Leading the battle against climate change: Actions for China

China could adopt a climate response centered on mitigation, adapting the country to climate risks and supporting global sustainable economic development.

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Executive Summary

As the COVID-19 pandemic sweeps through the globe, lives and livelihoods are threatened. Yet now more than ever, we need to bear in mind its larger implications. The same forces that have enabled the virus's assault on humanity underlie the larger threat of a changing climate. The current pandemic presents imminent and discrete dangers, while climate risks, by contrast, are gradual and cumulative. This means that a global climate crisis could be far lengthier and more disruptive than the coronavirus pandemic. Moreover, our responses to the pandemic will be critical factors in whether and how we achieve sustainability. In a time where the world faces simultaneous supply and demand shocks, building resilience through a focus on sustainability can and must be consistent with the effort to safeguard our economy and our lives.

Earth's climate is changing, after more than 10,000 years of relative stability. Since the 1880s, the planet's temperature has risen by about 1.1 degrees Celsius. As average temperatures rise, acute physical hazards such as heat waves and floods grow in frequency and severity, and chronic hazards, such as drought and rising sea levels, intensify.

For China, climate change is forecast to make the country warmer and wetter. If emissions continue to rise at the current rate, the threats of extreme heat and lethal heat waves could affect 10 to 45 million people by 2030, particularly in East China. The average share of outdoor working hours lost each year to extreme heat and humidity would increase from 4.0 percent today to as much as 6.5 percent in 2030 and 9.0 percent in 2050—equivalent to $1 trillion to 1.5 trillion in GDP at risk in an average year. The kind of heavy precipitation that was a once-in-50-years event in 1980 is expected to be two to three times more likely in 2030 and three to six times more likely in 2050.

Preventing further buildup of physical risk and stabilizing the climate will require rapidly reducing greenhouse-gas (GHG) emissions and ultimately taking emissions to net zero. China has mounted a vigorous response to climate risks and opportunities. These initiatives are admirable and, in some sectors, industry-leading. Nevertheless, given its scale and influence, it can do more. China still accounts for around 20 percent of global emissions, with net emissions of 16 gigatons of CO2 equivalents.

By making a rapid and orderly transition to a low-emissions pathway, China could greatly limit its exposure to both physical climate risk and transition risk, and it could tap new sources of economic growth. The country could also help reduce the world's GHG emissions to an extent that almost no other nation can.

China could adopt **a '4+3+3' climate response** centered on mitigation, adapting the country to climate risks and supporting global sustainable economic development.

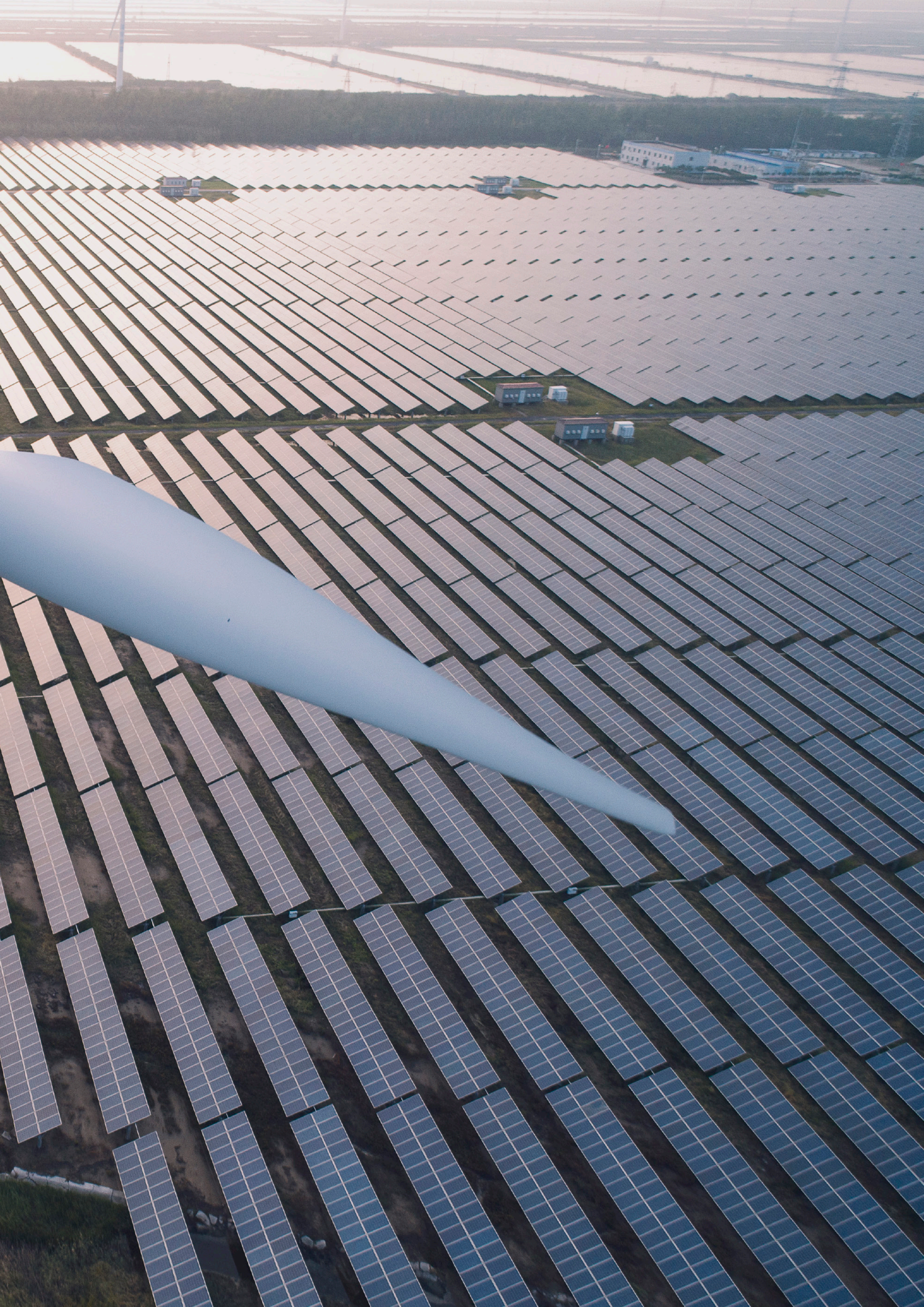
In order to transit to a low-emissions pathway in line with the Paris Agreement, we identified **4 ways for China to mitigate and decarbonize.** First, emissions could be reduced through demand-side measures, which include improving energy efficiency, optimizing industry processes, implementing circular economy measures, and encouraging shift in consumer patterns. Second, power and fuel mix would need to change. Power and transportation account for about a third of China's GHG emissions. Retiring inefficient coal plants and deploying more renewables, ramping up electrification, expanding the use of biomass, and growing the hydrogen market are all important steps. Third, scaling up a carbon-management industry is essential. China could invest in developing carbon capture, utilization and storage (CCUS) technology and further support reforestation. Fourth, non-CO2 emissions, like methane and nitrous oxide, would need to be significantly reduced as well. This includes reforming agricultural and food systems, such as improving fertilization practices, as well as eliminating fugitive methane emissions.

As climate hazards are likely to grow in frequency and intensity, climate adaptation measures are important. There are **3 ways to put resiliency at the core of China's city planning and infrastructure.** First, China needs to develop resiliency planning expertise and factor in physical risks into city planning policies, strategies, and operations across all departments. Second, infrastructure projects need to plan for the changing climate, including climate risk assessments to evaluate potential effects of acute and chronic hazards. Third, financial innovations could be promoted to better manage risks. Instead of relying on post-disaster government relief, climate risk insurance could be helpful to transfer some of this risk exposure in light of extreme weather events.

Lastly, in addition to decarbonizing and adapting at home, China can support sustainable economic development globally. There are **3 ways to support sustainable economic development.** First, China could develop, scale, and transfer low-emissions solutions. As the world seeks to move toward a low-carbon economy, demands for related exports and technologies—such as electrolyzers, sustainable aviation fuels, alternative proteins, and CCUS technologies—could increase dramatically. As it develops low-carbon technologies, China should aspire to be more than a manufacturer. It could provide financial and technological support to overseas customers. Second, it could mobilize capital flows for green projects. Given China's influence, it is well placed to prioritize cross-border green projects, to mobilize investment into green finance, and to encourage other countries to consider the climate impacts of their own infrastructure. Third, and most importantly, China could play a bigger role to support international climate collaborations. Dealing with climate change requires a rapid transition in all sectors, everywhere, at a time when global political leadership is in flux. For China, this is an opportunity to demonstrate its commitment to leading in the low-carbon transition.

In the post-coronavirus world, countries are going to grapple with restarting economies amidst a recession. The "next normal" could reflect an imminent restructuring of the global economic order. However, we cannot afford to leave the climate risk agenda on the table. Climate change is here, with associated physical risks. The next ten years are critical if the world is to meet its climate-change commitments. The fixed "carbon budget" means that the further we delay our actions, the steeper our future decarbonization path would need to be.

Dealing with climate risk will continue to be a top global priority and will force change in many industries. Although this transition will be difficult, it also is a time for China to show leadership in a new, low-carbon economy. The potential is huge.



Introduction

As the COVID-19 pandemic sweeps through the globe, lives and livelihoods are threatened. Yet now more than ever, we need to bear in mind its larger implications. The same forces that have enabled the virus's assault on humanity underlie the larger threat of a changing climate. The current pandemic presents imminent and discrete dangers, while climate risks, by contrast, are gradual and cumulative. This means that a global climate crisis could be far lengthier and more disruptive than the coronavirus pandemic. Moreover, our responses to the pandemic will be critical factors in whether and how we achieve sustainability. In a time where the world faces simultaneous supply and demand shocks, building resilience through a focus on sustainability can and must be consistent with the effort to safeguard our economy and our lives.

Earth's climate is changing, after more than 10,000 years of relative stability. Since the 1880s, the planet's temperature has risen by about 1.1 degrees Celsius (°C).[1] Climate scientists find that almost all countries have experienced increases in average annual temperatures over the same time frame. For example, the portion of the Northern Hemisphere that experiences a substantially hotter summer has expanded from less than 1 percent before 1980 to 15 percent in 2015.[2] Regions affected by climate change will continue to grow in number and size.

As average temperatures rise, acute physical hazards such as heat waves and floods grow in frequency and severity, and chronic hazards, such as drought and rising sea levels, intensify. Physical risks from climate change will continue to increase as long as humans continue to release long-lived greenhouse gasses (GHGs), like carbon dioxide, into the atmosphere. Risks are bound to increase for the next decade, because a certain amount of warming is "locked in" due to past emissions and the thermal inertia of the geophysical system.

For China, climate change is forecast to make the country warmer and wetter. If emissions continue to rise at the current rate,[3] the threats of extreme heat and lethal heat waves could affect 10 to 45 million people. The kind of heavy precipitation that was a once-in-50-years event in 1980 is expected to be two to three times more likely in 2030 and three to six times more likely in 2050.

Preventing further buildup of physical risk and stabilizing the climate will require rapidly reducing GHG emissions and ultimately taking emissions to net zero. The drive toward a low-carbon economy will create transition risks, such as the risk of rapid devaluations of certain companies. The longer that society delays action to address GHG emissions, the greater the buildup. At the same time, the low-carbon transition also creates significant opportunities for those who plan and invest now.

