COALITION FOR URBAN TRANSITIONS

SEIZING CHINA'S URBAN OPPORTUNITY

CITIES AT THE HEART OF THE 14TH FIVE-YEAR PLAN AND A NATIONAL VISION FOR NET-ZERO EMISSIONS

About the Seizing the Urban Opportunity series

This series, a collaborative effort by more than 36 organisations across five continents brought together by the Coalition for Urban Transitions, is being launched as a call to action ahead of COP26 in Glasgow. Our aim is to provide insights from six emerging economies demonstrating how fostering zero-carbon, resilient and inclusive cities can advance national economic priorities for shared prosperity for all. This report focuses on how to seize the urban opportunity in China.

The Coalition for Urban Transitions is a global initiative to support national governments in transforming cities to accelerate economic development and tackle dangerous climate change. Collectively, the contributors hope this report will provide the evidence and confidence that national governments need to submit more ambitious Nationally Determined Contributions in 2021 and to propel inclusive, zero-carbon cities to the heart of their COVID-19 economic recovery and development strategies.

Disclaimer

The analysis, arguments and conclusions presented here are a synthesis of the diverse views of the authors, contributors and reviewers and is an 18-month research effort building on the Coalition's 2019 *Climate Emergency, Urban Opportunity* report. The Coalition takes responsibility for selecting the areas of research. It guarantees its authors and researchers freedom of inquiry, while soliciting and responding to the guidance of advisory panels and expert reviewers. Coalition partners, some as organisations and others as individuals, endorse the general thrust of the arguments, findings and recommendations made in this report, but the text does not necessarily reflect the personal views or official policies of any of the contributors or their members.

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China's cities produce 90% of its GDP and are home to three-fifths of the population, 837 million in 2018. By 2050, four in five Chinese are expected to live in cities. But China's urban areas also face major challenges, including air pollution, traffic congestion and urban sprawl. Climate change poses growing threats as well, including severe floods, water scarcity, sea-level rise and extreme heat.

China has taken major steps to address its environmental challenges, reducing air, water and land pollution and strengthening enforcement, which has spurred greater compliance. It has also embraced nature-based solutions to build resilience, from reforestation, to the pioneering Sponge City Programme. And it has pledged to peak CO_2 emissions before 2030, and to reach carbon neutrality by 2060.

New analysis for the Coalition shows China could reduce greenhouse gas emissions from buildings, transport and waste in its cities by 48% in 2030 (1.94 Gt CO_2-e) and 89% in 2050 (3.37 Gt CO_2-e), relative to a baseline scenario, using proven low-carbon measures. With continued innovation, it may soon be possible to go even faster and further – and serve as a model for the world.

More than half of China's urban abatement potential is in cities that now have fewer than a million residents, which offer prime opportunities to shape urbanisation more sustainably. More than a quarter of the abatement potential depends on decarbonising the electricity supply – 68% of which came from fossil fuels in 2019.

Modelling for the Coalition indicates that these low-carbon measures would require incremental investments of US\$5.5 trillion to 2050, but yield returns with a net present value of at least US\$7.7 trillion over the next three decades. They could also support more than 15 million new jobs in 2030, mainly in building energy efficiency.

This is a pivotal time for China, with the 14th Five-Year Plan now unveiled and an updated Nationally Determined Contribution (NDC) in the works. China has also made major investments to revitalise the economy after the COVID-19 crisis, with US\$729 billion budgeted as of February 2021 for a wide range of projects, including electric vehicles and EV infrastructure, building renovations, railway infrastructure, and the Green Development Fund, but also strong support for carbon-intensive industries.

There is scope to do much more to foster compact, connected, clean and resilient cities. The report highlights numerous opportunities for action. Four that stand out as particularly promising are:

- **Put sustainable cities at the heart of the implementation of the 14th Five-Year Plan, annual investment plans, and the new NDC**, aiming to peak emissions in all urban areas (or at least a large share of them) by 2025. The 14th FYP will mobilise massive new investments and shape China's economic, social and

environmental trajectory for years to come. This is a chance to transform cities so they can lead the way to a carbon-neutral future.

- **Prioritise energy-efficient buildings – new construction and retrofits – in future stimulus packages and other spending.** This is a prime opportunity to support the creation of large numbers of jobs in cities and slow the rise in electricity demand.

- **Support small and mid-sized cities to enable them to drive compact, connected, clean and resilient urbanisation.** This is a chance to foster sustainable development, transform mobility and accessibility, and improve inter-regional equity.

- **Incorporate decarbonisation and resilience objectives, including nature-based solutions, in national urban design and regeneration strategies.** China now aims to have 80% of urban built-up areas meet Sponge City standards by 2030, for example. It is crucial to keep scaling up those efforts and incorporate equally ambitious measures in urban renewal projects.

Taizhou, China. Image: used with permission of Turenscape

INTRODUCTION

In China and around the world, national leaders face a triple challenge right now: ensuring a successful recovery from the devastation of COVID-19, pushing forward on their longer-term vision for development, and addressing the enormous threats posed by climate change. The pandemic has wrought havoc on the global economy, with particularly severe impacts on the poor. It has also highlighted the urgency of building resilience to a wide range of shocks, especially the growing impacts of climate change.

Cities are at the centre of that triple challenge. As population hubs and economic engines, they will play a crucial role in the recovery and in countries' long-term economic vitality. Many have also been particularly hard-hit by the pandemic, however. So now, more than ever, national leadership is crucial to ensure cities can "bounce back" and fully realise their potential as engines of sustainable, inclusive growth. As outlined in the Coalition's 2019 flagship report, *Climate Emergency, Urban Opportunity*,[1] only national governments can mobilise resources at the scale needed, and they control or drive key policy realms: from energy, to transport, to social programmes.

