# ACCELERATING CHINA'S URBAN TRANSITION

## PRIORITY ACTIONS FOR HIGH-QUALITY GROWTH AND ENHANCING LEADERSHIP FOR CARBON NEUTRALITY


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Residential buildings surrounded by trees and vegetation in Chengdu, Sichuan, China. Credit: LP2 Studio/Shutterstock.

## About this report

*Accelerating China's Urban Transition* is part of a report series from the Coalition for Urban Transitions. This report is a sister report to *Seizing China's Urban Opportunity: Cities at the heart of the 14th Five-Year Plan and a national vision for net-zero emissions*, which includes original climate and economic analysis and modelling to support the COP26 UN climate conference, and which informs this report.

*Accelerating China's Urban Transition* also draws from and builds on research from *China's New Urbanisation Opportunity: A Vision for the 14th Five-Year Plan*, which called for a new model of urbanisation in China to help drive high-quality economic growth while avoiding environmental costs. It examined China's historical transformation over the years to a predominantly urban society and identified three previous engines of growth and contrasted them with three new engines.

*Accelerating China's Urban Transition* complements these two reports by delving deeper into how cities can support the country to accelerate towards sustained, high-quality growth and carbon neutrality. It provides a detailed exploration of the economic case for transforming China's urban development model, outlines key priority actions to be taken in specific sectors and sets out strategies for financing this transformation.

Cover photo: High-rise buildings in Hong Kong. Credit: Mandy Choi on Unsplash.

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### Disclaimer

This research has been carried out under the auspices of the Grantham Research Institute on Climate Change and the Environment and Professor Qi Ye in conjunction with colleagues from Tsinghua University, Hong Kong University of Science and Technology, WRI China and LSE Cities. The views reflected in this report do not necessarily reflect the views of the wider membership of the Coalition for Urban Transitions or the UK government.

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# Abbreviations

| | |
|---|---|
| **ASI** | avoid-shift-improve |
| **BRI** | Belt and Road Initiative |
| **CCC** | clean, compact and connected cities |
| **CNY** | Chinese Yuan Renminbi (Currency Unit) |
| **EMC** | energy management contract |
| **EV** | electric vehicle |
| **FDI** | foreign direct investment |
| **GEP** | gross ecosystem product |
| **GDP** | gross domestic product |
| **$GtCO_2$-e** | gigatonnes of carbon dioxide equivalent |
| **$g/m^3$** | grams per cubic metre |
| **GW** | gigawatts |
| **IoT** | Internet of Things |
| **Jing-Jin-Ji** | Beijing-Tianjin-Hebei |
| **LGFV** | local government financing vehicle |
| **MaaS** | Mobility as a Service |
| **MEE** | Ministry of Ecology and Environment |
| **PBOC** | People's Bank of China |
| **PM** | particulate matter |
| **UHV** | ultra-high voltage |

Beijing. China. Retirees spend their leisure time in the park – dance, acrobatics and Tai Chi. Credit: Bagrin Ego/Shutterstock.

# Executive summary

## IMPACTS OF THE PACE AND SCALE OF CHINA'S URBANISATION

The strength and quality of China's growth in the coming decades depend on how its cities develop. Rapid urbanisation has been central to China's economic success story but China's future development is threatened by increasing air pollution, traffic congestion, social inequities and other pressures in cities. These problems have been labelled 'urban diseases' by the government and the country has made significant strides to alleviate them, but they are preventing cities from reaching their full economic potential.

In the next three to four decades, the urban population is estimated to reach 75–80 per cent of the total population. Ensuring that China's next 200 million urban residents breathe, move and work productively could put the country on a trajectory to prosperity and wellbeing. Conversely, polluted, inefficient and congested cities will undermine China's growth path.

Cities and how they are built – their 'urban form' – have strong lock-in effects that can last for decades, if not centuries. Amplified urban sprawl feeds inefficiencies that affect productivity and innovation, and expands into prime agricultural land, reducing resilience to natural disasters and health pandemics. Increasingly evident is how climate change and fossil fuel use in China are threatening the economic stability of its cities.

Accelerating the human-centric 'new urbanisation strategy' outlined in the 14th Five-Year Plan will enable China's sustainable urban transition to happen more quickly and allow China to reach higher quality growth sooner. Strategic low-carbon and sustainable urban infrastructure investments and supportive spatial policies for developing clean, compact and connected cities will unlock a myriad of economic, environmental and social benefits. It is critical to focus on energy, buildings, 'new infrastructure' and transport sector investments and apply fiscal strategies that both empower municipalities and incentivise these types of investments. By acting rapidly on these fronts,

many Chinese cities could peak their carbon dioxide emissions before 2025, allowing a national peak by 2025, a target some climate economists have suggested is necessary to place China on a viable pathway to reach its 2060 carbon neutrality pledge.

The form and trajectory of the further urbanisation that takes place in China will have long-term implications for the country and the world's economic and environmental outcomes. The 14th Five-Year Plan period, 2021 to 2025, is a crucial window of opportunity to act on these issues.

## ECONOMIC BENEFITS FROM TRANSFORMING CHINA'S URBAN DEVELOPMENT MODEL

The shape and layout of cities greatly affect their ability to thrive. The benefits of clean, compact and connected cities (or 'CCC cities') are significant and their development would be in line with the 14th Five-Year Plan's human-centric 'new urbanisation strategy', which shows recognition of the importance of cities to China's future economic and ecological goals.

Clean, compact and connected cities are associated with direct cost savings, increased productivity and innovation and improved resilience to economic and climate shocks. A recent analysis by the Coalition for Urban Transitions[a] found that a series of technically-feasible investments in low-carbon infrastructure could generate CNY50 trillion (US$7.7 trillion) in returns by 2050 and create more than 15 million new jobs, while reducing almost 90 per cent of carbon emissions in Chinese cities.

**Strategic low-carbon and sustainable urban infrastructure investments and supportive spatial policies for developing clean, compact and connected cities will unlock a myriad of economic, environmental and social benefits.**

Further, if China makes an early entry into emerging urban infrastructure and technologies, it can secure its future competitiveness in the global low-carbon economy. Exports of low-carbon urban technology, goods, talent and services would unleash long-term economic dividends for Chinese companies but also lock standards and technologies into low-carbon urban infrastructure over the long term. Urbanisation can also play a supporting role in China's regional rebalancing goals through the development of smaller, well-planned CCC cities in the country's interior.

Current economic models fail to fully capture both the powerful dynamics and the very attractive qualities found in less tangible forms of capital, such as social capital, natural capital and some forms of human capital. As a result, the benefits outlined above likely grossly underestimate the full range of economic and social benefits of CCC cities.

### Recommendations for unlocking the economic potential of cities

- **Embed the 14th Five-Year Plan's human-centric 'new urbanisation strategy,' which incorporates sustainable urban development, at the centre of forthcoming sectoral and municipal implementation plans.**
- **Include and prioritise robust indicators within the municipal government performance system that reflect and encourage the 14th Five-Year Plan's human-centric 'new urbanisation strategy'.**
- **Ensure a holistic cost-benefit analysis that is consistent with principles of the human-centric 'new urbanisation strategy' is carried out on urban infrastructure projects.**
- **Improve the international competitiveness of Chinese cities by systematically benchmarking their sustainable urban development progress against global peers.**
- **Incentivise low-carbon urban development by assigning specific, verifiable emission reduction responsibilities and prioritise city-level carbon inventory systems.**

[a] Coalition for Urban Transitions (2021) *Seizing China's Urban Opportunity: Cities at the heart of the 14th Five-Year Plan and a national vision for net-zero emissions*.

## PRIORITY NATIONAL POLICY ACTIONS TO TRANSFORM CHINA'S URBAN DEVELOPMENT MODEL

The central government can take specific actions in the energy, buildings, 'new infrastructure' and transport sectors to support clean, compact and connected cities. Practical decarbonisation pathways require coordinated governance in urban areas, tailored to and aligned with local economic development goals.

### Recommendations for national policy actions

- **Strengthen coordinated governance.**
- **Decarbonise cities' energy systems through stricter standards on coal-fired power plants and promoting renewable energy.**
- **Enhance energy efficiency in the buildings sector through enforcing green building standards and supporting deep retrofits.**
- **Emphasise 'rational', smart, low-carbon and resilient development in the construction of 'new infrastructure'.**
- **Implement an integrated 'avoid–shift–improve' strategy for green transport.**

## FINANCING CHINA'S URBAN TRANSITION

To meet China's climate goals under the Paris Agreement, China needs to spend an estimated CNY138 trillion (US$20 trillion) over the next three decades across all sectors. As cities are the primary source of China's carbon emissions, much of this investment is needed in the form of low-carbon urban infrastructure. Decades of rapid infrastructure growth, initially funded through the sale of land use rights and off-budget investment vehicles, have left many municipalities in deep debt. This situation has prompted concerns over the long-term ability of cities to sufficiently meet the financing needs of a low-carbon transition.

Meeting this financing challenge will require a multi-layered fiscal strategy that empowers municipalities with sufficient financial resources and incentivises low-carbon urban investments over the long term.

### Recommendations for financing the urban transition

- **Stabilise municipal financing through own-source revenues.**
- **Prioritise strengthening systems for data collection and data sharing.**
- **Include minimum environmental thresholds for projects funded by special purpose bonds.**
- **Scale up environmental information disclosure.**
- **Develop a clear taxonomy system for green bonds that defines the difference between sustainable and 'brown' projects or infrastructure.**

Photovoltaic power generation in Chongqing. Credit: WangAnQ/iStock.

# 1. Introduction

The unprecedented scale of China's transformation into an urban-majority country over recent decades is among one of the most significant global trends of the past half century. China's urban story is not only evident in the cityscapes of Shanghai and Shenzhen: it can also be measured across a wide range of economic and social indicators, from income levels to life expectancy. However, environmental and climate challenges are growing increasingly urgent to address, including air pollution, urban sprawl, natural disasters and greenhouse gas emissions. Although the government has taken significant steps to alleviate them, these challenges are starting to undermine the economy, hampering efforts to attain the goal of higher quality growth.

China's growth over the past few decades has been largely driven by the productive activities within its urban areas. The strength and quality of China's growth in the coming decades depend on how its cities develop. If its urban areas allow people to breathe, move and work productively, the whole country will benefit from increases in prosperity and wellbeing. Conversely, polluted, inefficient and congested cities will undermine China's growth. In recognition of this, China has envisioned a concept of development called 'ecological civilisation', which melds the balancing of environmental protection with economic growth and a host of social goals. China's historic climate goals announced in 2020 – for carbon neutrality, or net-zero carbon emissions, by 2060, and a carbon dioxide emissions peak before 2030 – underscore its commitment to a sustainable model of development.

## THE 14TH FIVE-YEAR PLAN: A CRITICAL TIME PERIOD

How China steers its development in cities within the 14th Five-Year Plan period of 2021 to 2025 will determine how quickly it can reach high-quality growth overall. China's promotion of human-centric 'new urbanisation' in the recently-released 14th Five-Year Plan is a significant positive step in continuing its work towards making its cities

more sustainable. China's urban vision is clear as the strategy includes compact development, and liveable, green, innovative, humane and resilient city concepts. With the right low-carbon and sustainable infrastructure investments and spatial policies in the implementation plans that follow, China could accelerate towards making this vision a reality and put itself in a stronger position to reach its 2060 carbon neutrality goal. If done rapidly, it could mean that many of its cities could peak their carbon dioxide emissions before 2025, enabling a national peak by 2025.

Strategic decisions for how cities handle climate change adaptation and mitigation during this 14th Five-Year Plan period will have a long-lasting impact for decades and centuries to come. As China prepares for another 200 million of its citizens to be integrated into urban areas by 2050, the choices made today to build clean, compact and connected cities will have significant implications for its economic, environmental and social future.

Accelerating the pace of well-planned and managed cities within this period requires greater economic productivity, resource efficiency, less energy use and greater resilience against natural disasters and disease pandemics. Now more than ever, in the midst of the COVID-19 pandemic, the importance of strengthening cities to increase their resilience is incontrovertible. There is a strong global trend: national governments, local policymakers and related stakeholders, including urban planners, developers, architects and community organisations, are pursuing policies to promote the development of sustainable cities with better density planning, mixed-use development, public and non-motorised transport, energy-efficient buildings and accessible green spaces, among many other features.

