



Synthesis Report 2020
on China's Carbon
Neutrality

China's New Growth Pathway:

From the 14th Five-Year Plan to
Carbon Neutrality

SUMMARY FOR POLICY MAKERS

Acknowledgments

This report is the product of a collaborative effort between Energy Foundation China and a multi-team research consortium. The research consortium is coordinated by the Energy Foundation China and the University of Maryland Center for Global Sustainability and includes both Chinese and international research institutions.

Energy Foundation China and the project team would like to thank the Energy Foundation China's Long-term Strategy for Decarbonization Task Force Advisory Roundtable, stakeholders, and reviewers that provide suggestions for improving the framing and analysis of this report.

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In addition, we would like to thank **Wei Xu**, **Lan Yu**, and **Yichu Lu** from the Energy Foundation China for their support in the proofreading and production of this report.

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December 2020

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Suggested citation

Energy Foundation China (2020). "Synthesis Report 2020 on China's Carbon Neutrality: China's New Growth Pathway: from the 14th Five Year Plan to Carbon Neutrality." Energy Foundation China, Beijing, China. Available at: <https://www.efchina.org/Reports-en/report-lceg-20201210-en>.

China's vision for carbon neutrality before 2060 demonstrates a commitment to global climate leadership and will serve as a foundation for China's growth and broadly-shared prosperity. It can advance China's leadership and competitiveness in the emerging green economy, support structural industrial reform away from polluting energy sources and industries, enhance energy security, and deliver significant and sustained improvements in health and human well-being as well as multiple benefits to the environment. Delivering on this vision will be challenging, but can be achieved through creation of robust

long-term strategies and identification of near-term actions across key sectors—electricity, buildings, industry, transport, agriculture, forestry, and land use—along with efforts to work across sectors through specific actions in policy, finance, and technology. This report sets out the broad outlines for decarbonization, identifies key elements of strategy across the economy and within individual economic sectors, and points forward toward continued research to support China's success in meeting its long-term goals for carbon neutrality, green growth, ecological civilization, and sustainable development.

CHINA'S VISION FOR CARBON NEUTRALITY IN A RAPIDLY EVOLVING WORLD

The world is changing. Revolutions in science, technology, and how we relate to each other are driving increased connectivity and substantial changes to economic productivity. Developments in information and communication technology, including artificial intelligence, big data, and quantum information, are driving changes in how we live and work and the ways that we interact with one another. Clean energy technologies such as batteries, photovoltaics, and new energy vehicles, have advanced far more rapidly than anticipated even a decade ago. These trends have created entirely new industries and business models which are fundamentally changing global development. The next decades will be crucial as new drivers of growth and development take the place of old ones.

China is also changing. Since the reform and “opening up” in 1978, China's GDP has grown at almost 10 percent annually, and more than 850 million people have been lifted out of poverty (World Bank, 2020). China is now the world's second largest economy, with expanding global influence. High growth, driven by resource-intensive and polluting manufacturing, export and investment, and low-cost labor, is proving unsustainable. Structural constraints, such as declining productivity and labor force growth, have already slowed China's economic growth. China's long-term economic expansion is also bringing forth institutional and social challenges. At the same time, China's middle-income population is growing, demanding ever greater goods and services, and increasingly yearning for a life of greater safety, health, well-being, and

equality.

Looking to the future, by mid-century, China will be a different country than today, and this presents its own long-term challenges and opportunities. Its standard of living will be more in line with the most advanced economies today, and the percentage of the population aged 65+ could be nearly 30%, rising from 11.5% in 2019 (UN-DESA, 2019). Its low-emissions development pathway must be seen against the backdrop of this more prosperous future, and not against the China of today.

As China navigates through these changing currents and looks toward the future, it has adopted a new vision for growth and development built around improving people's livelihoods and well-being (see box below). For example, the report of the 19th National Congress of the Communist Party of China reiterated “Two Centenary Goals”—“building a moderately prosperous society in all respects by 2021; and building China into a great modern socialist country that is prosperous, strong, democratic, culturally advanced, harmonious, and beautiful by 2049.” This vision for growth and development focuses on better quality, and more open, inclusive and cohesive economic, political, and social systems. A foundation for this new vision for growth and development is a model of sustainable development featuring greener, more efficient, and sustainable consumption and production that can help promote people's living standards and a healthier ecosystem—in short, an “ecological civilization”.

