intensity reduction in buildings	~ 1%	At least 1-2% per year until 2030, then 3-5% until 2060
Electricity share in building energy	55%	65% by 2030 (in line with announced targets for 2030)
Buildings emissions intensity (residential)	22 kg CO_2/m^2/year	8.89 kg CO_2/m^2 /year in 2030

Source: Climate Action Tracker, https://climateactiontracker.org/countries/china/policies-action/

To meet the Paris Agreement temperature goals, China will thus need to set more ambitious targets. Since the average age of the building stock is young, at 15 years, almost half of it will still be standing by 2050[48]: energy-saving retrofitting will be crucial to reduce energy intensity, and renovation rates will need to be increased. Likewise, accelerated

[44] https://www.rystadenergy.com/news/china-rooftop-solar-installations-hit-record-in-1q25
[45] https://www.thinkgeoenergy.com/sinopec-reports-doubling-of-geothermal-heating-capacity-since-2020/
[46] https://climateactiontracker.org/countries/china/policies-action/
[47] https://energyandcleanair.org/will-china-fulfil-its-key-climate-pledge/
[48] International Energy Agency, *An energy sector roadmap to carbon neutrality in China*, 2021, https://iea.blob.core.windows.net/assets/9448bd6e-670e-4cfd-953c-32e822a80f77/AnenergysectorroadmaptocarbonneutralityinChina.pdf

implementation of ultra-low energy new buildings, clean electrification and further decarbonization of building materials, including cement and steel, will be needed to stay on track. And more stringent standards will be needed for the building sector's energy efficiency.

The 15th Five-Year Plan, to be released early 2026, will be crucial to measure China's ambitions in the decarbonization of its building sector and the alignment of its upcoming policies with its neutrality target.

IV.2 - A Change in strategic focus and priorities is needed...

While targets in terms of carbon emissions are progressively set in plans, standards and labels, the bulk of the existing policy framework still focuses on operational energy saving and energy greening. Improving energy efficiency and carbon intensity will continue to be an important leverage to reduce the sector's emissions, but energy-saving measures, in particular, present a decreasing yield: the higher a building's energy efficiency already is, the costlier it becomes to improve it. Besides, operational emissions in China, both per square meter and per capita, are relatively low compared to other countries, while embodied emissions are higher. Therefore, a **shift of focus towards the levers of action that take into account the whole life-cycle of the buildings and aim at limiting new construction, would bring strategic benefits.** The promotion of low-carbon and bio-sourced materials, the recycling and reuse of materials, the promotion of retrofitting over destruction and reconstruction, and the limitation of large-scale projects and of new construction, are for now only timidly addressed in plans and policies. Progress on these fronts is for now still hindered by numerous disincentives - low-carbon materials, cement and steel are more expensive than regular ones, dumping wastes in landfills remains cheaper than their recycling, promoters' preference go to large-scale projects – and by the overall situation of the construction industry hit hard by the real estate crisis. Full-fledged policy frameworks, with effective incentive mechanisms, need to be developed.

Besides, when carbon emissions targets make it to national policies, plans and standards, they are mostly expressed in terms of carbon intensity, not in terms of emissions level, meaning the volume of emissions continues to grow with the sector. This marks a major difference with European countries like France, the UK, Japan, which aim at bringing down their building sector's emissions by a certain percentage compared to a year of reference. France even implemented a "carbon budget" system, with absolute carbon emissions caps for the building sector: 77 million tons per year in the 2019-2023 period, 59 million in 2024-2028, 42 million in 2029-2033[49]. In August 2024, China's State Council announced the upcoming enforcement of a "dual-control" system that would take both carbon intensity and total emissions control into account. The inclusion of ambitious targets in the 2026-2030 Five-Year Plan will be crucial to set the building sector on track for carbon neutrality.

[49] Ministère de la Transition Écologique et de la Cohésion des Territoires, *Feuille de route de la décarbonation du cycle de vie du bâtiment - Les propositions de la filière*, janvier 2023. https://www.ecologie.gouv.fr/sites/default/files/documents/Feuille_de_route_decarbonation_batiment.pdf

IV.3 - ... Which pilot programmes may be preparing

The Chinese leadership recently launched pilot programmes, such as the zero-carbon industrial parks and the low-carbon city pilot programme (LCCP)[50]. As is the case with other public policy objectives, these **pilot programmes may well prepare for a turning point in China's efforts to decarbonise the building sector**. Through these programmes, subsidised at the central level, the government is testing both policies and solutions. They are instrumental not only to test how local government officials could implement broad policy objectives set at the national level, but also to foster the development of the country's technical and production capacity to supply new services and materials. These real life experiments are also the opportunity to compare and assess the quality and competitiveness of participating business entities, domestic and foreign.

The programmes act as signals given to subnational Party leaders, research centres and businesses that the government is considering making the low-carbon transition of its building sector a priority in the coming years. The upcoming 2026-30 Five-Year Plan will confirm the pace chosen. Chinese businesses have already largely invested this dimension of the green transition. A wave of technology companies and building solution providers has emerged or expanded, taking advantage of the country's competitive advantage on AI, big data, solar panels and batteries. For instance, the State Grid Corporation of China is driving the deployment of smart meters and digital demand management systems. Broad Group, Landsea Green Group, and China Vanke are leaders in low-carbon prefabrication, green buildings, and intelligent retrofits. Startups and scaleups are developing AI-powered building management, advanced insulation, and new net-zero construction methods.

IV.4 - Emissions based standards and norms

Emissions based standards and norms are insufficiently developed, in particular for embodied emissions.

- **The *Green Building Label* (formerly Standard),** first introduced in 2006, includes criteria in terms of energy saving, the use of renewable energy and the use of green and reusable building materials. But expectations regarding carbon emissions are rather vague, with no explicit, measurable target**:** "computing and analysing building carbon emission is performed and measures are taken to reduce the carbon emission intensity in unit building floor area". Besides, since the system is credit-based, building owners can choose to focus on other items of its very broad scope[51].

⇒ Cf. Chinese Standards and Main Foreign Standards Used in China, Annex 1.

- **Relatedly, China lacks an operational standardized methodology to compute the emissions of buildings.** MOHURD did promulgate in 2019 a *National Standard for Building Carbon Emission Calculation* (cf. Annex 1), which defines how to calculate emissions for

[50] https://english.www.gov.cn/news/202507/09/content_WS686db54dc6d0868f4e8f3f9a.html https://www.tandfonline.com/doi/full/10.1080/1523908X.2024.2445064

[51] The Green Building Standard has 6 dimensions : Safety and durability; Health and comfort; Occupant convenience; Resources saving; Environment liveability; and Promotion and innovation.

buildings across their lifecycle, from material sourcing through construction to operation and demolition. But it still suffers from data quality and completeness issues, particularly with regard to embodied carbon factors, and faces difficulties in implementation by all stakeholders[52]. In any case, this MOHURD standard is not a performance one: it does not prescribe any carbon emission limits or reduction targets or thresholds for compliance or certification.