Recognising that developing and emerging economies face particularly complex challenges, the Coalition is focusing on six key countries in the lead-up to COP26 in Glasgow: China, India, Indonesia, Brazil, Mexico and South Africa. Together, they produce about a third of global GDP[2] and 41% of CO_2 emissions from fossil fuel use.[3] They are also home to 42% of the world's urban population.[4] The extent to which these six major emerging economies can unleash the power of cities to catalyse sustainable, inclusive and resilient growth is therefore critical not only for their future trajectory, but for the whole planet.

This paper presents the results of policy analysis and modelling on China, delving deeper into findings summarised in the Coalition's new *Seizing the Urban Opportunity* report.[5] But first, for context, we outline our key findings across the six countries, and how they fit with the Coalition's previous work.

Powering the recovery and long-term sustainable growth through cities

Climate Emergency, Urban Opportunity showed that a bundle of technically feasible low-carbon measures could cut emissions from buildings, transport, materials use and waste by almost 90% by 2050; support 87 million jobs in 2030 and 45 million jobs in 2050, and generate energy and material savings worth US$23.9 trillion by 2050.[6] Compact, connected, clean and resilient cities have significant wider economic, social and environmental benefits as well. With deliberate attention to equity and inclusion, low-carbon measures can also help lift people out of poverty by improving their access to jobs, education and vital services. And by avoiding urban sprawl, countries

can protect agricultural land and natural ecosystems around cities, with benefits for food security and resilience.

The COVID-19 pandemic has mobilised historic levels of public spending in many countries, but only a fraction promotes sustainability or climate resilience, and very little focuses on cities.[7] Local leaders, meanwhile, have continued to raise their ambition: from embracing the concept of "15-minute cities" where people can get almost anything they need within a 15-minute walk or bike ride,[8] to joining the Cities Race to Zero, pledging to reach net-zero carbon emissions by mid-century or sooner.[9]

Aiming to inform and inspire national leaders in the lead-up to COP26, the Coalition set out to answer three questions: 1. How can national governments in these six key economies leverage cities to build shared prosperity while decarbonising and building resilience? 2. How can they make the most of the potential for compact, connected, clean and inclusive cities to drive the COVID-19 recovery? 3. How can insights from these six countries inform efforts by other national governments, development partners and financial institutions to support a shift towards low-carbon, inclusive and resilient cities?

Three themes emerge clearly from our analysis:

1. **A low-carbon urban transformation is within reach, with broad benefits.** National governments can significantly accelerate decarbonisation by investing in compact, connected, clean and inclusive cities – and reap substantial economic, social and environmental benefits.

2. **Building resilience to climate change is as urgent as decarbonisation.** In all six countries, climate risks are immediate and severe, especially for the urban poor. Resilience-building is a multifaceted challenge: from embedding climate resilience in infrastructure and urban development, to adopting new technologies and practices to reduce climate risks, to addressing the socio-economic drivers of vulnerability in cities.

3. **There are many ways to foster low-carbon, resilient and inclusive cities.** National governments have a wide range of options to choose from, including low-cost and immediate opportunities, and there are many synergies between decarbonisation, resilience-building, COVID recovery efforts, and development programmes.

The global report lays out an agenda for action for national and local leaders as well as for the broader development community, including financial institutions. Transforming cities to become catalysts of sustainable, inclusive and resilient growth is a major undertaking, and it is likeliest to succeed if we all come together behind a shared vision. In the sections that follow, we delve into the challenges and opportunities for China in particular.

Though this report includes economic analysis, we recommend reading it together with a new report from the Coalition's China Programme, led by Hong Kong University of Science and Technology, Tsinghua University, the Grantham Research Institute at the London School of Economics and Political Science and the World Resources Institute (USA) Beijing Representative Office, which delves deeper into the economic case for ambitious action to decarbonise China's cities.

Aerial view of Shenzhen, China. Source: Shutterstock

THE PROMISE − AND CHALLENGES − OF CHINA'S CITIES

China's economic success story is built on cities, which produce 90% of its GDP.[10] Through a strategic, integrated approach to industrialisation and urbanisation, the government has built what is now the world's second-largest economy in absolute terms, with a GDP of US$14.3 trillion in 2019 – and the No. 1 economy in purchasing power terms.[11] From 2000 to 2018 alone, as China's urban population nearly doubled to 837 million (59% of the total),[12] GDP grew almost fivefold.[13] The share of people in extreme poverty has plummeted, from 40.3% in 1999 to 0.5% in 2016.[14] And urbanisation continues apace; by 2050, four in five Chinese are expected to live in cities.[15]

Yet even before the COVID-19 pandemic, China's cities faced major challenges. Though CO_2 emissions from energy use have plateaued,[16] they remain high, mainly due to heavy reliance on coal, which made up 61.9% of the total energy supply in 2018.[17] China also has 23 of the 50 cities with the worst air pollution,[18] which was linked to an estimated 1.2 million premature deaths nationwide in 2017.[19] Traffic congestion cuts into productivity; in 2018, Beijing, the most congested city in China, lost about CNY 180 billion, or about 6% of its GDP, on daily commutes.[20] Many other large cities struggle with severe congestion as well: from Jinan, to Dalian, to Hohhot, capital of Inner Mongolia.

