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China's turning point

How climate action can drive our economic future

August 2021

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We have a narrow window of time. The choices made today and over the next decade will determine our future. We have the opportunity to create a new engine for sustainable economic prosperity while at the same time preventing the worst consequences of a warming world.

Deloitte Economics Institute

Contents

Foreword

Our planet is our most precious asset and yet, without dramatic efforts to address climate change, the world as we know it is at risk.

No-one is immune to the impact of climate change, but for China, this crisis also presents a clear opportunity. That is to lead the world and find the next wave of economic growth by accelerating action to mitigate climate change.

By taking bold action now, we can create a new engine for economic prosperity, while at the same time reducing impacts to the environment. In doing so, we can leverage our leadership in the consumer economy, technology, and advanced manufacturing to supply the low-emission innovations, processes, and know-how the world needs.

Addressing the climate crisis creates huge opportunities for economic growth.

Through bold action now and in the decades that follow, we could avoid the worst effects of climate change.

China has already pledged to reach peak emission by 2030 and carbon neutrality by 2060. This report discusses how this can be achieved and quantifies China's potential gains. Our research challenges one of the main concerns stopping governments, businesses, and individuals from acting on climate change—the cost. It reframes the debate to show that what seems like a cost today is an investment in a climate-driven transformation for a more secure future.

The choices we make today and over the next decade will determine whether the worst effects of climate change are locked in or avoided. We are at a turning point, and it is time to discover how China and Asia Pacific can reshape the arc of economic history. But we can only do it if we do it together and we act now.

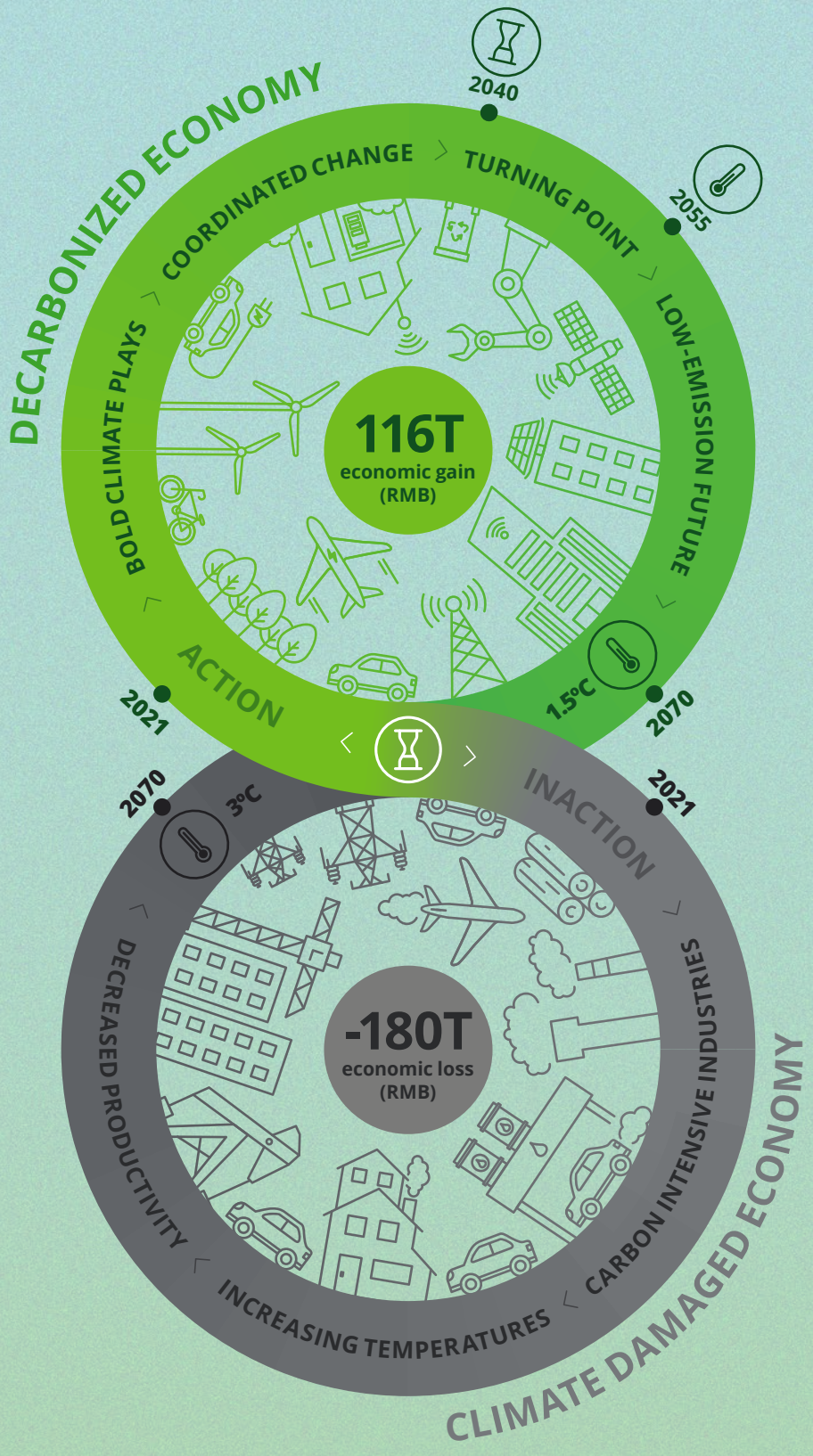
At Deloitte, we start with ourselves and have set a bold target to reach net zero emissions by 2030. We are also empowering our professionals, connecting with others, and engaging our broader ecosystem to create solutions that facilitate the transformation to a carbon neutral economy.

We look forward to working with you to help prevent the worst consequences of a warming world and realize the many opportunities presented by decarbonization.

Patrick Tsang
Chief Executive Officer,
Deloitte China

Cindy Hook
Chief Executive Officer,
Deloitte Asia Pacific

Executive summary


DECARBONIZED ECONOMY
COORDINATED CHANGE
TURNING POINT
LOW-EMISSION FUTURE
BOLD CLIMATE PLAYS
ACTION
2040
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1.5°C
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3°C
DECREASED PRODUCTIVITY
INCREASING TEMPERATURES
CARBON INTENSIVE INDUSTRIES
-180T
economic loss
(RMB)
CLIMATE DAMAGED ECONOMY

Leading the world toward a low-emission future

If left unchecked, climate change will impose steep economic costs on China. These costs will threaten the progress and prosperity the nation has enjoyed in recent decades. But there is an alternative path.

Rapid reductions in emissions in China and across the global economy, beginning now and continuing through this next critical decade, offer a way forward to a low-emission future. This potential future not only avoids the worst impacts of climate change, it also creates prosperous long-term economic growth for Asia Pacific and the world.

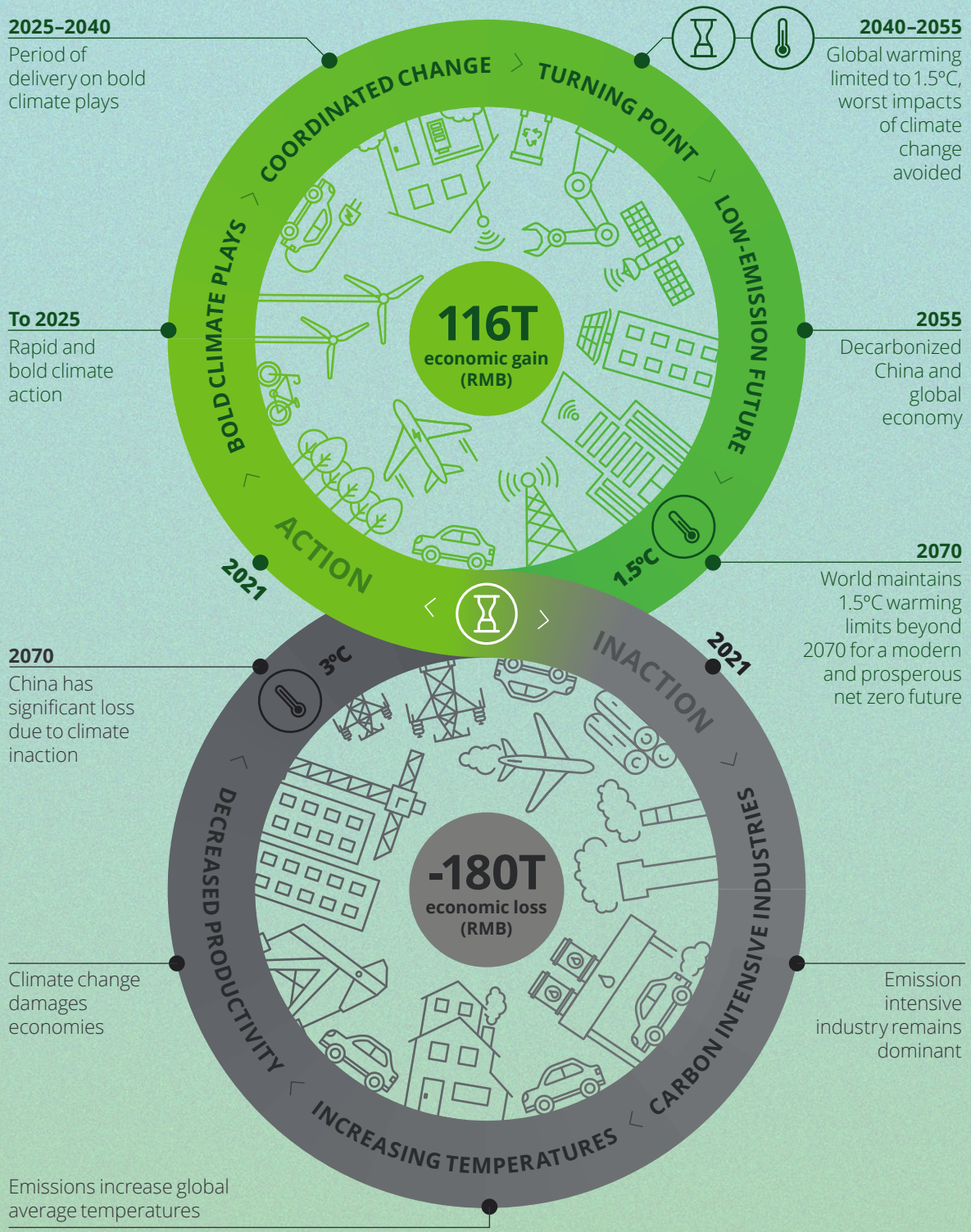
China is uniquely positioned to lead the world in these comprehensive decarbonization and systems transformation efforts. It has pioneered the critical technologies that will be required, making them affordable and scalable globally. China has the skills and know-how to export decarbonization, to the benefit of the region, its people, and the world.

However, there is a need to pivot from seeing efforts to limit global warming as optional costs, and instead view them as necessary and new areas of economic opportunity. This will require quantifying the value of climate change mitigation and the benefits that can come from decarbonization. This report aims to achieve these goals.

At the center of our research is Deloitte's uniquely calibrated Regional Computable General Equilibrium Climate Integrated Assessment Model, the D.CLIMATE model. This model integrates the economic impacts of physical climate change into a baseline economic trajectory to overcome the myopia of many current economic models. By factoring the costs of climate change into the baseline, our framework reveals the tremendous economic harms of inaction or inadequate action, as well as the immense opportunities that present themselves in transforming China's economy.

Rapid reductions in emissions—in China and globally—offer a way to avoid the worst impacts of climate change while creating long-term growth and prosperity.

Figure 1.1: Economic growth in China is the trend in a 1.5°C world



Source: Deloitte Economics Institute.

Note: China's stylized economic loss pathway reflects global average warming aligned with the RCP 6.0 baseline. The stylized economic growth pathway reflects limiting global average warming to no more than 1.5°C by 2050, in line with the current ambition of the Paris Agreement.