CONNECTING CHINA'S CARBON NEUTRALITY GOAL TO CHINA'S DEVELOPMENT GOALS THROUGH 2035

The new growth pathway that is implied by China's carbon neutrality goal will also be rooted in existing goals and policies. One recent and salient example of this is the connection between China's new development objectives and its overall technological context and growth strategy. The proposals for formulating the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and the Long-Range Objectives Through the Year 2035, adopted in 2020, outline China's major development goals for the next 15 years. Notable features of these goals include:

- ▶ Becoming a global leader in innovation by making major breakthroughs in core technologies in key areas.
- ▶ Building a modernized economy through "new industrialization, digitalization, urbanization, and agricultural modernization".
- ▶ Advancing eco-friendly ways of work and life across all areas of

society.

- ▶ Achieving a "Beautiful China" with steadily declining carbon emissions and a fundamental improvement in the environment.
- ▶ Improving overall lives of its citizens, focusing on well-rounded human development.
- ▶ Strengthening across diverse areas, including but not limited to the economy, health, per-capita GDP, inter-regional equity, and technology.

Overall, these goals for 2035 are clearly resonant with the strategies for carbon neutrality before 2060. The next phases of discussion and planning in China will focus on the policies and programs needed to connect today's situation through these 2035 goals, and continue this transition through 2060.

In September 2020, China announced that it aims "to have CO₂ emissions peak before 2030 and achieve carbon neutrality before 2060". While the overall carbon neutrality and emissions peaking goals are clear, the means to achieve them are still not well understood, and China has not yet submitted its Mid-century GHG Low-Emission Development Strategy. Moreover, while this transition will generate significant and broadly shared benefits to China and the world, navigating

these changing dynamics while also structuring a rapid and orderly transition toward this new economy presents challenges. In this light, this report provides an overall picture of pathways to support the carbon neutrality goal and China's new vision for growth and development, and it identifies both long-term sectoral strategies and near-term actions to put China on the road to carbon neutrality before 2060.

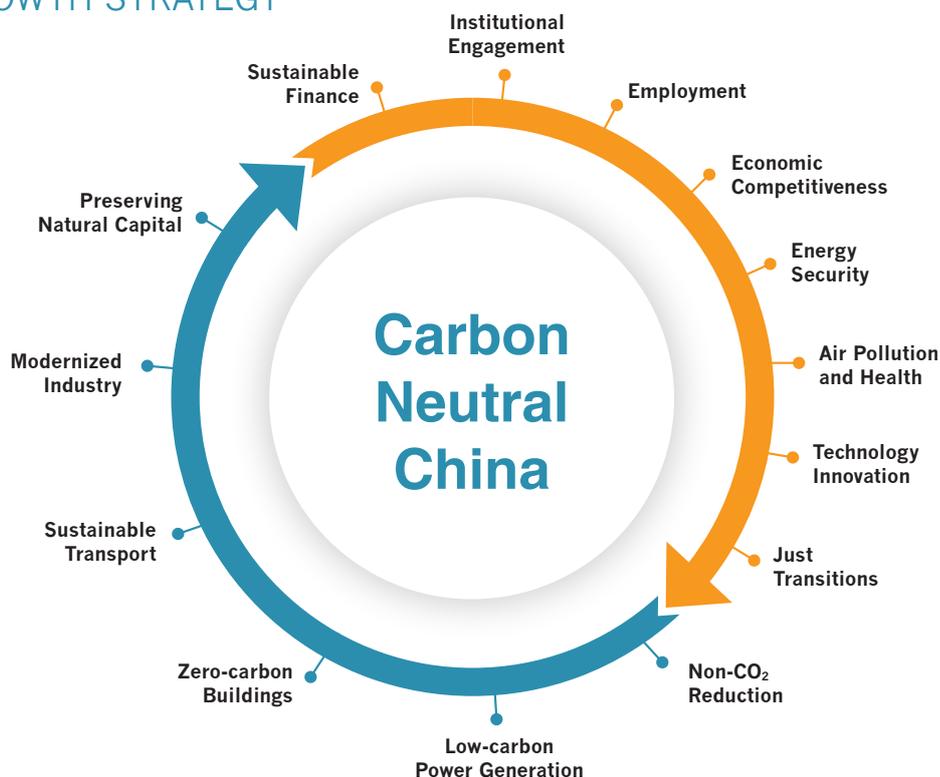
CHINA'S CARBON NEUTRALITY VISION AS THE FOUNDATION FOR HIGH-QUALITY GROWTH AND DEVELOPMENT