China is making major investments in public and non-motorised transport, but the number of cars on the roads is still rising steadily. As part of a strategy to create regional networks of well-connected cities, by the end of 2019, China had built 35,000 km of high-speed railways – including the Beijing-Guangzhou High-speed Railway, opened in 2012 as the longest high-speed rail line in the world – and 12 billion trips had already been made on high-speed rail.[21] Urban rail transit has also continued to expand, reaching 6,200 km of track in 40 cities by the end of 2019. Urban rail passenger volume increased by 174% from 2012 to 2019, to 23.9 billion trips nationwide (another 69.2 billion trips were made on urban bus lines). Through the Transit Metropolis Project, launched in 2012, the national government has encouraged cities to become models of healthy and sustainable urban transport; 87 cities have participated so far, and 33 have been classified as national models.[22] Bike-sharing is also increasingly encouraged, with services in more than 360 cities so far.[23] However, China is also investing heavily in highways, and car ownership continues to rise. By the end of 2020, about 372 million motor vehicles were registered across China, including 281 million automobiles;[24] new registrations were up 3.56% from 2019. Ownership of private cars grew fivefold from 2009 to 2018, and more than doubled from 2013 to 2018 alone.[25]

Urban sprawl continues to be severe. China's cities have consumed large swaths of rural land in recent decades; for example, 70% of the urban construction land added in China's 145 major cities in the 1990s was achieved by acquiring farmland.[26] Since 2005, new land use policies have aimed to protect cultivated land and rural communities, with some success. However, modelling for the Coalition shows that urban sprawl has continued apace, still consuming farmland.[27] As shown in Figure 1, between 2000 and 2014, Chinese cities expanded by 35,380 km^2 – equivalent to more than twice the area of the Municipality of Beijing.[28] Some failed projects have resulted in ghost towns and empty industrial parks.[29] Through the Ecological Conservation Redline initiative, enshrined in law in 2015 and now being implemented nationwide, China is working to protect at least 25% of its land – 2.4 million km^2 – to preserve important ecosystems.[30] By 2018, nature preserves and redline areas already spanned over 18% of China's territory,[31] providing protection for 90% of terrestrial ecosystem types and 85% of wild animal populations.[32] This work is immensely important both for biodiversity and for climate protection,[33] but it will further limit farmland,[34] making it even more crucial to stop urban sprawl.
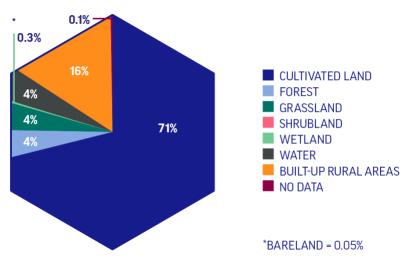
Figure 1. Land converted to urban areas in China by type of land cover, 2000–2014

Source: Marron Institute of Urban Management, New York University, 2019, for the Coalition for Urban Transitions and the Food and Land Use Coalition. See Annex 3 *for full methodology.[35]*
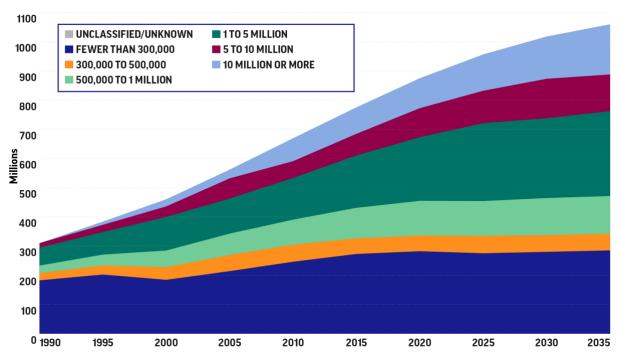
Income inequality is a problem both within and across cities. Though China's Gini index, 38.5 in 2016,[36] is below that of many developing and emerging economies, as of 2018, urban households in the wealthiest quintile had 5.9 times the disposable income of those in the poorest quintile.[37] Prosperity is also unevenly distributed across the country. Households in Shanghai, for instance, had 95% more disposable income, on average, than those in Chongqing in 2016, and 127% more than those in Gansu.[38] Major fiscal liabilities have also left many cities deep in debt, jeopardising the delivery of local services. Reforms are needed to increase municipal revenues and

reduce the need to incur debt or selling land; key options recommended by experts, especially to help smaller cities, include a surcharge on the national income tax and new city property taxes.[39]

Migrants play a key role in urban economies, but remain deeply vulnerable.
More than a third of China's labour force, 291 million workers as of 2019, are rural migrant workers.[40] Even in the best of times, these migrants and their families live in far more precarious conditions than fellow city-dwellers with an urban *hukou,* with limited access to housing or safety-net programmes. Indeed, migrants make up a large share of the population of China's "urban villages" – urban areas that are excluded from municipal oversight and services and often have substandard housing, overcrowding and poor sanitary conditions.[41] A 2017 World Bank report estimated that across China, half the migrant population lived in about 50,000 urban and suburban villages.[42] Many migrants are employed in the informal sector, and even those who have formal jobs are disproportionately in retail and services[43] or other sectors that were particularly hard-hit by the COVID-19 pandemic, resulting in high unemployment.[44] China has been removing hukou restrictions in recent years, starting with smaller cities and, since 2019, in cities of up to 3 million people, with relaxed restrictions in cities of 3–5 million, but no change in the largest 13 cities.[45] To ensure an equitable and inclusive recovery in China's cities, and build resilience to future shocks, it is crucial to continue this trend and provide more safety-net supports to migrants and their families. It is also important to support improvements in urban villages, some of which are already benefiting from urban renewal programmes,[46] and to build more high-quality, affordable housing.

More than half of China's urban population is in cities with fewer than 1 million people, which typically have fewer resources and more limited capacities to meet their residents' needs than larger municipalities. As of 2020, China had 20 cities with 5 million or more residents – almost twice as many as India.[47] But China also had 114 cities of 1–5 million people, home to a quarter of the urban population. More than half the urban population lived in cities with fewer than 1 million people, including 32% in settlements with fewer than 300,000 residents (see Figure 2). By 2035, the share of urban residents in smaller cities is projected to decline, while the number and population of larger cities will grow, but 44% of the urban population is still projected to live in cities with fewer than 1 million residents. Ensuring that these cities have the knowledge and resources to grow sustainably and build resilience will be crucial to promoting broad-based prosperity across China in the coming decades.