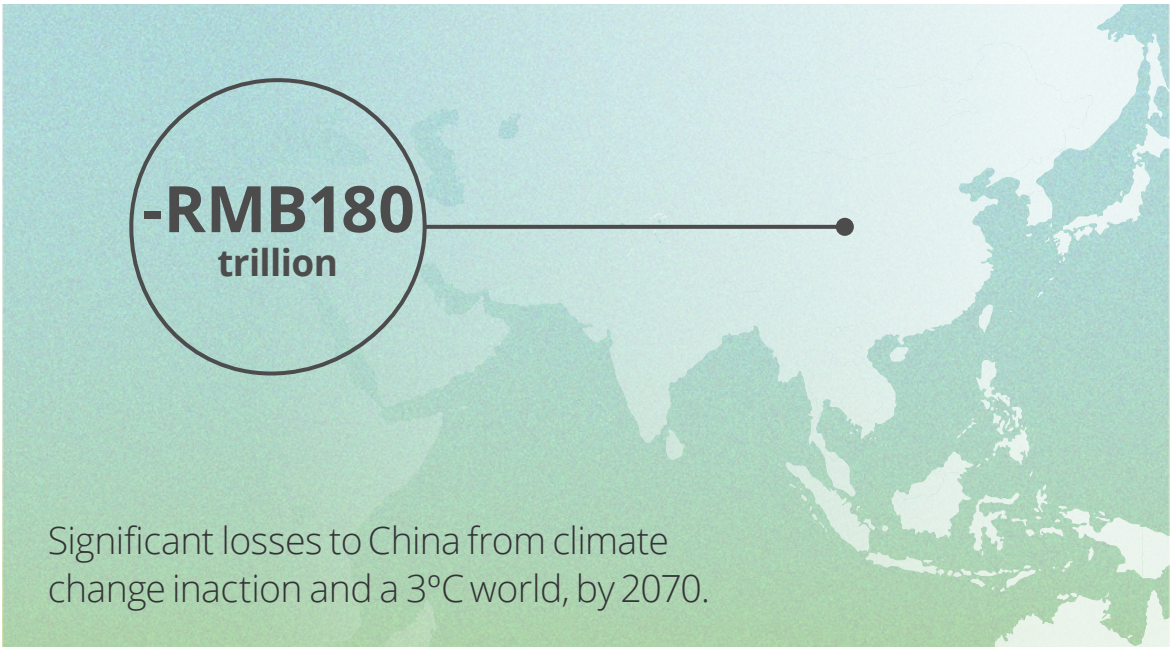
The cost of climate inaction

In the economic future Deloitte has modeled, China and the rest of the world do not significantly reduce emissions relative to current levels. This future has an emissions pathway that leads to global average warming of more than 3°C by 2070.

This pathway would lead to economic losses of more than RMB50 trillion in present value terms by 2050—or nearly 3 percent of China's gross domestic product (GDP) in 2050 alone. On average over the 30 years to 2050, that is an annual loss of 1.2 percent of GDP.

The result over the next half-century would be climate change–induced economic losses to China of approximately RMB180 trillion in present value terms.[a] This lost economic potential would total 6 percent of GDP in 2070 alone.

Figure 1.2: Economic loss in China due to climate inaction



Source: Deloitte Economics Institute D.CLIMATE model.

a. Total net present value (NPV) of deviation loss to GDP in China over the period to 2070, at a 2 percent discount rate. Refer to the Technical Appendix for a discussion on the selection and application of the discount rate.

Leading the way to a low-emission economy

Fortunately, the temperature changes and costs described above are not fixed. Although some degree of global temperature rise and climate impact is already "locked in" due to historical emissions, there is an opportunity to take bold action to enable economic prosperity and avert the worst impacts of an altered climate. Supported by the right economic framework, these actions can put China—and the world—on a path to realizing strong, equitable, and shared growth.

China is at the frontier of a new economic era and the development of a new system of production. By making the right choices now, it could chart a more prosperous path toward a low-emission future, accelerating progress in the rest of the world by exporting key technologies, processes, and know-how.

But time is of the essence. Policy and investment decisions made in the next several years will largely shape the economy and climate that China and the world inherit. This narrow window makes it even more important to understand the economics of a warming world and incorporate them into decision making that addresses the multiple market failures of climate change.

Decarbonization is a new economic engine

Our modeling shows that rapid decarbonization could yield economic gains of approximately RMB116 trillion (in present value terms) for China's economy by 2070. Compared to a world of climate inaction (the Representative Concentration Pathway (RCP) 6.0 baseline described below), China's GDP would grow by an average of 2 percent per year over the modeled decades to 2070.

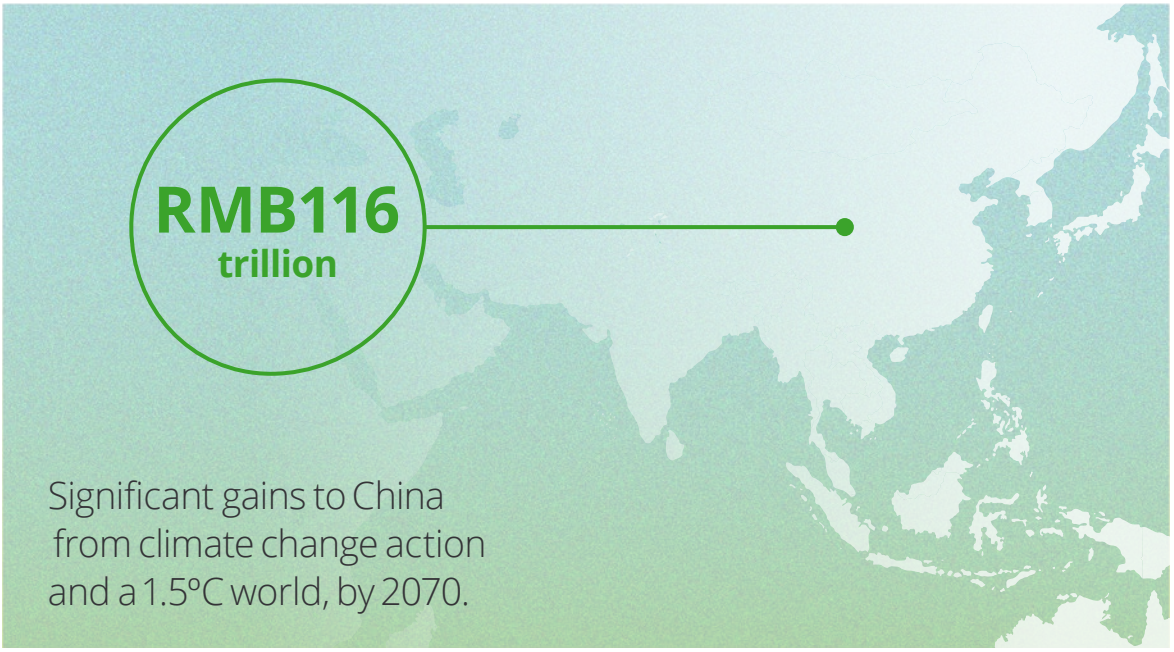
In 2070, that would equate to GDP growth of 3 percent and a gain in economic output of nearly RMB$11 trillion—equivalent to adding three times the current economy of Shanghai to China's economy during 2070 alone.[1]

In our forecasts, these economic benefits would be observed from the first year that bold climate policy decisions started delivering rapid investment and technology development consistent with limiting global average warming to 1.5°C by 2050.

RCP 6.0 explained

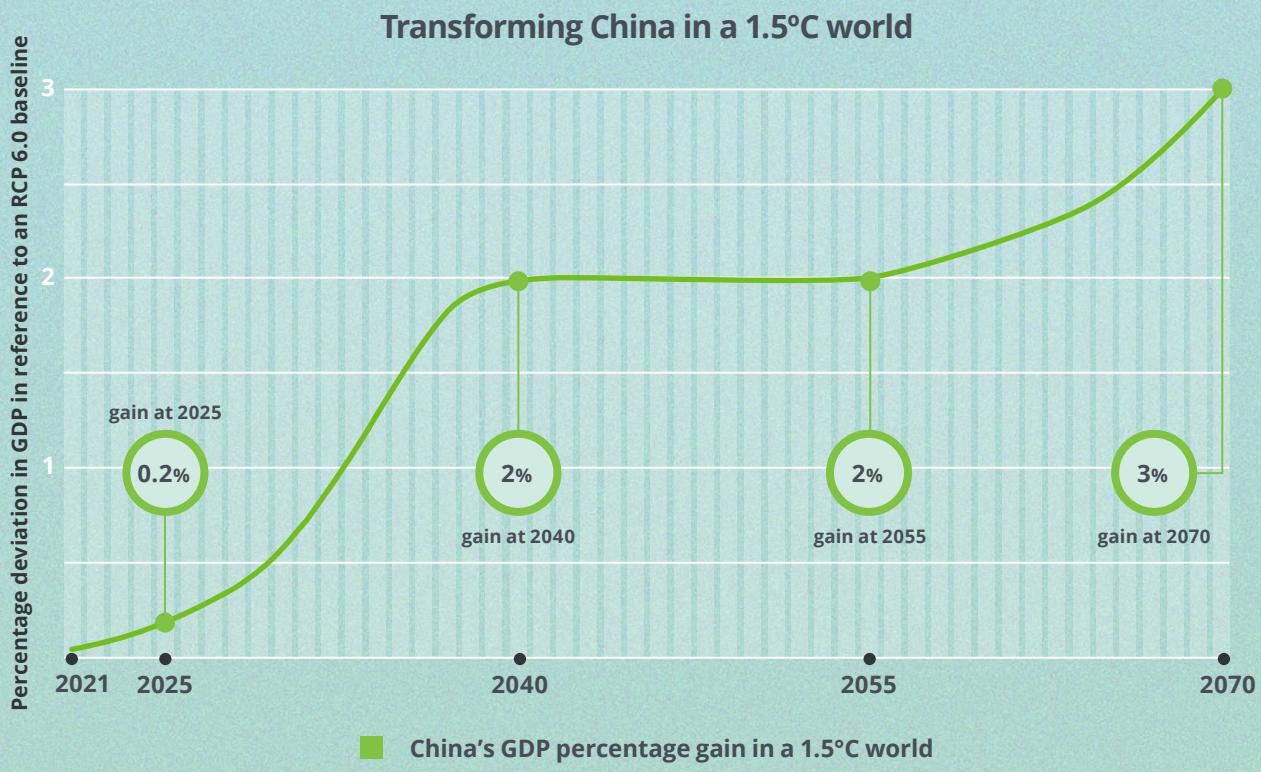
RCP 6.0 is one of the emission scenarios used by the Intergovernmental Panel on Climate Change (IPCC). RCP 6.0 assumes a scenario where the global community largely fails to introduce significant climate mitigation policies, making it an appropriate baseline for forecasting the potential effect of inaction. The IPCC's scenarios vary widely, depending on socioeconomic development and climate mitigation policy settings.

Figure 1.3: Potential economic gain for China due to decarbonization in a 1.5°C world



Source: Deloitte Economics Institute D.CLIMATE model.