Against the backdrop of global and domestic forces that will shape the coming decades, the economic transformation embodied in the concepts of ecological

civilization, beautiful China, and China's carbon neutrality goal can be seen as a blueprint for a new growth pathway that achieves multiple goals (Figure 1).

FIGURE 1. CHINA'S NEW GROWTH STRATEGY AND VISION FOR CARBON NEUTRALITY.

NEW GROWTH STRATEGY



International leadership, industrial expansion, and competitiveness. China is already a leader in technologies of the emerging global, green economy, and it is on its way to becoming a global leader in 5G technology and artificial intelligence—technologies that will be in high demand globally and that will help to underpin the green economy. If structured well, this new growth pathway can lead to accelerated innovations and development in these and other emerging industries, allowing China to solidify its position as an international leader in the science and technologies of the 21st Century, while leveraging them into a beneficial industrial transformation domestically and long-term economic competitiveness.

Jobs and prosperity. The transition away from a fossil-based economy will involve near-term challenges (see box on coal phaseout). Yet, against a backdrop of an evolving global green economy, the economic transformation reflected in the carbon neutrality goal can promote strong employment and broadly shared economic prosperity. Between 2010 and 2019, China attracted \$818 billion investment in the renewable

sector and became the world's largest market for both solar PV and solar thermal energy. Almost 40 percent of all global renewable energy jobs are in China, reaching over four million jobs in 2020 (IRENA, 2020). China's progress toward carbon neutrality will further expand job opportunities across the spectrum of the green economy, including battery production, renewable energy, construction (e.g., retrofitting existing buildings), related services (e.g., shared mobility), and foundational technologies such as digitalization.

Structural reform. The carbon neutrality goal will facilitate China's industrial structural reform as it shifts away from polluting, carbon-intensive industries to low-carbon industries. The low-carbon transition will increase industrial total factor productivity, change production methods, and cultivate new business models, and therefore help to achieve China's goal of structural adjustment, optimization, and upgrade.

Improved health, cleaner air. The carbon neutrality goal will reduce reliance on coal and other polluting resources and accelerate the current trend toward a

new generation of low-pollution vehicles. These changes can significantly reduce health risks from fine particles (PM_{2.5}), SO₂, and NO_x emissions. While China has made great strides in air pollution, current air quality standards are insufficient to meet long-term goals. Combining these standards with the green development implied by China's carbon neutrality goal will put China on a path to meet the highest air quality standards of the World Health Organization for PM_{2.5}.

Enhanced energy security. As one of the world's largest crude oil consumers, China surpassed the

U.S. to become the world's largest importer of crude oil in 2018 (IEA, 2020). China is also the world's largest consumer and importer of coal. In 2019, China consumed 2,870 Mtce of coal, comprising 53% of the global consumption, and imported 21% of the coal in the international market (IEA, 2020). The heavy reliance on imported fossil fuels undermines China's energy security. China's progress toward carbon neutrality will allow it to install more domestic renewable energy capacity, reducing its reliance on imported fossil fuels and leading to enhanced energy security.

PHASING OUT COAL IN THE ENERGY SYSTEM

As the world's largest coal consumer and producer, coal is deeply embedded in China's energy system and its economy. Coal contributed 58% of China's total primary energy consumption in 2019. It is widely used in electricity generation, steel and cement production, chemicals, and buildings.