Figure 2. China's urban population by city size class, 1990–2035 (historical and projected)

Legend:
- UNCLASSIFIED/UNKNOWN
- FEWER THAN 300,000
- 300,000 TO 500,000
- 500,000 TO 1 MILLION
- 1 TO 5 MILLION
- 5 TO 10 MILLION
- 10 MILLION OR MORE

Source: Analysis by the Coalition for Urban Transitions based on data from UN DESA, 2018. Data to 2015 are historical, 2020–2035 are projections.[48]

Confronting climate change

Climate change poses growing threats to China's cities, many of which are already being felt. Experts anticipate global warming of more than 1.5°C above pre-industrial levels to cause heavier precipitation, heat waves and more severe droughts in different regions of China.[49] A study of major cities found average summer temperatures in Shanghai and Chongqing, for example, are already dangerously high and rising.[50] Higher temperatures, combined with changes in precipitation, are also expected to reduce water availability in parts of China. This has implications for irrigated agriculture and food security, but also for some regions' water security and even for energy systems, as water is widely used for cooling in power plants.[51] Cities in northern China, most notably Beijing, already face severe water scarcity, exacerbated by water pollution.[52] Subsidence due to overdrawn aquifers threatens over 50 cities;[53] before the South-to-North Water Diversion Project helped ease water stress, parts of Beijing were sinking by over 10 cm per year.[54]

Floods pose a particularly severe threat in a changing climate. Life-threatening floods are alarmingly common, with a record 21 large-scale floods in 2020.[55] Altogether, 280 lives were lost, and damages reached US$35 billion.[56] In parts of southern China, the 2020 rainy season lasted nearly twice as long as average and

caused catastrophic flooding.[57] However, major flood risk mitigation efforts limited the damage; similar conditions in 1998 killed more than 4,000 people and destroyed 7 million homes. The government has combined ecosystems restoration with engineering solutions to protect vulnerable cities from floods – most notably through the Sponge City programme, now a nationwide initiative (see Box 1).

Box 1. Sponge Cities: Working with nature to build urban flood resilience

For many Chinese cities, water is both a scarce resource and a major natural hazard. Coastal and riverfront cities face escalating flood risks, and at the same time, groundwater reserves are shrinking due to over-abstraction – which also drives subsidence and worsens floods.[58]

In 2013, the government introduced "sponge cities", a concept developed by a Beijing landscape architect to enable cities to absorb, store and purify water, using a combination of nature-based solutions and strategically designed grey infrastructure.[59] In 2015, a Sponge City pilot was launched with 16 cities, with CNY 20.7 billion (US$3 billion) in funding from 2015 to 2017; another 14 cities were included in a second pilot phase.[60]

The concept is deliberately flexible, adaptable to the local environment. The measures adopted include absorptive roads and permeable pavements; rain gardens, parks and wetlands; and built-environment measures such as green roofs and rainwater reuse facilities.[61] The idea is to soak up rainfall, reducing runoff; control flooding; and store water that can be reused or help groundwater reserves.

During Typhoon Lekima in 2019, Sponge City measures are credited with helping Jinan avoid deaths and save over 1,000 properties.[62] In Wuhan, analysis for the Coalition found that nature-based approaches adopted through the Sponge City pilot saved almost US$600 million compared with upgrading the city's drainage system. Further analysis highlights significant co-benefits, including improved local air quality, biodiversity and conservation benefits, health and lifestyle benefits, and increased land value.[63]

Scaling up the Sponge City concept is not without its challenges – including costs, the need for coordination across jurisdictions, and logistical issues, such as finding nature-based solutions that can withstand the extreme weather in some cities.[64] Still, given the clear benefits and the urgency of flood risks, China's government has now set the goal of having 80% of urban built-up areas meet Sponge City standards by 2030.[65]

Coastal cities are in particular peril from floods, storm surges and sea-level rise.
As of 2015, modelling for the Coalition shows, more than 194 million people – over
13% of China's population – lived in coastal zones less than 10 metres above sea level,
92% of them in urban or quasi-urban areas (Figure 3).[66] These areas are also
economically critical: despite major efforts to boost economic activity inland, coastal
cities still contributed a third of China's GDP in 2019.[67] By one estimate, in 2050,
Guangzhou will face annual average losses exceeding US$13 billion (CNY89.8 billion),
making it the most vulnerable among the 136 major coastal cities around the world
included in the analysis.[68] Continued development in high-risk areas is also creating
new vulnerabilities. For example, major urban expansion in the Shenzhen region is
occurring at sea level, exposing high-value (and high-carbon) infrastructure – ports,
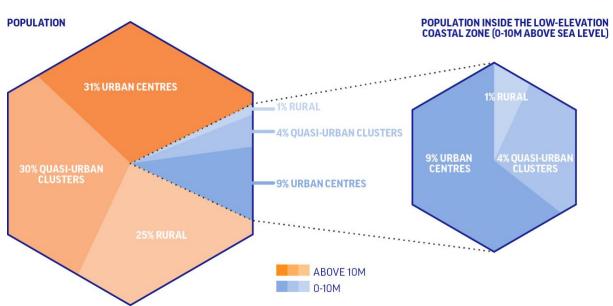airports, business districts – to becoming stranded assets.[69]

*Figure 3. Share of China's population inside and outside the low-elevation coastal zone
by settlement type, 2015*

POPULATION

31% URBAN CENTRES
1% RURAL
4% QUASI-URBAN CLUSTERS
9% URBAN CENTRES
30% QUASI-URBAN CLUSTERS
25% RURAL

POPULATION INSIDE THE LOW-ELEVATION COASTAL ZONE (0-10M ABOVE SEA LEVEL)

1% RURAL
9% URBAN CENTRES
4% QUASI-URBAN CLUSTERS

ABOVE 10M
0-10M

*Source: CUNY Institute for Demographic Research, Institute for Development Studies and Center
for International Earth Science Information Network, Columbia University.[70]*

China is actively working to make its cities more resilient. In 2015, the
government released a City Climate Change Adaptation Action Program. In 2017, it
began pilot projects in 28 cities, trying innovative policies, addressing urban heat
island effects as well as flood risks, developing a new meteorological disaster
monitoring platform as well as early warning systems, and working to improve urban
infrastructure design and construction, among other initiatives.[71] Efforts were also
made to increase stakeholder engagement in adaptation. China is also part of the
Global Commission on Adaptation and has launched a Global Center on Adaptation in

China to promote international cooperation on adaptation. A new National Adaptation Strategy is now under development, to guide action through 2035.