Figure 1.4: Four phases of action to achieve a decarbonized China in a 1.5°C world

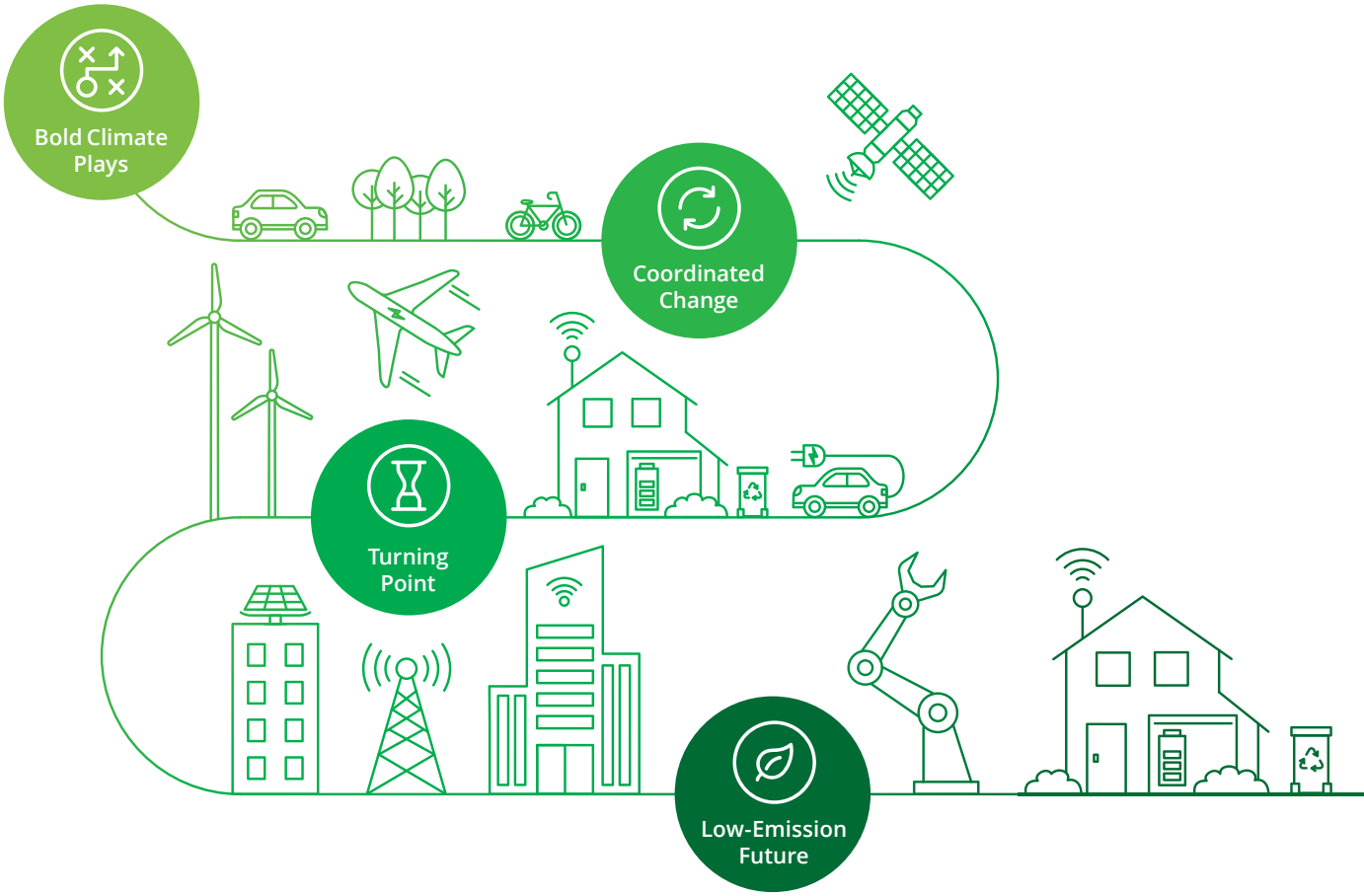


		Largest economic gains during transformation Ordered by largest GDP gain, level terms (RMB)
2021–2025	**Bold Climate Plays** Some industries enjoy immediate gains to GDP due to bold climate plays toward a 1.5°C world.	New energy Construction Public and private services Agriculture and forestry Retail and tourism Transport
2025–2040	**Coordinated Change** Some industries gain consistently in the key period of change toward a 1.5°C world.	New energy Public and private services Construction Agriculture and forestry Retail and tourism Water and utilities
2040–2055	**Turning Point** Significant industry decarbonization is achieved and rapidly gaining in a 1.5°C world.	New energy Public and private services Agriculture and forestry Retail and tourism Water and utilities Construction
2055–2070	**Low Emission Future** New economic structures and outputs remake China in a decarbonized 1.5°C world.	New energy Public and private services Agriculture and forestry Manufacturing Retail and tourism Construction Water and utilities

Source: Deloitte Economics Institute D.CLIMATE model.

China's turning point

In our modeling, the economic benefits of climate action would be immediate and would scale up rapidly for China. Our analysis shows that the structural adjustment costs of rapid decarbonization would be almost immediately offset by positive returns in the capital and technology that shift economies onto a decarbonized pathway. We also show how rapid decarbonization toward a 1.5°C world[b] would be likely to occur through the following four economic phases.



b. References to 1.5°C in this report describe a situation in which nations successfully achieve rapid decarbonization, limiting global average warming to 1.5°C by the middle of the century and maintaining that average until the end of the century. Under this scenario, China would achieve nearly net zero emissions by 2050. This scenario has been dimensioned and modeled by Deloitte Economics Institute.

Bold Climate Plays
from 2021 to 2025

The next few years will set the stage for rapid decarbonization. The decisions by government, regulators, business, industry, and consumers would reinforce initial progress and create the market conditions to deliver decarbonization at pace and scale. This would send price signals, transform supply chains, and lay the foundation for a structural shift that limits global average warming to 1.5°C. China's economy would see immediate gains during this period—particularly in the new energy, construction, and services sectors—as existing progress is leveraged and markets react.

Coordinated Change
from 2025 to 2040

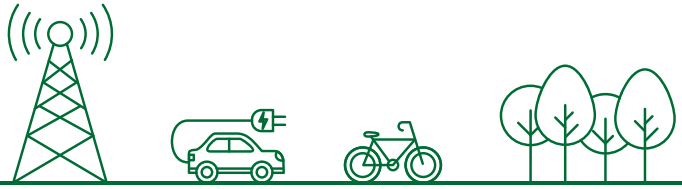
The hardest shifts in industrial policy, energy systems, and consumer behavior would occur in this period. Businesses and economies would begin to see the consequences of bold climate plays, with different industries and countries transforming at different paces. China would consistently gain as it extended its already-strong position in exporting decarbonization technologies and goods to the world. In turn, the export of low-emission technologies and energy would become a new pillar of the Chinese economy.

Turning Point
from 2040 to 2055

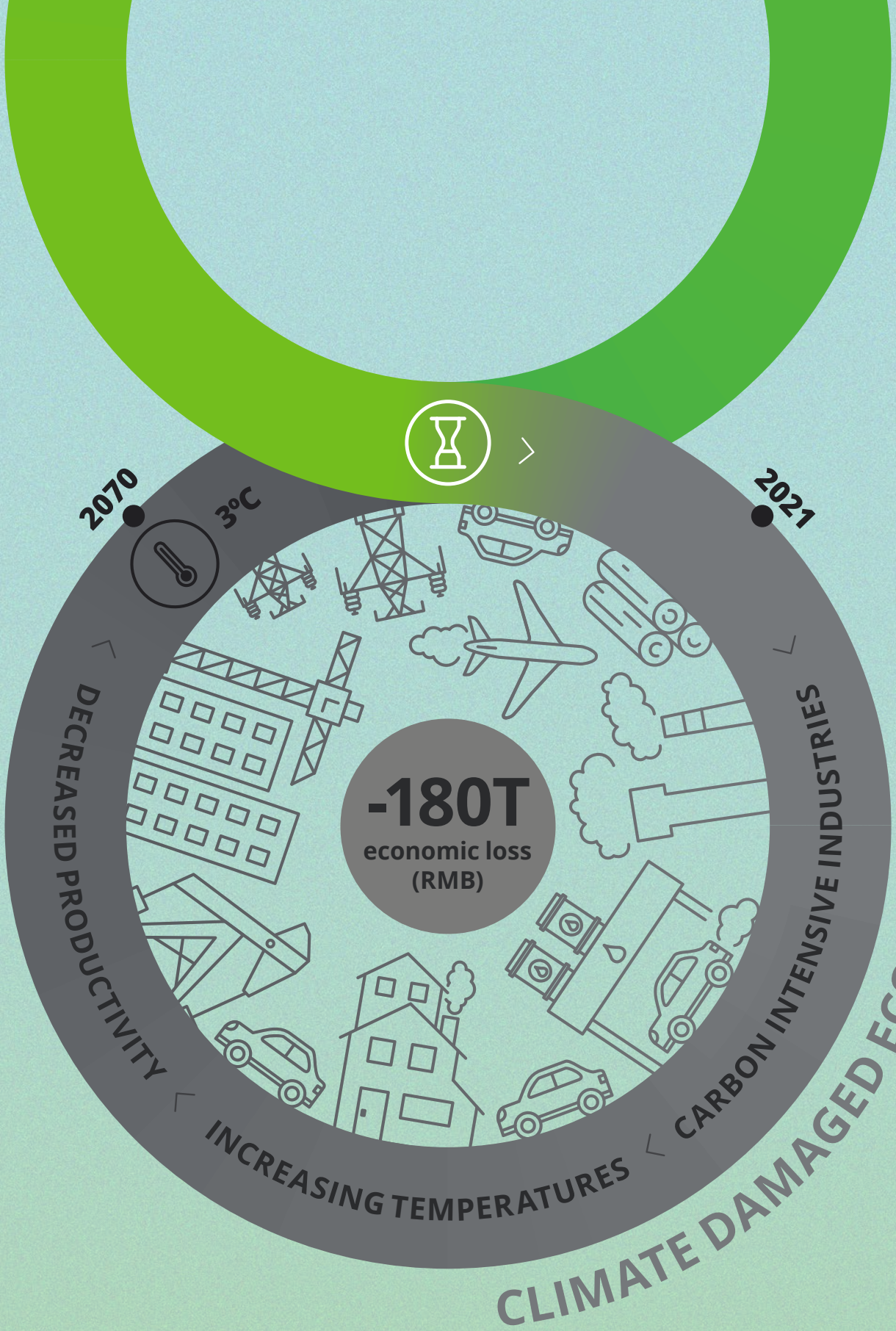
The decarbonization of high-emitting industries should be nearly complete by this period. The cost of new low-emission technologies would be decreasing and net economic gains would be shared more widely. Efforts to curb emissions would begin to manifest in lower global average temperatures relative to a higher-emitting posture (greater than 0.2°C average decrease across the decades to 2055, compared to the RCP 6.0 baseline). This pathway would result in a 1°C difference in the global mean temperature by 2070, relative to the RCP 6.0 baseline. **This period would be the climatic and economic turning point** that avoids a "locked in" higher-emission pathway and realizes the economic dividends of technological progress. In this phase, China would capitalize on the gains of climate change mitigation and early decarbonization, while the rest of the world caught up.

A Low-Emission Future
after 2055

By the end of the century, China's economy would be near net zero emissions and the world's economic systems of production would be keeping global average warming to around 1.5°C. Economic structures would be radically transformed, underpinned by a series of interconnected, low-emission systems spanning energy, mobility, manufacturing, and food and land use. The energy mix would be dominated by low- or zero-emission sources across every market, with green hydrogen and negative-emission solutions, both natural and technological, playing prominent roles. China would have pioneered these critical technologies, making them affordable and scalable globally, and it would be exporting decarbonization to the benefit of Asia Pacific and the world.



The economic costs of climate inaction


2070
3°C
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economic loss
(RMB)
CLIMATE DAMAGED ECONOMY

The new normal: a climate-damaged economy

Most economic thinking has it wrong.

Dominant economic projections do not account for the consequences of climate change, or the world's efforts to adapt to or mitigate the impacts. When they do consider climate change damage and mitigation policy, it is often in scenario analyses that compare alternative future states to the same incorrect starting point—and against an erroneous "business as usual" trend that assumes unconstrained economic growth via emissions-intensive economic production. This is the economic baseline that informs how most decisions and investments are made, for governments and businesses alike.

And no wonder. Since the Industrial Revolution, economic growth has moved nearly in lockstep with rising greenhouse gas (GHG) emissions.