## CHINA IN THE GLOBAL CONTEXT

China can lead on the transition towards a zero-carbon economy and benefit from being at the forefront of the new global growth story, where physical and human capital will be increasingly complemented by natural and social capital. Its goals are in line with international aspirations to achieve the Paris Agreement temperature goal of holding global warming to well below 2°C, pursuing efforts for a 1.5°C maximum increase. Countries around the world are setting targets for net-zero

China can lead on the transition towards a zero-carbon economy and benefit from being at the forefront of the new global growth story.

emissions of greenhouse gases, or carbon neutrality, and investing heavily in low-carbon infrastructure projects to stimulate economic recovery from the COVID-19 pandemic and aid the transition to a zero-carbon economy. If China accelerates the urban development plans it has outlined in the 14th Five-Year Plan, it has the opportunity to better compete in a carbon-constrained world and achieve market leadership through its innovations. If it moves too slowly, it may find itself being overtaken by competitors, and even confronted with restrictions on its high-carbon exports.

## OUTLINE OF THE REPORT

The report is divided into three further chapters and a conclusion.

**Chapter 1** examines the economic case for China's transition to a sustainable urbanisation model based on clean, compact and connected cities. The chapter argues that the benefits of healthy and liveable cities far exceed the investment costs associated with their development. It also explores the potential for China to secure market leadership in resource-efficient solutions and innovations central to the future low-carbon economy and makes recommendations for unlocking the economic potential of cities.

**Chapter 2** focuses on specific low-carbon and sustainable urban investments and supporting policies. It outlines priority policy actions that the central government can take in the energy, buildings, 'new infrastructure' and transport sectors. It makes recommendations aimed at developing clean, compact and connected cities that would support an early peak of city carbon emissions.

**Chapter 3** outlines China's fiscal challenges. It then explores strategies to empower municipalities and incentivise the financial sector to meet the estimated CNY138 trillion (US$20 trillion) needed to meet China's Paris Agreement goals, of which a significant portion must come in the form of low-carbon and sustainable urban infrastructure.

# 2. The economic case for China's sustainable urban transformation

## Summary


- Urban infrastructure investments and spatial policies geared towards creating clean, compact and connected (CCC) cities can generate vast economic rewards and bring long-lasting environmental and social benefits.
- Polluted, inefficient and congested cities will not only undermine China's carbon neutrality goals, but also diminish the country's economic growth potential and further expose urban areas to the environmental risks of climate change impacts.
- The 14th Five-Year Plan includes a human-centric 'new urbanisation' strategy to guide the development of China's cities. The plan's focus on low-carbon, sustainable and compact cities is aligned with the CCC cities framework.
- CCC cities have some measurable benefits, such as reduced infrastructure spending, productivity gains from reduced commuting times, and jobs created from low-carbon urban investments.
- Other benefits include increased potential for innovation due to agglomeration effects, and far-reaching economic effects from the improved wellbeing and health of urban residents.
- An urban development model based on CCC cities is also an opportunity for China to secure market competitiveness in resource-efficient solutions and innovations central to the future global low-carbon economy.
- In the shorter term, strategic investments and supportive measures for CCC cities can support many cities to peak their carbon dioxide emissions before 2025. This could enable a national emissions peak by 2025, making attainment of the 2060 carbon neutrality target more realistic.


## Recommendations

- Embed the 14th Five-Year Plan's human-centric 'new urbanisation strategy,' which incorporates sustainable urban development, into the centre of forthcoming sectoral and municipal implementation plans.
- Include and prioritise robust indicators within the municipal government performance system that reflect and encourage the 14th Five-Year Plan's human-centric 'new urbanisation strategy'.
- Ensure a holistic cost-benefit analysis that is consistent with principles of a human-centric 'new urbanisation strategy' is carried out on urban infrastructure projects.
- Improve the international competitiveness of Chinese cities by systematically benchmarking their sustainable urban development progress against global peers.
- Incentivise low-carbon urban development by assigning specific, verifiable emission reduction responsibilities and prioritise city-level carbon inventory systems.

Daytime architectural landscape and skyline in Chongqing, China. Credit: Dongfang Zhao/iStock.

## CONTEXT

### Climate change and fossil fuel use threaten the economic stability of China's cities

China faces significant climate change-related disaster risk, which could eliminate poverty reduction gains and prevent further growth. China is regularly among the top three nations most affected by disasters annually in terms of disaster frequency, lives lost and economic damage.[1] Due to the country's large size and varying geographies, the impacts of climate change on China are and will continue to be diverse. Global warming of more than 1.5°C above pre-industrial levels is expected to cause extreme weather events, including strong heat waves, tropical storms, severe rainfall and droughts in regions across China.[2,3] In particular, the country has very high exposure to typhoons and flooding, including flash, riverine and coastal flooding,[4] and the United Nations Office for Disaster Risk Reduction has estimated US$18 billion as the average annual loss from floods in recent years.[5] Floods cause major damage to agriculture and therefore to food security, a major concern of the government (see Box 1, p14).

More than 194 million people – over 13 per cent of China's total population and a fifth of the urban population – live in coastal zones less than 10 metres above sea level and 92 per cent of these in urban or peri-urban areas.[6] While these at-risk low-elevation coastal zones are a small fraction of the total urban land area, they are home to critical infrastructure and high-value real estate.[7]

Fossil fuel consumption also causes a threat to Chinese cities in a more direct manner: through air pollution. Despite notable improvements in air quality in many Chinese cities, air pollution in the form of ozone and particulate matter (PM) contributes an estimated US$40 billion a year in economic losses through social costs, including early death, equivalent to about 0.7 per cent of GDP.[8] At the higher end, some estimates value the health impacts of $PM_{2.5}$ exposure alone at 10 per cent of annual GDP.[9]

These health costs, however, do not reflect the true costs that air pollution has on Chinese cities and its citizens. Air pollution can affect rainfall patterns and the water cycle, reduce solar energy yields and affect plant and food crops from blocked sunlight and ozone loss.[10] Exemplifying the far-reaching effects of pollution, studies have even linked high levels of air pollution to a reduction in expressed happiness[11] and a significant reduction in intelligence.[12] This harms the development of human capital, the foundational driving force for economic growth.

## Replicating the existing sprawled urban form will have severe lock-in effects

Rapid urban transformation has been central to China's economic success story. At the start of the Reform and Opening Up period in 1978, just 18 per cent of Chinese people lived in urban areas, and this has grown to more than 60 per cent today.[13] China's urban population of 840 million people is roughly equal to the populations of the United States, EU and UK combined.[14] Nearly a third of the world's urban land expansion between 2000 and 2014 occurred in China, bringing the country's urbanised area to around 35,000km$^2$ (greater than the size of Belgium).[15]

China's dramatic transformation has come at considerable cost. About 85 per cent of energy-related carbon dioxide emissions are generated in China's cities.[16] Despite decades of rapid urbanisation, China remains more than 5 percentage points less urbanised than countries of similar income level[17] and it is to be expected that the population living in urban areas will continue to increase significantly. In the next three to four decades, the urban population is estimated to reach 75–80 per cent of the total population,[18] with accompanying increases in fossil fuel consumption.

How cities are built – their urban form – can have strong lock-in effects that can last for decades if not centuries. The urban form of cities can significantly affect travel behaviour patterns, such as whether people travel by car or other forms of transport, and land use decisions that can drive substantial energy use.[b] [19] Urban form is defined as a city's physical characteristics, including the density, size and settlement shape, and its infrastructure, from the layout of the street and road network, to transport structures, buildings and their materials and their spatial arrangement and public spaces.

China's model for urban development has been often characterised by low density, sprawling urban expansion following energy-intensive investments, which is inefficient. Although the exact proportion of carbon dioxide emissions attributed to the urban form of China's cities is not easily calculated, a number of studies show a correlation between urban form characteristics and carbon dioxide emission levels in Chinese cities.[20] For example, one study of 104 cities in China found that those with more centralised and compact urban forms are associated with lower per-capita emissions.[21]

China's urban sprawl is particularly unique because its cities have relatively dense urban centres while much of the municipality is made up of a fragmented patchwork of alternating urban and undeveloped pieces of land. Thus, China's definition of land within a city boundary includes both urban and rural areas. While much attention on Chinese cities has focused on the central urban core, in which most residents live, much of the economic and environmental inefficiencies lie in the urban sprawl that extends into the periphery.

This pattern has made it difficult for China's cities to achieve the full economic benefits that come with agglomeration, as well as causing substantial environmental costs. The piecemeal, disjointed tracts of built-up and rural land[22] that make up Chinese cities result from policies on land ownership, conversion quotas and the land acquisition process. Chinese cities are thus much less dense than would be expected compared with other developing cities around the world: a considerable majority of Chinese cities have seen their population density decrease over time, which is the inverse trend compared with the rest of East Asia.[23]

If China continues on this urbanisation path to accommodate its next 200 million urban residents, the lock-in effects from land use decisions and urban infrastructure choices could lead to serious economic consequences from worsening environmental and social impacts. Amplified urban sprawl feeds pollution, traffic congestion, social inequities – affecting productivity and innovation – and the loss of limited prime agricultural land, threatening food security and reducing resilience to natural disasters (see Box 1). Further urban sprawl would lock in even higher levels of energy consumption for years to come, decreasing the overall liveability of cities. These and other pressures, described by the government as 'urban diseases',[c] have caused China's leadership to move towards a new model of urbanisation.

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[b] Energy use in cities comes from embodied energy, from manufacturing and distribution of construction materials; operational energy, from heating and cooling and appliances; and fuel for transport, both public and private modes.

[c] The concept of 'urban diseases' includes air pollution, traffic congestion, housing and water scarcity among others, and was first given this label by the Chinese government in 2012.

Box 1

**China's food security in the context of climate change**

While 20 per cent of the world's population live in China, it has only 7 per cent of the world's arable land.[24] This relatively low per-capita endowment of arable land – at 0.09 hectares per person, versus 0.47 for the United States, for example – has made ensuring a stable food supply to all Chinese citizens a top-level government priority.[25] The government has established a 'red line', or strict minimum, for national agricultural land to remain above 1.8 billion mu (120 million hectares).[26] Rapid urbanisation in China with its rural-to-urban parcel conversion process continues to encroach on this land, while more food is being consumed by growing urban populations.[27] [28]

Natural disasters also threaten food security:[29] floods and droughts over the last four decades caused more than 50 per cent of total grain losses.[30] Environmental degradation in terms of soil, water and air pollution also poses major challenges, with toxic organic compounds and heavy metals identified, impacting food safety and security.[31] The potential volatility of food prices can have significant impacts on the agricultural sector and especially on the livelihoods of China's rural and lower-income urban residents. The production of food is likely to face further challenges in the context of climate change, again highlighting the importance of protecting agricultural land from unnecessary urban sprawl.

## CLEAN, COMPACT AND CONNECTED CITIES FOR CHINA'S LOW-CARBON AND SUSTAINABLE URBANISATION MODEL

### CCC cities are in line with China's 14th Five-Year Plan's human-centred 'new urbanisation strategy'

The shape and layout of cities greatly affects their ability to thrive. The benefits of clean, compact and connected (CCC) cities are significant[32] and bring a wealth of interconnected economic, social and environmental advantages.

**Compact, connected and clean cities bring a wealth of interconnected economic, social and environmental advantages and are aligned with China's aspirations for 'human-centred' urban development.**

CCC cities are aligned with China's aspirations for 'human-centred' urban development and support a transition to low-carbon and sustainable cities, as has been declared by the leadership since the early 2000s, and the focus of numerous central government plans and strategies on alleviating its urban stressors.[d] The National New Urbanisation Plan (2014–2020) and the Opinions on Urban Planning and Management (2016) are just two of many national strategies that emphasise urban liveability through limiting urban sprawl and making the best use of existing land through sustainable transport, compact road networks and mixed-use development, among other themes such as balancing development with ecological protection and urban-rural integration. The 14th Five-Year Plan has a human-centric 'new urbanisation strategy' section that calls for the 'completion' of this same new urbanisation concept. It includes qualifying adjectives describing this type of urbanisation, such as liveable, innovative, smart, green, low-carbon, humane and resilient, to guide China's urban growth strategies. Its vision for cities continues to be clear.

[d] Throughout the 2000s, President Xi Jinping emphasised 'people-oriented' or 'people-centered' urban development. Numerous plans and strategies reflect this aspiration, including the National New Urbanisation Plan (2014–2020), the first major national plan promoting sustainable urbanisation. China's 13th National Five-Year Plan (2016–2020), which dedicated a chapter to people-centered (or 'new') urbanisation, set the stage for a series of other national documents, such as the Guidelines for Urban Development and Management (2016) and the Guidelines on Strengthening Environmental Remediation and Urban Rehabilitation of Cities (2017). All of these promote a form of compact, connected and clean development in cities.