China has also taken major steps towards sustainability. In 2013, President Xi Jinping laid out a vision for an "ecological civilisation" (shengtai wenming)[72] with harmony between people and nature, cleaner industries, green technological innovation and ecosystems protection. China has taken actions to reduce air, water and land pollution and strengthened enforcement, spurring greater compliance.[73] It has already begun to decouple economic growth from carbon emissions: between 2013 and 2018, China's GDP grew by an average of 7.01% per year,[74] while its energy-related CO_2 emissions grew by an average of 0.81%.[75]

China's new Nationally Determined Contribution is a key opportunity to raise ambition. Prime Minister Xi Jinping has pledged to peak CO_2 emissions before 2030[76] and to reach carbon neutrality before 2060.[77] In December 2020, he offered a preview of the new NDC, which will aim to reduce the carbon-intensity of GDP by over 65% by 2030 (up from 60–65% in the first NDC; by the end of 2019, it had already been reduced by 48.1%); increase non-fossil energy to about 25% by 2030 (up from 20%; it was 15.3% at the end of 2019); increase forest stock volume to 6 billion m^3 by 2030 (up from 4.5 billion m^3, the previous target, reached by 2019); and increase total wind and solar capacity to 1,200 GW by 2030 (it was 415 GW at the end of 2019).[78]

The new 14th Five-Year Plan envisions steady progress on climate – not the transformation needed to reach net-zero by 2060. The draft plan unveiled on 5 March, 2021, sets mandatory goals to reduce CO_2 emissions per unit of GDP by 18% by 2025, and reduce the energy-intensity of GDP by 13.5%, along with modest targets for increased forest cover and air quality.[79] It also calls for developing compact, liveable, innovative, smart, green, humane and resilient cities. The new plan would thus keep China moving in the right direction, but as multiple international experts and advocates noted upon its release,[80] the progress risks being too slow to meet the 2060 goal, which requires transformative change. Indeed, a recent in-depth analysis found that China needs more ambitious near-term goals than those articulated by President Xi to date if it wants to reach net-zero before 2060.[81] The plan's implementation and accompanying investments can still raise ambition, and it is crucial that they do, in line with the government's vision for sustainable, inclusive and resilient urban centres. Cities have a great deal at stake in China's sustainability transition: from cleaner air, to improved urban accessibility, to a slew of new economic opportunities in green technology.

Cities in China's most economically advanced regions can lead the way to a net-zero future. Cities are important engines for shaping the quality of balanced and inclusive economic growth in China.[82] A coordinated regional approach can help unlock their full potential. China's three most developed economic regions – the Yangtze River Delta Region, Beijing-Tianjin-Hebei Area, and Greater Bay Area (Pearl

River Delta) – collectively contribute 40% of the national GDP and 34% of GHG emissions.[83] Recent research shows these regions have the potential to peak emissions by 2025, the end of the 14th Five-Year Plan, and that doing so would bring significant economic benefits.[84] The Yangtze River Delta region, for example, could increase fiscal revenue sixfold by 2050 from 2020 compared with a baseline scenario, reaching US$5.5 trillion (CNY 38.1 trillion) through ambitious climate actions such as increased vehicle and building efficiency, deep retrofits, combined heat and power generation and district heating, etc. Those actions could also create nearly 3.8 million more jobs annually from 2025, with direct and indirect benefits to other regions as well.

Urban leaders are already raising their own ambition. Eighty cities (about a third of prefecture-level cities) have pledged to peak emissions before 2030, and several, including Beijing and Shenzhen, are projected to peak well before 2025.[85] National government support for mass transit, electric vehicles and renewable energy has strengthened these efforts.[86] Chengdu, Dalian, Fuzhou, Hong Kong, Nanjing, Qingdao and Wuhan have gone even further, joining the Cities Race to Zero, pledging to reach net-zero carbon emissions by mid-century or sooner, with yearly reporting on progress.[87]

Box 2: How we built our analysis

This report combines original climate and economic modelling, spatial analysis, policy research and analysis, and country-specific insights gathered by consulting iteratively with urban, energy and climate policy experts in China, India, Indonesia, Brazil, Mexico and South Africa.

First, the Stockholm Environment Institute (SEI) modelled the urban greenhouse gas abatement potential in six countries, using a bottom-up assessment of mitigation options in **residential and commercial buildings, road transport, waste management, and materials for urban buildings and transport infrastructure**.

The model covers CO_2 emissions from energy consumption, process emissions from the production of cement and aluminium used in urban infrastructure, and methane (CH_4) emissions from landfills. It is important to note that emissions from industries within cities are not included. Thus, the urban share of emissions may appear smaller than in other studies. It is also important to note that this analysis was undertaken prior to the full impacts of COVID-19 being known. Hence, the baseline scenario, for example, does not factor in the potential economic impacts of COVID-19 on emissions pathways. Any planned future analysis will be adjusted to take this into account.

The baseline scenario reflects countries' commitments in their first round of Nationally Determined Contributions (NDCs) under the Paris Agreement, but not the latest updates. **This means the abatement potential between 2020 and 2050 identified in the analysis is all additional to the first NDCs.** For details on data sources, measure-specific assumptions and analytical steps, see Annex 1.