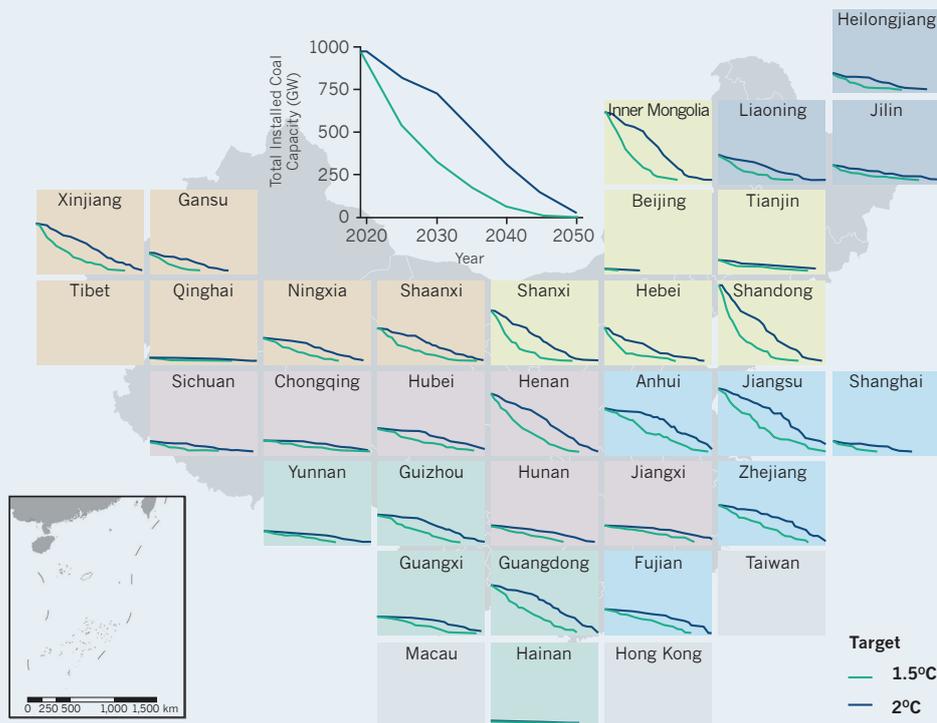
To achieve its carbon neutrality goal, China needs to accelerate a phaseout of the use of coal without carbon dioxide capture and storage (CCUS) across the economy. Scattered coal combustion from small industrial furnaces, boilers, residential heating, and cooking in rural areas should be eliminated within the timeline of the 14th Five-Year Plan (2021-2025). Coal power generation without CCUS should be eliminated by around 2040-2045. Coal consumption without CCUS in industrial sectors that are difficult to decarbonize (e.g., as a feedstock in steel production) should be eliminated around 2055-2060.

Phasing out coal from the power sector is particularly important. The power sector accounts for 54% of China's total coal consumption. Through an immediate halt of new construction of coal-fired power plants, rapid retirements of a small portion of old, dirty, inefficient coal plants in the near term, and gradually reduced utilization for operating plants, China can phase out coal power generation without CCUS by around 2040-2045, when the majority of existing plants reach a 30-year lifetime. Direct coal consumption in end-use sectors, mainly industry and buildings, can be phased out through a combination of strategies, including efficiency improvements, electrification, low-carbon fuel switching (i.e., to zero-carbon hydrogen or modern biomass), and structural changes that can reduce the demand for coal.



NATIONAL AND PROVINCIAL COAL POWER PHASEOUT PATHWAYS FOR A 1.5°C SCENARIO AND A 2°C SCENARIO.

(Source: Cui et al., 2020).



Phasing out coal will broadly support China's development agenda through improved air quality and human health, enhanced energy independence and energy access through low-cost renewables, and new jobs and growth opportunities in a green economy.

At the same time, phasing out coal presents near-term challenges. Many regional economies are heavily reliant on coal for employment and economic activity. Phasing out coal will require a comprehensive approach that addresses the impacts on coal-dependent economies.

Possible approaches include resettlement and retirement policies for older workers, retraining and education programs for younger workers, fiscal policies to provide compensation and financial support to both individuals and companies, as well as economic incentives to create new businesses and development opportunities for local economies. A coal phaseout with effective transition management can provide a better quality of life for millions of coal workers and for China's future energy workforce.