Figure 1

**Clean, compact and connected cities**


**Source:** Climate Emergency, Urban Opportunity (Coalition for Urban Transitions, 2019)

Figure 1 summarises some of the characteristics of CCC cities:

- ***Compact*** encompasses economic density, with a high density of people living and working in a given area; morphological density, making the most efficient use of available land and built space to meet people's needs; and mixed land use or mixed-use development, locating residential, employment, retail and leisure opportunities close to one another.[33]
- ***Connected*** can include ease of travel within cities to points of interest and amenities via sustainable transport, including non-motorised transport modes, and equitable access to a network of green spaces within neighbourhoods. Internet connectivity brings another important type of connectedness as part of an urban infrastructure service.
- ***Clean*** can include cleaner forms of energy use, transport, low-carbon industries and improved waste management. CCC cities are more liveable with a higher quality of life, achieved through cleaner air, more convenient and shorter trips through walking, biking and public transport, and a safe and affordable living environment.

## Direct cost savings

Direct cost savings are the most immediate benefits from infrastructure development associated with cities that are more compact because less land, materials and energy are needed to connect to people and places when they are closer together.[34] The investment needs are less for large infrastructure systems such as transit, telecommunications lines, waste management and water supply and sanitation. Further, in less sprawling cities per-capita operating costs of infrastructure and public services are reduced for more users, as are individual energy and transport costs.

The positive effects of dense urban form in these areas have been extensively studied,[35] with estimates that China could save up to US$1.4 trillion by pursuing more compact, connected urban growth that successfully integrates land and transport development.[36] [37] [38]

## Productivity and innovation

Urbanisation, productivity growth and innovation are closely related.[39] Beyond the direct cost savings mentioned above, a well-established body of literature has illustrated the link between compact and connected cities and economic productivity and innovation, especially in cities with efficient public transport networks that enable residents to commute to work and access services easily.[40]

Agglomeration generates economic benefits in three primary ways, as summarised by the Coalition for Urban Transitions[41] – through sharing, matching and learning benefits:

- ***Sharing benefits:*** Where many firms seek a common set of inputs, suppliers of those inputs are able to specialise and achieve economies of scale. This in turn means that purchasers benefit from lower costs and/or increased productivity.
- ***Matching benefits:*** Larger markets allow firms to find a better fit with their specialised needs, by employing workers with distinct skills and/or by linking to suppliers with distinct products. Greater specialisation of both labour and firms enables greater efficiency.

**Estimates show China could save up to US$1.4 trillion by pursuing more compact, connected urban growth that successfully integrates land and transport development.**

- ***Learning benefits:*** Close geographical proximity of workers and firms enables more frequent interactions both within and across sectors. This facilitates the spread of existing knowledge, in particular tacit knowledge that is hard to codify in documents or formulas.

A study conducted by the London School of Economics and Political Science showed that in Europe a 10 per cent increase in population density is linked to an increase of 1.9 per cent in gross value added.[42] Most studies suggest that productivity patterns in Asian cities are generally consistent with these agglomeration effects.[43] A study of 200 Chinese cities in the 1990s showed that workers' real incomes and output per worker were higher in bigger cities.[44] [45] Another study, of 120 Chinese cities, showed that a doubling in city size was associated with firm productivity increases of 3 to 8 per cent.[46]

The liveability of cities is also directly tied to a city's ability to attract human capital. Liveable cities are better able to compete in the marketplace for high skilled and high wage workers and businesses from across China and globally, thus boosting their economic and innovative capacities. A higher-paying job market can also benefit lower-skilled workers due to a spillover effect. The connection between innovation, talent and liveable urban spaces is a virtuous cycle that has been recognised and used in city branding strategies to promote economic development.

Box 2
**'Good density'**

Most studies on the benefits of compact cities relate to developed countries. There has been significant debate over whether promoting concentrated urban density makes sense in the developing country context, where many cities are already very densely populated.[47] For instance, China's cities have a much higher population density than US or European cities (with more than three times the average population density in China than in the US and almost twice more than in Europe), and some of the benefits associated with higher density seen in others places, such as decreased commuting times, are not clearly found across Chinese cities in some studies.[48] There are, of course, negative effects to being overly dense, such as overcrowding. The goal should be to design areas in a way that attains 'good density'.[49] Rather than further densifying already high-density areas, this means balancing population size and infrastructure development across a city to ensure connectedness between housing and jobs, coordinated with services and amenities, all to promote an improved quality of life.

Although the government has stated in recent years that managing population density and urban sprawl are priorities, remote sensing data show that urban sprawl is continuing to take place across China. In the central and western regions, cities continue to sprawl outwards,[50] while in many eastern cities, although the pace of sprawl has decreased, populations have been forced by increased housing prices to move into the city fringes. Thus, China's cities still have much scope to become more compact.

One approach to compact cities being adopted in China is the concept of '15-minute life circles'. Many Chinese cities have embedded this concept into their masterplans, including Shanghai as a frontrunner. It dictates that cities should be redeveloped or built by focusing on providing essential services and public spaces within a 15-minute walking distance. This is similar to initiatives like Paris's '15-minute city' and other similar schemes in Barcelona, Detroit, London and Portland.

## Urban resilience

Constructing CCC cities can strengthen the urban resilience of cities. Urban resilience is defined by the ability of a city to survive, adapt and grow despite the chronic stresses or acute shocks it experiences, such as natural disasters, economic crises, public health issues and social unrest.[51] The context section outlined some broad economic costs of inaction for mitigating and adapting to various climate shocks.

China should improve enforcement of its many policies in line with the CCC cities approach, resilience and nature-based solutions for climate change mitigation and adaptation. One of the most explicit policy tools to curb urban sprawl and preserve natural environments is the use of development-limiting restrictions or 'urban development boundary' lines.[52] This policy, pushed heavily by the central government since 2013 with mixed adoption results, was recently reinstated by the Ministry of Natural Resources, to be applied to provinces and cities.[e]

China is also one of the first countries to explicitly attempt coordinated, ecosystem-based management across local, regional and national scales. Incorporated into the national Environmental Protection Law in 2015, the Ecological Redline Policy demarcates priority land areas with high-value ecosystem services and prevents them from being built up for urban use. With recent mandates for regional and local government collaboration to enforce this policy, large areas of land are predicted to be protected from urban expansion.[53] This and other policies are due to be updated

[e] Proposed at the 2013 Central Urbanisation Work Conference by Xi Jinping. There has been a requirement to include 'Urban construction boundaries' in city masterplans by the China Town and Country Planning Act since 2006.

under the new, unified national territorial and spatial planning, and could benefit from alignment with CCC development.[f]

Finally, China's Sponge City pilot programme of dozens of cities, launched in 2013 to support urban water management, is gaining renewed attention amid fresh concerns about urban resilience and due to focus on the United Nations Biodiversity Conference, to be held in China in the spring of 2021. Stronger enforcement mechanisms for these policies and initiatives, and re-examination of other planning guidelines such as land conversion quotas and floor area ratio regulations for buildings, could accelerate resilience rewards.

## BENEFITS OF LOW-CARBON AND SUSTAINABLE URBAN INFRASTRUCTURE INVESTMENTS

### Return on investment

The returns on low-carbon urban infrastructure investments are significant. New analysis for the Coalition for Urban Transitions suggests that a package of technically-feasible low-carbon measures taken today could cut global emissions from certain urban sectors by almost 90 per cent by 2050. These sectors include green construction and retrofits, renewable urban energy, active and clean forms of mobility, and material and waste efficiency. The investments required to reduce urban emissions would be US$1.83 trillion (about 2 per cent of global GDP) per year, but they would generate annual savings worth US$2.80 trillion in 2030 and US$6.98 trillion in 2050. This yields a net present value of US$23.9 trillion.[54]

China could implement a package of low-carbon measures similar to those proposed to cut global emissions. Analysis specific to China by the Coalition for Urban Transitions indicates that it could produce significant economic returns and help reduce urban emissions from urban buildings,

New analysis for the Coalition for Urban Transitions suggests a package of technically-feasible low-carbon measures taken today could cut global emissions from certain urban sectors by almost 90 per cent by 2050.

transport and waste by 48 per cent in 2030 compared with today (1.94 gigatonnes of carbon dioxide equivalent [$GtCO_2$-e]) and 89 per cent in 2050 (around 3 $GtCO_2$-e). Together these measures would bring a net present value of US$7.7 trillion (CNY50 trillion) by 2050, based on energy and material cost savings alone. Realising this opportunity would require annual investments of US$170 billion (CNY1.1 trillion) per year between 2020 and 2050 – equivalent to about 1.3 per cent of China's annual GDP55 – but this could generate annual savings worth US$200 billion (CNY1.3 trillion) in 2030 and US$610 billion (CNY4 trillion) by 2050. These numbers are likely to be considerably underestimated as they do not take into account potentially higher energy prices, nor faster technology learning rates. Moreover, while commercial loans typically generate returns of 4.4 per cent in China, these investments would collectively yield 12.1 per cent.[56]

### Investment in low-carbon jobs

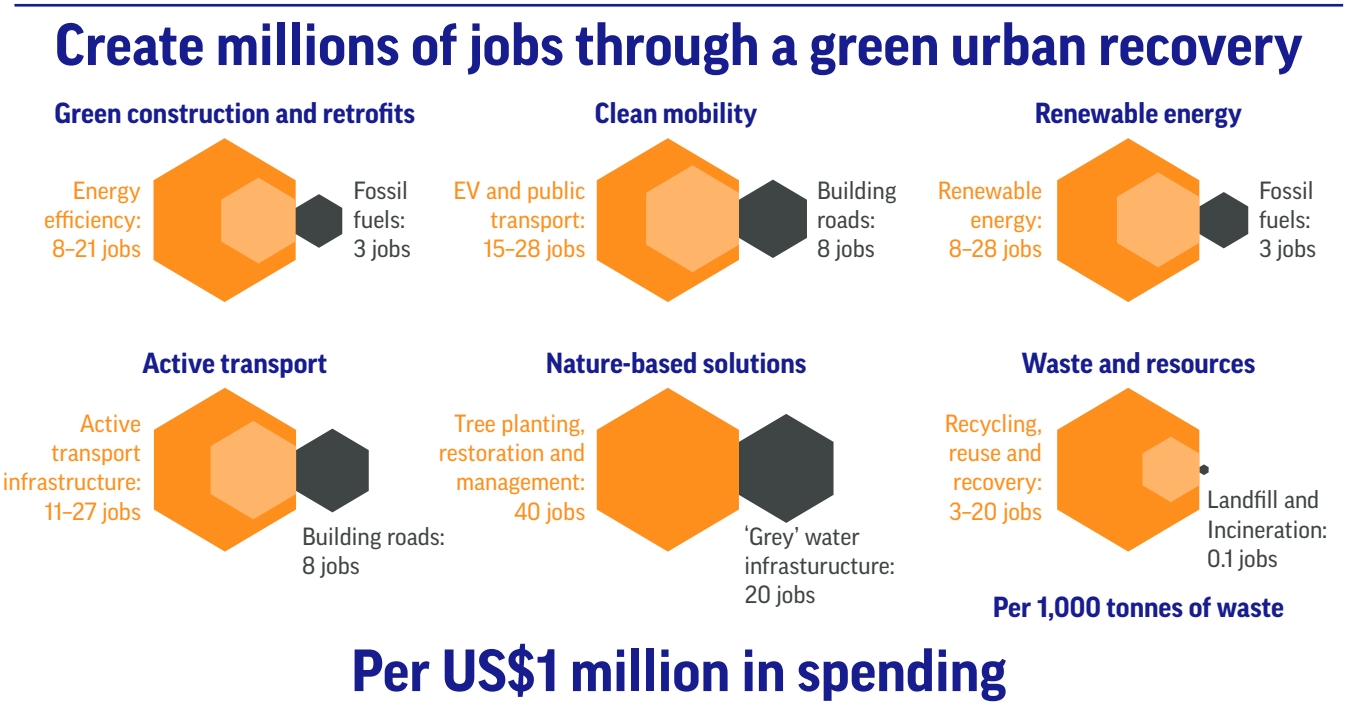
A lesson from the 2008 financial crisis is that green stimulus policies often have economic and environmental advantages over a traditional fiscal stimulus.[57] Ample research shows that investing in low-carbon urban infrastructure[g] can create more and higher-paying jobs than investments in traditional infrastructure, as illustrated in Figure 2. For example, renewable energy creates more jobs than fossil fuel investments by a large margin.

[f] The new National Territorial and Spatial Plan merged several sectoral plans previously implemented by different ministries to eliminate overlapping mandates and increase efficiency. Part of this is a new governance system that includes planning for urban development boundaries, agricultural redlines, and the ecological redline policy (the 'three red lines'), productivity-based land supply, carbon and pollutants intensity, constrained land supply, and development intensity.