China has mounted a vigorous response to climate risks and opportunities. The country's adaptation agenda has covered infrastructure resiliency, hazard alerts, emergency-relief planning, and other measures. China has topped all nations in renewable-energy investment for seven years and has the most wind and solar capacity of any country. In sectors that use a lot of energy, carbon intensity has dropped significantly.

Doubling down on these initiatives and others to make a rapid and orderly transition to a low-emissions pathway, China could greatly limit its exposure to both physical climate risk and transition risk, and it could tap new sources of economic growth. The country could also help reduce the world's GHG emissions to an extent that almost no other nation can. Taking up this challenge—announcing bold actions and delivering them—could have a powerful catalytic effect on other countries, encouraging them to move more quickly onto a low-carbon path. China has a historic opportunity to affect positive, global change. By taking this opportunity, the country could raise its standing on the international stage.

This paper provides facts and recommendations to inform thinking about how China could respond to climate risk and approach the low-carbon transition. It covers the following topics:

— Part 1 presents a global perspective on physical climate risks, and what adaptation and mitigation measures are needed to shift onto an emissions-reduction trajectory in line with the Paris Agreement.

— Part 2 gives a brief update on China's exposure to climate change through three case studies and its policy responses to date.

— Part 3 sets up recommendations for adaptation and mitigation.

Part 1

Global perspectives on climate change and policy response

Climate science tells us that a certain amount of warming and buildup of risk is locked in, because of what has already been emitted. That fact makes it critical to both address the damage that has already been done and to act today to limit further warming. Climate policy responses can therefore generally be categorized into adaptation measures (for managing near-term physical climate risks) and mitigation measures (for lessening greenhouse-gas emissions eventually reducing them to net zero to reduce future physical climate risk). Both adaptation and mitigation are necessary to avoid the impacts of climate change.

Physical climate risk

Climate risk and response, published by the McKinsey Global Institute (MGI), the business and economic research arm of McKinsey & Company, analyzed how climate change's physical impacts will manifest across five socioeconomic systems:[4]

1. **Livability and workability.** Hazards like heat stress could affect the ability of human beings to work outdoors or, in extreme cases, could put human lives at risk. Heat reduces labor capacity because workers must take breaks to avoid heatstroke and because the body naturally limits its efforts to prevent overexertion. Increased temperatures and a changing climate could also shift disease vectors and thus affect human health (see sidebar, "Does climate change increase the likelihood of disease outbreaks?").
2. **Food systems.** Food production could be disrupted as drought conditions, extreme temperatures, or floods affect land and crops. A changing climate could improve in some areas and degrade food system performance in others while introducing more or less volatility. In some cases, crop yields may increase; in other cases, changes could exceed thresholds beyond which some crops fail entirely.
3. **Physical assets.** Physical assets like buildings could be damaged or destroyed by extreme precipitation, tidal flooding, forest fires, and other hazards. Hazards could even materially affect an entire network of assets, such as a city's central business district.
4. **Infrastructure services.** Infrastructure assets are a particular type of physical asset that could be destroyed or disrupted in their functioning, leading to a decline in the service they provide or a rise in the cost of these services. A range of hazards including heat, wind, and flooding can disrupt infrastructure services. This in turn can affect other sectors that rely on these infrastructure assets.
5. **Natural capital.** Climate change is shifting ecosystems and destroying forms of natural capital such as glaciers, forests, and ocean ecosystems, which provide important services to human communities. This in turn imperils the human habitat and economic activity. These impacts, though hard to model, could be nonlinear and—in some cases, such as glacier melting—irreversible as the temperature rises. For some risks, such as forest fires and water scarcity, human mismanagement may play a role, but their extent and impact are multiplied by climate change.

0.7-1.2
billion people will live in areas with a non-zero chance of lethal heat waves by 2050 (not factoring in air conditioner penetration)

By 2030, all 105 countries examined could experience an increase in at least one major type of impact out of the above five socioeconomic systems by 2030. By 2050, under an RCP 8.5 scenario, the number of people living in areas with a non-zero chance of lethal heat waves would rise from zero in 2019 to between 700 million and 1.2 billion (not factoring in air conditioner penetration). Financial markets could bring forward risk recognition in affected regions, with consequences for capital allocation and insurance. Greater understanding of climate risk could make long-duration borrowing unavailable, affect insurance cost and availability, and reduce terminal values. This could trigger capital reallocation and asset repricing.

Does climate change increase the likelihood of disease outbreaks?
While there is no proven connection between climate change and the COVID-19 pandemic, there is in general a risk that outbreaks of other diseases could become more frequent due to climate change, according to researchers at Stanford University and elsewhere.[5]

As rising temperatures create more hot, humid climates, more parts of the world will provide favorable growth environments for vectors, such as mosquitos, ticks, and flies, that carry such diseases as malaria, Lyme disease, dengue, and West Nile virus.[6] Climate change's effects on food and water security, including heavier rainfall and flooding, can promote the spread of foodborne and waterborne illnesses, such as diarrhea.[7] Perhaps most concerning, thawing permafrost could release microbes and viruses that have been trapped and preserved for thousands of years.[8]

Studies on emerging infectious diseases attribute their increase to human activities, such as climate change and its variability, deforestation and associated biodiversity loss, and biological invasions.[9] In Malaysia, massive deforestation has caused fruit bats to migrate to new areas and food sources, creating conditions for new infectious contacts. Scientists suspected that this, together with the El Niño events, has caused the emergence of the Nipah virus.[10]

Climate change also increases the risk of natural disasters, which can promote disease outbreaks. For example, after a cyclone in 2018, cases of cholera jumped from 5 to 138 in Beira, Mozambique.[11]

Adaptation

Our research shows that four types of adaptation measures are needed and that their pace and scale will likely need to increase significantly (Exhibit 1). The first measure is protecting people and assets. Examples include increasing emergency preparedness, hardening infrastructure and assets, and building protective structures like sea walls. The second type of adaptation measure is building resilience, which involves building excess capacity or diversifying systems to create redundancy and backup—for example, raising inventory levels in production systems or building backup power capacity. The third measure is reducing exposure. It involves limiting exposure of people or assets to areas that are expected to see hazards become more severe or intense. In some cases, it might be practical to relocate assets and communities that are too difficult or costly to protect. Last is insurance and finance. Insurance is a crucial shock absorber to help manage risks, providing system resilience to recover more quickly from disasters and reduce knock-on effects.

Exhibit 1

Four types of adaptation measures are needed.

1

Protecting people and assets
- Increase emergency preparedness
- Harden infrastructure and assets
- Build protective structures like sea walls

2

Building resilience
- Raise inventory levels in production systems
- Build backup power capacity

3

Reducing exposure
- Relocate assets and communities that are too difficult to protect
- Redesign physical asset footprints based on full life cycle

4

Insurance and finance
- Subsidize premiums for vulnerable stakeholders
- Encourage parametrized insurance and catastrophe bonds
- Mobilize finance to fund adaptation measures

Source: McKinsey analysis

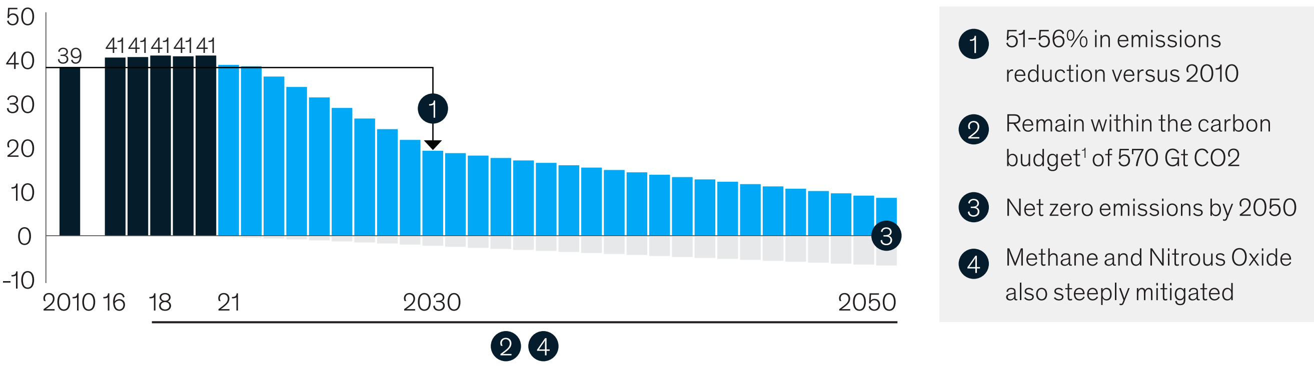
Mitigation

The Paris Agreement, which China signed in 2016, aims to limit global temperature rises to 2°C above preindustrial levels this century and preferably keeping the increase to 1.5°C. The goal of 1.5°C requires staying within a global "carbon budget" of 570 gigatons (Gt) of CO2 (Exhibit 2).

The climate system includes feedback mechanisms that could cause significant further warming (Exhibit 3). Examples include the melting of Arctic permafrost, which could release significant amounts of greenhouse gases; forest dieback that both releases greenhouse gases and reduces or eliminates major carbon sinks; and losses of global ice cover, which would cause Earth to reflect less solar energy.

Exhibit 2

The 1.5°C goal requires limiting carbon dioxide emissions to a global "carbon budget" of 570 Gt CO2.

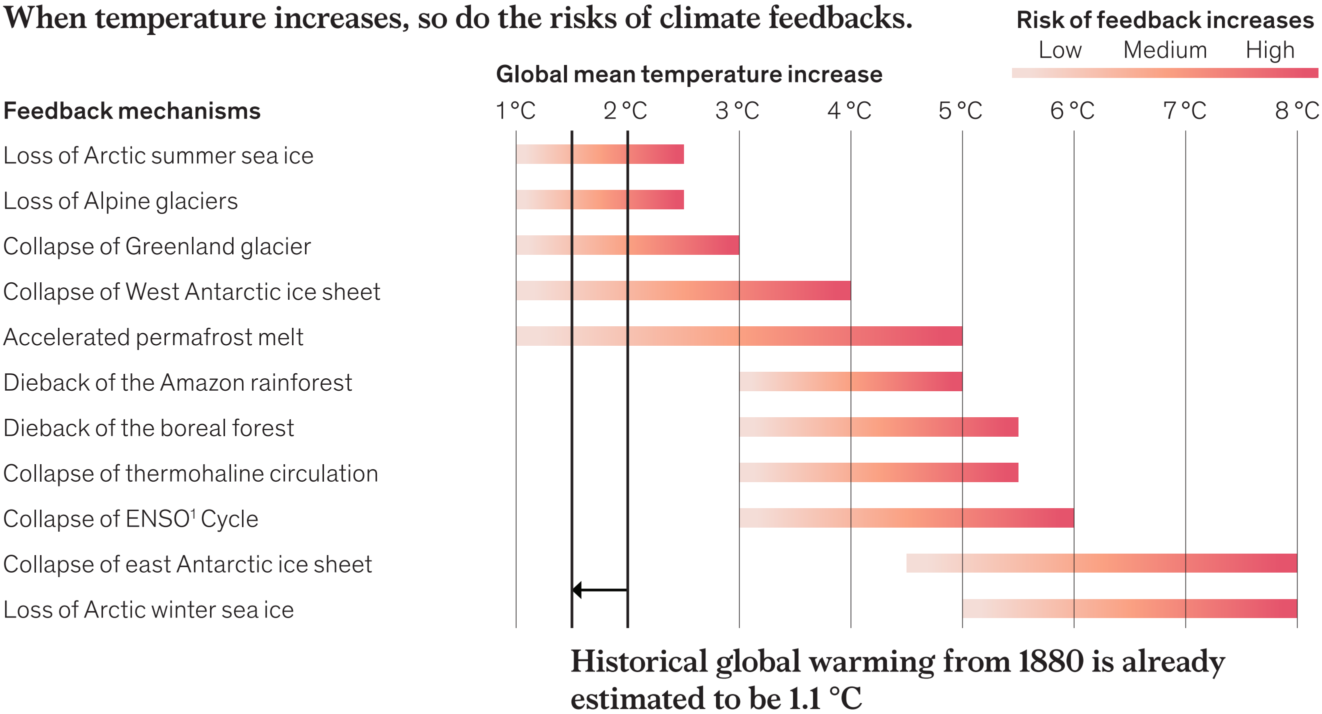


[1] 570 Gt of cumulative CO2 emissions from 2018 for a 66% chance of a 1.5 °C increase in Global Mean Surface Temperature (GMST) - Budget is 420 GtCO2 for a 1.5 °C increase in Air Temperature

Source: McKinsey 1.5C Scenario Analysis; IPCC, Le Quéré et al. 2018

Exhibit 3

When temperature increases, so do the risks of climate feedbacks.