Second, Vivid Economics modelled the **incremental investments through 2050** – that is, investments beyond baseline levels – needed to realise the abatement potential identified by SEI, using existing technologies and practices, and accounting for learning that would reduce costs over time. They also modelled the cumulative returns on those investments through 2050. Across all countries, the estimates presented in this report are **net returns** (i.e. net present value, or the extent to which benefits exceed costs over the period to 2050), discounted at 3.5% per year, assuming a 1% annual increase in real energy prices from 2014 levels. That is the central scenario in the analysis; for a comparison of results with different assumptions, see Annex 2, Part 3. Note that the economic returns estimate only considers direct energy and material cost savings and is thus partial. The returns would be higher if factors such as time savings from avoided congestion, increased productivity, improved health and environmental quality, and avoided climate change impacts were taken into account.

Finally, the Vivid analysis estimates the **direct, indirect and induced jobs** (full-time equivalent) that the modelled measures could support in 2030 and 2050, taking into account technology-specific labour productivity factors and adjusted to reflect typical differences in labour productivity between OECD and non-OECD countries. The estimates are based on uniform labour productivity assumptions for the six countries and provide indicative job numbers. Further work should collect more country-specific information to refine the results. **The job numbers reflect an estimate of net jobs by comparing green investment with an equivalent investment in fossil fuel projects**, while fully recognising the uncertainties in such counterfactuals. In all of these categories, we provide overall numbers as well as selected sector- and measure-specific estimates. For details on data sources and the full methodology, see Annex 2.

The third modelling exercise that informed our analysis was by the Marron Institute of Urban Management at New York University, which examined the **scale and composition of the conversion of land to urban purposes** in each of the six countries in the period 2000–2014. The results show not only how much cities' collective footprint grew in that time, but also what they displaced: farmland, built-up rural areas, forests, grassland, etc. For a detailed methodology, see Annex 3.

Finally, recognising that coastal populations are particularly exposed to climate change impacts, including sea-level rise, storm surges and other hazards, we drew on the work of the Institute for Demographic Research at City University of New York, the Center for International Earth Science Information Network at Columbia University, and the Institute of Development Studies to estimate the **share of each country's population living in coastal zones at less than 10 metres above sea level**, and the urban share of that population. While a detailed mapping of coastal climate risks in the six countries is beyond the scope of this report, this analysis provides some indication of the extent of the risk. For a detailed methodology, see Annex 4.

The four modelling exercises inform analysis in this report as well as the Coalition's global synthesis report, based on detailed literature reviews (including policy documents, peer-reviewed studies, grey literature and media coverage) and close collaboration with experts in the six countries, with additional input from a wide range of Coalition partners. The resulting recommendations are meant as illustrative examples, and should not be seen as an exhaustive list of options for national policy-makers in each country.

HOW URBAN ACTION CAN DRIVE DECARBONISATION AND ECONOMIC GROWTH

China's cities hold significant untapped abatement potential. New analysis for the Coalition shows that deploying a bundle of currently available low-carbon technologies and practices could reduce emissions from urban buildings, transport and waste by 48% in 2030 (1.94 Gt CO_2-e) and 89% in 2050 (3.37 Gt CO_2-e), relative to a baseline scenario (see Figure 4).[88] With continued innovation, it may soon be possible to go even faster and further – and serve as a model for the world. Notably, 53% of China's urban abatement potential is in cities that now have fewer than 1 million residents, which may still be taking shape and could greatly benefit from proactive action to avoid locking into carbon-intensive urbanisation.
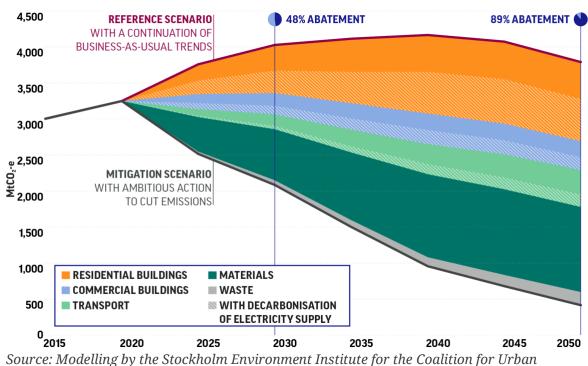
Figure 4. GHG abatement potential in key urban sectors in China to 2050

Source: Modelling by the Stockholm Environment Institute for the Coalition for Urban Transitions.[89]

Decarbonising electricity is crucial to realising China's urban abatement potential. More than a quarter (27.5%) of the potential identified in the three sectors depends on decarbonising the power supply – 68% of which came from fossil fuels in 2019.[90] This is because, as shown in the modelling, widespread electrification of building and transport energy is key to achieving large-scale GHG reductions. In its first NDC, China pledged to build a low-carbon energy system, and it has already met

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its target of reducing the share of power generated from coal to 58% by 2020, from 73% in 2015.[91] But China is still a major investor in coal power; a commitment to phase out coal[92] would significantly contribute to China's goal of achieving carbon neutrality before 2060.[93] The 14th Five-Year Plan calls for increasing the share of non-fossil fuel sources in China's energy mix to 20% by 2025, up from the 13th FYP's 15% target, and it calls for 1,200 GW of new wind and solar capacity.[94] That leaves significant scope for continued coal growth, and the plan expresses support for the "clean and efficient use of coal" – a major lock-in risk. China is already a global leader in manufacturing renewable energy technology for solar and wind power, with the potential to grow to meet domestic and international demand.[95] There are many other compelling reasons to completely stop investing in fossil fuel technologies – especially coal – and rapidly scale up renewables, including to further reduce air pollution and to avoid stranded assets. However, it is essential to ensure a just transition for the many workers whose livelihoods depend on incumbent technologies.[96] Job retraining and safety-net programmes, with priority to lower-income and lower-skilled workers, are particularly important.