[g] Low-carbon urban infrastructure in this chapter refers to investments in the buildings, energy, transport, materials and waste sectors.

Figure 2

**Low-carbon sectors out-perform traditional sectors in job creation**




**Source:** *The Economic Case for Greening the Global Recovery through Cities*, presentation, Coalition for Urban Transitions, 14 September 2020

The analysis underpinning the preceding subsection indicates that adopting the same package of low-carbon measures – cutting emissions from urban buildings, materials, transport and waste – could support 15.2 million jobs in China in 2030, mostly in energy efficiency in the buildings sector, and 3.5 million jobs in 2050, mostly in electric vehicles. For comparison, in 2017 China's automotive industry employed about 1.6 million people.[58] A recent study shows that the job creation rate of renewable energy industries, such as wind power and solar energy, and of the energy efficiency sector, is between 1.5 and three times that of traditional energy industries in China.[59]

## Weaning China off fossil fuel dependence

One of the benefits of transitioning away from a high-carbon urban model, especially by promoting low-carbon transport and renewable energy, is lowering China's dependence on imported oil. China is by far the world's largest importer of oil, with more than 10 million barrels being imported each day on average.[60] Dependence on oil puts China's economy at potential risk from supply disruption and price fluctuations. As a more compact urban form means fewer car journeys are needed and thus reduces fuel consumption, CCC cities can help the Chinese economy decouple from the volatility of the global oil market.[61]

China is also the world's largest subsidiser of fossil fuel energy, which is contributing to preventing a faster transition to renewable energy (see Box 3, p20).

# INDUSTRY LEADERSHIP POTENTIAL

## Leadership in low-carbon urban development

If China were to make an early entry in emerging low-carbon urban infrastructure and technologies, it could secure the country's competitiveness in the global low-carbon economy. Research shows that countries that successfully invest early in technologies and capabilities have better success in diversifying into future products and markets.[62] Cities across the world will increasingly be seeking to adopt a low-carbon urban development model to meet domestic and international climate change and sustainability goals. Chinese companies that develop capabilities in the technologies and innovations that accompany a low-carbon

development model domestically will compete more successfully in global markets. The increasing adoption of connected technologies is driving the growth of the global smart cities[h] market, which is expected to double in size by 2025, reaching US$820 billion.[63] While China has made significant strides in 'smart city' development, South Korea is currently a leading global supplier of 'smart city' solutions and technologies, a position gained in large part due to its domestic promotion of smart cities over the past decade (originally termed 'ubiquitous cities').[64]

The countries in the Belt and Road Initiative (BRI) are markets that China can target with its low-carbon infrastructure and technologies, to help those countries build more sustainable cities and avoid the severe economic, environmental and social consequences that China experienced due to its earlier urbanisation model.[65] Exporting low-carbon urban technology, goods, talent and services into the many BRI countries would unleash long-term economic dividends for Chinese companies. Moreover, it could lock Chinese standards and technologies into low-carbon urban infrastructure over the long term.

China's accelerated adoption of low-carbon infrastructure can also have the potential to support the transition of low-carbon technologies worldwide, not only in the BRI countries. The scale of China's market and the power of Chinese manufacturing can rapidly lower the cost of technologies and products. For example, China's entrance into solar panel manufacturing greatly reduced the cost of the technology and was a critical turning point for solar adoption globally.[66] There is potential for China to make similar contributions in emerging technologies such as energy storage and carbon capture.

As China applies new low-carbon infrastructure and innovations in cities, it can also become more attractive to foreign direct investment (FDI), which is a priority for the government. Moreover, new talent and companies drawn to China's new liveable urban environments will entice other companies to set up business in these cities, inducing further FDI and embedding foreign companies and the latest technologies into China's supply chains.

Box 3
**Fossil fuel subsidies**

Global fossil fuel subsidies play a significant role in keeping energy prices below their true market price, thus slowing the transition towards sustainable energy sources. It is estimated that globally, subsidies remain around US$5 trillion a year.[67] China is the world's largest subsidiser* of fossil fuel energy, contributing around US$1.5 trillion a year.[68] If global fossil fuel prices were more in line with their true costs, this would lead to significant economic welfare gains of more than US$1.2 trillion per year through reduced environmental damage, increased fiscal revenues and the adoption of new sustainable technologies.[69] More than half of these gains would be felt in emerging and developing economies in Asia, including China.[70]

**Defined as fuel consumption times the gap between existing and efficient prices (i.e. prices warranted by supply costs, environmental costs, and revenue considerations).*

[h] Smart cities use digital and telecommunication technology to improve the efficiency of services, operations and resources.

## URBANISATION AND REGIONAL REBALANCING

### CCC cities in the interior

One of China's long-term national goals has been to narrow the gap between the economically advanced and export-oriented coastal megacities and China's less developed interior. In May 2020 the State Council released new guidelines for the long-standing 'Go West' strategy that reinforce the need to develop China's western regions through the promotion of innovation and modern industries.[71] [72]

The economic opportunities afforded by China's first tier coastal cities drive significant internal migration flows away from the interior region. These migration flows can be considered a type of internal 'brain drain', pulling promising human capital away from interior cities, and in some ways this has hindered the local development of knowledge-based industries and contributed to unbalanced regional development.[73] Further, lower-skilled migrant workers from rural areas in the interior are overwhelmingly drawn to the first tier cities, often bypassing opportunities in cities closer to home in favour of the coastal cities. The economic and social costs to China's interior regions of this migration are hard to measure but are likely to be significant.

Urbanisation strategy can play a central role in this rebalancing through the development of smaller, well-planned CCC cities in the interior.[74] [75] In addition, existing cities in the interior could better retain and draw human capital flows by improving their economic and social offerings.[76] However, many of these cities still heavily rely on high-carbon industries. Though they may not be able to shift their economies from high-carbon industries immediately, taking steps towards a transition is wise. Many other interior cities are at a development stage where they have the opportunity to leapfrog the previous carbon-intensive city layouts by fully considering lock-in implications early on and avoiding them.

As China's more developed regions move away from high-carbon industries, there is the potential for the gap in economic competitiveness with interior regions to grow even further. If interior cities are locked out of the new low-carbon economy, they may experience an even more difficult future transition, further widening the disparities between China's developed and underdeveloped regions. More than half of China's potential for emissions abatement in urban areas by 2050 lies in cities that have currently fewer than one million residents,[77] so ensuring these smaller interior cities are on a low-carbon development path will be crucial for China to meet its climate and environmental objectives.

## CONCLUDING REMARKS AND RECOMMENDATIONS

While the numbers outlined for investment returns and job creation are compelling, they fail to capture the true scope of benefits from investing in clean, compact and connected cities. The figures do not yet include the many economic benefits from reduced air pollution and congestion, the increase in innovation, industry leadership and economic activities stemming from rebalancing and agglomeration in more CCC cities, or the many intangible attributes that result from a better standard of living.

A myriad of physical and mental wellbeing co-benefits can be unlocked by CCC cities. The value from a better quality of life and increased prosperity is often not visible, but is significantly present. For example, the benefits of having access to parks and green spaces can have extensive positive effects on emotional wellbeing, from exposure to nature and engendering a sense of community.[78] These improvements in wellbeing and health reduce the burden on health systems and also the number of working days missed.[79] Current economic models fail to capture both the powerful dynamics and the very attractive qualities found in less tangible forms of capital, such as social capital, natural capital and some forms of human capital.[80] As a result, the benefits outlined above likely grossly underestimate the full range of economic and social benefits of CCC cities.

The 14th Five-Year Plan's human-centric 'new urbanisation strategy', which covers low-carbon and compact cities, aligns and overlaps with the CCC cities framework described in this chapter. The 14th Five-Year Plan period from 2021 to 2025 is a particularly crucial window in which to act. The pace and scale of the country's low-carbon urban transformation carry long-term implications for China and the world's economic and environmental trajectory.

## Recommendations

- **Embed the 14th Five-Year Plan's human-centric 'new urbanisation strategy,' which incorporates sustainable urban development, into the centre of forthcoming sectoral and municipal implementation plans.**

  There is immense latent economic potential in Chinese cities. The 14th Five-Year Plan's call for more liveable cities through compact spatial policies, environmental protection, and improved transport, promotes key elements of a sustainable urban development path, and is a crucial opportunity to unlock vast economic gains from improved productivity, greater efficiencies and investments in low-carbon infrastructure. Clean, compact and connected cities are also found to be more innovative due to agglomeration effects and their ability to attract human capital. These are key to rebalancing capital and migrant flows to the interior. The effects on the wellbeing and health of urban residents stemming from more liveable cities are difficult to capture through economic modelling, but a reduction in air pollution alone has been shown to create significant economic dividends.

  Instead of keeping the human-centric 'new urbanisation strategy' as a separate goal within one part of the 14th Five-Year Plan, to be addressed on its own, cities should be positioned as the central organising unit to address the many long-term structural economic and social goals set across the 14th Five-Year Plan.

  Accelerating sustainable urban development during the 14th Five-Year Plan should mean that many of China's cities peak their carbon dioxide emissions by 2025, making it possible for a national peak by that same year.

- **Include and prioritise robust indicators within the municipal government performance system that reflect and encourage the 14th Five-Year Plan's human-centric 'new urbanisation strategy'.**

  China's system of municipal government performance plays a powerful role in how cities are shaped. The indicators and targets in this system act as scorecards to evaluate city performance, including monitoring the country's Five-Year Plan implementation, and therefore guide the types of urban projects approved and implemented in a city. Since they are tied to government officials' appraisal and promotion, meeting these targets is of the highest priority.

  With human-centric 'new urbanisation' included in the 14th Five-Year Plan, the government can seize the opportunity to promote a low-carbon urban transition by thoroughly reforming its government performance system through more robust, practical and comprehensive indicators to measure the outcome of existing spatial development policies and carbon reduction programmes. China's many urban development initiatives are difficult to enforce due to imprecise programme definitions, inadequate spatial resolution tools, and, most significantly, strong short-term economic and political incentives that drive decisions by local governments to build outward. Consolidating some of the original voluntary metrics created for these pioneering initiatives – such as the Sponge City and Low Carbon Eco-cities Pilot Programmes and urban development boundary and Ecological Redline Policy spatial policies – and absorbing them into the government performance system indicators, could bring accountability to China's new urbanisation strategy.

  Furthermore, doing so would not only improve the public sector performance of individual municipalities, but would also provide incentives for local governments to cooperate and collaborate on regional development themes, such as air and water pollution within the environment, transport connectivity and public service delivery sectors, and trade.

- **Ensure a holistic cost-benefit analysis that is consistent with principles of the human-centric 'new urbanisation strategy' is carried out on urban infrastructure projects.**

  The economic cost-benefit analysis of urban infrastructure projects should be consistent with low-carbon and sustainable urban development and should take account of the huge economic impacts of damage caused by air pollution, climate change and biodiversity loss. Much of the economic cost-benefit analyses that continue to prioritise 'brown' infrastructure, including building new coal-fired power plants, would likely fail a more holistic measure of the true

economic costs over the long term. Thus 'brown' investments, while seemingly cost-efficient in the present, are actually suboptimal and expensive over the longer term. A holistic cost-benefit analysis can boost the real economic efficiency and minimise locking in infrastructure choices that could lead to serious economic consequences from worsening environmental and social impacts. Additionally, projects should consider the full time horizon over which the impacts of 'new infrastructure' occur.

Over the long term, a new system to reflect the costs of such negative externalities on the environment would be instrumental for China's high-quality development. For example, assessing the worth of natural capital by quantifying its economic value through the widespread adoption of natural capital accounting is critical. China is making noteworthy developments to prioritise and recognise natural resources within an expanded definition of economic value, including piloting tools and analysis to build calculations to measure Gross Ecosystem Product (GEP), or the total economic value of all ecosystem products and services in both monetary and biophysical value, and has launched efforts to create 'natural resource balance sheets'. The Ministry of Finance and the Ministry of Natural Resources are leading on these natural capital accounting pilot programme assessments. Scaling up these efforts for integrated use countrywide can contribute to more holistic cost-benefit analyses. In the long run this could eventually deter high-carbon project investments and encourage low-carbon ones.

- **Improve the international competitiveness of Chinese cities by systematically benchmarking their sustainable urban development progress against global peers.**

  Cities are in competition globally for talent and capital. Resource-efficient and liveable cities are best poised to draw the most talented individuals and companies, further sustaining economic growth and leadership. A strong internal system has cities across China competing among themselves on a host of economic and social development indicators. China has actively been learning and applying best practices in sustainable urban development from global cities across many sectors, from waste management to energy-efficient building practices to enforcement measures of spatial policies.