[1] El Niño–Southern Oscillation.

Source: Shellnhuber, J. "Why the right goal was agreed to in Paris." *Nature Climate Change.* (2016); Steffen, W. et al. "Trajectories of the Earth system in the Anthropocene." *Proceedings of the National Academy of Science.* (2018); Lenton T. et al. "Tipping elements in the Earth's climate system." *Proceedings of the National Academy of Science.* (2008). Lenton, T. "Arctic climate tipping points." *Ambio.* (2012); Chadburn, S.E et al. "An observation-based constraint on permafrost loss as a function of global warming." *Nature Climate Change.* (2017). DeConto, R. & Pollard, D. "Contribution of Antarctica to past and future sea-level rise." *Nature.* (2016).

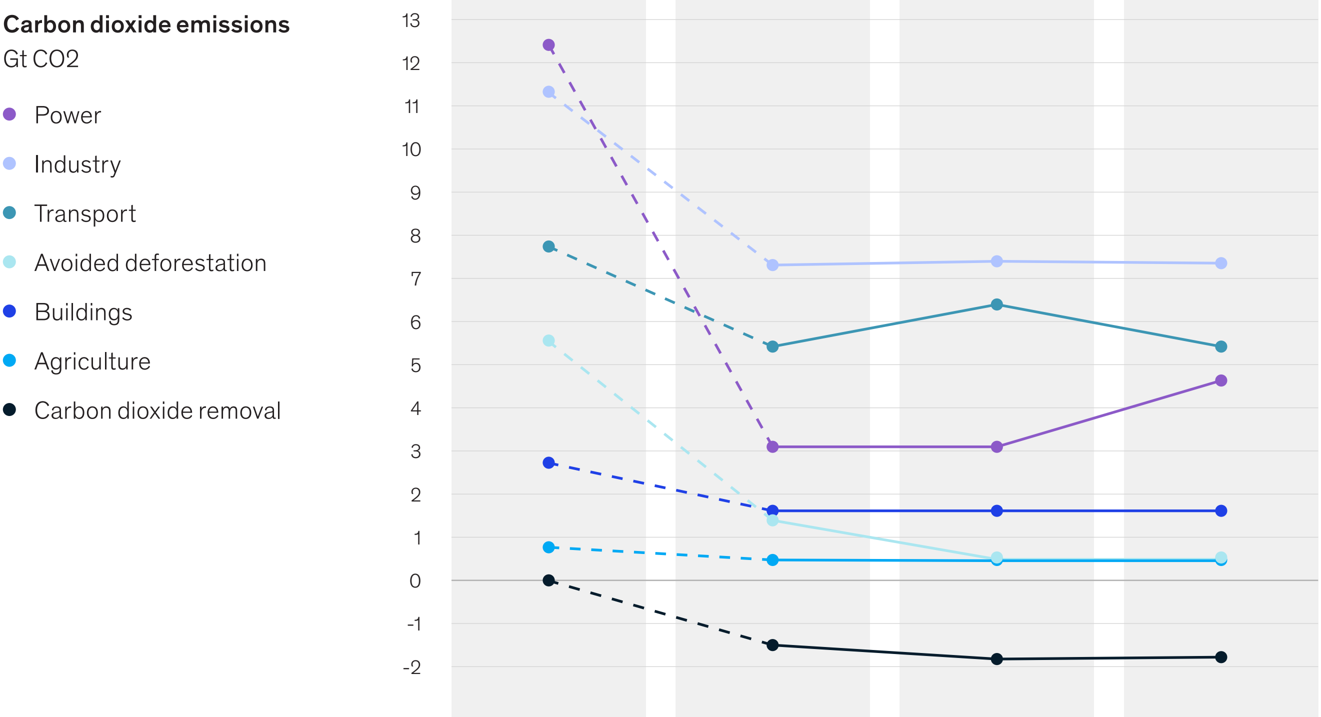
Latest McKinsey research explores the math behind three technically achievable global scenarios for achieving decarbonization in line with a 1.5°C warming target (Exhibit 4).[12] All the scenarios, we found, would imply immediate, all-hands-on-deck efforts to dramatically reduce greenhouse-gas (GHG) emissions. The first scenario frames deep, sweeping emissions reductions across all sectors. Another scenario assumes oil and other fossil fuels remain predominant in transport for some time, with aggressive reforestation absorbing the surplus emissions. The third scenario assumes that coal and gas continue to generate power for longer than the first scenario, with even more vigorous reforestation making up the deficit.

In all scenarios, drastic reduction in global coal-powered electricity generation, by 70 to 80 percent of current levels, is necessary to achieve nearly carbon-free power systems by 2030, which then support decarbonization of other sectors through electrification. In parallel, the use of carbon-capture technologies would need to scale up by more than 50 times from today's level. Given that China accounts for around 45 percent of the world's coal-powered electricity generation, the country has a huge role in decarbonizing the global power system.

Exhibit 4

Three challenging – yet possible – decarbonization scenarios could limit global temperatures below 1.5 °C.

	2016	2030 Scenario A	2030 Scenario B	2030 Scenario C



Decarbonization pace	2016	2030 Scenario A	2030 Scenario B	2030 Scenario C
Coal generation TWh/year	9,585	2,100	2,100	3,200
xEVs sales[1] % of total sales	<1	54	42	54
Captured CO2 via CCUS MtCO2/year	33	1,700	1,700	1,300
Net deforested land Mha/year	14	3	1	1
Additional land reforested for carbon dioxide removal Mha/year	0	11	14	13

[1] Includes sales of BE Vs, FCEVs, PHEVs, and HEVs

Source: Global Energy Perspective – Reference Case 2019; McKinsey 1.5C Scenario Analysis

Part 2

China’s climate exposure and policy response to date

Due to a changing climate, China is expected to continue becoming warmer and wetter. This could mean more, and worse, physical climate hazards such as storms and floods. This is the conclusion from our analysis of how climate risk in China would evolve in a higher-emissions, lower-mitigation scenario.

China's physical climate risk

Climate change is already affecting China. China's *Third National Assessment Report on Climate Change,* [13] led by China's Ministry of Science and Technology, the China Meteorological Administration, Chinese Academy of Sciences and Chinese Academy of Engineering, found that the average temperatures in China have increased up to 1.5°C since 1909, higher than global averages. Sea levels off eastern China rose 93 millimeters between 1980 and 2012, while glaciers shrank 10% between 1970s and early 2000s.

Because China is such a big country, though, there are and will be regional variations. Climate scientists typically divide China into seven regions. By 2050, climate change is expected to have distinct effects on each (Exhibit 5). Some areas are expected to become wetter, others to become drier, and many to get hotter. (In the appendix, three case studies explore how climate risks could evolve in China in a higher-emissions, lower-mitigation scenario through three case studies.)

10-45
million people could be affected by extreme heat and lethal heat waves in China by 2030

Specifically, summer in China will likely last longer and feature more very hot days. A larger share of the population could be living in areas with some annual probability of lethal heat waves.[14] Under those conditions, China would see lower labor productivity and a reduction in the effective number of hours that people can work outdoors. By 2030, the threats of extreme heat and lethal heat waves could affect 10 million to 45 million people. The average share of outdoor working hours lost each year to extreme heat and humidity would increase from 4.0 percent today to as much as 6.5 percent in 2030 and 9.0 percent in 2050—equivalent to $1 trillion to 1.5 trillion in GDP at risk in an average year. East China is expected to have the highest probability of lethal heatwaves, and a relatively large decrease in outdoor working hours (see Appendix: case study 1).

In addition, China is forecast to face a higher likelihood of extreme rainfall, which would increase the share of its capital stock that is at risk of riverine flood damage.[15] The number of people affected by riverine flooding each year is expected to grow from 67.5 million in 2020 to around 83 million in 2050.[16] Statistically, expected average annual losses from both riverine and flash flooding could increase from $35 billion today to $51 billion in 2050.[17] Northwest China will have the highest flood risk of any region (see Appendix: case study 2).

There would be a slight increase in the share of time spent in drought over a decade and some decrease in the risk of water stress.[18] China could see statistically expected yields increase about 2 percent overall by 2050 relative to a 1998–2017 baseline, with some regional variations, including potential yield decreases (see Appendix: case study 3).

Exhibit 5

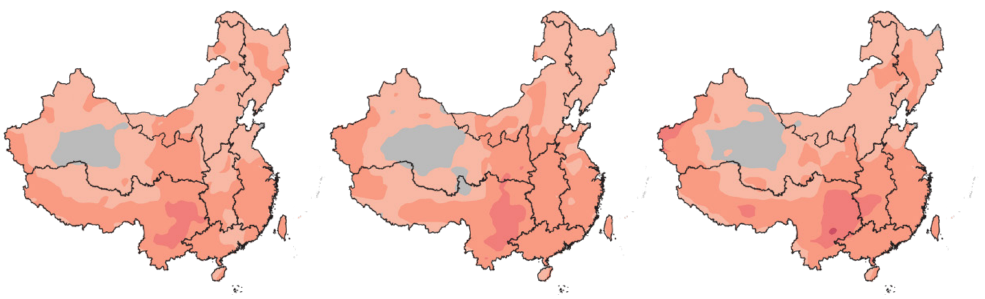
Climate hazards are projected to intensify in China.

Based on RCP 8.5

Seven climate regions of China

Northeast China	North China	Northwest China	Southwest China	Central China	East China	South China
Heilongjiang	Beijing	Gansu	Chongqing	Henan	Anhui	Guangdong
Jilin	Hebei	Ningxia	Guizhou	Hubei	Fujian	Guangxi
Liaoning	Inner Mongolia	Qinghai	Sichuan	Hunan	Jiangsu	Hainan
	Shanxi	Shaanxi	Tibet		Jiangxi	Hong Kong
	Tianjin	Xinjiang	Yunnan		Shandong	Macau
					Shanghai	
					Taiwan	
					Zhejiang	

2020[1] | **2030** | **2050**



Drought frequency[2]
% of decade in drought

0 | 1–10 | 11–20 | 21–40 | 41–60 | 61-80 | >80

Lethal heat wave probability,[3] % p.a.