As humanity burned fossil fuels, removed forests, and converted land to intensive agriculture, it enjoyed the "fruits" of those actions: economic growth, rising standards of living, and better quality of life.[c] The world economy has expanded almost every year since 1750. While growth has not been constant or even—across countries or individuals—GDP growth has, on average since the Industrial Revolution, been around 1.5 percent per year.[2]

That emissions-intensive growth has been perhaps most evident in the Asia Pacific region, where the last several decades have seen dramatic economic expansion and hundreds of millions rising out of poverty—alongside rapidly increasing carbon dioxide (CO_2) emissions.[3]

Growth with consequences

China's development is the apotheosis of this trend. Economic reforms and trade liberalization in the late 1970s enabled the economy to expand rapidly.[4]

China's economy has grown at an average rate of almost 10 percent a year for the past four decades—a rate of sustained growth rivaled by few countries in history.[5] That growth transformed an economy that was heavily reliant on agriculture into the manufacturing and services powerhouse of today.[6]

China's growth has lifted around a billion people out of poverty, and supported a burgeoning middle class and large-scale urbanization.[7] It has also benefited the global economy by offering productive and comparatively economical labor, and access to new markets for trade and consumer goods.[8]

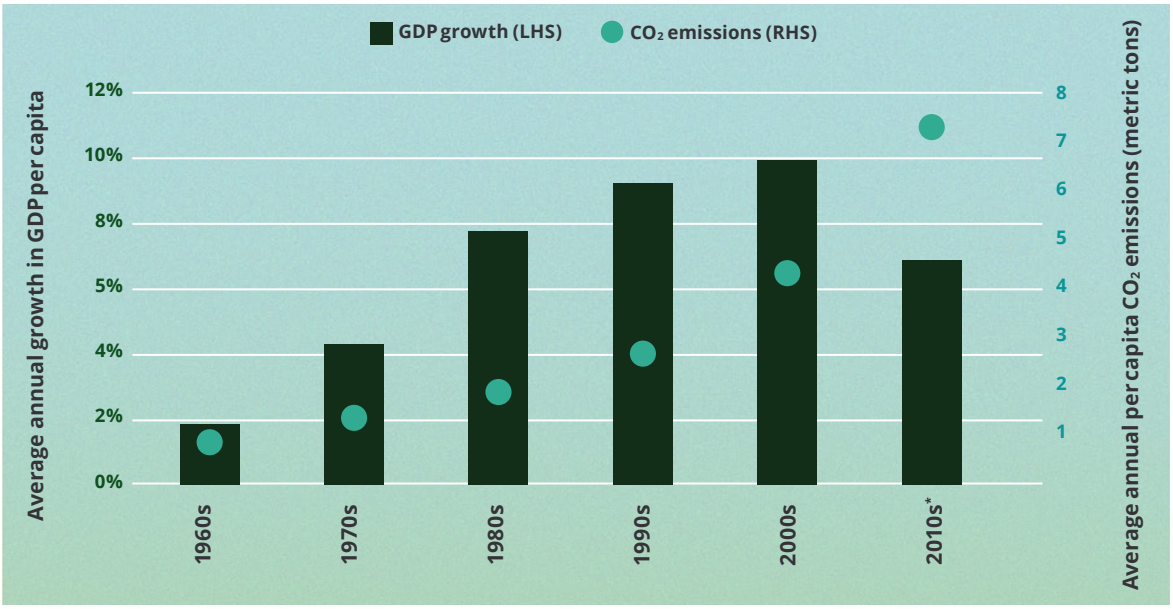
A consequence of this breakneck growth has been the rapid acceleration in China's GHG emissions, particularly CO_2.[9]

Rapidly growing energy demand has been met largely with fossil fuels, leading China to be the world's largest emitter of GHGs (see Figure 2.1). China accounts for nearly a third of global carbon emissions, and in 2019, it emitted more than all OECD nations combined.[10]

China is also the world's largest producer and consumer of coal. Since 2000, the country's coal consumption has increased more than fourfold and today accounts for around half of global demand.[11]

c. Economic growth as measured by GDP, and improved standards of living as measured by increasing GDP per person.

Figure 2.1: Trends in China's per capita GDP growth and carbon emissions[12]



Source: Deloitte Economics Institute analysis of World Bank data.
*Per capita GDP growth to 2019; per capita emissions to 2016.

Changing the economic narrative

Mainstream economic theory and models assume unconstrained emissions do not have negative consequences for economic growth potential.

This view of the world has now come up against the overwhelming scientific consensus—and increasingly our own lived experiences—telling us that the current system of economic production is generating untenable changes in the climate.[13] These changes put at risk China's hard-earned economic growth and prosperity.[14]

It is important to recognize that:

- **China has economic progress and prosperity to lose in a warming world.**[15] As a highly populated and climatically diverse region, it is exposed to a wide range of costly climate impacts. Historical emissions mean that future climate damage is inevitable, but as this report discusses, there are opportunities for China to thrive and become a world leader in exporting a new global economic model that reduces the link between emissions and growth.
- **China is positioned to be a global powerhouse in a low-emission world.** China has the skills, economic resources, and connections to enable growth in a low-emission world.[16] For example, China is already the largest exporter of renewable energy products and it has around 70 percent of the global solar photovoltaic component manufacturing capacity.[17]
- **China has much to gain from being an early mover.** As a manufacturing leader with highly developed supply chains, the country has the potential to service the low-emission and green technology needs of Asia Pacific and the world.[18] China can export the means for global decarbonization.

China is already moving. In addition to a commitment to peaking emissions before 2030, it recently committed to carbon neutrality before 2060, with its 14th Five-Year Plan outlining further emissions reductions and non-fossil energy consumption targets of 20 percent by 2025.[19] These commitments define China's economic endgame: a low-emission economy that maintains productivity and growth.

But for China to deliver on these commitments and balance decarbonization and development, the economic impacts of a changing climate need to be included in economic baselines, and therefore decision making. A failure to do so will result in poor economics, poor risk management, and dangerously inadequate efforts to address the climate crisis.

Deloitte's D.CLIMATE model integrates the economic impacts of physical climate change into a baseline economic trajectory, to overcome the myopia of many current economic models. By factoring the costs of climate change into the baseline, our framework reveals the tremendous economic harm of inaction or inadequate action, as well as the immense opportunities that present themselves in remaking China's economy.

The high costs of inaction

Unmitigated climate change threatens to wipe out decades of hard-won economic growth in China. The foundations of the nation's prosperity—its natural and human capital—are at risk, and along with them its standard of living, its prospects for future growth, its place on the global stage, and the wellbeing of its people.[20]

If China's recent economic story is one of growth, unchecked climate change would make its future narrative one of decline.

Climate change could reverse China's hard-won economic gains.

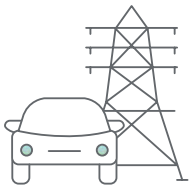
Figure 2.2: How climate change impacts the economy

Impacted workers

Heat stress, the "slowing down" of workers, and their reduced ability to perform results in lower labor productivity.

Lost productive land

A loss of productive land through rising sea levels and a reduced level of productive activity on the land impacts low-lying and coastal areas.



Stalling productivity and investment

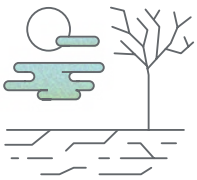
Economies suffer as investment repairs existing assets instead of contributing to new, more productive capital. Climate change stalls economic progress.

Diminished health and wellbeing

Increased incidence of mortality and morbidity disrupts living standards and the lives of the working population.

Disrupted flow of global currency

The scale of loss of tourism and international money circulating in economies impacts business, jobs, and livelihoods.



Agricultural losses

Despite adaptation, climate change inaction limits what farmers can do. Significant variations in crop yields damage the agricultural sector's output.

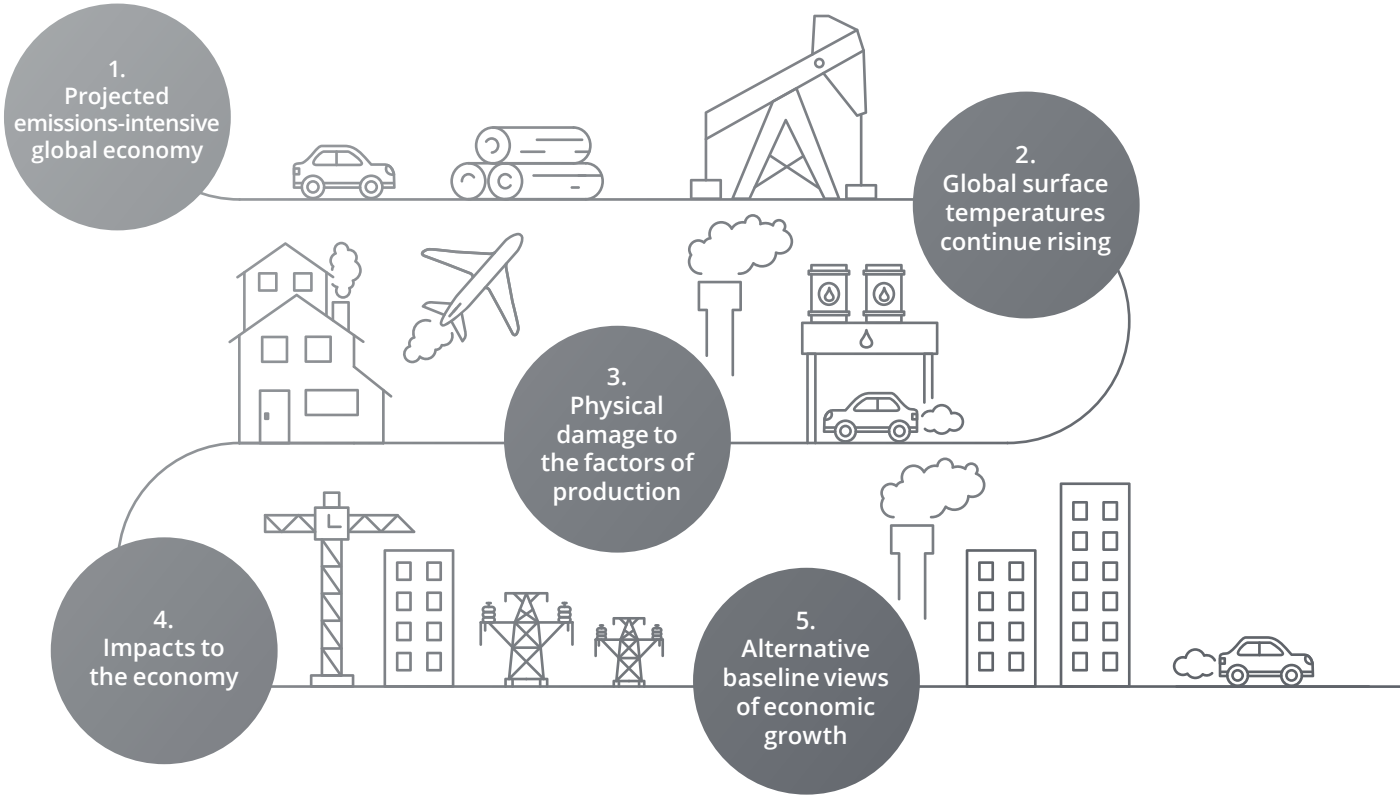
Source: Deloitte Economics Institute.

Modeling climate inaction in China

Global emissions will continue to rise if no further substantial action is taken to mitigate climate change. The outcome would be increasing global average warming toward the end of the century. In this world, inaction on climate change would be the baseline path for the economies of China and the world. This baseline scenario would negatively impact economic growth when compared to a world without climate change (refer to the Technical Appendix for more detail).

This modeling framework involves significant research on region-specific climate and economic impacts across Asia Pacific, which are used as inputs for Deloitte's D.CLIMATE model (refer to the Technical Appendix for more detail).

To quantify this conclusion, Deloitte modeled the economic impacts of a changing climate on long-term economic growth in China, using the following stepped process.