Looking at good practices abroad, the *Carbon Risk Real Estate Monitor* (CRREM) initially introduced in Europe, has shown its usefulness in assessing buildings' current and projected operational emissions, against an ideal pathway aligned with a 1.5°C scenario. This methodology also has the advantage of connecting objectives and data in terms of energy saving and energy mix and ones in terms of emissions.

- **As for building materials, the green product certification system doesn't systematically require a carbon footprint report or a rating against benchmarks.** Among the 72 green building material standards adopted by the China National Accreditation Administration (CNCA), only one, for a steel product, currently includes a carbon emissions benchmark expressed in $kgCO_2e$/unit of product). This is an important missing piece in China's toolbox to curb embodied emissions. However, the regulatory landscape is evolving rapidly: in January 2025, new national standards were issued for insulation materials, stone, ceramic sanitary ware and wood-plastic composites, introducing low-carbon criteria, including quantified thresholds and the quantifying of the carbon footprint over the product's entire life cycle. More materials are expected to have standardized carbon emission benchmarks in the coming months.

⇒ Cf. Chinese Standards and Main Foreign Standards Used in China, Annex 1.

- **Audits, third-party verification and certification are most of the time not compulsory in current green labelling mechanisms.** For example, only six of the green building material labels require a carbon footprint report prepared by a third party. The monitoring and reporting of carbon emissions is mostly the responsibility of enterprises (for building materials) and building stakeholders (building management entities, private or public, for operational emissions). In order for them to fulfil this now mandatory mission, extensive capacity-building will be needed. And control systems, with independent third-party monitoring, will be needed to supplement the existing MOHURD-operated inspection apparatus.

IV.5 - Funding and incentives

According to estimates made by the IFC in 2023, China would need to invest 1,330 billion USD in the next ten years to green its building stock through retrofitting and new constructions[53]. Decarbonization has indeed a huge cost, shouldered by the government, the

[52] RICS Policy Paper, Decarbonising the built environment in China, November 2023.
[53] International Finance Corporation, *Building Green - Sustainable Construction in Emerging Markets*, 2023. https://www.ifc.org/content/dam/ifc/doc/2023/building-green-sustainable-construction-in-emerging-markets.pdf

industry and the users; public financing and a finely crafted array of incentives and regulations are needed to incite builders, owners and users to undergo this transformation.

While a complete assessment of the funding and incentive system is out of the scope of this report, some key elements can still be pointed out that slow down the decarbonization process of the country's building sector.

In the building sector as in others, public funding is indispensable to spur decarbonization efforts. Public funding is needed to finance large infrastructure changes, like the development of district heating in Northern urban areas, and to subsidize costly programs, like trade-in schemes for example. While the central government policies and subsidies ensure a certain level of consistency over the territory, public funding mechanisms present several shortcomings.

- **Public policies and plans provide only vague guidelines on the financing.** For example, the *Action Plan for the Acceleration of Energy Conservation and Carbon Reduction in the Construction Sector*, issued in March 2024, displays one short paragraph on the financial support mechanisms, which states in a rather elliptical manner that "fiscal, tax, financial, investment and price policies conducive to building energy conservation and carbon reduction" should be "improved and implemented". It also adds that "banking and insurance institutions should be encouraged to improve green finance" without further detail. This text, as most policy papers, doesn't spell out any incentive mechanism nor funding mechanism.
- **Public funds for the building sector's decarbonization are fragmented** across ministries, across administrative levels, and partly blended with industrial decarbonization budgets. The amounts earmarked for the sector are not always specified (consumer goods trade-in programs for example, can cover both home appliances and electric vehicles). This situation complicates the sector's stakeholders' access to public funding.
- **Most public incentives rely on the budget of local authorities,** the central government usually only providing a share of the total necessary amount. This means that public incentives mechanisms and amounts can vary widely according to the financial situation of the local authorities and the policies they choose to prioritize. Which in turn means that the level of decarbonization in the building sector varies widely according to the provinces, cities and counties.
- **Public procurement standards currently don't integrate carbon emissions limits.** Since public buildings have higher construction standards, public procurement has pushed for the use of green materials and could provide development opportunities for new technologies and decarbonized materials. But the absence of carbon emissions thresholds in green building materials doesn't allow this positive dynamic to unfold.

Besides, market incentives currently don't play in favour of building decarbonization.

- **The real estate crisis that's been hitting China since 2021 is slowing the pace of decarbonization.** With property prices falling, developers are less likely to prioritize decarbonization measures, which require upfront investment. Local governments have less fiscal space to subsidize decarbonization and banks have reduced their exposure to the real estate sector. The trend is unlikely to improve in 2025, with an expected 8.4% drop in real estate investment[54] compared to 2024.

- **China's Emission Trading System (ETS), in its current version, does not contribute to reducing emissions,** by contrast with the EU's which has been instrumental in the region's decades-long decreasing trend of GHG emissions. Low carbon prices (expected to reach 13€/tCO_2e in 2025) mean that decarbonization is not lucrative. And while the ETS extension to cement, steel and aluminium industries should bring an additional 1,500 companies into the system, increasing the total carbon emissions covered by 3 billion tons, allowances for 2025 will be equal to 2024 emissions, which will not encourage companies to reduce their emissions. Then, from 2026 to 2027, allowances will be focusing on carbon intensity, allowing the production to increase if efficiency is improved. Again, these criteria will not contribute to a reduction of the emissions. After 2027 and the full implementation of the ETS for these sectors, benchmarks and tightened carbon intensity requirements are supposed to be implemented. But their level is currently unknown.

- **Because of the low degree of awareness amongst the public, the extra costs caused by decarbonization efforts are not compensated by the possibility of higher market prices for real estate developers.** If they are not compelled by legislation and/or benefitting from public subsidies, developers are not incited to decarbonize. In this respect, it is symptomatic that buildings in China being granted international green building labels, more demanding than the Chinese one, are mostly owned by foreign companies operating in China but subjected to the ESG obligations of their home country.

⇒ Cf. Chinese Standards and Main Foreign Standards Used in China, Annex 1.

V - CONCLUSION AND COOPERATION OPPORTUNITIES

As shown by the amount of regulations and standards issued by China in late 2024 and early 2025, the country is currently laying the foundations for accelerating the decarbonization of its building sector. For foreign actors, public or private, who learn to navigate the specificities and complexities of this sector in China, new opportunities might arise.

Navigating local complexities

- **Identifying national and local actors and partners can prove difficult.** Many ministries are involved in the development of the legal framework and the industrial standards governing buildings decarbonization. Many other actors, less visible but also influent and sometimes easier to access for foreign actors, can also play a role in the legislative and technical orientations: local bureaus of national ministries, local governments,

[54] https://www.reuters.com/markets/asia/analysts-downgrade-chinas-property-price-outlook-2025-trade-tensions-pose-fresh-2025-05-23/

academic institution, private or semi-public companies with close relations to national ministries… Understanding the full ecosystem of the building sector is a real challenge.