≤2 | 3–5 | 6–10 | 11–15 | 16–30 | 31–45 | 46–60 | >60

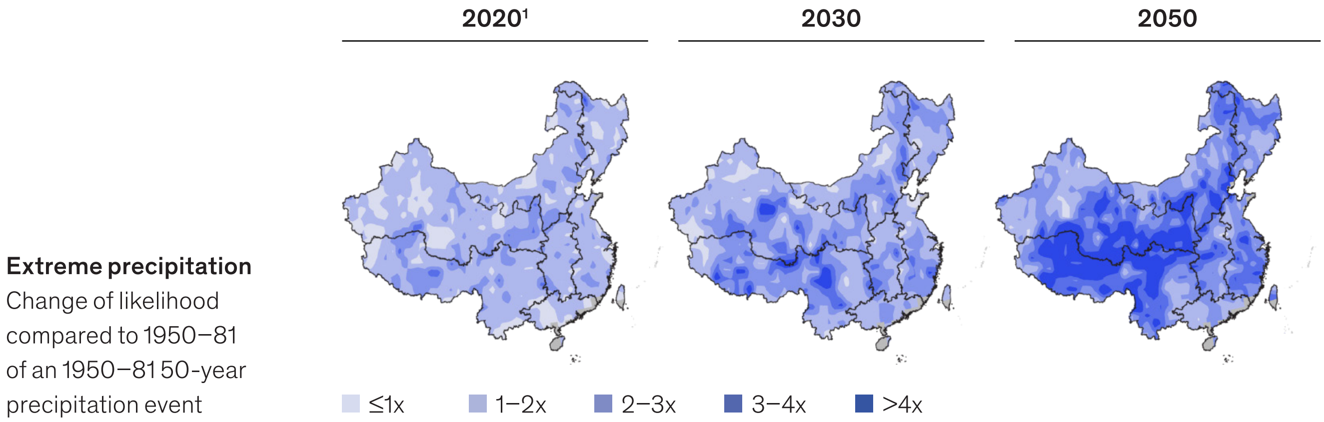
The boundaries and names shown on this map do not imply official endorsement or acceptance by McKinsey & Company.

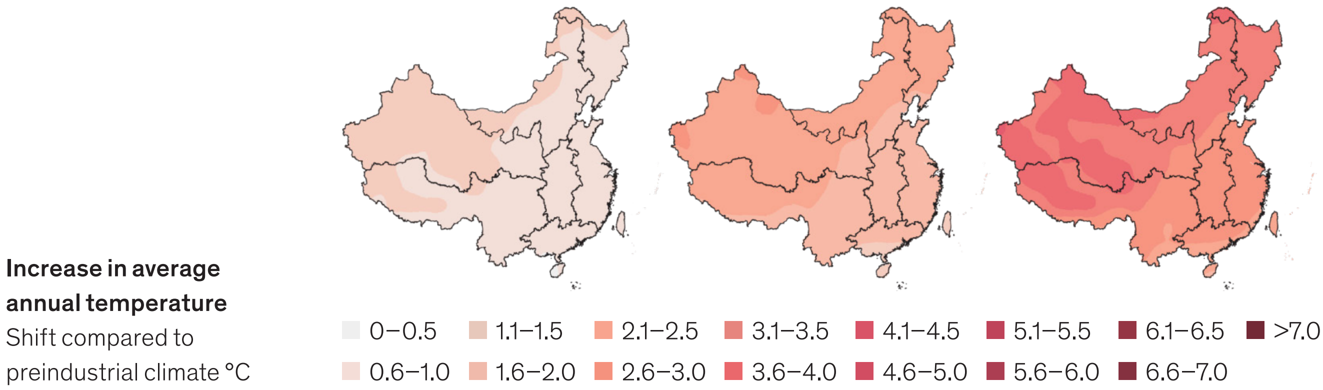
1 Time periods typically refer to 20-year periods. For 2020, we typically use the period 1998-2017, for 2030, we use 2020-2040, and for 2050, we use 2040-2060.

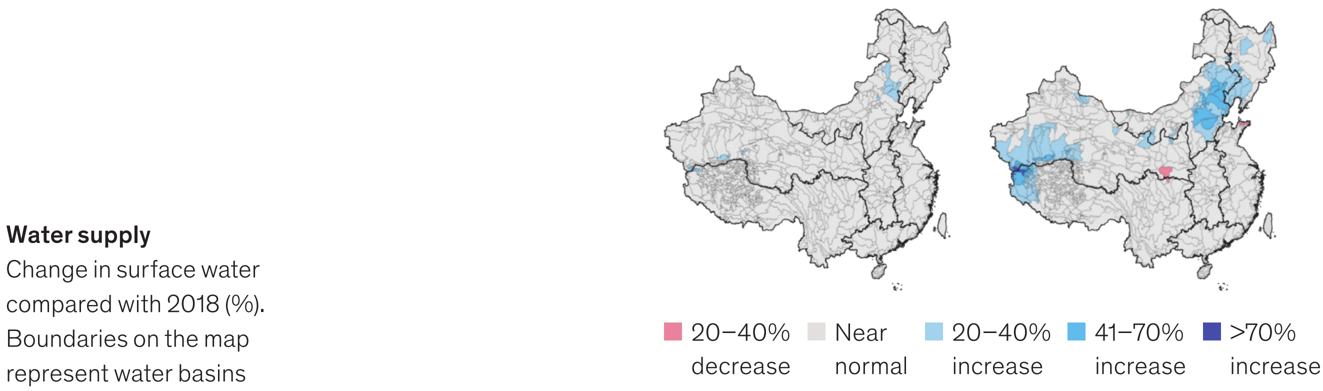
2 Measured using a 3-month rolling average. Drought is defined as a rolling 3-month period with Average Palmer Drought Severity Index (PDSI). PDSI is a temperature and precipitation-based drought index calculated based on deviation from historical mean. Values generally range from +4 (extremely wet) to –4 (extremely dry).

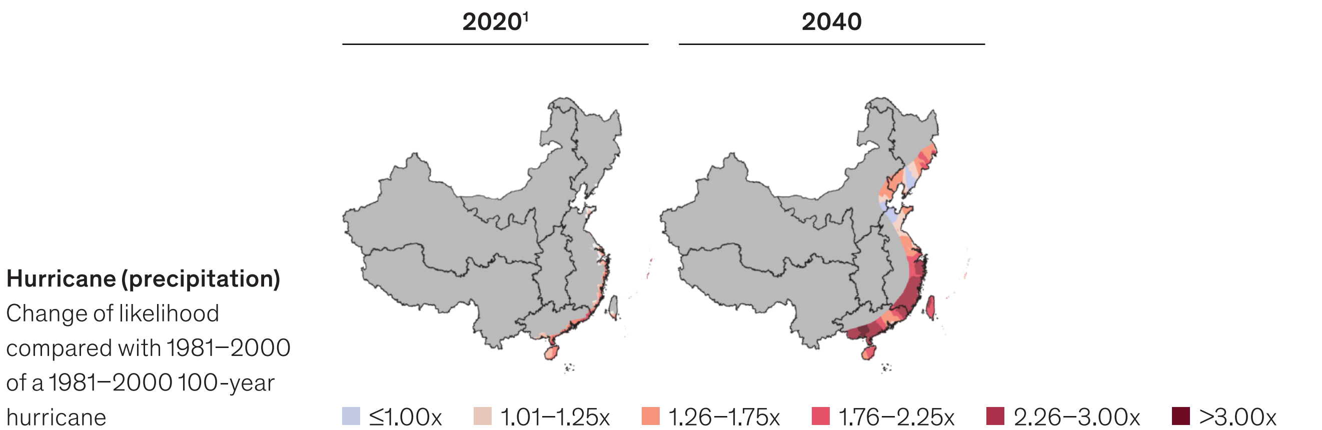
3 A lethal heat wave is defined as a 3-day period with maximum daily wet-bulb temperatures exceeding 34 °C wet-bulb, where wet-bulb temperature is defined as the lowest temperature to which a parcel of air can be cooled by evaporation at constant pressure. This threshold was chosen because the commonly defined heat threshold for human survivability is 35 °C wet-bulb, and large cities with significant urban-heat-island effects could push 34 °C wet-bulb heat waves over the 35 °C threshold. Under these conditions, a healthy, well-hydrated human being resting in the shade would see core body temperatures rise to lethal levels after roughly 4–5 hours of exposure. These projections are subject to uncertainty related to the future behavior of atmospheric aerosols and urban-heat-island or cooling-island effects.

Source: Woods Hole Research Center; World Resources Institute Water Risk Atlas (2018); World Resources Institute Flood Risk Analyzer; McKinsey Global Institute analysis









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Source: Woods Hole Research Center; World Resources Institute Water Risk Atlas (2018); World Resources Institute Flood Risk Analyzer; McKinsey Global Institute analysis

China's policy response to date

China's adaptation measures are crucial for managing its own risks. But China also has the scale and influence to move the needle on global GHG emissions and to help lead the world toward a more stable climate. In important ways, it has already started to do so (Exhibit 6).

On adaptation, having released its National Strategy for Climate Change Adaptation in 2013, China has spent RMB 3.9 trillion on adaptation measures during the 12th five-year plan period (2011–15),[19] equivalent to 1 percent of GDP in 2015.

On mitigation, China has taken many steps toward decarbonization and greening the economy. China has led global investment in renewable energy for seven consecutive years;[20] it has a larger electric-vehicle (EV) market than Europe and the United States combined.[21] By promoting a technological "energy revolution," developing renewable energy, and reforming energy markets, energy-intensive sectors like mining and textile manufacturing have markedly increased their efficiency.

Internationally, China has made important commitments. It co-convened the Global Commission on Adaptation in 2018, which defined eight areas for adaptation solutions, and began its Year of Action in 2019 to advance these solutions worldwide.[22] And when it signed the Paris Agreement in 2016, China pledged to help mitigate future climate risks.

Exhibit 6

China has taken important steps to address climate change.