1

The model projects economic output (as measured by GDP) with emissions reflecting RCP 6.0 to the year 2100.[d] RCP 6.0 represents a single scenario without significant additional efforts to constrain emissions (the baseline scenario).[21] This results in a projected emissions-intensive global economy.

2

Increased atmospheric GHGs cause average global surface temperatures to continue rising above pre-industrial levels.[e] In the RCP 6.0 baseline scenario, global average temperatures increase more than 3°C above pre-industrial levels by the end of the century.[f] (Note that present-day temperatures have already risen more than 1.0°C above pre-industrial levels.)

3

Warming causes the climate to change and results in physical damage to the factors of production. The Deloitte model includes six types of economic damage, regionalized to the climate, industry, and workforce structure of each defined geography in Asia Pacific.

4

The damage to the factors of production is distributed across the economy, impacting GDP. Any change in emissions (and, correspondingly, temperatures) over time results in changes to these impacts and their interactions. The economy impacts the climate, and the climate impacts the economy.

5

The key variables of time, global average temperature, and the nature of economic output across industry structures combine to offer alternative baseline views of economic growth. Specific scenario analysis is then conducted, referencing a baseline that includes climate change damage. Scenarios can also include policy actions that either reduce or increase emissions and global average temperatures relative to the RCP 6.0 baseline view.

d. IPCC-adopted emission scenarios vary widely, depending on socioeconomic development and climate mitigation policy settings. RCP 6.0 is chosen as an intermediate baseline scenario as it includes no specific or significant climate mitigation policy effort, making it an appropriate baseline for reference.

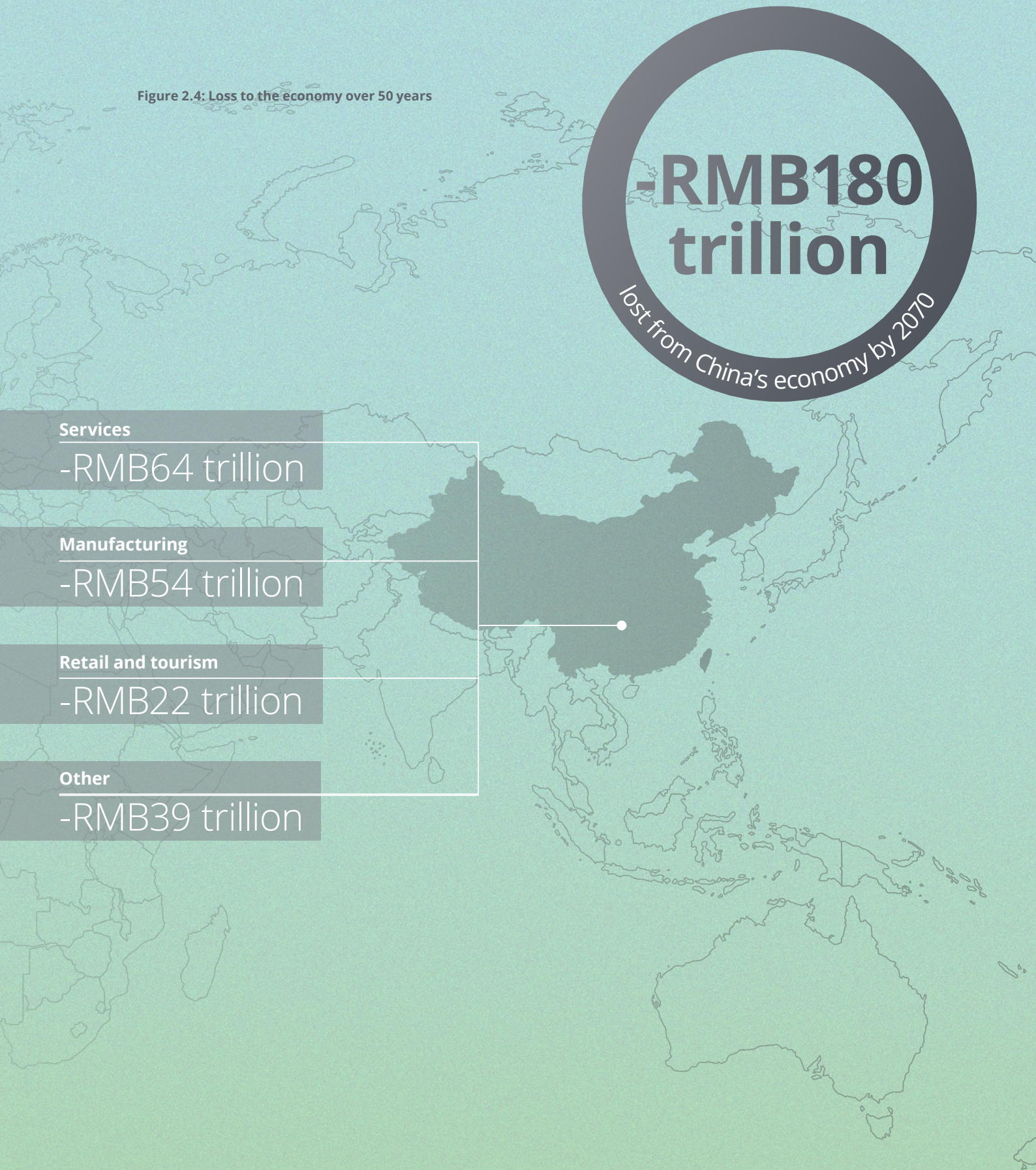
e. Pre-industrial is defined in IPCC assessments as the multi-century period before the onset of large-scale industrial activity around 1750.

f. The associated climate data (like annual temperature increases and atmospheric concentrations) are sourced from a synthesis of the models available through the Coupled Modeling Intercomparison Project (CMIP6). See the Technical Appendix for further detail.

Figure 2.3: Sector loss at 2070, in a climate damaged China in a 3°C+ world

Source: Deloitte Economics Institute D.CLIMATE model.

Figure 2.4: Loss to the economy over 50 years



Source: Deloitte Economics Institute D.CLIMATE model.

Note: Total NPV of deviation loss to GDP in China over the period to 2070, at a 2 percent discount rate.
Refer to the Technical Appendix for a discussion on the selection and application of the discount rate.

The economic cost of climate change to China

In the economic future modeled, China and the rest of the world do not significantly reduce emissions relative to current levels. This future has an emissions pathway that would lead to global average warming of more than 3°C by 2070.[g]

The result over the next half-century, by Deloitte's estimates, would be climate change–induced economic losses to China of approximately RMB180 trillion in present value terms.[h] This loss to economic potential would equal 6 percent of GDP in 2070 alone.

If substantial actions are not taken, climate change would, in average annual terms, reduce China's economic potential by 2.5 percent per year over the next 50 years.

This pathway would lead to economic losses of more than RMB50 trillion in present value terms by 2050—or nearly 3 percent of China's GDP in 2050. On average over the 30 years to 2050, that is an annual loss of 1.2 percent of GDP.

Substantial losses to industries, firms, and workers

China's economy is highly exposed to the economic damage caused by climate change. Over the next 50 years, the top five most impacted industries in terms of economic activity comprise over 90 percent of the country's current output.

These industries—services (government and private), manufacturing, retail and tourism, construction, and transport—are economic powerhouses and major sources of employment in China. Together, they form the basis of the country's contemporary economic engine.

Deloitte estimates that by 2070, these five industries would experience an annual loss in the value added to GDP of more than RMB7 trillion per year.

In our model, the impacts would be most significant for labor and physical capital, and the industries that draw heavily on them would experience the greatest economic losses. Manufacturing and construction would suffer from impacts to their asset base and lower levels of labor productivity associated with worsening human health conditions and heat stress.

In recent years, manufacturing has comprised around half of all economic output and accounted for around one in three jobs in China. However, heat stress and other factors could lower productivity and lead to losses of nearly RMB7 trillion in economic value added to GDP by 2070.

Service-based industries, such as retail trade and tourism, are highly exposed to increasing labor impacts and are also expected to suffer considerably in the modeled scenario.

g. IPCC-adopted emission scenarios vary widely, depending on socioeconomic development and climate mitigation policy settings. RCP 6.0 is chosen as an intermediate baseline scenario as it includes no specific or significant climate mitigation policy effort, making it an appropriate baseline for reference.

h. Total NPV of deviation loss to GDP in China over the period to 2070, at a 2 percent discount rate. Refer to the Technical Appendix for a discussion on the selection and application of the discount rate.

Workers from industries experiencing larger economic losses, including manufacturing and construction, would be displaced and would shift into sectors such as agriculture that are expected to be less severely impacted by climate change. As global average warming increased to 2070, our modeling shows the agricultural sector would experience lower crop yields and would contribute less economic value to China's economy, even as it added nearly 1 million workers by 2070 to compensate for lower productivity in this scenario.

The driving factors of these economic losses are not novel phenomena. Climate change impacts are being felt by the Chinese economy today, albeit at a less frequent and less extreme scale than they would be 50 years from now.

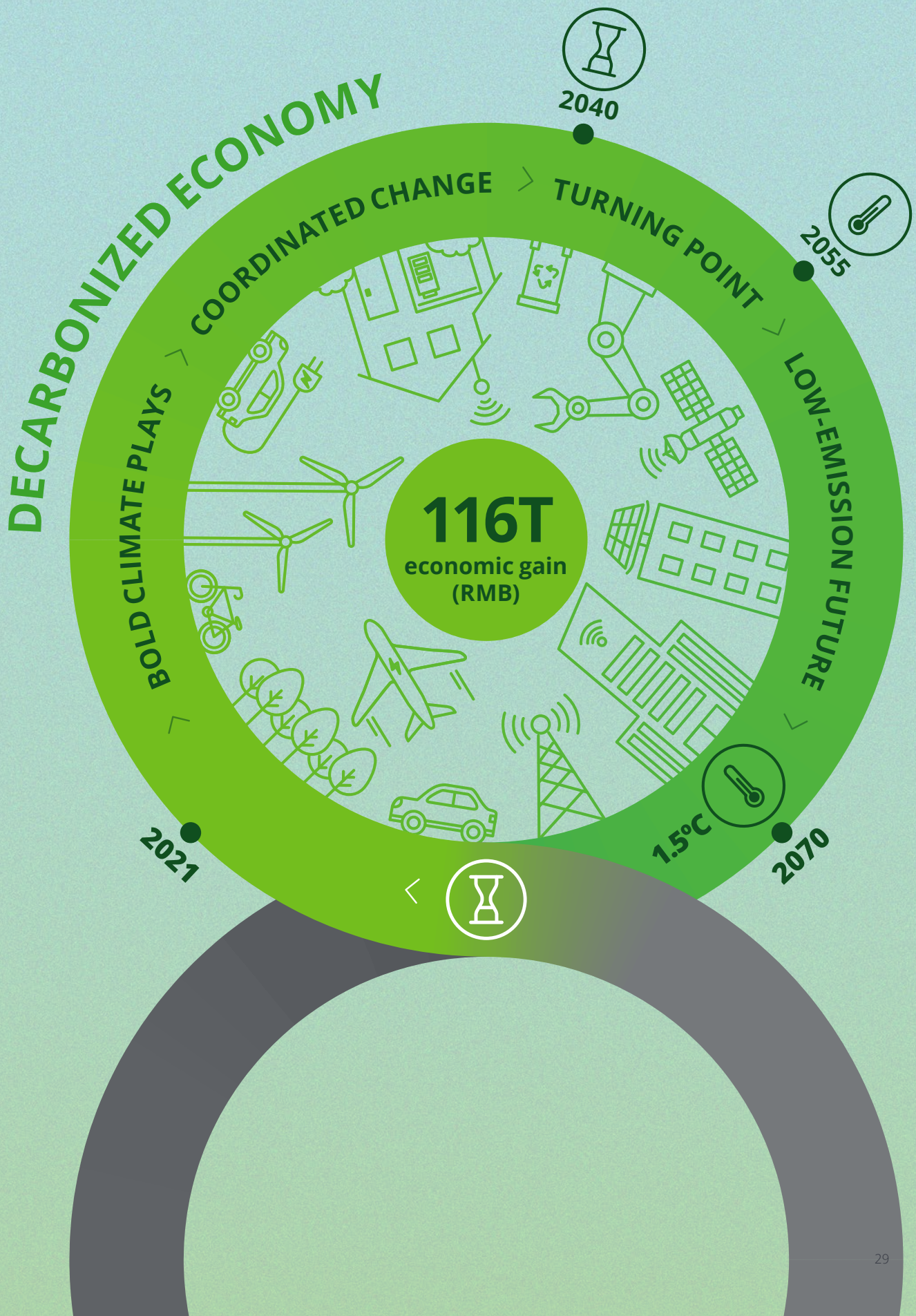
For example, greater rainfall in the northern Xinjiang region—which has experienced a near doubling of summer rainfall over the past 50 years—has resulted in more frequent flooding in one of the driest regions on Earth. This has interrupted mining and agricultural operations, risking the livelihoods of those who live and work there, and posing a major risk for key national infrastructure projects such as the Belt and Road Initiative.[22]

In regions throughout China, extreme heat events have occurred more frequently under a warming climate. Some studies have indicated so-called "once in a century" events could occur every 1.5 years under a 2˚C warming scenario. This has real implications for many industries in China, particularly labor-intensive sectors that are highly exposed to the physical climate (including construction and agriculture).[23]

Figure 2.5: Largest industry losses in China due to climate change

Source: Deloitte Economics Institute D.CLIMATE model.