Investing in decarbonising China's cities could yield substantial economic benefits. Analysis for this report suggests that fully implementing the modelled low-carbon measures would require incremental investments of US$5.5 trillion, but could yield returns with a net present value of at least US$7.7 trillion by 2050 (Figure 5).[97] The analysis also provides indicative numbers of jobs that could be supported by the investments, suggesting that they could collectively support 15.2 million new jobs in 2030, mostly in energy efficiency in the buildings sector.[98]
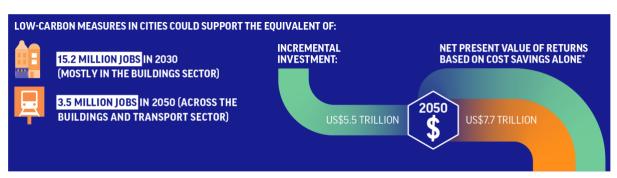
Figure 5. The economics of selected low-carbon measures in Chinese cities

LOW-CARBON MEASURES IN CITIES COULD SUPPORT THE EQUIVALENT OF:

15.2 MILLION JOBS IN 2030 (MOSTLY IN THE BUILDINGS SECTOR)

3.5 MILLION JOBS IN 2050 (ACROSS THE BUILDINGS AND TRANSPORT SECTOR)

INCREMENTAL INVESTMENT: US$5.5 TRILLION

2050 $

NET PRESENT VALUE OF RETURNS BASED ON COST SAVINGS ALONE* US$7.7 TRILLION

Source: Modelling by Vivid Economics.[99] Note: These job and growth numbers are based on scenarios and are not forecasts of future outcomes. The job numbers in particular are subject to a high level of uncertainty, as explained in Annex 2, *and should be interpreted with caution.*

Modelling for this report shows many economically attractive options: from residential lighting efficiency improvements in cities, which require only US$3.78 billion in incremental investments but could yield savings with a net present value of

US$94.78 billion, to fostering a shift to public transport, which would require US$172.48 billion in incremental investments, but yield savings with a net present value of US$3.35 trillion by 2050. Investing in energy-efficient passenger and freight vehicles could also yield particularly large economic benefits.

The buildings sector holds large abatement and job creation potential. Almost half of China's urban abatement potential (48%), the emissions modelling shows, is in the buildings sector: improving the efficiency of heating and cooling, appliances and lighting, cooking and water heating, and using clean energy.[100] Buildings in China account for 20% of energy consumption and 25% of GHG emissions.[101] Improving the efficiency of heating, cooling and lighting would not only reduce emissions, but also make buildings more comfortable and reduce energy costs. This is also a great opportunity to create jobs: the economic modelling suggests that new construction and deep retrofits to maximise energy efficiency could support 10.1 million new jobs in the residential sector and 3.6 million in the commercial sector in 2030.[102]

Some Chinese cities have become leaders in building energy efficiency. Since China adopted its first national Standard for Green Building Evaluation in 2006, pioneering cities have led the way in using the standard – and later updates – to promote more sustainable construction as well as retrofits, monitor progress, and keep raising ambition, with central government support.[103] Shenzhen promoted green buildings research and demonstration projects, started making green standards mandatory for some buildings, then designated Guangming District as the first in the country where green standards are required for all construction. The district has become a national demonstration zone, one of several eco-city pilots funded by the central government.[104] Shanghai's Changning District, meanwhile, pioneered China's first online platform to monitor public buildings' energy performance in 2007, and created a Low Carbon Office that coordinated retrofits of 45% of the district's public and commercial building floor area between 2013 and 2018.[105] The district's success spurred a larger initiative across the Shanghai metropolitan area that has retrofitted 5.87 million m^2 of floor area since 2016 and avoids about 190 Mt CO_2 of annual emissions. Changning District has also joined Beijing, Qingdao and Fuzhou in the C40 China Buildings Programme, part of a global initiative supporting more than 50 major cities.[106] Beijing has focused on demonstrating ultra-low energy consumption buildings, while Qingdao is developing new ways to finance retrofits to depend less on subsidies, and Fuzhou is demonstrating a wide range of renewable energy technologies. China can leverage these pioneering cities' success to accelerate progress nationwide by adopting a strong policy framework on building energy efficiency; providing financial incentives, especially for smaller cities, to stimulate private sector participation; continuing to support local innovation; and promoting knowledge-sharing, so the frontrunners' standards and practices can be adopted by cities all across the country.

Electric vehicles are another prime opportunity. The New Energy Vehicles Programme, launched in 2001, has already put China at the forefront of transport electrification.[107] The government helped 10 cities to procure EVs and install charging infrastructure, then expanded its support to another 39 cities,[108] complemented with generous R&D funding and careful regulation of the auto industry.[109] China dominates the global market for EVs; it is home to 40% of the world's electric passenger cars and over 99% of the world's electric buses and electric two-wheelers.[110] Ambitious action in China's cities can also help promote the technologies of Chinese firms such as CATL, which leads on battery storage, and Shenzhen-based BYD, which is making electric buses for cities around the world.[111] In 2017, Shenzhen became the world's first major city with an all-electric bus fleet, over 16,000 vehicles, with taxis electrified next.[112] Modelling for this report suggests that incremental investments of US$603 billion will be needed over the next three decades to fully realise the potential of a switch to EVs in China's cities – but those investments would more than pay for themselves, yielding positive returns already in 2030, and cumulative returns to 2050 with a net present value of US$229 billion.[113]

Evidence shows that it is cheaper and easier to act early.[114] Favouring investments that are high-carbon or not resilient to climate change – whether it is coal-fired power plants or risky coastal development – will mean that China needs to retrofit or replace these assets later, at a significant cost. As our analysis shows, a clean energy supply is crucial to fully decarbonising cities. This is why as detailed sectoral plans are developed to implement the 14th Five-Year Plan, it is important to ensure that they reflect the FYP's vision for more sustainable cities, including by discouraging any further coal expansion. Given the country's commitment to carbon-neutrality by 2060, coal plants built now will most certainly be stranded assets.[115] Choosing sustainable infrastructure and technologies instead will position China as a global leader at a time when both resilience and decarbonisation are increasingly recognised as urgent priorities. China's economic clout and generous development assistance also indicate its choices will have impacts well beyond its borders: the Belt and Road Initiative, in particular, could either lock emerging economies into high-carbon development paths or help to secure a climate-safe future.[116]