  For Chinese cities to compete globally, they could formalise a type of benchmarking scheme for low-carbon and sustainable urban development, systematically comparing themselves over time to cities internationally and making improvements. This would avoid Chinese cities becoming less internationally competitive by being locked into a particular urban development path reinforced through established but suboptimal domestic practices.

- **Incentivise low-carbon urban development by assigning specific, verifiable emission reduction responsibilities and prioritise city-level carbon inventory systems.**

  Requiring cities to develop specific and verifiable emissions reduction roadmaps can incentivise and speed up low-carbon urban development in cities and accelerate the economic benefits of an urban transition. Concrete and consistent city-level carbon inventory systems are key to ensuring new urban infrastructure is sustainable. These are necessary in order to measure, report and verify inventories to develop specific and distinct emission reduction actions for the diverse development pathways of China's cities. At present, the methodology for carbon accounting and inventory is more developed at the central and provincial levels and is inconsistent and uncomprehensive at the city level, due to city boundary discrepancies, different definitions of economic development levels and non-centralised statistics.

  Some major cities across the country are already on the path towards peaking their emissions by 2025. They have developed carbon roadmaps and are implementing low-carbon investment solutions, while other cities, which rely more on carbon-intensive industries, can aim to peak at a later date. Planning for differentiated timetables for peaking emissions should start now. For all cities, having clear city-level carbon inventories to create specific carbon reduction targets can accelerate their transition to long-term, higher quality growth.

# 3. Priority national policy actions to realise China's sustainable urban transformation

## Summary

- Realising China's urban opportunity will require visionary leadership from the national government.
- Key actions taken in the energy, buildings, 'new infrastructure' and transport sectors can unlock economic, environmental and social benefits, and support the majority of cities to peak their carbon dioxide emissions by 2025, accelerating the national peak to that year.
- Practical decarbonisation pathways require coordinated governance in urban areas, tailored to and aligned with local economic development goals.
- The decarbonisation of urban energy systems is a critical step towards reaching China's climate targets. This requires strictly limiting the building of new coal-fired power plants and promoting the early retirement of existing coal-fired power plants, while concurrently accelerating the development and integration of renewable electric power.
- Energy efficiency in the buildings sector is another key area for decarbonisation. National governments could incentivise local governments to design policies that improve the energy efficiency of buildings and encourage energy saving for the 14th Five-Year Plan period.
- The government's push for 'new infrastructure' (digital, information and innovation infrastructure) presents an opportunity to direct low-carbon investments. Investments can be channelled towards building smart infrastructure that enhances energy efficiency and promoting other low-carbon technologies. This construction should encompass the implementation of 'smart city' technologies and the strengthening of urban resilience.
- An integrated avoid–shift–improve approach could support the development of green transport. This includes shifting transport budgets to fund rail networks, green transport and electric vehicle (EV) charging infrastructure; constructing an integrated transport system; and piloting Mobility as a Service (MaaS) within urban agglomerations.

## Recommendations

- Strengthen coordinated governance.
- Decarbonise cities' energy systems through stricter standards on coal-fired power plants and the promotion of renewable energy.
- Enhance energy efficiency in the buildings sector through enforcing green building standards and supporting deep building retrofits.
- Emphasise 'rational', smart, low-carbon and resilient development in the construction of 'new infrastructure'.
- Implement an integrated 'avoid–shift–improve' approach to support green transport.


Urban farm in Central Hong Kong. Rows of green vegetables fill the foreground. A small wind turbine stands in front of the city skyline. Credit: Boogich/iStock.

## CONTEXT

### Targeted action in sectors

The central government has recognised that targeted low-carbon and sustainable infrastructure investments in specific sectors are fundamental to reach its economic goals and ambitious climate targets. China has made significant investments in the energy, buildings, 'new infrastructure' and transport sectors already and can continue to support key policy actions in these sectors. Coordinated governance is also needed in urban areas, tailored to and aligned with local economic development goals. Examples of best practice from within China and other countries have shown that coordinating governance mechanisms towards reaching climate change and environmental goals can lead to greater mainstream acceptance of sustainable action and increased ambition.[81 82]

## COORDINATED GOVERNANCE OF THE ENVIRONMENT AND THE ECONOMY AT THE CITY LEVEL

Integrating economic development and environmental goals within the development strategies of cities is fundamental to achieving high quality growth and reaching climate and environmental targets. Successful coordinated governance models in China could be scaled up across the country through national government mandates. Shenzhen is an example of a city that has successfully integrated its transport and power generation sector goals (see Box 4, p26). At the national level, China's institutional reforms of 2018 have incorporated the functions of responding to climate change into the Ministry of Ecology and Environment (MEE), which may provide institutional support for China to carry out coordinated governance.

Box 4

**Coordinated governance between transport and power generation in Shenzhen to reduce emissions and enhance development**

The coordinated governance practices of Shenzhen can provide important lessons for other Chinese cities hoping to achieve an early peak in emissions. Shenzhen is one of China's four first-tier cities. It has a high population density and strong economic growth. Over the past decade, the city has implemented a quality-oriented, innovation-driven, green development strategy that emphasises the coordinated governance of climate change, air pollution and industrial upgrading.[83]

Shenzhen first identified the transport and power generation sectors as the two major contributors of both carbon dioxide and fine particulate matter ($PM_{2.5}$) emissions. The city then implemented policies to reduce these emissions, aimed at both sectors. In August 2013 the city announced a plan to end coal-fired power generation. Today, only one coal-fired power plant remains in Shenzhen, and the amount of power it generates is declining rapidly. Coal-fired power has been replaced with power generated from natural gas and renewable sources, which now make up nearly 90 per cent of the city's total power generation capacity.

Shenzhen has actively promoted the use of 'new energy vehicles', or electric vehicles, public transport, and bus rapid transit. Shenzhen is the first city in the world to achieve 100 per cent electrification of its buses, boasting 16,359 electric buses, 510 bus charging stations, and 5,000 charging points in operation in 2017.[84] And in 2019 Shenzhen achieved 100 per cent electrification of the city's taxis.

From 2010 to 2017, Shenzhen's carbon emissions per CNY10,000 (US$1,316) of GDP decreased by 26.3 per cent. Meanwhile, the city's air quality has improved significantly. Its annual average $PM_{2.5}$ concentration had declined to 26 grams per cubic metre ($g/m^3$) in 2018 from 33 $g/m^3$ in 2014, exceeding the national standard (35$g/m^3$), and achieving a good quality of air on 94.5 per cent of days.[85]

## Implementing interregional coordinated governance

Urban agglomerations should be the focus of the next stage of high-quality, balanced and socially inclusive economic growth. A coordinated regional approach for the success of urban agglomerations is key. Examples of successful urban agglomerations in China include Beijing-Tianjin-Hebei (Jing-Jin-Ji), the Yangtze River Delta and the Pearl River Delta. These three agglomerations collectively contribute 40 per cent of China's national GDP.[86] They were first created by developing urban agglomeration authorities and metropolitan development laws that required the integration of regional plans. It is important to replicate this model across the country by determining regions' competitive advantages, focusing on their spatial planning and efficiency of urban land use, and integrating the concept of clean, compact and connected into urban areas to increase efficiency and resilience.[87]

Given the differences in development between regions and urban–rural imbalances resulting from China's rapid urbanisation,[88] [89] equity and inclusion should be consciously incorporated into low-carbon and resilient urban transition pathways. Guided by the target for peaking carbon emissions, the national government could develop a differentiated timetable for cities to peak, according to each city's local conditions. A number of cities have committed to peaking emissions by a certain year through pilot programmes. The national government could now delineate a timeline for cities not included in the pilots, requiring that regions with high levels of economic development take the lead in achieving peak emissions.[90] [91] [92] Cities in the most developed regions could also be encouraged to pioneer green development and adopt urban carbon-neutrality roadmaps during the 14th Five-Year Plan period of 2021–2025.

## DECARBONISING CITIES' ENERGY SYSTEMS

Approximately 85 per cent of China's carbon dioxide emissions are related to urban energy consumption, a rate that is much higher than in Europe (where it is 69 per cent on average) and somewhat higher than the United States (80 per cent).[93] The main reason for this difference lies in urban China's reliance on fossil fuels. Currently, coal still accounts for 38.5 per cent of urban energy sources on average, which is much higher than in leading cities around the world such as Tokyo (12 per cent), Paris, London and Singapore (all around 1 per cent).[94] Decarbonising electricity by shifting to renewable energy would deliver 44 per cent of China's urban emissions abatement potential. Therefore, early peaking of urban carbon emissions calls for the decarbonisation of energy plants in cities. This, in turn, requires strict limitations on the building of new coal-fired power plants and promoting the early retirement of existing plants, while concurrently accelerating the development and integration of renewable electric power.

### Tightening standards for coal-fired power plants and promoting renewable energy

China remains a major investor in coal power, with the total installed capacity of coal reaching 1,080 gigawatts (GW) by the end of 2020.[95] Despite plans to reduce the number of coal-fired power plants, the national government continues to authorise new power plants – in early 2020, for example, China put 38.4 GW of new plants into operation.[96] It is imperative that a robust plan and timetable to phase out coal[97] is established and that standards for existing coal-fired power plants are tightened. These actions would support some cities to decrease their coal-fired electricity consumption and increase renewable electricity to achieve carbon emissions abatement targets during the 14th Five-Year Plan period.

Going further, the national government should call for the most polluting coal-fired power plants to be retired, and the ban on additional coal generation capacity should be reimposed as soon as possible. The original ban was lifted in 2018, resulting in the justification and construction of additional coal-fired power generating units. Policies to curb these existing plants are needed urgently. Moreover, the function of coal-fired power should transform from baseload to peak load, particularly after 2030.

The decarbonisation of China's energy systems also relies on the development of non-fossil power generation, especially intermittent renewable energy. However, the lack of power grid capabilities to deal with volatility and seasonal imbalances in power currently presents a major challenge. A number of critical actions are now needed: investment in research and development of a system for optimal allocation of intermittent renewable energy resources, starting with the integration of smart power grids, and establishment of a strong ultra-high voltage (UHV) power network as the backbone network in China. These efforts would comprehensively improve China's ability to enhance the transmission capacity of power grids to ensure safe operations, meet needs for large-scale access, transmission and consumption of clean renewable energy, and enable cities to pursue more power from water, wind, solar and electricity. Reforming the electric power market could improve the efficiency of energy production and utilisation, establish a clear and reasonable transmission and distribution price system, and ultimately better guide power planning as a whole.

### Optimising urban energy planning and promoting low-carbon urban energy consumption

Low-carbon energy development plans within the 14th Five-Year Plan period that emphasise clean energy sources while taking into account the use of coal, oil and natural gas are key to optimising urban energy planning. This type of carefully planned multiple-energy-source planning could set an ambitious pathway to decarbonisation and peaking emissions. While this planning can be mandated by the national government, local governments could balance the supply and consumption sides within urban low-carbon energy planning. Given the relatively higher price of renewable electricity compared with fossil fuels in China, communications and outreach to city residents to raise awareness of the benefits of a sustainable transition and encourage behaviour change could be beneficial. Local governments could support targeted education and services on green energy efficiency in communities, promote energy-saving and low-carbon equipment and facilities, and actively encourage community residents to pursue low-carbon lifestyles and behaviours.

## ENERGY EFFICIENCY IN THE BUILDINGS SECTOR – GREEN BUILDING STANDARDS AND DEEP RETROFITS

Only green and efficient urban buildings can guarantee the development of a low-carbon urban transition. National governments could incentivise local governments to design diverse policies that improve the energy efficiency of buildings and encourage energy saving in urban buildings during the 14th Five-Year Plan period. Renovating older residential areas could be an initial priority.

### Requiring public buildings to peak emissions first

Public buildings consume the most energy within the buildings sector and should therefore be the focal point for future emissions reductions in cities. Overall, the buildings sector[i] accounted for 20 per cent of China's total primary energy consumption and 25 per cent of greenhouse gas emissions in 2016.[98] Improving the efficiency of heating, cooling and lighting would make buildings more comfortable, cut energy bills, and deliver up to 15 per cent of China's urban abatement potential.[99] It is critical to improve the energy efficiency of public buildings, and promote energy conservation and emissions reduction, through innovative technologies.[100] During the 14th Five-Year Plan period, the national government could focus support on the scaling up of pilot projects to advance the energy efficiency of public buildings. These could include combined heat and power systems and distributed energy systems, among others.