The economic gains of rapid decarbonization


DECARBONIZED ECONOMY
2021
BOLD CLIMATE PLAYS
COORDINATED CHANGE
2040
TURNING POINT
2055
LOW-EMISSION FUTURE
2070
1.5°C
116T
economic gain
(RMB)

A new economic climate

The economic costs of climate change are not fixed. Although some degree of global temperature rise and climate impacts are already "locked in" due to historical emissions, there is an opportunity to take bold action to enable economic prosperity and avert the worst impacts of an altered climate. Supported by the right economic framework, these actions can put China—and the world—on a path to realizing strong, equitable, and shared growth.

China is at the frontier of a new economic era and the development of a new system of production. By making the right choices now, it could chart a more prosperous path toward a low-emission future while accelerating progress in the rest of the world by exporting key technologies, processes, and know-how.

Accelerated decarbonization could bring substantial benefits to China and the world. China could use the transition to a low-emission footing to restructure its economy toward growth in advanced industrial sectors, leveraging clean energy export markets and making clean energy technologies affordable for countries around the world (including developing countries, which will see a rapid increase in energy demand over the coming years).[24]

But time is of the essence. Policy and investment decisions made in the next few years will largely shape the economy and climate that China and the world inherit. This narrow window makes it even more important to understand the economics of a warming world and incorporate them into decision making that addresses the multiple market failures of climate change.

China's announced objective to reach carbon neutrality by 2060 shows it is serious about the economic opportunity offered by climate-led transformation. The nation accounts for around 28 percent of global emissions today,[25] with 40 percent coming from energy and 70 percent from coal—which has proven and economical substitutes.[26]

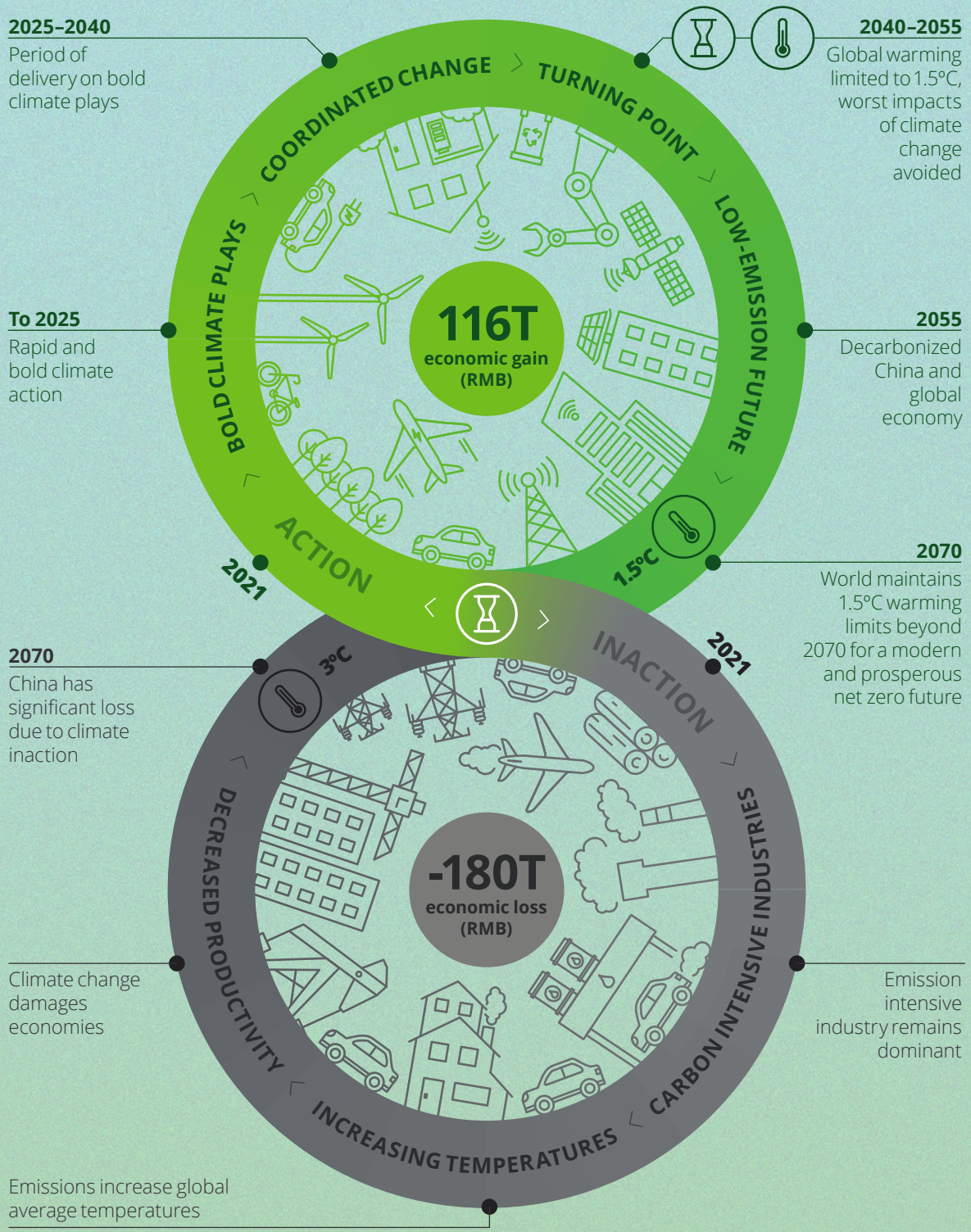
Prior to the onset of the COVID-19 pandemic, growth in emissions slowed as primary energy consumption[j] decelerated and renewables and natural gas displaced coal in the global energy mix.[27] This shift saw the largest ever increases in renewable energy consumption.[k,28] These increases accounted for more than 40 percent of global growth in primary energy in 2019—larger than for any other fuel type, and growing the overall renewables share of the global energy mix.[29] China led this increase, with its use of renewables growing by more than any other country in 2019.[30]

The transformation to a low-emission economy is already underway, even if the challenges are formidable. China is the global leader in installed solar power. It is also home to most of the world's leading manufacturers of solar photovoltaics and solar power technology exports. This has already helped drive down the cost of renewables globally, making them among the cheapest sources of electricity in history.[31] In 2020, China opened the second-largest solar farm in the world with a capacity of 2.2 gigawatts.[32] Furthermore, China is already the world's leader in the production and sale of electric vehicles.[33]

j. A measure of total energy demand of a country.

k. Including biofuels and all traded renewable electricity, excluding hydro.

Figure 3.1: Economic growth in China is the trend in a 1.5°C world



Source: Deloitte Economics Institute.

Note: China's stylized economic loss pathway reflects global average warming aligned with the RCP 6.0 baseline. The stylized economic growth pathway reflects limiting global average warming to no more than 1.5°C by 2050, in line with the current ambition of the Paris Agreement.

China can export decarbonization to the world

As China rapidly decarbonizes, it has an opportunity to share key technologies, approaches, and expertise more broadly. This would accelerate the global shift to a low-carbon future and open up economic opportunities for businesses in China.

Many of the key low-emission solutions are complex to produce—requiring the underlying technology as well as related skills, knowledge, research and development ecosystems, and capital.[34] China's economy is well suited to meeting this challenge and is already a leader in many key technologies. As noted above, it is already the world's largest producer of solar panels, wind turbines, batteries, and electric vehicles, as well as one of the world's largest investors in clean energy.[35] Around 70 percent of the world's solar photovoltaic component manufacturing capacity sits in China.[36]

Green hydrogen is likely to play an important role in a future low-emission economy, and China has emerged as one of the world's largest "gray" hydrogen[l] markets, both in production and consumption.

The country has the largest hydrogen production volume worldwide, with existing industrial hydrogen production capacity of 25 million metric tons per year. On the consumption side, China sold more than 3,000 fuel cell electric vehicles from 2017 to 2019 (all commercial vehicles), making it one of the world's largest markets for deployment.[37]

This early lead means it is easier for the economy to diversify and scale up into new green and low-emission products and services.[38] Its high degree of "green economic complexity"— the knowledge, skills, financing, and supply chain connections to create low-emission goods, and the services that go with them[39]—extends these strengths.

China has the economic fundamentals to increase its green export trade ratio, and the types and volume of low-emission products that can be competitively exported. Coupled with the size of its domestic market, China can help drive down the cost of the critical solutions needed to reduce global emissions, to the benefit of China and the world.

l. Gray hydrogen refers to hydrogen that is produced using fossil fuel sources.

Decarbonization is a new economic engine

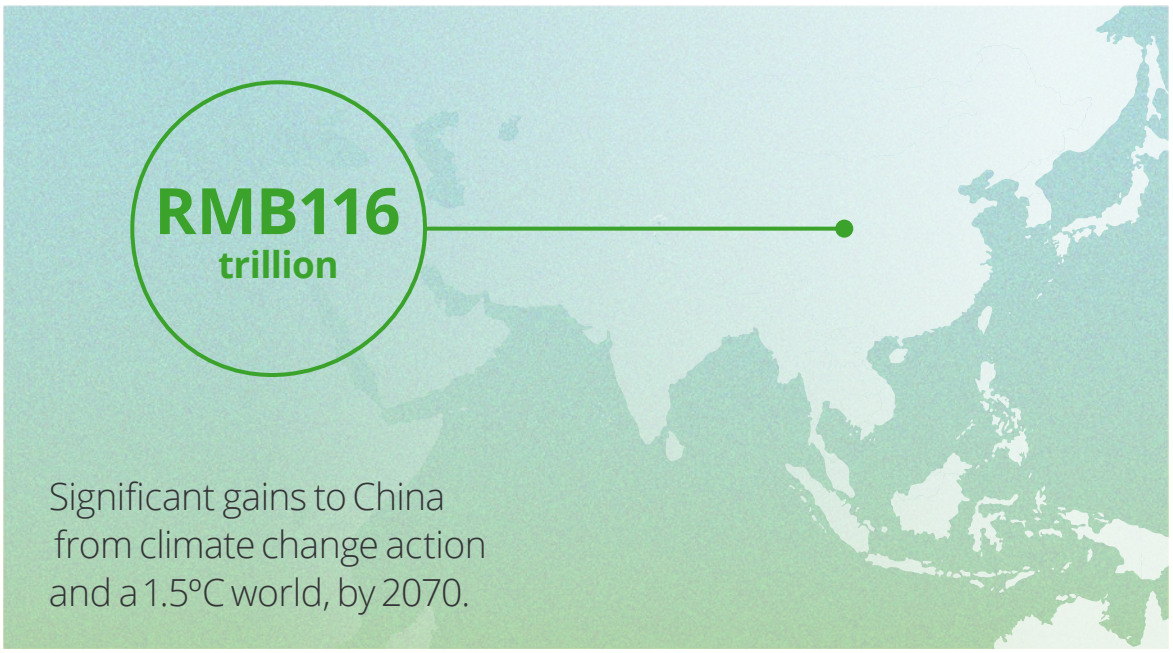
Rapid decarbonization could yield gains for China's economy of approximately RMB116 trillion in present value terms by 2070. Compared to a world of climate inaction (the RCP 6.0 baseline scenario), China's GDP would grow by an average of 2 percent each year over the modeled decades from today to 2070.