⇒ Cf. Decision-making bodies, Annex 5.

- **While standards and legislations are emitted at the national level, their implementation relies most of the time on local authorities.** This means that the sector is fragmented: implementations schemes, constraints and incentives vary widely from one province to another, and sometimes even from one city to another.

Opportunities for cooperation and economic partnerships

From the current policy orientations and the still existing challenges facing the decarbonization of China's building sector, several lines of opportunities for international cooperation can be identified.

- **China is currently building a standardized methodology to calculate, report and monitor carbon emissions in the building sector and international cooperation could bring expertise in:**

- Calculating, reporting and monitoring carbon emissions in the sector;
- Developing methodologies to compute the carbon emissions at the building level (such as CRREM in Europe);
- Developing certification and auditing capacities.

- **Weaknesses in the incentives system slow down the country's building decarbonization**. Foreign expertise on public and market incentives could help increase the efficiency of China's decarbonization efforts. Experience sharing on the use of energy and carbon pricing as a leverage in decarbonization could be useful.

- **On a technical level, current Chinese priorities should open opportunities in:**

- **Buildings digitalization and smart monitoring** (BIM);
- **Retrofitting**, with a focus on high-performance technologies;
- **Low carbon materials**: China is investing a lot in R&D and might be willing to develop technological cooperation. The country is also opening its market to some specific building materials: lower tariffs have been announced in 2025 for low-carbon concrete products, advanced insulation materials, smart HVAC systems with AI-driven energy optimization[55]. This might represent business opportunities for foreign enterprises with high technology products;
- **Heat pumps**, with a focus on high-performance technologies;
- **Recycling and reusing building materials**. This is an axis of decarbonization that China is currently exploring and on which it is seeking international expertise.

- **European actors and researchers should also be encouraged to closely follow recent technological developments and innovative business models in China.** There's no reason to think China will not replicate in this sector its success stories of renewable energy and

[55] https://www.eusmecentre.org.cn/publications/green-development-in-china-opportunities-and-challenges-for-european-smes/

electric vehicles. Its global leading positions in key technologies such as solar panels, batteries, artificial intelligence and data analysis give the country a crucial advantage from the start.

- **Although beyond the scope of this report, it would also be interesting to see how China is developing exports and outbound investments of materials and expertise, supported by the Belt and Road Initiative.** China is, for instance, indeed already exporting low-carbon cement plants to Central Asia. The rethink of construction processes and the introduction of prefab parts may well help developing countries green their building sector at a relatively lower cost, while ensuring new sources of revenues for Chinese companies; Innovations from China are already influencing developing countries and densely populated regions with similar building challenges, especially in efficient retrofitting, smart heating, and scalable bio-based materials.

- **The Green Building Standard / Green Building Label / Three Star System (MOHURD)**

Introduced by MOHURD as soon as 2006, the « Three Star System » is a voluntary rating system designed to evaluate and promote green buildings. There are four levels of certifications for green buildings: Basic Grade, 1-Star Grade, 2-Star Grade and 3-Star Grade. The latter is attributed by MOHURD, others are granted at the local level. Local authorities are entitled to adjust the evaluation standard applicable to the lower certification rates.

The latest (and third) update of the standard was issued in 2019 (Green Building Evaluation Standard, GB/T 50378-2019). It was followed by the Green Building Creation Action Plan in 2020 and the Green Building Label Management Measures in 2021. Since October 1st, 2024, partially revised provisions of the 2019 standard are being implemented.
The building's evaluation takes place after the completion of the construction. The current assessment criteria are classified as follows:

- Safety and durability
- Health and comfort
- Occupant convenience
- Resources saving
- Environment liveability
- Promotion and innovation

Some of the specific requirements within these categories are indirectly connected with decarbonization: these are mainly connected with energy-saving measures, with the share of renewable energies, and with the use of green and reusable building materials.

Only one item in the "Promotion and innovation" category directly refers to carbon emissions, requiring that "computing and analysing building carbon emissions is performed and measures are taken to reduce the carbon emission intensity in unit building floor area". But **no capping in carbon emission or intensity is formulated**. Besides, most importantly, **since the system is credit-based, building owners can choose to focus on other items and leave this one out.**

As of the first half of 2022, more than 25,000 buildings had been certified under this green building standard. The current target enshrined in the Building Energy Conservation and Green Building Development Plan during the 14th Five-Year Plan Period is that **all new buildings should be green ones (at least Basic Grade), and 30% should reach at least 1-Star rating by 2025**.

- **Assessment Standard for Green Retrofitting of Existing Building (MOHURD, adopted in 2015, implemented since 2016)**

The national standard GB/T51141-2015 defines how to evaluate green retrofit of existing buildings. It covers seven major categories and requires two stages of evaluation: design evaluation and operational evaluation, to be conducted one year after commissioning and use.

This standard does not include any explicit operational emissions nor carbon intensity targets.

- The General Code for Energy Efficiency and Renewable Energy Application in Buildings (MOHURD, adopted in 2021, implemented in 2022)

The most important document regulating buildings operational decarbonization is the "General Code for Energy Efficiency and Renewable Energy Application in Buildings", GB 55015-2021, implemented since April 2022. It provides clear and more demanding targets for energy consumption:

"**The average design energy consumption level of new residential buildings and public buildings should be reduced by 30% and 20% respectively on the basis of the energy-saving design standards implemented in 2016**.
The average energy saving rate in different climate zones shall meet the following requirements:
The average energy saving rate of residential buildings in severe cold and cold regions should be 75%;
Except for severe cold and cold regions, the average energy saving rate of residential buildings in other climate zones shall be 65%;
The average energy saving rate of public buildings should be 72%."

This Code is also, and most importantly, the first mandatory one for carbon emissions from buildings:

"**The carbon emission intensity of newly built residential and public buildings should be reduced by an average of 40% on the basis of the energy-saving design standards implemented in 2016**, and **the carbon emission intensity should be reduced by an average of more than 7kg CO_2/m^2/year** » (compared to 2016 baseline).

In addition to an energy consumption report, the Code also asks for a **renewable energy usage** and a **carbon footprint report** for new buildings, the three of them to be included as early as the preliminary design phase.

- **Green Building Materials Label (MOHURD and MIIT, 2014)**

The Green Building Materials Label is a voluntary certification system jointly launched by MOHURD and MIIT in 2014, with the first batch of labels issued in 2016.

It classifies materials into 1 to 3 stars levels based on lifecycle environmental impact, performance and recyclability. MOHURD and MIIT manage national level labels (3-Stars), while provincial authorities oversee 1-Star and 2-Stars levels.

While the initial version of the Label did not include low-carbon criteria, **more stringent standards are progressively being issued** for certain categories of building materials. In January 2025, for example, new national standards were issued for insulation materials, stone, ceramic sanitary ware and wood-plastic composites. **These new standards introduce low-carbon criteria, including quantified thresholds and the quantifying of the carbon footprint over the product's entire life cycle.**

- Green Product Label (SAMR and MIIT, 2017)

Supervised by SAMR and MIIT, the Green Product Label was launched as a pilot program in 2017, and formalized in 2020. Its scope is broader than the Green Building Materials Label, since it covers many more categories of products, but it overlaps for some building materials that can get both labels (some provincial procurement regulations actually require dual certification).