CHINA'S VISION FOR CARBON NEUTRALITY IN A GLOBAL CONTEXT

The Paris Agreement has as one of its central goals "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels". Based on the most current research, the Intergovernmental Panel on Climate Change (IPCC) has concluded that net global CO₂ emissions should reach zero around mid-century to limit warming to 1.5°C.

In this light, China's carbon neutrality goal is a significant contribution to the international processes for limiting warming to 1.5°C. It is consistent with recent global modeling studies that try to identify the most globally "cost-effective" pathways to 1.5°C (see Figure 2). At the same time, the sooner before 2060 that China can reduce emissions to zero or near-zero, the greater the chance of limiting warming to 1.5°C.

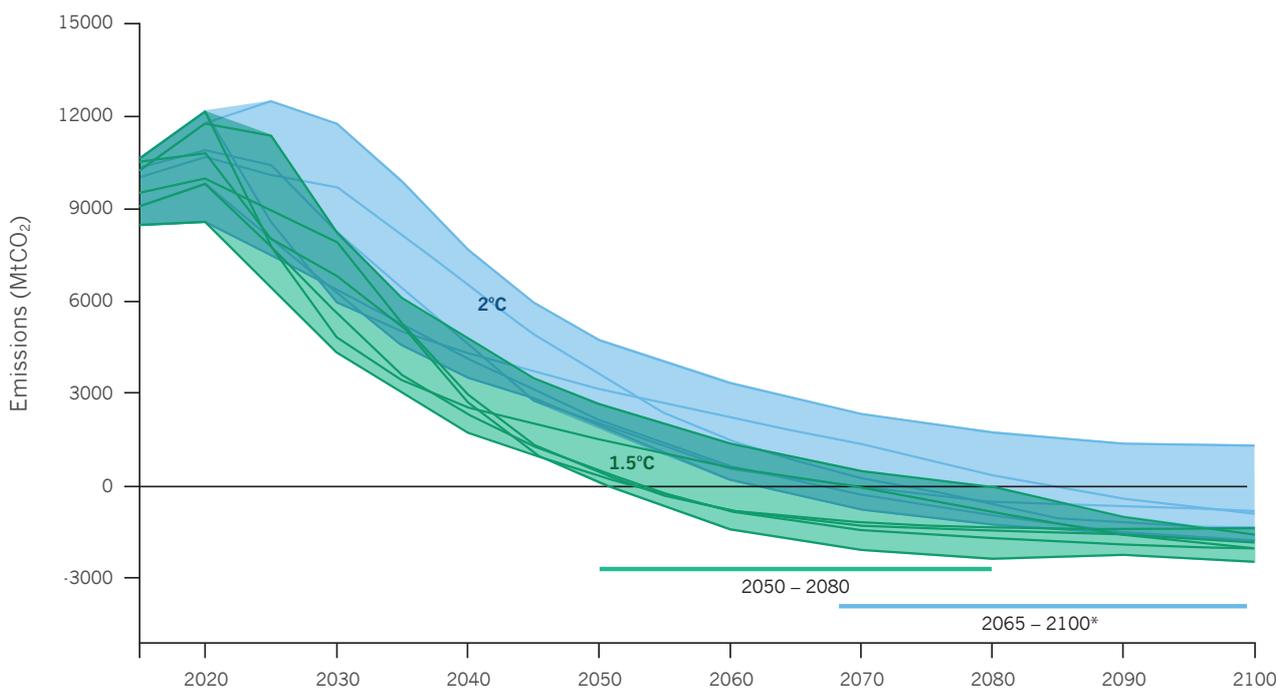
While the global goal is to reach carbon neutrality around mid-century, different countries may do so at different times while still giving the world a good chance to limit warming to 1.5°C. Within the context of the Paris Agreement, countries need to make their domestic decisions about when to reach carbon neutrality based on national circumstances such as their domestic low-carbon resources, their strategies for growth and development, and, importantly, their ability to sequester carbon and eke out the final emissions reductions needed to reach net zero. Different ways of looking at

equity and fairness will also influence perceptions of when different countries should reach carbon neutrality. Approaching the question from the perspective of global economic efficiency, for example, leads to different perspectives than asking the same question from the perspective of equity, measured, for example, in terms of per-capita emissions or historical responsibility. These various perspectives cannot be reconciled into a single number for any country. They do, however, provide a sense of the range of possibilities.