2013

Release of the National Strategy for Climate Change Adaptation

Publication of the Air Pollution Control Action Plan; this banned the construction of new coal-fired power plants in various coastal provinces

2014

Release of the National Plan on Climate Change (2014–20). This set the target of 700 GW in renewable power by 2020

2015

In its Intended Nationally Determined Contribution (INDC), China pledged to bring carbon emissions to a peak by 2030 and increase the share of nonfossil-energy carriers of the total primary energy supply to around 20%

2016

China pledged $5.1 billion to assist developing countries in addressing climate change and development problems

China signed the Paris climate accords, in which countries agreed to work to limit global temperature rises to 2 °C

2017

The share of nonfossil fuels in China's primary energy consumption rose from 12% to 14.3%

China invested $126.6 billion in renewable energy

2018

China announced it had reduced its carbon intensity 45.8% from 2005 levels, 2 years ahead of its target

Source: Press search

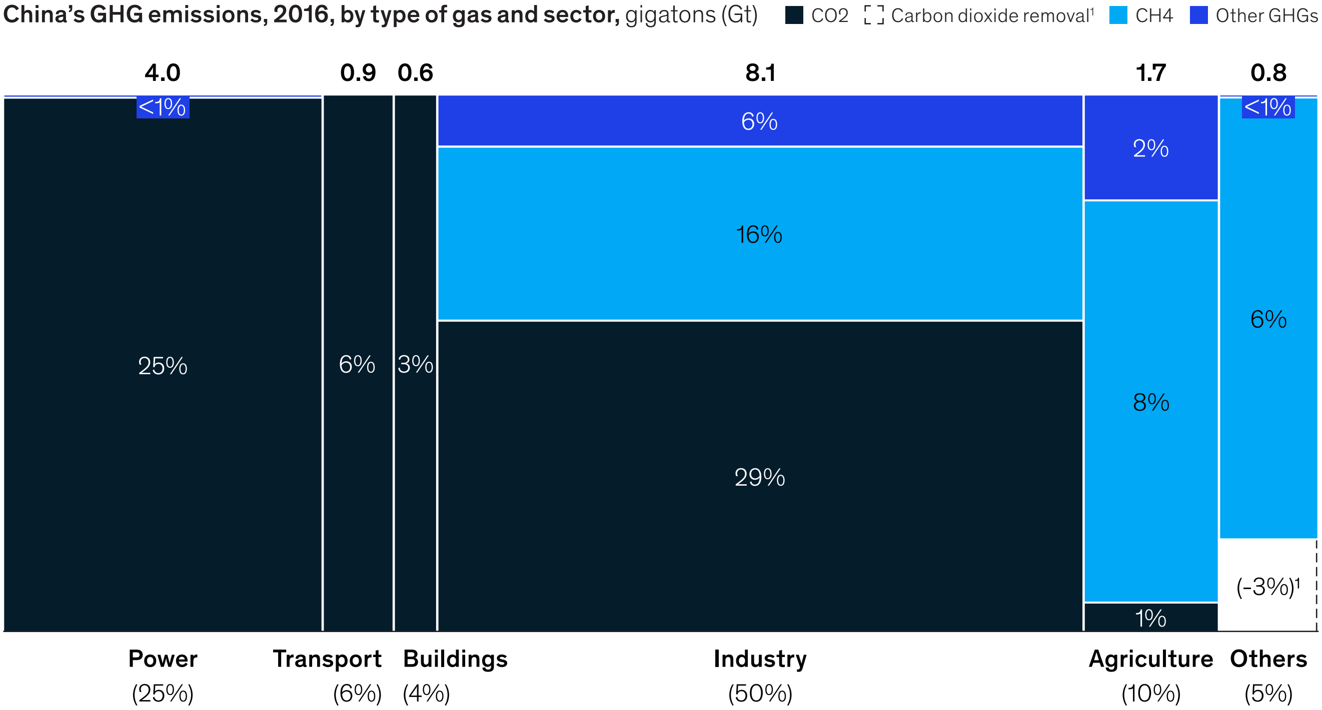
Nevertheless, China still accounts for around 20 percent of global emissions, with net emissions of 16 gigatons (Gt) of CO2 equivalents (Exhibit 7).[23] On a per capita basis, though, China's CO2 emission is less than half of that of United States or Canada[24]. Coal accounted for about 70 percent of China's 2018 total electricity generation, and China increased its coal-fired power capacity 42.9 gigawatts in the 18 months to June 2019, outstripping closures of coal-fired power plants in the rest of the world.[25] In addition, methane (CH4), a powerful greenhouse gas, contributes approximately 30 percent of China's net emissions, mostly from the fossil-fuel value chain, including coal mining, and from food and agriculture (beef and rice).

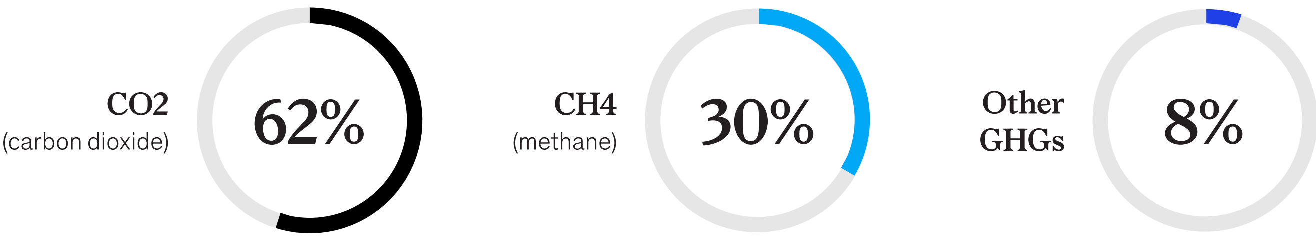
Exhibit 7

China's greenhouse-gas (GHG) emissions reached 16 gigatons of CO2 equivalents.

CO2 makes up for over 60% of total emissions and CH4 adds another third

China's GHG emissions, 2016, by type of gas and sector, gigatons (Gt)





[1] 0.2Gt of net negative emissions includes 0.3Gt of negative emissions from LULUCF and 0.1Gt from other sources (waste, and others).

NB: In addition to energy-related CO2 emissions, emissions from process (eg, from cement production), deforestation, agriculture, waste, and negative emissions are included. Conversely, emissions from biotic feedbacks are not included (eg, permafrost thawing, wildfires).
NB2: Does not include perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).

Source: FAO; EDGAR; Global Energy Perspective – Reference Case 2019; McKinsey 1.5C Scenario Analysis

Part 3

A '4+3+3' climate response for China

China's initiatives are admirable and, in the automotive sector and some others, industry-leading. Nevertheless, given its scale and influence, it can do more. Bold climate leadership could help both China's economy and its environment, and enhance its global role. China could adopt a '4+3+3' climate response centered on mitigation, adapting the country to climate risks and supporting global sustainable economic development (Exhibit 8).

Exhibit 8

China could adopt a '4+3+3' climate response.

4 + 3 + 3

Mitigation: Help with decarbonization

— Reduce demand through efficiency, optimization, and circularity

— Change the power and fuel mix

— Scale up a carbon-management industry

— Lower methane and nitrous oxide emissions

Adaptation: Put resiliency at the core of planning and infrastructure

— Build system resiliency in city and infrastructure planning

— Update planning and risk assessment models for resiliency

— Promote financial innovation to manage climate risk

Support sustainable economic development globally

— Develop, scale and export climate solutions

— Mobilize capital for green projects globally

— Support global climate collaboration

Source: McKinsey analysis

Mitigation: four ways to help with decarbonization

McKinsey has identified four broad categories of requirements, that, if met, have the potential to decarbonize the global economy and thus stabilize the climate. The requirements could be broken down and cascaded into a standard set of sustainability indicators. This could enable Chinese state-owned enterprises and businesses to start incorporating sustainability into their strategic agenda.

Reduce demand through efficiency, optimization, and circularity

There are four categories of demand-side measures that can significantly reduce emissions, including:

a. **Energy-efficiency improvements.** China could be the pacesetter and propose new energy efficiency industry standards in appliances, lighting, electrical equipment and building codes. Take the transportation industry as an example—China could standardize truck tire designs, ship propulsion and hull shape, and aircraft drag to increase the thermal efficiency of internal-combustion engines and to improve aerodynamics. Doing so can lower fossil fuel consumption per kilometer.

b. **Process optimization.** Switching to the best available technologies could reduce energy use, such as dry cement kilns or naphtha catalytic cracking for monomer production in plastics. China should have a clear policy roadmap to incentivize adoption of low-carbon technologies through subsidies, push for economies of scale to drive down costs, and eventually transit to market-based mechanism to expand them at scale. Meanwhile, data analytics could help the transport sector to improve logistics and operational efficiency through, for example, better air traffic management or reduced movement of underutilized trucks and ships. China has lots of expertise in customer-based logistics optimization, such as using digital truck brokers to match outbound and inbound logistics demands. These technologies could be expanded beyond trucking. It could also further improve its algorithms to achieve higher efficiency.

c. **Circular economy measures.** Circular economy aims to design out waste, keep products in use and regenerate natural systems. According to Ellen MacArthur Foundation, it could lower China's cost of access to goods and services and save approximately 5.1 trillion USD in 2030, equivalent to 14 percent of China's projected GDP in 2030.[26] The government plays a key role. Public funding could be used to accelerate the scaling of circular business solutions, such as including relevant criteria in public procurement tenders. Cities should ensure relevant infrastructure–like waste collection systems, treatment and recycling facilities, material banks–is in place to ensure effective recirculation of materials.[27] Furthermore, business practices could be redesigned with circular economy in mind, such as better plastic packaging design to reduce demand for virgin plastics and oil, and scrap steel to bypass the carbon-intensity of processing of iron ore.

d. **Shift in consumer patterns.** The coronavirus pandemic has accelerated many climate-friendly adjustments. Widespread usage of remote communication systems has replaced in-person meetings during the lockdown. In China and rest of the world, the governments could take the lead to encourage these solutions to endure even after the pandemic. Teleworking, reducing long-distance business trips, and switching air travel to high-speed rail travel could help reduce transportation demand and emissions.

Cutting across these measures is the importance of individual behavior. Consumers can use lower-carbon options to travel—train instead of car, rail instead of plane; reduce food waste; less beef and lamb; and opt for environmentally friendly goods, such as EVs, all while reusing and recycling.

Mobilizing the consumer requires raising public awareness of climate change and educating the next generation. This is beginning to happen. Starting in September 2020, the Italian government will require all public schools to administer 33 hours of teaching per year to children in every grade on the topic of climate change and environmental sustainability.[28] In the United States, California has collaborated with Ten Strands, an educational nongovernmental organization, to provide an environmental curriculum to all K–12 students.[29]

China's Ministry of Education could incorporate sustainability-related topics into the curriculum and in relevant subjects in the National College Entrance Examination. Community-based initiatives, such as the existing China Youth Climate-Action Network (CYAN), also can help promote sustainable behavior.

31%
of China's GHG emissions come from power and transportation

Change the power and fuel mix

Power and transportation account for about a third of China's GHG emissions. China cannot decarbonize, then, without massive change in these sectors.

a. **Deploy more renewables.** China is the world leader in solar and wind capacity. That represents tremendous progress. However, the scale of its needs will require that much more be done to reduce power-sector emissions.