Certified products must quantify their carbon footprint, taking into account the full life-cycle, and innovation in carbon reduction is encouraged and may earn bonus points.

However, **this Label does not impose quantified carbon thresholds**.

- **National standard for building carbon emission calculation (2019, MOHURD)**

This standard, GB/T 51366-2019 provides technical methodologies to calculate emissions for buildings across their lifecycle. It covers from material sourcing through construction to operation and demolition. It incorporates all major greenhouse gases and mandates use of official emission factors. **It is a methodology standard, not a performance one: it does not prescribe any carbon emission limits or reduction targets or thresholds for compliance or certification**.

- **Requirements of the greenhouse gas emissions accounting and reporting (MEE, from 2015 on)**

The GB/T 32151 series provides a national standard system to guide enterprises in different industries on how to calculate, document and report their greenhouse gas emissions. The very first one of the series, issued in 2015, targeted power generation companies. The series now comprises almost 50 parts, and keeps expanding, with as many as 18 new standards implemented in April 2025.

According to official comments published with this batch, these new standards aim to solve the problem of “unclear boundaries and difficult mutual recognition” of the carbon emission accounting system and to build a standardized path for enterprises to accurately calculate and report carbon emissions.

These standards are not specific to building material enterprises, but some building material enterprises are covered. Here are a few examples from the most recent batch:

GB/T 32151.36-2024 Requirements of the greenhouse gas emissions accounting and reporting - Part 36: Thermal insulation enterprises
GB/T 32151.37-2024 Requirements of the greenhouse gas emissions accounting and reporting - Part 37: Fired wall and roof and paving building materials enterprises
GB/T 32151.38-2024 Requirements of the greenhouse gas emissions accounting and reporting - Part 38: Cement-based products enterprises
GB/T 32151.39-2024 Requirements of the greenhouse gas emissions accounting and reporting - Part 39: Calcined gypsum enterprises
GB/T 32151.40-2024 Requirements of the greenhouse gas emissions accounting and reporting - Part 40: Building waterproof material enterprises

Earlier standards in this same series also covered buildings related activities, such as:
GB/T 32151.8-2023: Requirements of the greenhouse gas emissions accounting and reporting - Part 8: Cement enterprises
GB/T 32151.9-2023: Requirements of the greenhouse gas emissions accounting and reporting - Part 9: Ceramic production enterprises
GB/T 32151.7-2023: Requirements of the greenhouse gas emissions accounting and reporting - Part 7: Flat glass enterprises

- **Method of Low Carbon Assessment for Building Materials (SAMR, issued in 2024, implemented since April 2025)**

Standard GB/T 44716-2024 **is the first national standard dedicated to low carbon assessment at the building material product level. It covers production-stage carbon emissions (mandatory) and use-stage avoided emissions (optional)** for materials with energy-saving or clean energy functions. Its purpose is to evaluate low-carbon performances of products by comparing their CO_2 emissions against a reference level determined based on industry-average performance.

- **Foreign Green Building Labels used in China**

LEED

Established in 2000, the American LEED rating system for green building is recognized all over the world and is also being used in China along with the national “Three Star System”.

The LEED rating system is also credit-based, with 35% of the credits related to climate change, 20% to human health, 15% to water resources, 10% to biodiversity, 10% to green economy and 5% to community and natural resources. In the latest version of the system, most credits are related to operational and embodied carbon. One credit is directly connected to the reduction of GHG emissions.

By the end of 2024, China had more than 3,620 LEED-certified projects, representing a total surface of more than 103 million m^2. It's the second largest market in the world for LEED certification after the US.

Buildings seeking this certification mainly belong to foreign companies: the headquarter of Volkswagen Group China, of JLL Shanghai, Nike China's Logistics Center, McDonald's restaurants, Unilever manufacturing, distribution and logistics facilities.

BREEAM

The British BREEAM certification is also used in China, albeit on a smaller scale with 100 certified buildings only.

It is credit-based, with nine assessment areas including energy consumption, health and liveability, green project management, green building materials, pollution control, land use, waste management, green transport and water use. Three new indicators have been recently added, among which a "Whole Life Cycle Carbon Emissions" criterium.

Annex 2: National overarching guidelines including decarbonization targets

- **First batch of national overarching guidelines, 2021.**

Title	Issuing body and date	Contents related to building decarbonization	Comments
14th Five-Year Plan for Economic and Social Development (2021-25) and Long-range Objectives Through the Year 2035	Drafted by the CCP, Oct. 2020 Issued by the NPC, March 2021 Full text in Chinese in English	Chapter 11 (out of 19) of the text is fully dedicated to green development: - Implement the new era of building policies that are suitable, economical, green and beautiful - Build liveable, innovative, smart, green, humanistic and resilient cities - Promote digitalized management of urban buildings - Promote green building materials, prefabricated buildings, and steel structure residences, and construct low-carbon cities - Promote the green transformation of building materials	The 14th Five-Year Plan sets China's development goals for the 2021-2025 period. The general target for carbon emission per unit of GDP is a reduction of 18% in 2024 compared to 2020. No quantified target is given in this text for the buildings.

Action Plan for Carbon Dioxide Peaking before 2030	State Council October 2021 Full text in English in Chinese	Among the key tasks: - Pushing the building materials industry to peak carbon dioxide emissions - Accelerating building energy efficiency improvement: by 2025, all newly constructed buildings in urban areas should meet green building standards - Accelerating the optimization of building energy consumption structure: by 2025, renewable resources should account for 8% of the alternative to conventional energy used in buildings, target of 50% photovoltaic coverage of the roofs of new public buildings and factories	One of the main targets of the plan: By 2030, the share of non-fossil energy consumption will reach around 25%, and carbon dioxide emissions per unit of GDP will have dropped by more than 65% compared with the 2005 level, successfully achieving carbon dioxide peaking before 2030.

Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy	State Council October 2021 Full text in English in Chinese	The chapter on "In-depth industrial restructuring" mentions building materials as one of the sectors that will be subjected to a specific implementation plan One chapter is fully dedicated to "Improving the quality of green and low-carbon development of urban and rural areas" and refers to: - limitation of gross floor area in urban zones - avoid large scale construction and demolition - promotion of green building practices throughout the construction process - promotion of energy-conserving and low-carbon buildings, including raising energy conservation standards, gradual introduction of energy consumption caps, energy efficiency assessment and labeling, promotion of green and low-carbon building materials and of recycling - improving the energy consumption structure of buildings, by promoting electric conversion, low-carbon and renewable energies	General targets: - by 2025, energy consumption per unit of GDP will be lowered by 13.5% from the 2020 level; carbon dioxide emissions per unit of GDP will be lowered by 18% from the 2020 level; the share of non-fossil energy consumption will have reached about 20%. - by 2030, CO2 emissions per unit of GDP will have dropped by more than 65% compared to 2005; share of non-fossil energy consumption will have reached about 25%; CO2 emissions will peak. - by 2060, the share of non-fossil energy consumption will be over 80%, China will be carbon neutral. No quantified target for buildings.