Cities could start by strictly enforcing green building standards, requiring all new buildings to meet the Assessment Standard for Green Building (standard GB/T 50378-2019). Cities could also play an active role in promoting the application of energy management contracts (EMCs) in large public buildings, thereby unlocking the market potential of energy efficiency upgrade programmes for public buildings. Integrating more technology and innovation into building and district energy systems is also important. Attention should be paid to both system efficiency and the use of renewable energy, particularly for cooling, heating and power supply to public buildings. Pilot projects could then be scaled up to normalise industry practices and standards for different categories of buildings, such as ultra-low, near-zero, zero-energy, and energy-plus buildings.[j] Additionally, cities could encourage inclusion of distributed photovoltaic power generation on rooftops through the use of policy subsidies or green finance.

Cities could also incorporate smart energy consumption management systems. These systems would provide a clear view of energy consumption in public buildings and ultimately show the benefits of the initiatives recommended above. These systems would encourage data-driven policymaking and help to ensure an effective pathway towards peaking carbon emissions.

### Supporting deep building retrofits for urban residential buildings

Residential buildings should be another focus. To support deep retrofits of residential buildings, it is essential to popularise the use of energy-saving equipment, strengthen education around energy conservation and emissions reduction, and renovate old urban residential building communities. Older residential buildings could be prioritised for renovation because this is where the most upgrading is needed. In July 2020 the Chinese national government put forward a policy plan that increased financial support for the comprehensive renovation of residential buildings built before 2001.[101] Local governments could take the opportunity to mobilise private capital, advocating the widespread use of energy-saving technologies and equipment and encouraging buy-in through bond issuance and green finance, among other options.

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[i] Energy consumption refers to commercial energy use during the building operations stage; it excludes biomass and biogas energy consumption.

[j] An ultra-low energy building is a house built using low energy methods, and allows a very low and very efficient use of energy. Several types of ultra-low energy houses exist. The aim of near-zero-energy buildings is to consume very little energy. The small residual demand is largely met by renewable energy generated onsite or nearby. A zero-energy building produces enough renewable energy to meet its own annual energy consumption requirements, thereby reducing the use of non-renewable energy in the building sector. Energy-plus building generally means a building with an energy performance that is so good that the energy generated by the building is higher than the energy used by the building.

Another significant step that local governments could take would be to tighten environmental standards for energy-saving materials and require their installation in renovation projects. For instance, cities could implement a variety of low-carbon and energy-saving pilot projects to encourage the uptake of photovoltaic and sporadic wind power in building projects. This could be complemented by targeted public education campaigns to explain the importance of energy conservation and of renewable energy.

## LOW-CARBON, SUSTAINABLE AND RESILIENT DEVELOPMENT IN NEW INFRASTRUCTURE CONSTRUCTION

As part of the COVID-19 recovery plans, the national government launched a stimulus package targeted at building digital, information and innovation infrastructure, or so-called 'new infrastructure'. This differs from traditional infrastructure in its emphasis on new technologies, including 5G base stations and big data centres, high-speed railways, urban rail systems and new energy vehicle charging points, for example. The construction of 'new infrastructure' would facilitate digital transformation across industries and sectors.[102]

'New infrastructure' should be low-carbon, including smart infrastructure developed as part of clean, compact and connected cities. These investments would enhance energy efficiency and promote the development of other low-carbon technologies and innovative business models.[103] Channelling these 'new infrastructure' investments in this way would support a move to a low-carbon economy and could make China more competitive in the international marketplace. It would also create sustainable and inclusive economic, health and environmental benefits, and demonstrate climate ambition and leadership internationally.

The focus of building 'new infrastructure' should fall on the two important areas of implementing 'smart city' technologies and strengthening urban resilience.

### Implementing smart city development

The national government has been promoting smart cities as a way to address climate and environmental concerns.[104] The term 'smart city' refers to the use of technology to improve urban infrastructure and services, from energy grids to transport systems, parking, water treatment, waste management, and more.[105] [106] Smart cities represent a new way of thinking about urban space and future development goals and serve as models for the integration of green energy systems, energy efficiency, sustainable mobility, environmental protection and economic sustainability.[107] The core foundation of the cities will be advanced technology, and specifically the Internet of Things (IoT): storing and distributing cloud-based data to improve energy and operational efficiencies, and as a result air quality, traffic controls, health care and more.

The following are some of the considerations that should be taken at the different stages of developing smart cities:

***1. Planning stage:*** Information asymmetry and redundancy among city-level governments in China present serious challenges for the design and planning of smart cities.[108] The national government could take the lead to formulate operation rules, evaluation systems and standards for smart cities.

***2. Operation stage:*** This stage should make use of big data platforms in smart cities to strengthen the construction of digitised public assets.[109] Smart elements, such as smart parking lots/carparks, smart manhole covers and smart buildings can also be connected by IoT techniques to support the efficient operation of cities and their capabilities to respond to emergencies.

***3. Construction stage:*** Attracting private-sector investment should be a part of constructing and implementing smart technologies. 'Smart city' development should promote the intelligent, digital upgrading of traditional infrastructure, including transport, energy, water conservancy and municipal administration infrastructure.

### Accelerating urban resilience

The development of urban resilience and the construction of resilient cities in China have developed rapidly in recent years. While resilient cities are often primarily focused on geological, climate and other disaster responses, they should be viewed through a wider environmental, economic and societal lens with goals for disaster prevention.[110] Resilient cities are those that are able to bounce back from and protect against future economic,

environmental, social and institutional shocks. They foster sustainable, inclusive development and social wellbeing for residents.[111] [112]

Beijing was the first city in China to incorporate the construction of resilient cities into its urban planning.[113] Since then, Yiwu in Zhejiang, Deyang in Sichuan, Haiyan in Zhejiang, and Huangshi in Hubei have formulated and implemented resilience plans and have been included in the global '100 Resilient Cities' (an initiative of the Rockefeller Foundation).[114]

The following are some of the considerations that should be taken in the different stages of accelerating urban resilience:

***1. Pilot and planning stage:*** Consistent definitions and parameters for the construction of resilient cities should be established first. The parameters should be applied to building resilience into industry, infrastructure, public services and social governance within cities. Resilience planning should address inefficiencies within the urban system and develop mechanisms to promote coordinated operation across sectors. For example, resilient city planning should establish an efficient coordination mechanism among diverse local industries and incorporate disaster prevention and related infrastructure construction into overall spatial planning. In terms of public services, aside from ensuring basic healthcare, medical capacity should be improved to respond to emergencies.

***2. Assessment stage:*** The 'urban risk physical examination' pilot programme should be expanded and conducted as a routine assessment for evaluating urban resilience. In June 2020 the Ministry of Housing and Urban-Rural Development issued the Work Plan for Urban Physical Examination. Thirty-six Chinese cities had carried out these assessments of risk and resilience by the end of the year.[115] Moving forward into the 14th Five-Year Plan period, this pilot programme should be broadened to include the active use of big data technology, such as 'smart city' development and the construction of 'new infrastructure', and comprehensive risk assessments. The Ministry of Housing and Urban-Rural Development could also establish and lead platforms to house the information obtained by these urban physical examinations, including detailed resilience indicators that meet municipal needs and capacities.

***3. Development stage:*** Beyond the city, resilience planning can then be applied to broader regional crisis response strategies and in urban agglomerations. First, it is necessary to construct regional linkage mechanisms and develop regional resilient-city networks: emergency response protocols could be strengthened by linking cities together to ensure that emergency supplies and services can be shared; and cities could share regional digital infrastructure. At the national level, the government should carry out security risk assessments of urban agglomerations, jointly build a unified and comprehensive information platform for regional disaster prevention and risk prediction management, and establish regional risk monitoring and early warning systems.

## AN INTEGRATED 'AVOID–SHIFT–IMPROVE' GREEN TRANSPORT STRATEGY

Avoid–shift–improve (ASI)[116] is a comprehensive approach that aims to promote alternative mobility solutions and develop sustainable transport systems. It does this through reducing travel demand and improving logistics (avoid), shifting away from motorised forms of mobility (shift), and increasing vehicle efficiency, electrification and use of low-carbon fuels (improve). This integrated strategy has the potential to alleviate traffic congestion and reduce transport emissions, and could deliver about 10 per cent of China's urban emissions abatement potential.[117]

To date, the ASI strategy has been successfully implemented by a number of local governments in China, such as Beijing. The national government could now implement a comprehensive, integrated ASI solution. This would first entail feasibility studies across many policies, addressing the implementation arrangements and coordination of existing measures. A monitoring and evaluation mechanism to ensure that transport planning is coordinated with land use plans and that policy measures can be adjusted and upgraded regularly is key. Local governments should be required to follow the same procedure to monitor and evaluate their own plans and policies. Finally, national urban transport policies should integrate green transport as a priority, which would send a clear signal to local governments and incentivise them to increase the attention they give to green transport.

Below we describe actions that are part of integrated ASI strategies: shifting transport budgets to fund rail networks, green transport and electric vehicle charging infrastructure, constructing an integrated transport system, and piloting Mobility as a Service.

## Shifting transport budgets

Rail infrastructure occupies less land, consumes less energy and emits fewer emissions than road infrastructure and transport. The World Resources Institute estimates that transferring freight to rail or waterways will result in the reduction of 432 million tons of carbon dioxide emissions by 2050 compared with a business-as-usual scenario.[118] The national government could allocate a larger budget to inter- and intra-city rail networks, and require local governments to shift road budgets towards supporting public transport and walking and cycling infrastructure. This is particularly important for urban agglomerations and those local government areas that are undergoing rapid urban development. To accelerate vehicle electrification, EV charging infrastructure can also be included in the priorities of transport budgets.

To further speed the shift of freight transport from road to rail, other supporting measures include improving rail and waterway capacities and quality of services, and encouraging multimodal transport and the application of big data to freight logistics management.

The introduction of road pricing is another option, for example through congestion charges, toxicity charges or parking pricing. This is in line with the principles of the 'user pays' and the 'polluter pays'. A level of road pricing is needed that would internalise the environmental costs of driving, reduce the demand for car travel, and incentivise a shift to green transport and new mobility services. Road pricing is especially promising because it can raise significant funds for public budgets, which then serve as own-source revenues for local governments, potentially funding green transport infrastructure projects, without negative economic impacts.[119] Implementation of road pricing requires national legislation, regulation, and policies to provide legal safeguards.[120]

## Constructing an integrated transport system and piloting Mobility as a Service (MaaS)

The need for more connected intercity travel is growing, which calls for intensive, diversified and efficient modes of transport.[121] To promote sustainable intercity travel within urban agglomerations, the national government should take the lead on improving specific aspects of the transport network. These include building intercity railways and integrating rail transit networks at different levels, improving intercity shared mobility and public transport systems to provide seamless connectivity for green transport, and integrating regional transport payment systems.

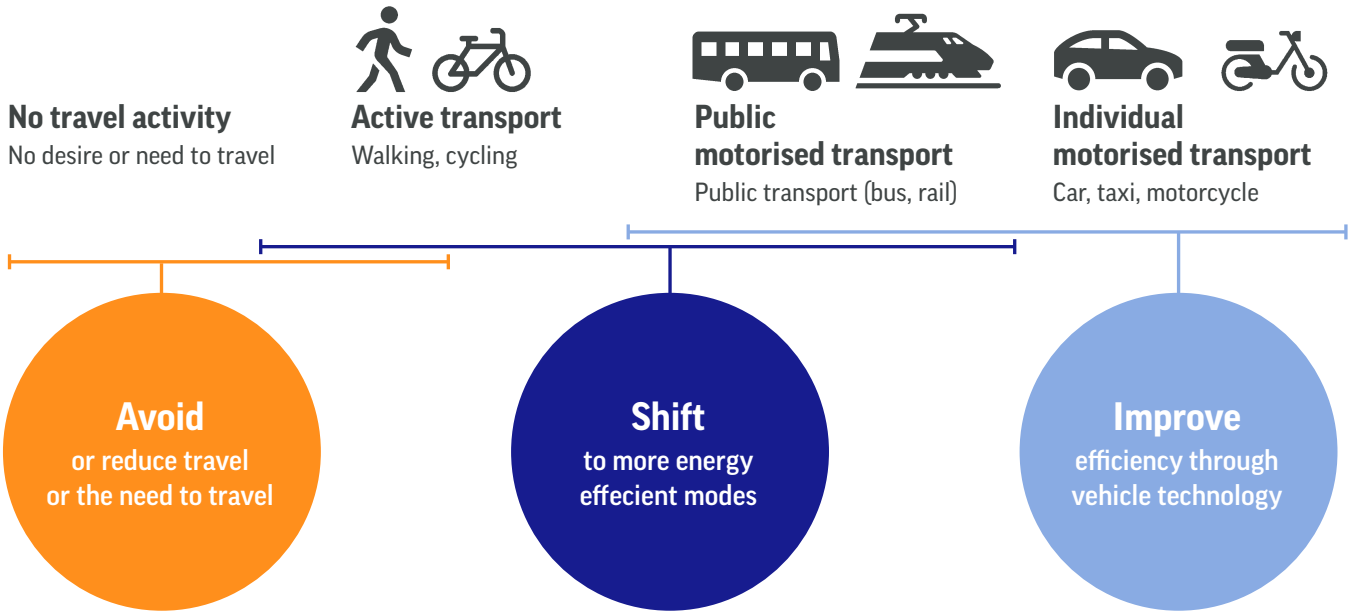
Capitalising on these efforts, the government could build a travel planning information service platform and pilot Mobility as a Service (MaaS) – an on-demand mobility service that integrates transport services, real-time transport information, payment and ticketing into a single digital platform – in order to meet personalised mobility needs. Residents of the urban agglomeration would thus be provided with a door-to-door travel service from departure to destination, which would encourage them to use only public transport for intercity travel. Given the imbalance in regional development, MaaS should be piloted first in China's most developed urban agglomerations – the Yangtze River Delta, Beijing-Tianjin-Hebei, and the Greater Bay Area – and then scaled up to other regions.