Coal still accounts for nearly 70 percent of China's power generation.[30] China must scale up its efforts to retire inefficient coal plants and replace them with renewables, or the world will be unable to meet its climate commitments. As Jiang Kejun, a senior researcher from NDRC Energy Research Institute, said, "Phasing out coal-fired power generation is not as hard as we thought, and it is actually totally doable."[31] His research identified 18 percent of China's coal plants, accounting for 10 percent of China's capacity and mostly located in northern or northeastern China, are suitable for near-term retirement, based on their technical attributes, profitability, and environmental impact.[32]

China could consider a methodical and measured approach to reform its downstream coal industries. It would need to balance regional economic development needs, national energy supply security and environmental impact. Coal-based production is unlikely to be profitable in a future where crude price remains low in a prolonged period of time. Without appropriate reform, there could be significant financial and economical risks to the industry and the region.

b. **Electrify transport, building and industry.** China's EV fleet is the biggest in the world, but it still represents only about 2 percent of the vehicles on the road. Large cities account for most of the sales.[33] China should push to accelerate the sales of EVs. Exhibit 3 shows that xEV sales (including BEVs, FCEVs, PHEVs, and HEVs) would need to be around half of total vehicle sales in 2030, to achieve decarbonization in line with a 1.5°C warming target. To maintain and grow its leadership in this sector, China could be more ambitious and aim to have almost all new car sales in xEV by 2030. This is critical, as a 1.5C pathway implies that by 2030, the majority of vehicle sales globally would need to be electric, including battery, fuel-cell, and hybrid vehicles. Electrification also needs to go beyond vehicles. China could support buildings' energy needs with electricity (or even better, renewables through installing solar panels on rooftops) instead of fossil fuels. Electrifying industrial processes, such as heating, could further eliminate direct fossil fuel use.

c. **Expand the use of biomass, biofuels, and bioenergy.** In some sectors, such as aviation, it will be difficult to move away from liquid hydrocarbon fuels. China can take action to scale production of sustainable aviation fuel (SAF) in two ways. First, build new or convert existing refineries to bio-refineries. SAF production based on hydrogenated vegetable oils, esters, and fatty acids can be scaled up to partially replace fossil kerosene jet fuel. (Note that the source of the feedstock for biofuels is important, to avoid the unintended consequence of deforestation.) Supporting policy via a fuel tax or direct subsidy could encourage SAF adoption. Second, support development of next-generation biofuels. Other biofuel production pathways, such as bioethanol to jet fuel, biomass gasification, and power-to-liquids, are in their infancy. China can support these emerging technologies by funding basic research and start-up phases.

d. **Grow the hydrogen market.** Hydrogen is an inexhaustible energy carrier that can generate heat and electricity with water vapor as the only by-product. Versatile, clean, and safe, it can decarbonize sectors such as long-distance transportation, industrial energy, and building heat and power. It could also complement the use of wind and solar resources, which are intermittent; since hydrogen can be stored, it makes the grid more flexible. Estimates suggest that hydrogen could in theory meet 18 percent of the world's final energy demand in 2050, thereby reducing annual CO2 emissions by about 6 Gt compared with today's technology.[34]

21
million tons of hydrogen was produced in China in 2017, but vast majority was "grey hydrogen"

To build a hydrogen ecosystem in China, it is important to clean up hydrogen production. In 2017, China produced about 21 million tons of hydrogen (one-third of global production).[35] The vast majority was "gray hydrogen," meaning that it was produced from fossil fuels, a process that emits CO2. To support decarbonization, hydrogen production would need to be done differently. "Blue hydrogen" is an option; this uses existing processes but adds carbon capture. "Green hydrogen" is, via electrolysis, using renewable power sources. The cost of green hydrogen is still high but coming down quickly, due to cheaper renewables and electrolyzers.

Government support is crucial to begin the transition to blue and green hydrogen. For example, expanding China's emission-trading system to cover industrial production would encourage a shift from gray hydrogen. Nonfinancial measures could be effective—for example, working with industry leaders to set targets for low-carbon hydrogen production. These would help acknowledge the important of hydrogen and scale it up as an attractive alternative for industrial heating. This could offer dramatic decarbonization opportunities for industries like steel, aluminum and cement.

For hydrogen to gain widespread use, China must also rapidly expand its distribution network, including pipes and filling stations for fuel-cell-powered vehicles (FCEVs). The China Hydrogen Alliance expects that only 100 refueling stations will be installed by the end of 2020—not many, considering China's vast size.[36]

Hydrogen production and distribution infrastructure, funded by a combination of public and private sources, should be constructed regionally, based in clusters instead of centrally, considering the need for extensive pipes to distribute hydrogen. Provincial governments could work together to map out hydrogen supply locations and pipe systems and build control centers to oversee production and develop common standards. The central government can help facilitate these efforts among provincial governments, such as by standardizing fueling nozzles.

Scale up a carbon-management industry

a. **Expand CCUS.** At the moment, CCUS is costly and limited; storage and transport infrastructure are limited. Through rapid iteration and testing of carbon capture at industrial sites and coal plants, China could become a CCUS leader.

   CCUS retrofits can prevent more than 90 percent of CO2 emissions from entering the atmosphere; the collected gas must then be sequestered or put to productive use. If CCUS is to make a difference, the next few years will be a critical time to improve the technology, build supporting infrastructure, and lower costs. Ultimately, power plants with CCUS could be combined with bioenergy, resulting in negative-emissions power generation. Several CCUS projects are in place in China, but these efforts are tiny relative to the scale of the need. Moreover, regulatory uncertainty and high costs have limited CCUS development, in China and elsewhere.[37]

   On the policy side, China's existing CCUS regulatory framework is insufficient to support this ambition[38]. There is no legislation related to CCUS in China (only guidelines and outlines), resulting in a lack of legal responsibility. Most policies concentrate on the storage component of CCUS and neglect the capture and transportation components. Also, the approval process is complex, because CCUS is an integrated technology and does not fit into the management of one department. China could prioritize CCUS legislation, to cover the entire spectrum of CCUS and simplify its approval process to encourage larger-scale deployment.

   High capital costs are the biggest barrier. Without a direct tax stimulus policy or other support, it is difficult for CCUS projects to be economically feasible. China could set up specific funding to boost research and deployment or target subsidies to electricity produced via CCUS plants. Once China achieves economies of scale, these financial supports could be cut back.

b. **Stop deforestation and support reforestation.** Deforestation is a significant challenge globally, but it is comparatively less serious in China, thanks to logging bans and monitoring programs. China's forest cover increased by more than 46,000 square miles between 2000 and 2010.[39] On one hand, China could play a critical role in ending global deforestation. Brazil and Democratic Republic of Congo are the top two countries losing the most tropical primary rainforest in 2018.[40] They also happen to be the top destinations for China's FDI in Latin America and Africa respectively, accounting for 55 billion and 12 billion USD from 2005-2017.[41] China could leverage its relationships and influence in current deforestation hot spots. On the other hand, there is great opportunity for China to export its afforestation expertise. China has successfully turned one-third, or 6,000 square kilometers, of Inner Mongolia's Kubuqi desert green. The project is now estimated to be worth $1.8 billion USD over 50 years.[42] Teams from Saudi Arabia and Pakistan were also attracted to study China's desert greening techniques. These expertise could help support afforestation efforts globally.

Lower methane and nitrous-oxide emissions

Methane (CH_4) and nitrous oxide (N_2O) are greenhouse gases that make the second- and third-greatest contribution to climate change, respectively. Methane has a particularly acute impact in the near term, and in a 1.5°C scenario, it would need to fall globally approximately 35 percent by 2030 and 65 percent by 2050.[43] Methane has a much shorter lifetime in the atmosphere than CO_2, but is a far more potent greenhouse gas. Reducing its emissions, then can play a disproportionate role in limiting near-term temperature increases and reducing the risk of irreversible climate feedbacks or tipping points.

a. **Reform agricultural and food systems.** Globally over a 20-year time frame, agriculture, forestry and land-use change account for approximately 27 percent of global GHG emissions,[44] almost as much as industry. Since 2000, China's agriculture production emissions have increased 16 percent; it is now the largest agriculture emitter in the world.[45] Doing better will require changes in production and consumption systems. McKinsey has identified 25 GHG-efficient farming technologies and practices.[46] Two are particularly relevant for China.

   First, improve fertilization practices in rice cultivation. China's rice-based diet means it accounts for 29 percent of global rice consumption[47] and 28 percent of production. Flooded rice paddies provide ideal conditions to produce methane.[48] Improved fertilization practices in rice cultivation,[49] better rice-paddy water management, and expanded adoption of dry direct seeding could reduce methane emissions in the sector by about 40 percent. Encouraging shifts to these practices, through subsidies on equipment or penalties on methane emissions, could mean a huge deal to China and the world.

24%
of agriculture emissions could be saved by Chinese farmers, if they were to apply nitrogen fertilizer at the same level as farmers in the US

   Second, reduce the use of nitrogen fertilizers. Chinese farmers use an average of 305 kilograms of nitrogen per hectare per year—more than four times the global average.[50] What makes dealing with this difficult is that 99 percent of Chinese farms are smaller than five hectares, a much higher percentage than in the rest of Asia or Europe.[51] To change Chinese farmers' behavior will require engaging them individually. Nevertheless, this can be done and will prove worthwhile. Applying nitrogen to levels seen in the United States could cut agriculture emissions 24 percent and save farmers $22 per hectare. Yields could also improve. The government can further expand its organic fertilizer subsidy scheme,[52] thereby encouraging farmers to replace or scale back traditional nitrogen fertilizers.

   The other side of the good equation is to consider food consumption. China could become competitive in the emerging alternative-proteins industry and begin to shift consumption toward cleaner and healthier foods. Ruminant animal protein, like beef and lamb, produces pre-farm gate emissions at levels that are about ten times as much as poultry or fish. In general, China is expected to consume more meat over the next decade. By 2028, per capita beef consumption is expected to be 4.1 kilograms per capita, making China the second-largest beef market, after the United States.[53] Because beef consumption in China is much less than that of other markets on a per capita basis, it will be easier to educate and shape consumption behaviors now and limit the rise in demand for beef before new habits are formed.

b. **Eliminate fugitive methane emission.** About a third of China's fugitive emissions is generated through its coal sector,[54] further supporting the case for reducing its use. There is also an opportunity to reduce fugitive methane in the oil-and-gas industry, where most actions are profitable and relatively easy. This includes substituting Kimray pumps with electric pumps and detecting and repairing small distributed leaks.

Adaptation: three ways to put resiliency at the core of city planning and infrastructure

The coronavirus pandemic highlights the important need for resiliency—the ability to absorb a shock. Both pandemics and climate risks represent physical shock, which translate into an array of socio-economic impact. As countries restart the economy to save lives and livelihoods in a post-coronavirus world, it is also critical to build a much greater economic and environmental resiliency as part of the recovery ahead. As we discussed previously, climate hazards are likely to grow in frequency and intensity, given the “locked in” global warming from past emissions. China needs to limit its risk and safeguard vulnerable populations. Doing so will require the concept of environmental resiliency to be at the core of city planning and infrastructure projects. This principle and the following suggestions can also be applied to agricultural and natural systems.

Develop resiliency planning expertise

To make Chinese cities resilient, officials need to factor in physical risk into their policies, strategies, and operations across all departments—housing, transportation, water, sewers, and so on. This will require embedding a focus on resiliency at the heart of city planning. Cities will need to systematically assess their exposure to physical climate risk. Systems might need to be redesigned to strengthen protection—for example, building defenses like sea walls or elevating buildings, decentralizing power systems and water grids, and driving up insurance penetration as a shock absorber to transfer risks and offer timely relief support.

The resiliency mind-set must be at the heart of city planning. There are efforts to promote this idea. The Rockefeller Foundation’s 100 Resilient Cities initiative, which ran from 2013 to 2019, provided cities with capacity building, funding, and technical support to assess and plan for a wide range of risks, including those related to climate.[55] Two Chinese cities, Huangshi and Deyang, participated in the 100RC initiative and have developed their physical resilience strategies accordingly. Meanwhile, a number of cities, including Cape Town, Chicago, London, New York, and Rotterdam, have created resilience strategies. For example, the Lower Manhattan Coastal Resiliency (LMCR) project aims to reduce flood risk from storm surges and sea-level rises through 2100.[56]

China’s NDRC could play a role in creating a resilience playbook to help cities measure their climate resiliency and to identify areas of particular urgency. The tool kit could help cities define resiliency initiatives and create a network of experts. To help with implementation, NDRC could provide technical support and help build local government capabilities. NDRC could also coordinate with the Ministry of Housing and Urban-Rural Development and the Ministry of Ecology and Environment to identify cities, to pilot specific programs and convene a resiliency council to support their work.