In 2070, that would equate to GDP growth of 3 percent and a gain in economic output of nearly RMB11 trillion—equivalent to adding three times the current economy of Shanghai to China's economy during 2070 alone.[40]

The economic gains arising from climate action would be immediate for China. Rapid decarbonization would create structural adjustment costs, but they would be quickly canceled out by positive returns to the capital and technology that shifts China's economy onto a decarbonized pathway.

In our forecasts, these economic benefits would be observed from the first year that bold climate policy decisions started delivering rapid investment and technology development consistent with limiting global average warming to 1.5°C by 2050.

Figure 3.2: Potential economic gain for China due to decarbonization in a 1.5°C world



Source: Deloitte Economics Institute D.CLIMATE model.

Figure 3.3: The process of economic adjustment to decarbonization in a 1.5°C world scenario

Source: Deloitte Economics Institute D.CLIMATE model.

Note: Total NPV of deviation gains to GDP in China over the period to 2070, at a 2 percent discount rate.
Refer to the Technical Appendix for a discussion on the selection and application of the discount rate.

China's turning point

Realizing the economic benefits of decarbonization will require broad changes across the Chinese economy, particularly in its energy mix and industrial base. But China has made good headway.

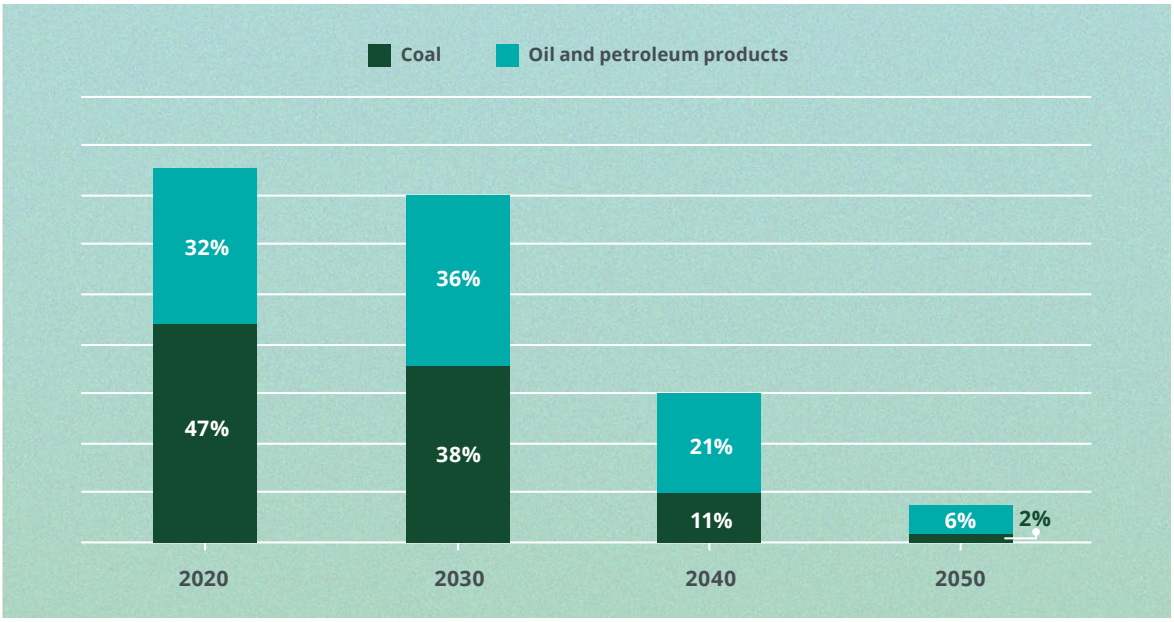
Fast-falling clean energy prices are paving the way for China to already be on track to reach its goals. The average cost of electricity from a new solar farm in China has fallen by 82 percent over the last decade, while wind power prices have dropped by a third, making both cheaper than new coal power plants.[41]

In the modeled scenario, renewable energy (primarily solar and wind) would be foundational and used in electrolysis to create green hydrogen, which could be transported for use.

A decarbonization pathway for China and its heavy industrial plants requires the retention of some fossil fuels, to allow for fluctuating outputs from renewables. Development and deployment of carbon capture and storage technologies will be critical to reaching net zero emissions.

Although China's future energy mix would include fossil fuels, their share would plummet over time: from 95 percent in the early 2020s to just 6 percent by 2070. The composition of China's fuel mix would shift to cleaner energy sources over the next 50 years, largely driven by green hydrogen. In the Deloitte model, hydrogen would make up a quarter of China's fuel mix by 2070, compared to 1 percent in 2030.

Figure 3.4: China's fossil fuel usage by 2050

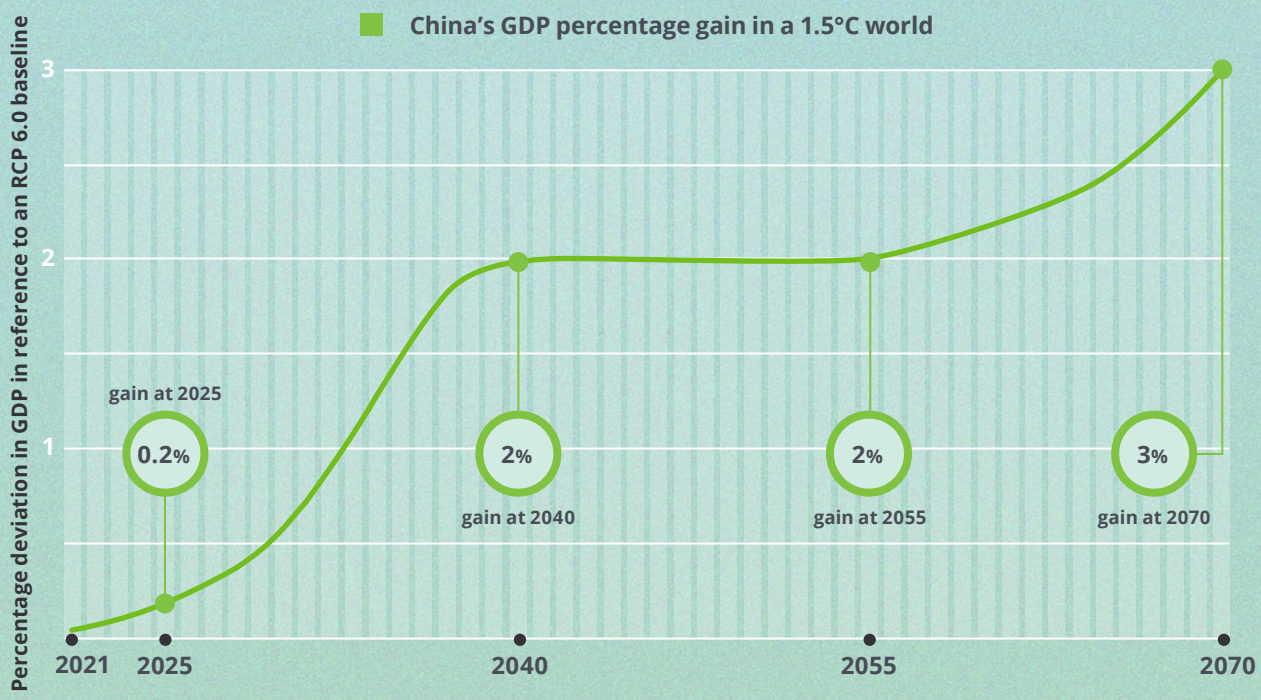


Deloitte Economics Institute D.CLIMATE model.

The path to decarbonization

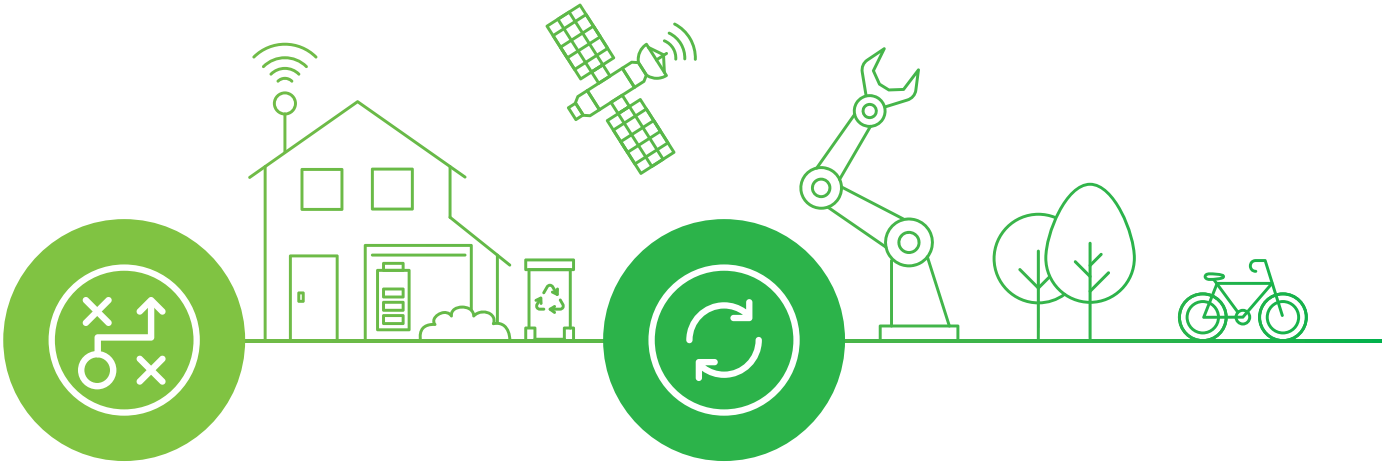
Deloitte expects rapid decarbonization to a 1.5°C world to follow four key economic phases.

Figure 3.5: Four phases of action to achieve a decarbonized China in a 1.5°C world



	Largest economic gains during transformation Ordered by largest GDP gain, level terms (RMB)	
Bold Climate Plays 2021–2025	New energy Construction Public and private services	Agriculture and forestry Retail and tourism Transport
Coordinated Change 2025–2040	New energy Public and private services Construction	Agriculture and forestry Retail and tourism Water and utilities
Turning Point 2040–2055	New energy Public and private services Agriculture and forestry	Retail and tourism Water and utilities Construction
Low Emission Future 2055–2070	New energy Public and private services Agriculture and forestry Manufacturing	Retail and tourism Construction Water and utilities

Source: Deloitte Economics Institute D.CLIMATE model.



Bold Climate Plays
from 2021 to 2025

The next few years set the stage for rapid decarbonization. The decisions by government, regulators, business, industry, and consumers would reinforce initial progress and create the market conditions to deliver decarbonization at pace and scale. This would send price signals, transform supply chains, and lay the foundation for a structural shift that limits global average warming to 1.5ºC.