**An Avoid-Shift-Improve strategy could deliver about 10 per cent of China's urban emissions abatement potential.**

## SUMMARY OF RECOMMENDATIONS

- **Strengthen coordinated governance.** Practical decarbonisation pathways require coordinated governance in urban areas, tailored to and aligned with local economic development goals. A coordinated regional approach would maximise benefits. Establishing urban agglomeration authorities and metropolitan development laws could support the integration of regional plans.
- **Decarbonise cities' energy systems through stricter standards for coal-fired power plants and promoting renewable energy.** Decarbonisation of urban energy systems is a critical step towards reaching China's climate targets. The national government could encourage cities to develop comprehensive low-carbon energy development plans within the period of the 14th Five-Year Plan. These plans could place an emphasis on clean energy sources while taking into account the use of coal, oil and natural gas. Multi-energy source planning thus could set an ambitious pathway to decarbonisation and peaking emissions.
- **Enhance energy efficiency in the buildings sector through enforcing green building standards and supporting deep retrofits.** The national government could incentivise local governments to design a range of policies that improve the energy efficiency of buildings and encourage energy saving in urban buildings during the 14th Five-Year Plan period. The initial focus could be on the renovation of older residential buildings.
- **Emphasise 'rational', smart, low-carbon and resilient development in the construction of 'new infrastructure'.** The national mandate for the construction of digital, information and innovation – or 'new' – infrastructure presents an opportunity to develop low-carbon infrastructure. The associated urbanisation processes should include the implementation of smart city technology and the strengthening of urban resilience.
- **Implement an integrated 'avoid–shift–improve' approach to support green transport.** The national government could implement an integrated avoid–shift–improve (ASI) solution to develop green, or sustainable, transport systems. Specific actions within integrated ASI strategies include shifting transport budgets to fund rail networks, green transport and electric vehicle (EV) charging infrastructures; constructing an integrated transport system; and piloting Mobility as a Service (MaaS) within urban agglomerations.

Figure 3
**The avoid-shift-improve (ASI) approach**




**Source:** *Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I)* (Transformative Urban Mobility Initiative, 2019).

# 4. Financing China's sustainable urban transformation

## Summary


- To meet its climate goals under the Paris Agreement, China needs to spend an estimated US$20 trillion over the next three decades across all sectors. As cities are the primary source of China's carbon emissions, much of this investment needs to take the form of low-carbon and sustainable urban infrastructure.
- Decades of rapid infrastructure growth, initially funded through the sale of land use rights and off-budget investment vehicles, have left many municipalities in deep debt, prompting concerns over meeting the financing needs of a low-carbon and sustainable transition. A multi-layered fiscal strategy is needed that empowers municipalities with sufficient financial resources and incentivises low-carbon urban investments over the long term.
- An important step is to empower Chinese cities themselves with the fiscal stability they require. Several well-designed local taxes have been identified that can provide cities with additional own-source revenues. These include a beneficiary property tax, a 'piggyback' tax on the personal income tax and a national carbon tax with a 'piggyback' tax.
- Chinese cities can also be empowered to make low-carbon and sustainable investments through more efficient data sharing and coordination; by using special purpose bonds; and expanding issuing requirements to include minimum environmental thresholds for certain projects.
- The financial system needs to be incentivised to prioritise low-carbon and sustainable urban investments. An estimated more than 85 per cent of the total funding needed for the low-carbon infrastructure to meet carbon neutrality goals needs to come from outside of government budgets.
- The vast majority of banks and other financial institutions still lack the information and knowledge of climate risks to be able to grasp fully the latent market potential of green finance. Considering ways to incrementally change the valuation of projects and project time horizons would effectively increase the cost of financing for high-carbon projects as well as reduce the relative costs for sustainable projects.


## Recommendations

- Develop stable own-source revenue streams at the municipal level.
- Prioritise strengthening systems for data collection and data sharing.
- Include minimum environmental thresholds for projects funded by special purpose bonds.
- Scale up environmental information disclosure.
- Develop a clear taxonomy system for green bonds that defines the difference between sustainable and 'brown' projects or infrastructure.
- Incorporate more sophisticated environmental risk and pricing mechanisms for Chinese banks.

River with waterside deck and greening bank in Ningbo city. Credit: syrnx/Shutterstock.

## CONTEXT

### China's fiscal challenges

The low-carbon and sustainable transformation of China's urban areas is crucial to global efforts to limit global warming to well below 2˚C, while making efforts to limit the increase to 1.5˚C, as set out in the Paris Agreement. To meet this challenge China will need to invest US$20 trillion over the next three decades, across all sectors.[122] In an ambitious move, in autumn 2020 China announced it would reach carbon neutrality by 2060 and peak its carbon dioxide emissions "before 2030".

Low-carbon infrastructure investments in cities are crucial since cities are the primary source of China's carbon emissions. The country currently has more than 110 cities with a population of one million and above[123] and these cities are growing steadily. Estimates indicate that almost half of the world's expected construction in this decade will occur in China.[124] The specific low-carbon measures in energy, buildings, 'new infrastructure' and transport described in Chapter 2 can place cities on a low-carbon development path. As described in Chapter 1, the development of clean compact and connected (CCC) cities can increase the prosperity and wellbeing of residents by reducing pollution, congestion and inefficiencies.

However, there is a gap between the country's ambitious high-level objectives and the financing choices and priorities of municipal governments. The successful translation of these national goals into local policies is critical, as the majority of the decisions that establish the form of urban areas are determined at these levels.[125] Meanwhile, Chinese cities are undergoing extensive fiscal reforms. Decades of rapid infrastructure growth, initially funded through the sale of land use rights and then through off-budget local government financing vehicles, have left many municipalities in deep debt. Subsequent restrictions have led to a decline in local government revenue, leaving even less capacity and incentive for investing in new forms of low-carbon infrastructure. China must now strike a balance between the mounting fiscal pressures to deliver with lower fiscal resources[126] and the increasing need to finance low-carbon urban infrastructure.

## MUNICIPAL FINANCES

While the central government sets the general direction of China's economy, local governments play the dominant role in shaping the practical

decisions that shape a city, including the development and financing of infrastructure projects. Currently, municipal governments are responsible for the majority of China's urban infrastructure development.[127] Decentralisation has been a defining feature of China's fiscal system since the beginning of the Reform and Opening Up era, when control over the allocation of resources, planning and budgetary powers was transferred to cities.[128] This decentralised fiscal model has impressively met the demands created by rapid urban growth over the past four decades. However, it has also led to creative off-budget financing models and large amounts of debt.

China's transition to a market economy through the mid-1990s presented many challenges, which put extraordinary pressure on municipal budgets as the momentum of rural-to-urban migration ramped up. Formal local government budgets depend mostly on revenue-sharing and central government transfers, but because these often have not equalled the amounts required to fulfil mandates for developing and funding urban infrastructure and services, cities have found other ways to cope.

As described above, cities turned to revenues from land-use sales as a significant form of financing. Additionally, local governments generated debt through off-budget local government financing vehicles (LGFVs). The LGFVs were created as separate legal entities to carry out public goods functions and finance profit-making activities through bank loans, project bonds and creating public–private partnerships.[129] Under this framework, the LGFVs are technically the debtors but in reality debt liabilities remain implicitly underwritten by municipal governments.

These complex LGFVs became extensively used across the country because they facilitated the enormous amounts of capital needed to fund China's urban development.[130] In addition to funding infrastructure, LGFVs are often involved in other profitable sectors, mainly real estate and financial services.[131]

In 2015, in response to concerns over vast local government debt and other ills created by off-budget financing, China's central government moved to transfer more than CNY15 trillion of local government debt, including from LGFVs, onto the official ledger through a debt swap programme, replacing implicit debts with government bonds.[132]

The Ministry of Finance at this time also clarified that LGFV debts would no longer be treated like government debt, and hence would be allowed to fail, like any other debt. While 'closing the back door', the Ministry of Finance also 'opened the front door' by allowing for the issuance of new 'special purpose' bonds. These bonds are project-based and can be repaid by revenues generated by the projects, allowing for new types of official debt to replace LGFVs as the main mechanism for financing infrastructure investments.

Although special purpose bonds are a close replacement for the kind of off-budget infrastructure funding local governments used before 2015, these reforms have led to greater supervision and smaller overall budgets. The result has been an ongoing reliance on LGFVs. Total off-budget debt held by LGFVs had grown to more than CNY10 trillion (US$1.5 trillion) as of July 2020,[133] back to levels similar before the debt swap programme. Thus, there are many unresolved questions over the long-term pattern of local government financing, financial risk and the viability of planned infrastructure projects and as a consequence many creditors are becoming increasingly wary of lending to local governments.[134]

## Stabilising municipal financing through own-source revenues

China's indirect urban financing model destabilises long-term decision-making and complicates efforts to promote sustainable infrastructure development. The interplay between investment corporations, banks and municipal governments often incentivises short-term profit-seeking behaviour. Land transfers as a means of fundraising often take the form of high-return real estate projects that are usually far from sustainable and often consist of an unnecessary expansion of urban sprawl.[135]

One of the most destabilising factors for municipalities is the lack of own-source revenues. This has been extensively explored by Ahmad and Colenbrander (2020), who conclude that having access to their own revenues would improve cities' accountability for service delivery, would "protect their budgets from the effects of national tax cuts", and would also "create incentives for prudent fiscal management by enabling sustainable access to private finance".[136] In addition to the challenges

created by the gap in funding from government fiscal transfers, shared revenues often fluctuate in response to the changing priorities of the central government, making it difficult to anchor a system of local government bonds or the management of liabilities.[137] Own-source revenue allows cities to provide financial sustainability and create the appropriate incentive structures for infrastructure projects.[138]

Below is a list of some suggested local taxes:[k]

- **Beneficial property tax.** A recurrent property tax would generate revenue and alleviate local governments' reliance on land transfers and off-budget debt. Beneficial property taxes are based on occupancy depending on size and location, and simple criteria such as local infrastructure and services. They avoid the complexities of property valuations found in traditional property tax schemes.

  Based on an analysis of revenues and income distribution across six provincial capitals, Ahmad et al. (2020) propose raising 2 per cent of city-level GDP by applying a relatively modest occupancy tax based on property size and location. This proposal links the property tax with city-level GDP so that richer municipalities pay higher rates than poorer cities. This variation in rates between cities can encourage more efficient land use and promote greater investment in lower-income cities.[139] Although property taxes have been considered without action being taken for over a decade by the Chinese authorities, they are being discussed anew in light of the current fiscal challenges faced by municipalities.

- **A 'piggyback' on the personal income tax.** Among the most straightforward ways of strengthening own-source revenues for cities is a supplementary 'piggyback' tax on the national personal income tax. Allowing municipalities to place a local tax surcharge can help ensure more predictable local budgets. It can also expand the tax base by encouraging local governments to generate information on assets, profits and rents.[140] Currently personal income tax in China is much lower than in many developed countries.[141] As income levels rise, personal income tax has the potential to be an increasingly significant source of revenue generation.