Update planning and risk assessment models for resiliency

$6
in future costs could be saved by every dollar invested in building resilient infrastructure

Infrastructure projects need to take the changing climate into account, managing for risk over the lifetime of the asset. That means building for resiliency from the start, so that the asset does not break down or get disrupted if disaster strikes or conditions change. In the long run, prevention is cheaper than repairing the damage after a major event.[57] Every dollar invested in building resilient infrastructure saves an estimated $6 in future costs.[58]

One approach is to include probabilistic forward-looking modeling of physical-climate impact assessment in all infrastructure projects. This would enable planners to design for resiliency. For example, South Africa conducted a climate risk assessment when it began planning the expansion of the Port of Durban. As a result of this work, planners made the port higher to cope with the possibility of rising sea levels and developed a plan to deal with heavier rainfall and winds.[59]

Climate risk assessments need to evaluate what effects acute hazards like flooding could have on infrastructure assets and also on the possible effects of chronic hazards like rising heat (for example, reduced efficiency of power transformers and the grid). Once such assessments are done, there are many ways to respond, such as reinforcing or elevating structures, erecting physical barriers, increasing backup capacity, and relocating assets to less vulnerable areas.

China already requires environmental-impact assessments (EIAs) for new infrastructure projects. These focus on water, air, noise, and wastes; there is no requirement to track GHG emissions or to assess resiliency. China could revise its EIA regulations and bring them up to the highest international standards. For example, EU regulations assess both the project's likely impact on climate change and the attendant climate risks a project could be exposed to; the EIA can order that projects be modified to be more resilient.[60]

Given the complexity of climate risk assessments, it might make sense for China to start with pilot projects in regions facing the highest level of climate risk. That would allow local governments to learn from experience and to figure out what capabilities, such as data collection and risk modeling, they need to develop.[61]

Existing infrastructure stock also is important and needs to be hardened against climate risks. China should conduct a careful assessment of the key risks facing existing infrastructure. Then it could implement relevant hardening policies, with careful consideration of what measures to undertake and when, based on asset turnover and maintenance cycles.

Promote financial innovation to better manage risk

As Chinese cities prepare for resilience, insurance protection needs to be part of their planning. Extreme weather events are economically costly and socially destabilizing. Counting on the sovereign to backstop all risks is not sustainable – increasing physical climate risks means that total potential risks could be even larger than the Chinese GDP.

Instead of relying on post-disaster government relief, there is an opportunity to transfer some of this risk exposure to insurance. Climate risk insurance could be helpful in several ways. It creates cash flow for people who need it, while protecting government finances. It can also help governments plan for unexpected hazards. Finally, it might encourage the construction of more resilient projects: better-protected assets require a lower insurance premium.[62] In developing climate risk insurance, public authorities and the insurance industry would have to make sure the right regulatory and financial framework is in place.

Protection could come in three levels: micro (individuals and businesses); regional (municipalities and provinces); and sovereign. A wide variety of investment structures could be developed, including traditional loss-based insurance but also catastrophe bonds or weather derivatives, which transfer the risk to institutional investors on the financial markets. The value of these alternative solutions is determined by a weather index, like temperature, windspeed, rainfall or snowfall. Given these complexities, expertise and systematic effort from government, regulators, and the private sector both within China and internationally. Access to global insurance markets is crucial in order to diversify risks.

China has a long way to go in this regard.[63] Take agriculture insurance. Penetration (premiums as percentage of agricultural GDP) is only 30 percent of the global level, while coverage (insurance amount over total value of assets) is only half of that of the United States.[64] Overall, while it has been growing, China's insurance penetration is only 4 percent, half the global average,[65] and natural-catastrophe coverage is underdeveloped.

Support sustainable economic development globally

In addition to decarbonizing and adapting at home, China can support sustainable economic development globally. By developing low-emissions solutions, mobilizing capital flows for green projects, and supporting international climate collaboration China's actions at home can have a global impact.

Develop, scale, and transfer low-emissions solutions globally

As the world seeks to move toward a low-carbon economy, demands for related exports and technologies could increase dramatically. China already leads the world market for solar photovoltaic (PV) panels and is seeing growing demand for wind turbines, batteries, and electric vehicles. China should look ahead and align its technology investments to what the world will want next. Specifically, China could see investment opportunities for the following products and services to address the global need for climate solutions:

— Alternative proteins and other solutions to reduce methane emissions from livestock

— Electrolyzers, fuel cells, and the supporting infrastructure and components that will be crucial for sustainable hydrogen production

— Carbon capture, use, and storage (CCUS), which will be needed for decarbonization of industry

— Sustainable aviation fuels, likely derived from organic waste or bioenergy initially

— Batteries and electricity storage technology, building upon China's expertise in electric vehicles

These technologies are for the most part also critical for China's own mitigation responses. By deploying them domestically China can reduce their economic risk and support other countries that are seeking to reduce emissions of their imports and companies seeking to reduce emissions in their value chains (known as Scope 3 emissions).

As it develops low-carbon technologies China should aspire to be more than a manufacturer. China should actively support the adoption of low-carbon technologies by providing financial and technological support to overseas customers. Doing so would support both the development of global scale for Chinese corporations and the accelerated achievement of mitigation goals.

Mobilize capital for green projects

In both inbound and outbound foreign direct investment, China ranks second globally.[66] That makes it a major player. It could use its influence to encourage investment in adaptation and mitigation projects.

China is well placed to prioritize cross-border green projects; to mobilize investment into green finance; and to encourage other countries to consider the climate impacts of their own infrastructure. China could consider including stricter, legally-binding environmental requirements into cross-border deal terms. It could also revise the Ministry of Commerce's list of "encouraged sectors and negative list". Explicitly including green sectors, such as renewable energy, and excluding activities like coal production would send a much stronger signal to host countries to step up their green game.

Support international climate collaboration

Dealing with climate change is the challenge of the 2020s. It requires a rapid transition in all sectors, everywhere, at a time when global political leadership is in flux. For China, this is an opportunity to carve out a new role. China could make bigger and bolder commitments, to demonstrate its commitment to the transition to a low-carbon world. That would be good in and of itself; it might also inspire others to follow suit. Leading global climate initiatives could take many forms.

First, China could support international discussions to set standards on effective carbon mechanism and pricing. China, together with rest of world, could rethink the optimal international carbon mechanism, be it an emission trading scheme or a carbon tax system. If the cost of carbon reduction in China is lower than that of the developed world, a global carbon pricing scheme could be beneficial. This means that China's carbon price likely needs to go up.[67] It also means that China would need to consider expanding its scheme to more sectors and provinces, while exploring the potential of a "tax neutral" scheme – a carbon tax to replace same existing taxation, so net tax could be lower if businesses manage to reduce emissions.

Second, China could shape development financing and help support a low-carbon future globally. It could drive collaboration among multilateral development banks through the Asian Infrastructure Investment Bank (AIIB). It could also actively look into leadership roles through the World Bank and other development banks. Aiming to be "lean, clean and green", one of AIIB's goal is to invest in sustainable infrastructure and help develop a green economy.[68] Development banks can jointly review and define more stringent standards based on Paris Agreement, then reform and implement their energy, transport and sustainable city investment strategies.

Third, China could expand its involvement in international trade groups to elevate the climate agenda within sectors. Many have called on businesses to align their trade associations' climate policy advocacy to be consistent with the goal of net-zero emissions by 2050.[69] Chinese businesses could play a leading role to orchestrate changes in sectoral practices.

~80
countries have committed to cut GHG emissions to net zero by 2050

Last, China could set bolder international ambitions too. A net-zero commitment—that is, to cut GHG emissions to net zero by 2050—could be an area for discussion.[70] As of December 2019, about 80 countries, including almost all of the European Union, have taken this pledge. By taking a leading role in climate and sustainability issues, China can position itself as a strategic partner.

...

In the post-coronavirus world, countries are going to grapple with restarting economies amid a recession. The "next normal", as we argued, could reflect an imminent restructuring of global economic order.[71] However, we cannot afford to ignore the climate risk agenda. Climate change is already here, with associated physical risks. Dealing with climate risk will continue to be a top global priority and will force change in many industries. The next ten years are critical if the world is to meet its climate-change commitments. The further we delay our actions, the greater our physical risk and the steeper our future decarbonization path would need to be.

Appendix

Case studies on the effects of physical climate risks in China by 2050

The following three case studies illustrate how, using the five-system framework (see Part 1), near-term physical climate risks could affect China.

Case study 1: Extreme heat lessens China's livability and workability

Extreme heat and humidity can have a dramatic effect on people's health and ability to work outdoors. Pushing the human body's core temperature above its optimal level of 37°C causes rapid declines in performance. The core temperature needs to rise only 0.2°C to compromise one's multitasking ability and 0.9°C to compromise neuromuscular coordination; 3°C induces heatstroke, and 5°C can mean death.[72]

Hot weather is not new to China. What is different is that climate change could bring more, and deadlier, heat waves. In the summer of 2019, the China Meteorological Administration issued a "yellow warning" for regions south of the Yangtze River in southeastern and southern China. Major cities in this area, including Shanghai and Chengdu, suffered temperatures of more than 40°C.[73] At average humidity of 50 percent, temperatures above 40°C are equivalent to 31°C in "wet-bulb" temperature (a metric that incorporates both heat and humidity). The lethal wet-bulb temperature is 35°C. At that level, healthy, well-hydrated adults resting in the shade can see their core temperatures rise to deadly levels after four to five hours.[74]

110-250

million could be exposed to extreme heat and lethal heat waves by 2050

Today, no Chinese regions are prone to lethal heat waves; climate change could greatly increase the likelihood. By 2030, extreme heat and lethal heat waves could affect ten million to 45 million people. The average person in that group could have a roughly 25 percent chance of experiencing a lethal heat wave at least once in 2025-2035 (without factoring in air conditioning). The number of people exposed to extreme heat and lethal heat waves could climb to 110 million to 250 million by 2050. For them, the probability of being exposed to a lethal heat wave at least once in 2045-2055 could increase to 35 percent.[75] A hotter China will be a less livable China. One way to adapt is to increase air conditioner penetration, currently 60 percent.[76] However, unless the greenhouse-gas intensity of air-conditioning technology can be reduced, more air-conditioning could also mean higher emissions.

Another hazard is chronic exposure to extreme heat and humidity, which can reduce labor productivity and the number of hours that people can work outdoors. In hot, humid conditions, workers must take frequent breaks to avoid heatstroke, and their bodies tire more quickly. Such effects could fall on more than half of China's working population: 26 percent work in the agricultural sector,[77] and 28 percent of industrial employment takes place at least partially outdoors. MGI estimates that for China, the average share of outdoor working hours lost each year to extreme heat and humidity would increase from 4.0 percent in 2020 to as much as 6.5 percent in 2030 and 9.0 percent in 2050 (Exhibit 9).[78] As a result, the share of China's GDP lost to heat and humidity could double from 1.5 to 3 percent by 2050—equivalent to $1 trillion to $1.5 trillion in GDP at risk in an average year.[79]

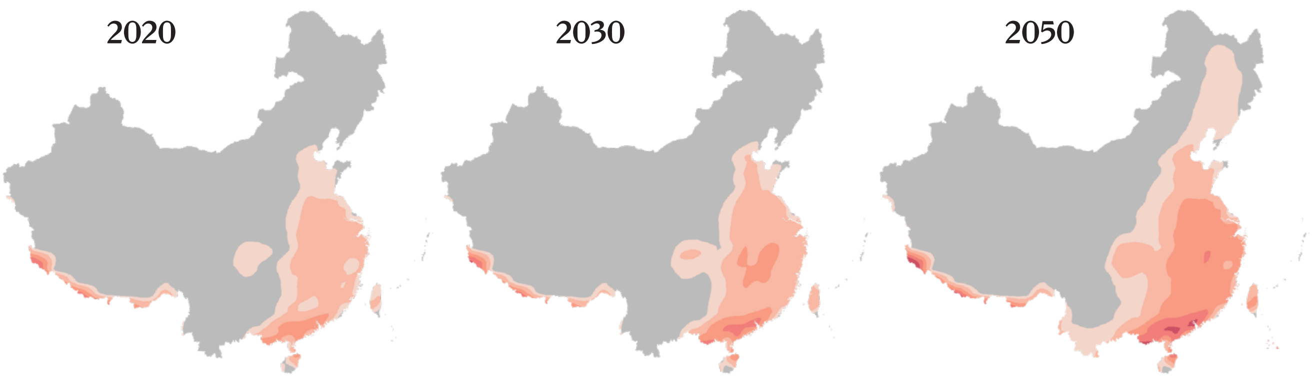
Exhibit 9

More working hours are lost as temperatures rise.