In China, the policies in the 14th Five-Year Plan outlining further emissions reductions and non-fossil energy consumption targets should start to send market signals to regulators, businesses, and consumers.[42] State-owned firms, including some of the biggest carbon emitters, are expected to be among the first to respond to policy signals from the top. For example, in March 2021, the State Grid published a carbon action plan saying it would achieve carbon neutrality in its operations, and place more emphasis on supporting and encouraging electricity generators' carbon transition plans.[43]

In aggregate, China's economy would see immediate gains during this period, particularly in the new energy, construction, and services sectors, as existing progress is leveraged and markets react. China's energy sector would also benefit from the domestic deployment of increasingly cheap technologies and markets, enabling switching from fossil fuel energy sources to low-emission energy sources.

Coordinated Change
from 2025 to 2040

The hardest shifts in industrial policy, energy systems, and consumer behavior would get underway by this point. This would be the decade in which economies, businesses, and industries began to see the consequences of bold climate plays, with different industries and regions transforming at different paces.

China's economy would ride the wave of progress already made in clean energy technologies, and achieve further gains as it exported decarbonization technologies and goods to the world. China would have established its strength in the essential technologies for decarbonizing the electricity and transportation sectors, including solar and wind power, advanced batteries, and electric vehicles. Rapid growth in export markets would make clean energy a new pillar of the Chinese economy.

Turning Point
from 2040 to 2055

Our model suggests the decarbonization adjustments in industry should be almost complete by this period. The cost of new low-emission technologies would continue to decrease, and net economic gains would be more widely shared. This is when the material benefits of limiting global average warming through decarbonization would be likely to materialize, in the form of a greater than 0.2°C average difference in the global mean temperature in the decade leading up to 2055, compared to the RCP 6.0 baseline.

This would be the climatic and economic turning point, preventing the shift to a "locked in" higher-emission pathway while realizing the economic dividends of systems-level transformations. China's strong foundation and early mover advantage would give it an edge in clean energy export markets. But in the decades to 2050, other major global economies would begin to catch up—adopting the now-cheaper clean energy technologies that China helped bring to market in the two decades prior. China's economy would continue to grow in this phase, but at a reduced rate as it adjusts to the global economy becoming more competitive in clean energy.

A Low-Emission Future
after 2055

Beyond 2055, our model predicts China's economy would be near net zero emissions and the economic systems of production would keep global average warming to around 1.5°C by the end of the century. Economic structures would be radically transformed, underpinned by a series of interconnected, low-emission systems spanning energy, mobility, manufacturing, and food and land use.

The energy mix would be dominated by low- or zero-emission sources across every market, with green hydrogen and negative-emission solutions, both natural and technological, playing prominent roles.

China is uniquely positioned to lead the global transition to a low-emission future and derive economic gains for its economy from the first year after bold policy moves are made. By 2070, our modeling shows it would experience annual net economic gains of nearly 3 percent compared to a world where no climate action is taken. The country would have pioneered critical low-emission technologies, making them affordable and scalable globally. By exporting decarbonization, China would create benefit for its own people, the Asia Pacific region, and the world.

Endnotes

1 Zhang, Z. (2019). *Shanghai: Industry, Economics, and Policy.* China Briefing.

2 Bank of England. (2019). *How has GDP growth changed over time?*

3 Friedlingstein, P. et al. (2020). "The Global Carbon Budget 2020." (2020)12, *Earth System Science Data.*

4 Lin, Justin et al. (1996). *The China Miracle – Development Strategy and Economic Reform.* Hong Kong: The Chinese University Press; Naughton, Barry. (1995). *Growing out of the Plan – Chinese Economic Reform 1978 – 1993.* Cambridge: The Cambridge University Press; Tisdell, C. (2008). "Thirty Years of Economic Reform and Openness in China: Retrospect and Prospect." *Economic Theory, Applications and Issues Working Papers;* Chow, G. (2004). "Economic Reform and Growth in China." (2004)5, *Economic Reform and Growth in China;* Garnaut, R. and Song, L. (1999). *China: Twenty Years of Economic Reform.* Canberra: ANU Press.

5 World Bank. (2021). *GDP % annual growth – China.* Selected data from World Bank national accounts data and OECD National Accounts data files 1960–2020.

6 Dutta, M. (2005). "China's industrial revolution: challenges for a macroeconomic agenda." (2005)15, *Journal of Asian Economics;* Eng, I. (2002). "The Rise of Manufacturing Towns: Externally Driven Industrialization and Urban Development in the Pearl River Delta of China." (2002)21, *International Journal of Urban and Regional Research;* Paul, J. (2016). "The Rise of China: What, When, Where, and Why?" (2016)30, *The International Trade Journal.*

7 The World Bank. (2021). *Overview;* Farrell, D. et al. (2006). *The Value of China's Emerging Middle Class.* McKinsey & Company.

8 Ceglowski, J. and Colub, S. (2007). "Just How Low are China's Labour Costs?" (2007)30, *World Economy*; Woetzel, J. (2019). *China and the World – Inside the dynamics of a changing relationship.* McKinsey Global Institute.

9 Green, F. and Stern, N. (2016). "China's Changing Economy: Implications for its Carbon Dioxide Emissions." (2017)17, *Climate Policy*; Garnaut, R. et al. (2008). "China's Rapid Emissions Growth and Global Climate Change Policy." In *China's Dilemma: Economic Growth, the Environment and Climate Change.* Canberra: ANU Press.

10 Ritchie, H. and Roser, M. (2021). "CO_2 Emissions. Our World in Data; Global Carbon Project (2021)." *Global Carbon Budget – Data;* Larsen, K., et al. *China's Greenhouse Gas Emissions Exceeded the Developed World for the First Time in 2019.* Rhodium Group, May 6, 2021.

11 Zheng, X. et al. (2020). "Drivers of Change in China's Energy-related CO_2 Emissions." (2020)117, *Proceedings of the National Academy of Sciences - PNAS;* Zheng, J. (2019). "Regional Development and Carbon Emissions in China." (2019)81, *Energy Economics.*

12 The World Bank. (2021). *World Development Indicators.*

13 IPCC. (2014). *Climate Change 2014 Synthesis Report: Fifth Assessment Report (AR5);* IPCC. (2018). *Global Warming of 1.5°C.*

14 Bank of England. (2019). *How has GDP growth changed over time?*

15 Sall, C. (2013). *Climate Trends and Impacts in China.* World Bank; National Intelligence Council. (2009). *China:*

Impact of Climate Change to 2030; UNESCAP. (2016). *The Economics of Climate Change in the Asia-Pacific Region*; Asian Development Bank. (2019). *The (Economic) Impacts of Climate Change: Some Implications for Asian Economies*; McKinsey & Company. (2020). *Leading the Battle Against Climate Change: Actions for China.*

16 World Resources Institute. (2020). *China Can Grow its Economy Through Stronger Climate Action*; The World Bank. (2013). *Seizing the Opportunity of Green Development in China*; Institute for Urban and Environmental Studies. (2010). S*tudy on Low Carbon Development and Green Employment in China.*

17 Global Times. (2021). *China tops world for renewable energy exploration and utilization;* Mealy, P. and Teytelboym, A. (2020). E*conomic complexity and the green economy.*

18 Ibid.

19 Ibid.

20 Asian Development Bank. (2017). *Promoting Ecosystem Services and Forest Carbon Financing in Asia and the Pacific;* WWF. (2012). *Ecological Footprint and Investment in Natural Capital in Asia and the Pacific;* IPCC. (2007). *Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the IPCC AR4; Rasul, G. (2021). "Twin Challenges of COVID-19 Pandemic and Climate Change for Agriculture and Food Security in South Asia." (2021)2, *Environmental Challenges.*

21 IPCC. (2014). *Climate Change 2014 Synthesis Report: Fifth Assessment Report (AR5).*

22 Chen, S. (2021). "How deadly floods in western China could threaten new Silk Road." *South China Morning Post*, 2 April 2021; SBS. (2021). *More than 20 workers trapped in flooded mine in China's Xinjiang region*; OCHA Services. (2018). *20 dead, 8 missing as record heavy rain triggers floods in Xinjiang.*

23 Sun, C. et al. (2019). "Changes in extreme temperatures over China when global warming stablilized at 1.5˚C and 2.0˚C." (2019)9, *Scientific Reports.*

24 International Energy Agency. (2019). *China Power System Transformation, Technology report.*

25 Friedlingstein, P. et al. (2020). "The Global Carbon Budget 2020." (2020)12, *Earth System Science Data;* Climate Action Tracker. (2021). *Country Overview.*

26 International Energy Agency. (2020). *Asia Pacific.*

27 BP. (2020). *Statistical Review of World Energy.*

28 Ibid.

29 Ibid.

30 Ibid.

31 International Energy Agency. (2020). *World Energy Outlook 2020.*

32 Bates Ramirez, V. (2020). "Huge new solar farm just came online in China." *The Mandarin*, 12 October 2020.

33 REN21. (2020). *Renewables 2019 Global Status Report.*

34 Mealy, P. and Teytelboym, A. (2020). "Economic complexity and the green economy." (2020), *Research Policy.*

[35] Campbell, C. (2019). "China Is Bankrolling Green Energy Projects Around the World." *Time,* 1 November 2019.

[36] International Energy Agency. (2020). *Sustainable Recovery.* World Energy Outlook Special Report in collaboration with the International Monetary Fund.

[37] Deloitte. (2020). *Fuelling the Future of Mobility: Hydrogen and fuel cell solutions for transportation, Volume 1.* Deloitte China.

[38] Mealy, P. and Teytelboym, A. (2020).

[39] Arthur, W.B. (2014). *Economic complexity: A different way to look at the economy.* Sante Fe Institute; Arthur, W.B. (2014). *Complexity and the Economy.* 1st ed., Oxford: Oxford University Press; Hausmann, R., et al. (2013). *The Atlas of Economic Complexity: Mapping Paths to Prosperity.* 2nd ed., Cambridge: MIT Press; Hausmann, R., and Hidalgo, C. A. (2009). *The building blocks of economic complexity.* Proceedings of the National Academy of Sciences; OECD. (2021). *Global value chains and trade.*

[40] Zhang, Z. (2019). *Shanghai: Industry, Economics, and Policy.* China Briefing.

[41] Marcacci, S. (2021). *China's Carbon Neutral Opportunity: Economic Growth Driven by Ambitious Climate Action.* Forbes.

[42] World Resources Institute. (2021). *China's 14th Five-Year Plan Sets Foundation for Climate Action, But Important Details Are Still Needed.*

[43] Zhe, Y. and Yunong, W. (2021). "Carbon neutrality in China: behind the corporate hype." *China Dialogue,* 12 April 2021.

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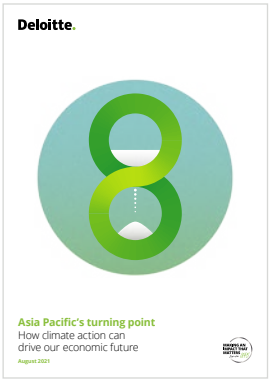

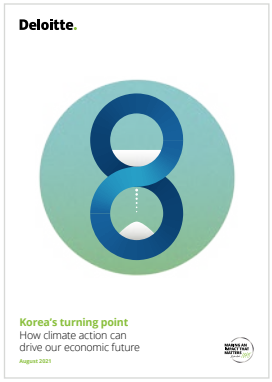

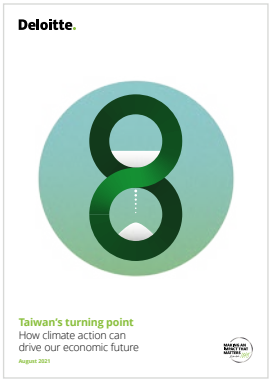

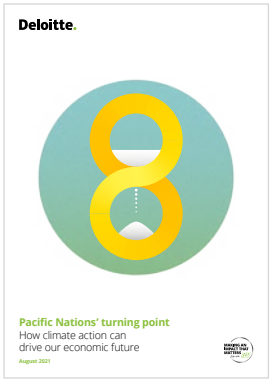

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