Buildings, their construction, their materials and operation, are systematically mentioned in these texts of overarching policies: this is a sign of the importance granted to the sector's greening. These documents also provide the major strategic orientations chosen to decarbonize buildings.

- **Second batch of overarching guidelines, 2024.**

After a first batch of policies in 2021, following the release of the 14th Five-Year plan, a new wave of top-level documents was issued in 2024 by the CCP Central Committee and the State Council (Table 2). These texts reveal two new features of the current national policies: the intention to accelerate the greening of China's economy as a whole; and a new focus on carbon emissions.

Title	Issuing body and date of issue	Contents related to building decarbonization	Comments
Opinions on accelerating the comprehensive green transformation of economic and social development	CCP Central Committee State Council July 2024 Full text in Chinese	- Vigorously promote the green and low-carbon transformation of iron and steel and building materials - Continuously update binding standards for carbon emissions - Reasonably raise the resource and environmental access thresholds for new construction, reconstruction and expansion projects, and resolutely curb the blind launching of projects with high energy consumptions and high emissions - Promote the deep integration of industrial digital intelligence and greening, deepen the application of artificial intelligence, big data, cloud computing, industrial Internet and other technologies in building construction and operation - Vigorously develop green and low-carbon buildings: establish a building energy efficiency rating system, increase the proportion of star-rated green buildings, promote the large-scale development of ultra-low-energy consumption buildings. Accelerate energy-saving and carbon-reducing renovation, promote high-efficiency lighting, air-conditioning and lifts. Optimize the energy structure of buildings, promote the integrated construction of photovoltaic buildings, develop clean and low-carbon heating. - Explore the development of carbon emission evaluation of projects,	Part 6 (out of 12) of this document is fully dedicated to "Promoting green transformation of urban and rural construction and development". Part 10 is dedicated to "Improving the policy system for green transformation", and deal mainly with fiscal and taxation policies, financial tools and investment mechanisms to promote green transformation, with a mix of public and market-based mechanisms. Very few quantified targets are given in this text, and none related to buildings. But the

		strictly control energy consumption and carbon emissions of new projects. - Incorporate carbon footprint requirements into government procurement in due course (buildings are not specifically targeted here, but they are implicitly). - Green smart home appliances, energy-saving cookers and green building materials will be launched in rural areas. - Carry out multi-level pilots to promote synergies in pollution reduction and carbon reduction in key areas such as urban and rural construction.	document provides strategic priorities for green transformation, and many of them are directly or indirectly related to building decarbonization.
Action Plan for Energy Conservation and Carbon Reduction during 2024-2025	State Council May 2024 Full text in Chinese	Among the main objectives for the Chinese economy: - Reduction of 2.5% of energy consumption per unit of GDP in 2024. - Reduction of 3.9% of carbon dioxide emissions per unit of GDP in 2024. - The proportion of non-fossil fuel energy consumption should reach 20% in 2025. Among the key tasks: - Energy saving and carbon reduction actions in the building materials industry: by the end of 2025, 30% of cement and ceramic industries should be above the energy-efficiency benchmark. In the two-year period, the building materials industry should reach energy savings of 10 million tons of standard coal and reduce its carbon emissions by 26 million tons. - Building energy-savings and carbon reducing action: same targets as in the Action Plan 2021 plus newly-built ultra-low and near-zero energy consumption buildings will increase by 20 million square meters compared to 2023. Renovation targets: 200 million square meters of completed energy-saving renovation compared to 2023;	Out of the ten industrial sectors specifically targeted by this action plan, four are connected to the building sector: the steel sector, building materials, building operations and energy-using products and equipment. Other targeted sectors include energy production (reduce fossil fuel and boost non-fossil fuel energy consumption), petrochemical and chemical industries, non-ferrous metals sector, transportation, and public organizations.

		energy-saving rates of renovated residential and public buildings should increase by 30% and 20% respectively compared to 2023. - Energy conservation and carbon reduction actions for energy-using products and equipment: the proportion of energy-efficient products in household refrigeration equipment should reach 60%, the proportion of energy-efficient products in general lighting equipment should reach 50%.	
Work Plan for Accelerating the Establishment of a Dual Control System for Carbon Emissions	State Council July 2024 Full text in Chinese	- Iron and steel, building materials, urban and rural construction are among the key sectors specifically targeted in this Work Plan. - These sectors should improve their carbon emission accounting mechanism, establish monitoring and early-warning mechanisms for carbon emissions. - Carbon emission evaluation has to be incorporated into the energy-saving review of buildings. - GHG emission will be included in the environmental impact assessment of construction projects and in key industries like iron and steel and building materials. - In the formulation of national standards, priority will be given to key products, including iron and steel, aluminium, cement, lime and glass. - The construction of a carbon footprint background database will be accelerated for key industries. - Organize pilot implementation for carbon labelling certification, with a focus on key products.	This Work Plan sets a three-steps roadmap to build a dual control system for carbon emissions: - Until the end of 2025, the focus will be put on capacity building of carbon emission measuring, accounting and monitoring. - During the next five-year plan (2026-2030), the focus will be on controlling carbon intensity and on building a comprehensive system for evaluating carbon emission. - After the peak of carbon emission, the focus will shift on controlling total carbon emission in addition to carbon intensity.

Annex 3: Implementation plans specifically targeting the building sector and the construction industry

Title	Issuing body and date	Main contents related to building decarbonization	Comments
14th Five-Year Plan for the Development of the Construction Industry	MOHURD January 2022 Full text in Chinese	- Encourage the adoption of prefabricated buildings with a target of more than 30% of the new construction in 2025. - Support research on low-carbon construction material, including green concrete and alternative cement - Promote smart building technologies and accelerate the integration of Building Information Modeling (BIM) technology throughout the entire life cycle of projects - Limit building waste at new construction sites to less than 300 tons per 10.000 m² - Encourage recycling of construction waste and use of sustainable building materials - Push for renovation and retrofitting to improve energy efficiency instead of new construction	Few quantified targets in this text. In terms of decarbonization measures, emphasis is put on prefabricated buildings, digitalization and waste management.
14th Five-Year Plan for Building Energy Conservation and Green Building Development	MOHURD March 2022 Full text in Chinese	Among the main objectives to reach by 2025: - total primary and secondary energy consumption of building operations to reach 1.15 billion tons equivalent coal. - 30% increase of energy efficiency in new residential buildings - 20% increase of energy efficiency in new public buildings - energy-saving renovation of more than 350 million m² - construction of more than 50 million m² of ultra-low and near-zero energy consumption buildings - 30% of newly built urban buildings should be prefabricated - installed capacity of photovoltaic power generation in new	Following the general guidelines set by the 14th five-year plan and the Action plan for carbon peaking, this text provides specific targets for the building's sector.