Based on RCP 8.5

≤5 | 6–10 | 11–15 | 16–20 | 21–25 | 26–30 | 31–35 | 36–40 | >40

Share of lost working hours[1]



The boundaries and names shown on this map do not imply official endorsement or acceptance by McKinsey & Company.

[1] Lost working hours include loss in worker productivity as well as breaks, based on an average year that is an ensemble average of climate models.

Source: Woods Hole Research Center

Case study 2: Heightened flood risk threatens people, property, and infrastructure.

In Chinese folklore, Yu the Great tamed flooding rivers with a system of controls that helped irrigate farmlands. In modern times, too, China is well acquainted with the reality of floods. Since 1990, the country has absorbed about $1 trillion in flood-related economic losses.[80] Each year from 2008 to 2018, floods harmed an average of nine million hectares of cropland and killed 760 people.[81]

Climate change could make floods more common. Researchers estimate that climate change doubled the flood risk that led to the 2017 floods in Hunan province, which threatened the livelihoods or destroyed property of 11.6 million people, resulting in $7.2 billion in direct economic losses.[82] In July 2018, heavy rains inundated the Sichuan basin and parts of northwest China, causing floods and mudslides. Across Sichuan, Shaanxi, and Gansu provinces, 6.1 million people suffered direct damages to their lives and livelihoods (including 25 deaths), and economic losses were estimated at $4.8 billion.[83]

$51

billion could be lost on average annually from both riverine and flash flooding in 2050

MGI analysis shows that climate change is likely to further increase China's flood risk. The chance of flash floods is expected to increase three to four times in parts of western China (Exhibit 10). Overall, the country's five-day rainfall average is expected to increase 25 percent by 2050.[84] The additional precipitation will have pronounced effects in the Yangtse and Minjiang river basins.[85] Considering today's level of flood protection, the number of people affected by riverine flooding each year is expected to grow from 67.5 million in 2020 to around 83 million in 2050.[86] Average annual losses from both riverine and flash flooding could increase from $35 billion today to $51 billion in 2050.[87]

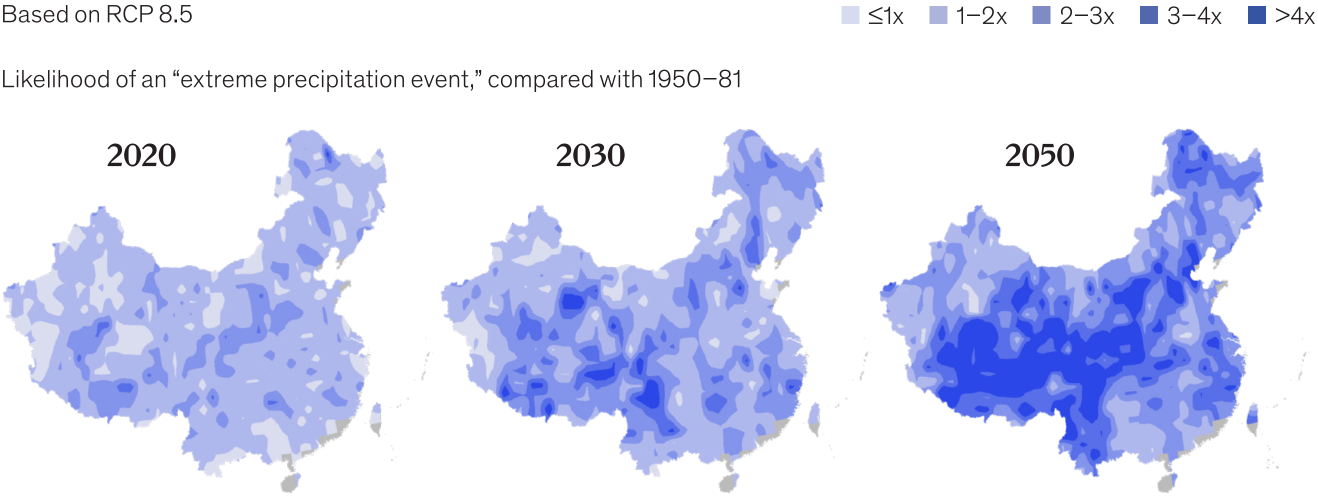
Like other climate hazards, flooding can also have significant knock-on effects. For example, most mining of heavy rare earths takes place in China's southeastern region. There, the annual likelihood of rainfall heavy enough to trigger mine and road closures is projected to rise from about 2.5 percent today to 4 percent in 2030 and 6 percent in 2050.[88]

Exhibit 10

The risk of a once-in-50-years extreme precipitation event is likely to intensify.

Based on RCP 8.5

Likelihood of an "extreme precipitation event," compared with 1950–81



The boundaries and names shown on this map do not imply official endorsement or acceptance by McKinsey & Company.

Source: Woods Hole Research Center

Case study 3: Climate change could bring higher crop yields but also increase volatility

Climate change's effects on agricultural systems will differ from place to place. In general, climate change is expected to increase the volatility of crop yields. Rice, wheat, corn, and soybeans make up almost half the calories of an average global diet. Three of these crops—rice, wheat, and corn—could experience increases in the risk of a significant yield decline in China by 2030. Only soybeans could see lower risk (Exhibit 11).

A yield shock in China could have significant knock-on effects, given that it produces 28 percent of the world's rice, 24 percent of its corn, 18 percent of its wheat, and 4 percent of its soybeans. Since the world has built up a global stock of grain,[89] a yield shock in China would probably not lead to food shortages, but it could trigger higher prices.

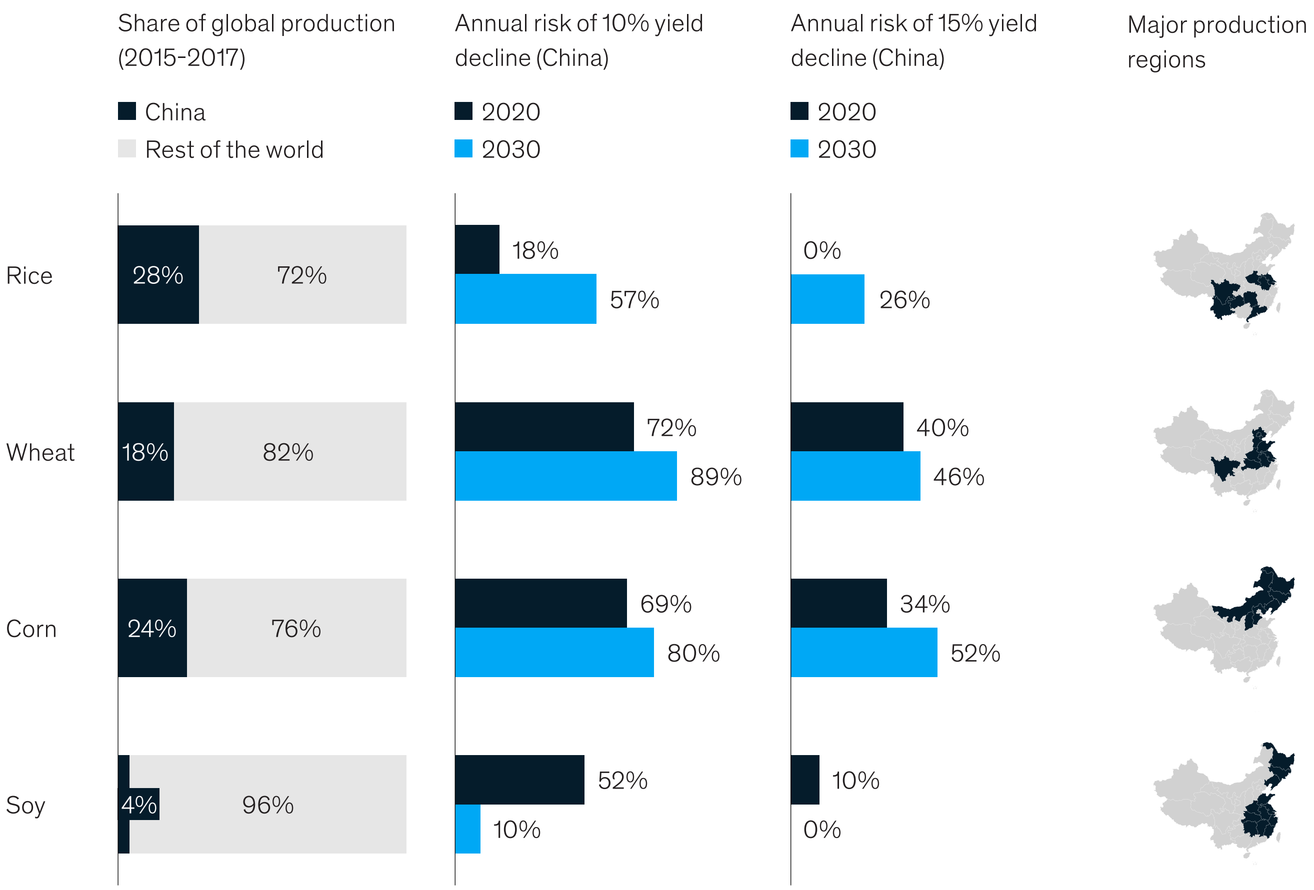
Examining the possible impact of chronic shifts in climate conditions on total yield for the four crops and in all seven regions, we find that average yields could increase by about 2 percent by 2050 relative to a 1998–2017 baseline, driven primarily by an increase in soy yields.[90] However, there is also greater risk of yield declines in rice, wheat, and corn, as well as greater risk of heatwaves, floods, or the spread of agricultural pests.

Regional variations are, by definition, not reflected in national averages. These variations could bring changes in where crops are grown. For example, parts of northern China could see higher yields due to warmer temperatures; more rain in other parts of China could result in yields falling. Over time, it is possible that agricultural activity will shift to take advantage of improved conditions in new areas, thereby reducing the effect of higher yield volatility.

Exhibit 11

The risk of crop yields falling could rise in China, which is a major agricultural producer.

Based on RCP 8.5



The boundaries and names shown on this map do not imply official endorsement or acceptance by McKinsey & Company.

Source: Woods Hole Research Center; South China Morning Post; press search

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[80] The estimate refers to direct economic losses in the agriculture, forestry, animal husbandry and fishery, industrial, infrastructure and transportation, and water conservancy sectors.

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