- **A local carbon 'piggyback' tax.** China's national carbon emissions trading system was launched on 1 February 2021 and is a milestone in climate policy and mitigation efforts. The country has been experimenting with various options for about a decade with carbon market pilot provinces and cities.[l] Beginning with the energy sector, the national carbon emissions scheme has the potential to be the largest emissions trading system in the world.[m] A local surcharge could then be levied on top of this carbon price and perhaps applied to sectors outside the power sector, such as transport.[142]

  This could allow cities to accelerate the reduction in demand for polluting activities and encourage a more rapid shift towards cleaner technologies and solutions. Cities could cooperate by setting the same carbon tax level to avoid the relocation of businesses due to concerns about the impact on competitiveness. The combined carbon price provided by the emissions trading system and city-level carbon tax would provide a powerful market signal that would redirect public and private financial flows and investments away from high-carbon activities towards low-carbon alternatives.

In addition to the supplementary city-level carbon tax, localities could devise other Pigouvian taxes[n] to aggressively tackle other issues such as traffic congestion, air pollution, greenhouse gases, and other undesirable 'urban diseases', as the Chinese government has labelled them. One such tax,

[k] The following draws from and summarises previous research from E. Ahmad and S. Colenbrander, *Financing a Sustainable and Inclusive Urban Transition in China*, https://urbantransitions.global/wp-content/uploads/2020/03/Financing_a_Sustainable_and_Inclusive_Urban_Transition_in_China_web_FINAL.pdf

[l] These pilots have taken place in Hubei Province, Guangdong Province, Shenzhen, Beijing, Tianjin, Shanghai and Chongqing, and two registered exchanges in Fujian Province and Sichuan Province.

[m] To meet the carbon emissions peak before 2030 and carbon neutrality goal, the Ministry of Ecology and the Environment announced plans to extend the system to other industry sectors and civil aviation.

[n] Pigouvian taxes are taxes on market activities that create adverse effects for society, such as taxes on plastic bags, gas or cigarettes.

already in place, is the Environmental Protection Tax, which was introduced in 2018 to penalise companies for exceeding permitted amounts of solid waste, air, noise and water pollution. This tax replaced local pollutant discharge fees, of which the central government took 10 per cent. Under this tax, all fees from pollution that take place within a municipality go to the city government. While this tax sets an important framework, it has been recognised that it has had a limited effect and a more ambitious set of Pigouvian taxes are needed.[143] If other Pigouvian taxes are imposed, collectively these revenues could be even more impactful if they are explicitly earmarked to further support sustainable investments.

## Data sharing

Another challenge for municipalities in low-carbon financing is identifying the value of low-carbon investments. Different government agencies within the same cities usually establish their own data systems for city information, often collecting and calculating the same type of data under different definitions and methodologies. This results in inconsistencies and fragmentation that make cross-sector joint decisions on infrastructure projects difficult and benchmarking challenging. Furthermore, there are few incentives to share data among different agencies, posing an institutional challenge to integrated planning, implementation, and monitoring and evaluation. For regional issues like air pollution, which necessitates a regionally cohesive response, it poses a particularly acute problem. Incompatible datasets downstream can undermine financing for low-carbon projects upstream.

City-level project planning needs to be backed by good data and shared systems. Data-sharing systems are being piloted across the country, including a small project funded by the World Bank that aims to consolidate municipal-level information among a few cities.[o] The project helps develop a platform that connects data systems from key government agencies to be used to inform projects. While this platform effort has many limitations and is not intended to be comprehensive, it is an initial pilot project to support more consistent and unified definitions and methodologies to demonstrate that this can provide a common basis for integrated planning and decision-making among cities. This and other pilot platforms could eventually inform a bigger, more ambitious and inclusive system across government agencies that would enable the monitoring of performance and progress of low-carbon investments, which can ultimately inform and attract financing.

## Greening special purpose bonds

As mentioned above, special purpose bonds allocated by the central government are designed to transition away from local government financing vehicles as the primary investment tool for local governments. Their use has been further expanded in response to the COVID-19 pandemic. In 2020, CNY3.75 (US$580 billion) of these bonds were issued, up from CNY1.82 trillion (US$280 billion) in 2019.[144] These special purpose bonds included support for 'new infrastructure' – in line with existing high-level economic objectives, such as data centres, 5G, artificial intelligence, and the Internet of Things, among others. In the end, however, most of these bonds ended up in more traditional, energy-intensive sectors. This is a missed opportunity because, as outlined in Chapter 1, investing in low-carbon infrastructure now pays back multiples in the future.

In 2021, the central government plans to issue CNY3.65 trillion (US$560 billion).[145] An immediately high-impact recommendation would be to include minimum environmental thresholds for a certain percentage of projects. Such requirements, strengthened over time, would be a powerful signal that a move to a low-carbon transformation is needed, incentivising investment into low-carbon urban infrastructure. Promoting low-carbon projects can also help local governments familiarise themselves with low-carbon projects, making them more bankable over time.

## GREEN FINANCE

Existing government budgets will cover less than an estimated 15 per cent of the total funding for the low-carbon infrastructure needed to meet carbon neutrality goals.[146] As a result, the large majority of China's sustainable infrastructure will have to be financed through non-public sources.

Meanwhile, the Chinese government has been

[o] Chongqing, Chengdu, Ningbo and the Chongqing-Chengdu cluster.

ambitiously promoting green finance. In 2016 China became the first country in the world to develop a green finance policy framework. But much had been done before. In 2012 the People's Bank of China (PBOC) issued green credit guidelines, and in 2015 green finance was included in the State Council's ecological civilisation directive. Most recently, in October 2020, the government further released guidelines to steer investment towards mitigating climate change by encouraging financial institutions to develop climate-friendly green financial products and financing for low-carbon projects. By the end of 2020 China's outstanding green project loans had reached around US$1.9 trillion, the largest amount globally.[147]

Despite this clear direction from the central government, however, the vast majority of banks and other financial institutions still lack the information and knowledge of climate risks needed to be able to grasp fully the latent market potential of green finance. In the current system, many types of sustainable urban infrastructure do not yet have clearly established investment returns that are familiar to creditors. This makes it challenging to channel investment to more innovative low-carbon projects. For example, investors might be familiar with the infrastructure associated with solar power – an investment path that has been well worn – but may be less familiar with other interventions such as nature-based solutions.

A powerful step would be to require greater disclosure of the environmental impact of the projects and assets in which financial institutions invest. Currently, many financial institutions are not incentivised to share environmental information. A survey conducted in December 2020 of Shenzhen-based financial institutions showed that only a quarter had transparent guidelines on their environment-related investment activities.[148] A lack of compulsory requirements as well as a lack of unified standards were cited as impediments to environmental information disclosure. In March 2021 Shenzhen will require financial institutions to disclose environmental impact – the first time a local government in China has called for such a mandate. The Shenzhen rules could set the basis for a national rule, paving the way for the roll-out of transparent environmental information.

Another challenge is that low-carbon infrastructure projects tend to require longer preparation and investment cycles than more traditional, often 'off-the-shelf' projects. The investment cycle of projects at the municipality level is typically three to five years, significantly shorter than in many other parts of the world.[p] Innovative low-carbon projects, due to their novelty, often require extra time to design and coordinate between developers and government departments. Longer cycles can deter both investors and local government officials in China, who often have their key performance indicators tied to growth. Changes made in the valuation of projects and the project time horizons would effectively increase the cost of financing high-carbon projects as well as reduce the relative costs of sustainable projects.

## Green bonds

The development of green bonds has been central to China's green finance framework. In 2015 the government issued *Guidelines on Green Bonds Issuance*, which specified issuance procedures as well as definitions for green assets and sustainable projects and other relevant regulatory measures.[149] Since then, their relatively simple structure and transparency requirements have contributed to the rapid growth of the market for green bonds. In 2019 China led the world by issuing green bonds worth US$55 billion.[150] Many Chinese provincial and local governments have contributed to this momentum by issuing their own guidance documents on green finance. Currently, there are at least five pilot green finance zones, where banks and other investors can access a variety of incentives for low-carbon projects. By the end of 2018, Chinese local government entities had issued green bonds worth nearly US$6 billion.

Despite this progress, a range of bottlenecks need to be addressed. One of the core barriers to green bonds is limited awareness and difficulty for investors in identifying sustainable assets and projects, meaning that investment-ready sustainable projects are not always apparent.[151] The underlying issue stems from the fact that many of these assets have not yet been standardised or categorised, so that even if investors are keen, they are often unable to locate them.

[p] The average length of many related types of loans from Chinese banks is about two to five years. Thus, if funding is needed for a 10-year project, for example, it would require raising funds five times, significantly increasing investment risks. Many sustainable projects in subways, railways water treatment, solid waste etc. have lengthy investments periods which might take 10 or even 20 years before investments generate a return, far beyond the current loan periods of most Chinese banks.

In the long term, a unified and robust taxonomy system would help China's green finance objectives. Currently, there are two types of green bond and credit standards; green financial bonds are guided by one set of standards, while corporate bonds are guided by another. The development of a clear and overarching taxonomy system would reduce uncertainty about what is considered low-carbon, sustainable or green, thereby lowering transaction costs to enter the market. Furthermore, identifying what makes a project low-carbon is one major task, but equally important is defining shadow, or 'brown' project parameters. Green bonds are currently exclusively focused on low-carbon sectors; it is important to create a viable, credible pathway that would enable the greening of existing 'brown' projects in other sectors, like cement, steel and plastics.

China recently made changes to its *Green Bond Endorsed Project Catalogue* (2020 edition). This acts as a consolidated resource for domestic guidelines, removing the need to consult different documents depending on the type of bond. Significantly, it removes 'clean coal' from being considered as sustainable, a meaningful effort that moves China in the direction of aligning with global standards of green guidelines and criteria. For regulators, issuers and investors, this can considerably simplify the process of identifying green assets, opening the door to greater international participation.[152]

## SUMMARY OF RECOMMENDATIONS

- **Develop stable own-source revenue streams at the municipal level.**
  Own-source revenues enable cities to provide financial sustainability and create the appropriate incentive structures for infrastructure projects. Several well-designed local taxes would be effective, including 'piggyback' taxes on the national emissions trading system and on income taxes, as well as a beneficial property tax.[153] Shared revenues often fluctuate in response to the changing priorities of the national government, making it difficult to anchor a system of local government bonds or the managing of liabilities.[154]

- **Prioritise strengthening systems for data collection and data sharing.**
  Increased consistency and unified definitions and methodologies can provide a common basis for integrated planning and decision-making. This would also enable the monitoring of performance and progress of low-carbon investments, which could inform and attract financing.

- **Include minimum environmental thresholds for projects funded by special purpose bonds.**
  Connecting special purpose bonds with goals for sustainable urban development can be introduced and phased in incrementally. Such requirements, strengthened over time, would be a powerful signal to incentivise investment in low-carbon urban infrastructure.

- **Scale up environmental information disclosure.**
  Environmental information is a crucial step in further growing the development of green finance. In particular, it will help financial institutions assess and take stock of environment risk liabilities and create greater transparency in their investments. It can also set the foundation for a more market-based approach to low-carbon finance.

- **Develop a clear taxonomy system for green bonds that defines the difference between sustainable and 'brown' projects or infrastructure.**
  China's green bonds are currently regulated by many different groups. Although efforts have been made to standardise domestic green bond standards, there is still much to be done. Alignment of domestic and international green definitions could entice global investors, reduce transaction costs, and reduce regulatory barriers to market entry. Furthermore, all green bonds are currently exclusively focused on sustainable sectors; it is important to create a viable, credible pathway that enables the greening of 'brown' projects in other sectors, such as cement, steel and plastics.

Green riverbank along the Yangtze in Wuhan. Credit: Keitma/Shutterstock.

# The way forward

Climate change is the key global issue contemporaneous with China's rise to economic prominence. The global response to this environmental challenge will in large part determine the material and social wellbeing of our planet in the coming decades. This reality is already transforming the global economy towards new low-carbon and sustainable business models, a trend that will undoubtedly accelerate. 2021 will be a pivotal year, as the major economies emerge from the COVID-19 pandemic, boosted by recovery measures. China is at a unique juncture to drive an ambitious sustainable and low-carbon transformation, riding on strong economic tailwinds.

A focus on an urban development model of clean, compact and connected cities during the 14th Five-Year Plan period can place China on a long-term trajectory for better quality economic growth and further demonstrate China's commitment to and leadership of the global cooperative actions against climate change. It is also a critical step in ensuring competitiveness in a carbon-constrained world. To act at scale will require massive investment in low-carbon and sustainable urban infrastructure, a transition to cleaner energy and a rethink of the urban form of Chinese cities and their planning. Although the challenges to achieve this are great, the economic benefits of action are greater still and vastly outweigh the costs.

A focus on an urban development model of clean, compact and connected cities during the 14th Five-Year Plan can place China on a long-term trajectory for better quality economic growth.

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