		buildings should exceed 50 million kW - more than 100 million m² of building should be equipped with geothermal energy - renewable energy substitution rate in urban buildings should reach 8% - electricity consumption should exceed 55% of buildings energy consumption Among the safeguarding measures: - Improve the legal and regulatory standards system, including building carbon emission accounting standards - Implement incentive policies at all levels, using financial funds, prices, taxes, green finance - Improve the government procurement demand standards for green buildings and green materials - Explore the path of carbon emission trading for large buildings - Gradually establish an energy efficiency evaluation and labelling system - Enhance the accuracy of statistical data	
Implementation Plan for Carbon Peaking in Urban and Rural Construction	MOHURD + NDRC July 2022 Full text in Chinese	- By 2030, new building energy efficiency should reach 83% in cold climate zones, 75% in other zones; new public buildings energy efficiency should reach 78% - By 2030, buildings electrification rate should reach 65%, with 50% rooftop photovoltaic installation for all new public buildings and factories, and a scaling up of heat pumps, electric cooking appliances and PEDF buildings - In 2030, 40% of new buildings built that year should be prefabricated - By 2030, 55% of construction wastes should be reused	This implementation plan builds on the general targets provided by the 14th Five-Year Plan for Building Energy Conservation and Green Building Development and provides new and more detailed targets. It also includes more general guidelines related to urban

		- Strictly control buildings destruction, favour renovation over demolition	planning.
Action Plan for the Acceleration of Energy Conservation and Carbon Reduction in the Construction Sector	MOHURD + NDRC March 2024 Full text in Chinese	- In 2025, the area of ultra-low and near-zero energy consumption buildings will increase by more than 20 million m² compared to 2023 - In 2025, the area of energy-saving renovation of existing buildings will increase by more than 200 million m² compared to 2023 - In 2025, electricity consumption should exceed 55% of buildings energy consumption - In 2025, the replacement rate of renewable energy in urban buildings will reach 8% - Stricter management of building demolition - Acceleration of R&D - Improving statistical and accounting systems of energy consumption and carbon emission - Intensifying regulations, standards and incentives	First mention of a statistical and accounting system of carbon emission in buildings as key tasks. The acceleration mainly concerns total area of newly built ultra-low and near-zero energy consumption buildings (target of 50 million m² in the Five-Year Plan vs. 200 million m² in this plan) and of renovated areas (350 million m² in the Five-Year Plan vs. 200 million m² between 2023 and 2025). Electricity consumption rate and replacement rate are unchanged compared to 2021.

Annex 4: Implementation plans targeting building materials

Title	Issuing body and date	Main contents related to building decarbonization	Comments
14th Five-Year Plan: Action Plan for the Development of the Raw Materials Industry	MIIT Ministry of Natural Resources Ministry of Science and Technology December 2021 Full text in Chinese	Among the development targets: - By 2025, the comprehensive energy consumption per ton of steel is to be reduced by 2%, consumption per unit of clinker in cement products is to be reduced by 3.7%, carbon emissions from electrolytic aluminium is to be reduced by 5%. - Improve the utilization rate of industrial and solid wastes - Efforts in R&D are emphasized for the steel industry and the construction materials As part of the greening strategy: - Support key industries such as iron, steel and cement to build a system of statistical accounting, monitoring and assessment of carbon emissions - Implement mandatory energy consumption limit standards per unit of product	Chapter 5 (out of 8) is fully dedicated to greening the industry.
Implementation Plan for Carbon Peaking in the Building Materials Industry	NDRC MIIT MEE MOHURD SAMR November 2022	Among the main objectives: - In line with the 14th Five-Year plan, the comprehensive energy cost has to be reduced by over 3% in cement clinker production units during the period - Ensure that the building materials industry will reach carbon peak by 2030 Among the key tasks: - Reinforce total volume control - Promote raw material substitution, accelerate the use of low-carbon cement, accelerate the level of solid waste utilization - Increase the use of alternative fuels and increase the efficiency of energy	In 2022, carbon emission volumes of cement production accounted for about 70% of overall carbon emission volume for the construction materials industry.

	Full text in Chinese	use - Accelerate R&D on low-carbon and energy-saving technologies. Select and announce a batch of energy-saving and low-carbon building materials technologies and equipment every year and promote more than 100 items by 2030 - The carbon emission indexes of construction materials will be incorporated into the green building materials standard systems, and their certification will be accelerated Among the safeguarding measures: - Study the inclusion of cement and other key industries in the national carbon emissions trading market - Improve the standard measurement system and carbon emission accounting system of the industry, formulate carbon emission limit standards, revise energy consumption limit standards	Fossil fuels accounted for 30% of carbon emissions across the industry. No quantified targets are formulated for the key tasks except the number of energy-saving and low-carbon technologies and equipment.
Promoting High-quality Development of the Steel Industry	NDRC MIIT MEE January 2022 Full text in Chinese	Among the main targets to reach by 2025: - Green and low-carbon will be promoted in depth. - A resource recycling system with inter-industry coupling development will be built - More than 80% of iron and steel production capacity will be transformed to ultra-low emission - The comprehensive energy consumption per ton of steel will be reduced by more than 2% - Carbon peaks will be reached before 2030 - The recycling and processing system of steel scrap will be basically sound - The amount of steel scrap resources used by the iron and steel industry will reach more than 300 million tons	
Special Action Plan for Energy	NDRC MIIT	Among the main targets: - By the end of 2025, the energy consumption per ton of steel will be reduced	

Saving and Carbon Reduction in the Iron and Steel Industry	MEE SAMR National Energy Administration May 2024 Full text in Chinese	by more than 2% compared to 2023 - From 2024 to 2025, about 20 million tons of standard coal will be saved, emission reduction of carbon dioxide will be about 53 million tons Among the key tasks - By the end of 2025, the proportion of iron and steel production capacity above the energy-efficiency benchmark level will reach 30% - Promote the use of scrap steel resources, expand the import of renewable iron and steel raw materials, promote scrap steel recycling. By the end of 2025, the utilization of scrap steel will reach 300 million tons. Among the safeguarding measures: - Promote the upgrading of standards, including for carbon emission accounting and low-carbon process technology	
Special Action Plan for Energy Conservation and Carbon Reduction in the Cement Industry	NDRC MIIT MEE SAMR National Energy Administration May 2024 Full text in Chinese	Among the main targets: - By the end of 2025, the cement clinker production capacity will be controlled at about 1.8 billion tones - The proportion of production capacity above the energy-efficiency benchmark level will reach 30% - The comprehensive energy consumption of cement clinker per unit of product will be reduced by 3.7% compared to 2020, thereby saving 5 million tons of standard coal and 13 million tons of CO2 by 2025. Among the main tasks: - Implement low-carbon fuel substitution, no new self-burning coal-fired units. By the end of 2025, the proportion of cement kilns using alternative fuel will reach 30% and the proportion of alternative fuel consumption in the cement industry should reach 10% - Promote the substitution of non-carbon raw materials, promote the production of low-carbon cement, promote clean transportation in the industry. By the end of 2025, clean transport should read 50%	

		-Promote the use of industrial waste as raw materials. By the end of 2025, the amount of waste utilized in the cement industry should reach 800 million tons - Encourage data collection and intelligent control systems Among the safeguarding measures: - Accelerate and update standards for energy-saving and carbon emissions - Accelerate the introduction of technical specifications for the evaluation of low-carbon cement - Promote the construction of a carbon footprint standard system	

The building industry is also a secondary target of plans dealing with other sectors but including provisions directly or indirectly related to it. While these policies are not specifically designed for the buildings, they still provide additional information about the strategy implemented to reach the decarbonization of the sector.