UNLOCKING THE POTENTIAL OF CHINA'S CITIES

China's vigorous response to the COVID-19 pandemic has kept mortality remarkably low[117] and enabled the country to grow its GDP by 2.3% in 2020 while other major economies shrank.[118] Per capita income also grew, though urban households' expenditure dropped by 6% in real terms.[119]

As of February 2021, China had approved US$729 billion in fiscal stimulus, including investments in electric vehicles and EV infrastructure, building renovations, railway infrastructure, and the country's Green Development Fund.[120] However, China has also provided strong support to carbon-intensive industries, relaxed some environmental reporting, streamlined permits for coal mining, and extended subsidies for fossil fuel vehicles. There is scope to do much more to foster compact, connected, clean and inclusive cities and to build climate resilience.

This is a pivotal time for China. The implementation of the new 14th Five-Year Plan provides a unique opportunity to leverage cities to drive green growth across the country: building smart infrastructure, developing healthier cities, enhancing energy efficiency, and promoting the development of low-carbon technologies and innovative business models.[121]

China is also getting ready to submit its updated NDC under the Paris Agreement. Not only is this a chance to show climate leadership through bold commitments, going even beyond what President Xi has already previewed – it is also a chance to demonstrate urban ambition in particular, both in decarbonisation and in resilience-building.

We have highlighted multiple opportunities for national action throughout this report. At this particular moment, four avenues of action that we see as particularly important are:

> **Put sustainable cities at the heart of the implementation of the 14th Five-Year Plan, annual investment plans and the new NDC,** aiming to peak emissions in all urban areas (or at least a large share of them) by 2025. The 14th FYP will mobilise massive new investments and shape China's economic, social and environmental trajectory for years to come. This is a chance to transform cities and enable them to lead the way to a carbon-neutral future. Highlighting urban action in the NDC and requiring cities to peak emissions and issue carbon-neutrality roadmaps by 2025 – with central government support – could greatly accelerate urban climate action. Many of these investments also align well with China's competitive advantages. For instance, as production of EVs (cars, buses and other vehicles) scales up, robust EV charging infrastructure in cities can accelerate uptake, with benefits for the economy and for urban air quality.

Prioritise energy-efficient buildings – new construction and retrofits – in future stimulus packages and other spending. This is a prime opportunity to create large numbers of jobs in cities and slow the rise in electricity demand – which nearly doubled, in per capita terms, from 2008 to 2018[122] – even as China continues its impressive renewable energy deployment. Pioneering cities have already shown how high standards, monitoring systems and supportive institutions can drive large-scale change and innovation. With strong policy and fiscal support from the central government, cities across China can emulate their best practices, and sharply reduce energy costs and GHG emissions while improving livelihoods.

Support small and mid-sized cities to enable them to drive compact, connected, clean and resilient urbanisation. With more than half of China's urban abatement potential in cities with less than a million residents, and growing interest in improving economic opportunities in smaller and inland cities,[123] this is a chance to foster sustainable development, transform mobility and accessibility, and improve inter-regional equity. Along with direct investment and technical expertise, cities would benefit from fiscal reforms to enable them to generate more own-source revenues.

Incorporate decarbonisation and resilience objectives, including nature-based solutions, in national urban design and regeneration strategies. The Sponge City programme, for instance, has been scaled up, with a goal of 80% of urban built-up areas meeting its standards by 2030.[124] Overall, efforts to build flood resilience have already saved lives and avoided major economic losses, improved groundwater recharge, and made cities healthier.[125] It is crucial to keep scaling up those efforts and incorporate equally ambitious decarbonisation measures in urban renewal projects. The potential for both resilience-building and decarbonisation is enormous: in 2020 alone, China's government set out to renovate 39,000 aging settlements, at a cost of about CNY 4 trillion (about US$600 billion).[126]

ENDNOTES

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[2] Their collective share in 2019 was 31.7%, including 17.3% from China. Authors' calculations based on World Bank GDP data (PPP, in current international $). See https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD.

[3] Authors' calculations based on 2018 data from the International Energy Agency (total CO_2 emissions): https://www.iea.org/data-and-statistics.

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[13] See World Bank GDP data (PPP, in constant 2017 dollars): https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD?locations=CN.

[14] See World Bank data for poverty headcount ratio at US$1.90 per day (PPP, constant 2011 dollars): https://data.worldbank.org/indicator/SI.POV.DDAY?locations=CN.

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[88] Modelling for the Coalition by the Stockholm Environment Institute. See Annex 1 for a detailed methodology. https://urbantransitions.global/urban-opportunity/seizing-the-urban-opportunity/annexes/

[89] This analysis estimates global urban GHG abatement potential using a bottom-up assessment of mitigation options in urban buildings, transportation, infrastructure construction and waste management. For a detailed methodology, including assumptions and data sources, see Annex 1. https://urbantransitions.global/urban-opportunity/seizing-the-urban-opportunity/annexes/

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[98] These estimates are indicative only, and include direct, indirect and induced jobs.

[99] These estimates of annual returns and net present value are sensitive to discount rates, energy prices, learning rates, and other factors. Job creation estimates are only indicative and include direct, indirect and induced full-time equivalent jobs. For a detailed methodology and data sources, see Annex 2. https://urbantransitions.global/urban-opportunity/seizing-the-urban-opportunity/annexes/

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The Coalition partners listed endorse the general thrust of the arguments, findings and recommendations made in this report.*

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