Title	Issuing body and date	Main contents related to building decarbonization	Comments
14th Five-Year Plan on Industrial Green Development	MIIT December 2021 Full text in Chinese	- Promote large-scale use of industrial solid waste in building materials production - Extract valuable elements from solid waste to produce energy-saving building materials - By 2025, complete ultra-low emission transformation of 530 million tons of steel production capacity - Promote green smart home appliances - Accelerate the development of new building materials such as biomass, wood and gypsum	Iron, steel and building materials are among the sectors specifically mentioned in the text as targets of green transformation.

Implementation Plan for Carbon Peaking in the Industrial Sector	NDRC MIIT MEE July 2022 Full text in Chinese	- Iron, steel and building materials are among the key sectors mentioned in the text. - "Major actions" to be taken are detailed for the steel and iron industry: control production capacities, promote energy-saving and low-carbon technologies; by 2025, processing capacity of iron and steel scrap will reach 180 million tons, proportion of short-flow steelmaking will reach 15%. It will reach 20% by 2030. - "Major actions" for the building materials industry include the increase of energy-saving and low-carbon technologies and equipment ; by 2025, the level of energy consumption per unit product of cement clinker will drop by more than 3%. - Promote green and low-carbon products in rural and urban construction, incorporate carbon mission indicators in green building materials standard system and accelerate certification; create pilot cities for green building materials; promote solar water heaters, photovoltaics and heat pumps in construction; promote energy-efficient air-conditioners, lighting appliances, lifts. - Build a standard measurement system, establish and improve the industrial sector carbon peak standard system, develop carbon emission accounting. - Study emission benchmarks for key industries and formulate carbon emission quotas; develop green finance	

Implementation Plan for Sci-Tech Supporting Carbon Peaking and Carbon Neutrality (2022-2030)	MIIT NDRC Ministry of Science and Technology +6 other Ministries August 2022 Full text in Chinese	- A focus is made the R&D on low-carbon and zero-carbon steel and iron - Another on urban and rural construction R&D targeting decarbonization, emission reduction, energy conservation and efficiency, and specifically wall heat preservation, building dismantling and reuse, green and low-carbon building materials, light, electrification, intelligent construction, heating and cooling technologies, thermal power synergy, natural carbon sequestration building materials, bamboo, wood, recycling technologies, building planning, design and operation. - The creation of demonstration projects is encouraged for the "Hydrogen in Ten Thousand Homes" project, for low-carbon industrial processing (iron, steel, cement), for low and zero-carbon buildings. - Technologies promoting clean manufacturing, low and zero carbon construction, emissions monitoring, verification and accounting will benefit from financial support.	With this plan, China aims to achieve major breakthroughs in low-carbon core technologies in key sectors by 2025; it targets a 18% drop in CO2 emissions per unit of GDP and a 13.5% drop in energy consumption per unit of GDP from 2020 levels. China also plans to deepen international cooperation in low-carbon science and technology innovation.
Action Plan to Promote Large-scale Equipment Upgrades and Trade-ins of Consumer Products	State Council March 2024 Full text in Chinese	- Iron, steel and building materials are among the key industries specifically targeted by this plan for upgrade - Buildings and urban equipment are also targeted for upgrades: residential lifts, heating, gas supply, external wall insulation, doors and window, heating installation - Home appliances are targeted for trade-ins and recycling, smart homes are encouraged - Home appliances and household products are mentioned in the products to be submitted to carbon labelling and green certification	No quantified targets are set in this text.
Implementation Plan for the	NDRC +14 other	Main targets to reach: - By 2027, the carbon footprint management system will reach its initial step	Among the key products targeted, priority is

Establishment of a Carbon Footprint Management System	ministries and institutions July 2024 Full text in Chinese	of development, with the release of general rules and standards for footprint accounting in line with international standards, the introduction of rules and standards for about 100 key products, and the establishment of a preliminary system of labelling, certification and grading management. - By 2030, rules and standards will target about 200 key products, the labelling, certification and grading system will be fully established. The carbon footprint accounting rules, factor database and carbon labelling certification system will be in line with international standards, and a substantive participation in the formulation of international rules on product carbon footprint will have been made.	explicitly given to many buildings-related items: iron and steel, cement, glass, electrical and electronic appliances.

Annex 5: Decision-making bodies

Many actors are involved in the formulation and issuance of China's policies, plans and standards related to the decarbonization of the building sector.

National government agencies

The **National People's Congress**, through the five-year plan, approves general orientations and targets developed by the State Council. The Congress also approves national laws that form the legal framework of building decarbonization.

The **State Council** emits administrative regulations that supplement the national laws and get into the processes of their implementation.

Under the supervision of the State Council, several government bodies are in charge of managing activities related to building decarbonization. They also emit action plans, norms and standards in their specific field of action.

The National Development and Reform Commission (NDRC) is a macro management institution. It is in charge of "promoting the implementation of sustainable development strategies"[56] "coordinating energy and resource conservation and comprehensive utilization", and "coordinating the environmental protection industry and clean production". One of its duties is also to "put forward and implement energy consumption control targets and tasks".

The Ministry of Housing and Urban-Rural Development (MOHURD) formulates policies and national standards for the construction sector and supervises their implementation. It is the main ministry driving the decarbonization effort at the building's level.

The Ministry of Industry and Information Technology (MIIT) is in charge of industrial planning, policies and standards, and it monitors daily operations of industrial branches. As such, it is responsible for the management of the building materials industry.

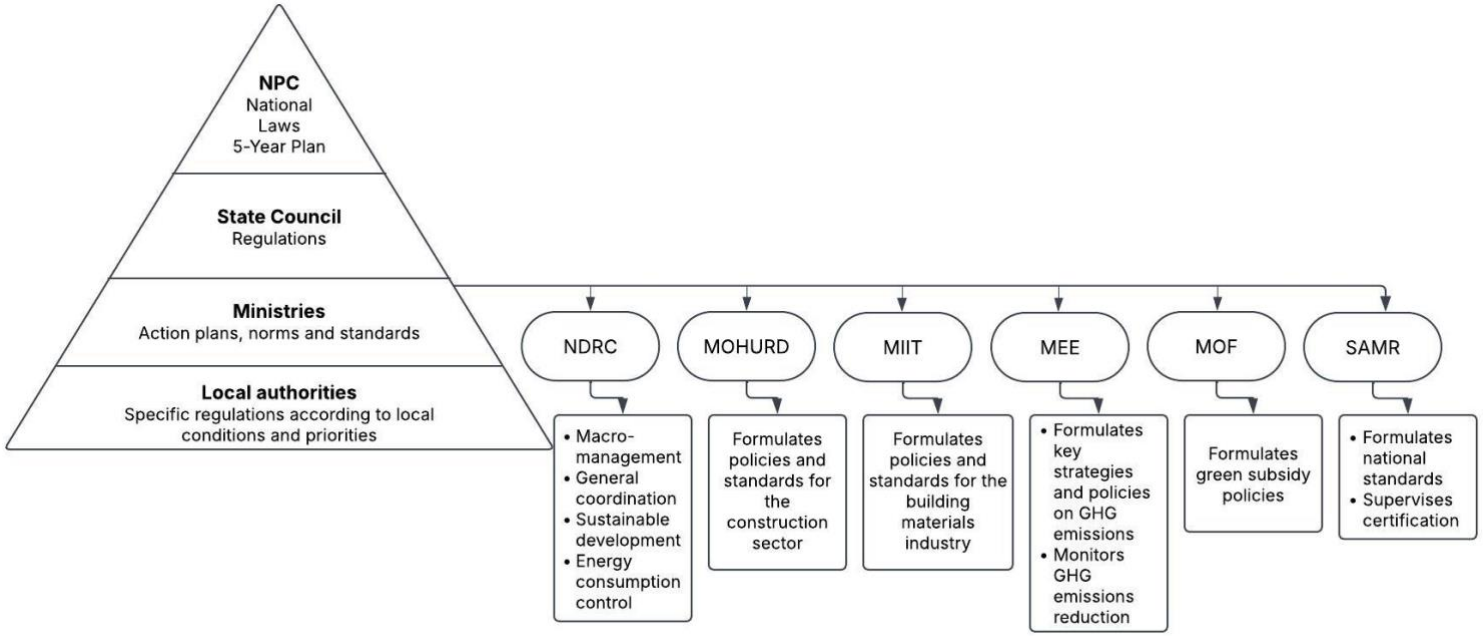
[56] https://en.ndrc.gov.cn/aboutndrc/mainfunctions/

The Ministry of Ecology and Environment (MEE), "supervises and administers to ensure the attainment of national emissions reduction targets"[57], "organizes the monitoring of greenhouse gas emission reduction", and "initiates the formulation of key strategies as well as plans and policies tackling climate change and greenhouse gas emissions".

The Ministry of Finance (MOF) is involved in the formulation of green subsidy policies.

The State Administration for Market Regulation (SAMR) elaborates national standards and supervises their implementation and subsequent certification.

Other ministries and government bodies can sometimes be involved in the formulation of specific regulations: Ministry of Science and Technology, Ministry of Natural Resources, National Energy Administration.



[57] https://english.mee.gov.cn/About_MEE/Mandates/

In June 2021, a **Special Leading Group on Carbon Peaking and Carbon Neutrality** was set up to coordinate all activities related to China's dual carbon targets. The first meeting of the group was chaired by Vice-Premier Han Zheng and attended by 60 top-level officials, including the heads of all key ministries and committees: ministers of finance, construction, natural resources, science and technology, foreign affairs, ecology and environment, the director of NDRC, the governor of China's central bank. The role of this Group is to coordinate efforts to peak carbon emissions and achieve neutrality.

Local government agencies

Local institutions replicate the national ones at the provincial, municipal and county levels.

Under China's "target responsibility system" (TRS), key targets are allocated by the central government to the provinces, and the provinces in turn disaggregate their own targets among all municipalities, and municipalities' government then assigns targets to relevant enterprises within its jurisdiction. TRS was first introduced for energy saving and pollution reduction during the 11th Five-Year Plan (2006-2010) and then expanded to include carbon intensity targets with the 12th Five-Year Plan (2011-2015).

Local authorities issue policies and regulations to execute the national policies according to their local conditions. Some of these local regulations can be more demanding than the national targets, and strategies to reduce buildings' emissions can differ widely between northern and southern provinces, and between rural and urban areas.

Public Service Units and Social Organizations

China has a large network of "public service units" (PSUs) and social organizations and even companies established by national and local governmental agencies, and reporting to them. Designed to serve the developmental needs of the society, they provide research and analytical support for the drafting of national policies and standards, and they inform the public.

The Ministry of Housing and Urban-Rural Development (MOHURD) for example, is owning several PSUs, such as:

- China Academy of Urban Planning and Design
- Research Institute of Standards and Norms
- Technology and Industrialization Development Center
- Policy Research Center
- Information Center
- National Academy for Mayors of China
- Human Resources Development Center
- Practice Qualification Registration Center
- China Architectural Culture Center
- China Construction News
- National Termite Control Center of China

MOHURD owns the following companies in the media and publishing businesses:

- China Architecture and Building Press
- China City Press
- Architecture Magazine

The ministry also established and/or supervises many social organizations such as:

- Chinese Society for Urban Studies. This organism describes itself as “the governmental-authorized national green building evaluation institution to develop and implement the China Green Building Standard GB/T 50378”, “working with China Green Building Council and focusing on sustainable building research and assessment”. In 2009, the Society opened a branch dedicated to green building, the Green Building Research Center, whose mission is to conduct “theoretical research, scientific popularization and industry promotion”, and to “provide green building label evaluation and technical support services for the market’. This research centre participated in the edition of industrial standards related to green buildings.
- China Real Estate and Housing Research Association conducts theoretical and decision-making research contributing to the formulation of guidelines and policies and serving the development of the real estate industry.
- The Architectural Society of China defines its mission as “pursuit of academic excellence, pioneer in industry development, assistant to government and home for members”. It also conducts international cooperation and exchanges.
- China Civil Engineering Society carries out academic exchanges, international scientific and technological exchanges, provides advice on national scientific and technological policies.

- Urban Planning Society of China carries out academic research, supports government decision making and promotes international exchanges.
- China Construction Labour Institute carries out academic research, promotes national and international business exchanges, provides opinions and suggestions for government departments to formulate policies and regulations.
- China Real Estate Appraisers and Agents is an association of real estate professionals and related companies. It carries out research, provides opinions to the government on real estate regulations, contributes to the drafting and promotion of standards, conducts international cooperation and cooperates with foreign companies investing in China.
- Construction Accounting Society of China carries out research on financial and taxation policies related to urban renewal, on the transformation of the construction, on the auditing of construction projects.
- China Association of Mayors conducts research on urban development and published the annual “China Urban Development Report”. It organizes several national and international workshops, many of them focusing on sustainable urbanization and green development.
- China Council for the Promotion of International Trade - Construction Sub-Council is a channel for the construction industry to carry out international trade and investments and promotes the internationalization of the construction industry.