FIGURE 2. CHINA'S CO₂ EMISSIONS FOR 1.5°C AND 2.0°C SCENARIOS FROM SELECTED MODELS.

Sources: CO-LINKS global scenarios (McCollum et al., 2018; Roelfsema et al., 2020) and emissions pathways from GCAM-China. * Note that one 2.0°C scenario does not reach zero before 2100.

TOTAL CO₂ EMISSIONS IN CHINA



China intends to achieve carbon neutrality before 2060. Regardless of precisely when before 2060 China reaches carbon neutrality, it is essential that China's emissions peak quickly and, depending on actions of other countries, be brought very close to zero by mid-century in order to limit warming to 1.5°C. The concept of carbon neutrality is a valuable organizing framework for international action, but what ultimately matters for limiting warming is the totality of emissions over time

—“cumulative emissions”—and not just the emissions at mid-century. Earlier peaking and faster long-term reductions will help to limit China's cumulative CO₂ emissions. Indeed, both global and national studies consistently call for China's emissions to peak almost immediately to limit temperature change to 1.5°C. Scenarios that limit warming to 2°C may peak toward 2030.

If China’s CO₂ emissions do not peak before 2030, not only will its cumulative emissions be higher, it will create substantial challenges for achieving carbon neutrality before 2060 and limiting cumulative emissions because China’s economy will be “locked in” to higher emitting assets that will be difficult to

move away from, for example, new coal-fired power plants; and it will limit the time for the broader societal, economic, and energy system transitions needed to limit emissions. In other words, delay would put the carbon neutrality goal in doubt.

SECTORAL AND STRATEGIES FOR DECARBONIZATION

Carbon neutrality is an economy-wide challenge. It will not be possible to bring China’s CO₂ emissions to zero without substantial emissions reductions across all sectors of the economy—including buildings, industry, transportation, electricity, refining, agriculture, and forestry. And net emissions must be brought to zero despite continued economic growth across China’s economy. Each sector presents its own challenges and opportunities and will follow its own timeline (Table 1). Nonetheless, at least two strategic themes emerge both from existing research and the new research supporting this report. First, electricity provides greater near-term opportunities for substantial emissions reductions relative to other sectors, due to the many alternative

options and the increasing economic competitiveness of wind and solar power. This does not obviate the need for immediate action across all sectors; it only highlights that it will be possible to see substantial results in electricity more quickly than in other sectors. Second, there are a number of applications in which low-cost mitigation options do not exist today. This includes, for example, air transport, many industrial processes, and high-temperature heat. Research typically anticipates that these will be the last sectors to be decarbonized or that they may never be fully decarbonized. At the same time, technology is evolving rapidly, and opportunities for mitigation decades from now may be very different than today.

TABLE 1. SECTORAL CO₂ REDUCTIONS ACROSS MODELS RELATIVE TO 2015.

Note that percentages are calculated based on 2015 numbers from the scenarios rather than from China’s inventories, to allow for differences in base year numbers. Differences in base year numbers arise from differences in sectoral accounting methodologies among models. Negative values indicate increases. Note also that subsets of scenarios were used to calculate ranges in each sector. Models used in the table include ERI-Industry, GCAM-China, ICCCSD-LoMLoG, IPAC-AIM/technology, MESSAGEix-GLOBIOM, PECE_LIU_2019, PECE V2.0, POLES-JRC 2019, and Transportation-CATS.

Sector	2035		2050	
	1.5°C	2°C	1.5°C	2°C
Electricity	20%~60%	0%~45%	100%~120%	80%~100%
Buildings	0%~70%	0%~50%	50%~95%	20%~80%
Industry	30%~70%	20%~35%	75%~95%	50%~80%
Transportation	-45%~25%	-60%~-5%	40~90%	25%~65%

Meeting China’s carbon neutrality goal implies a rapid and extensive scale-up of low-carbon energy (Figure 3). Scenarios explored in this study found an upscaling of low-carbon sources from about 6% in 2015 to about

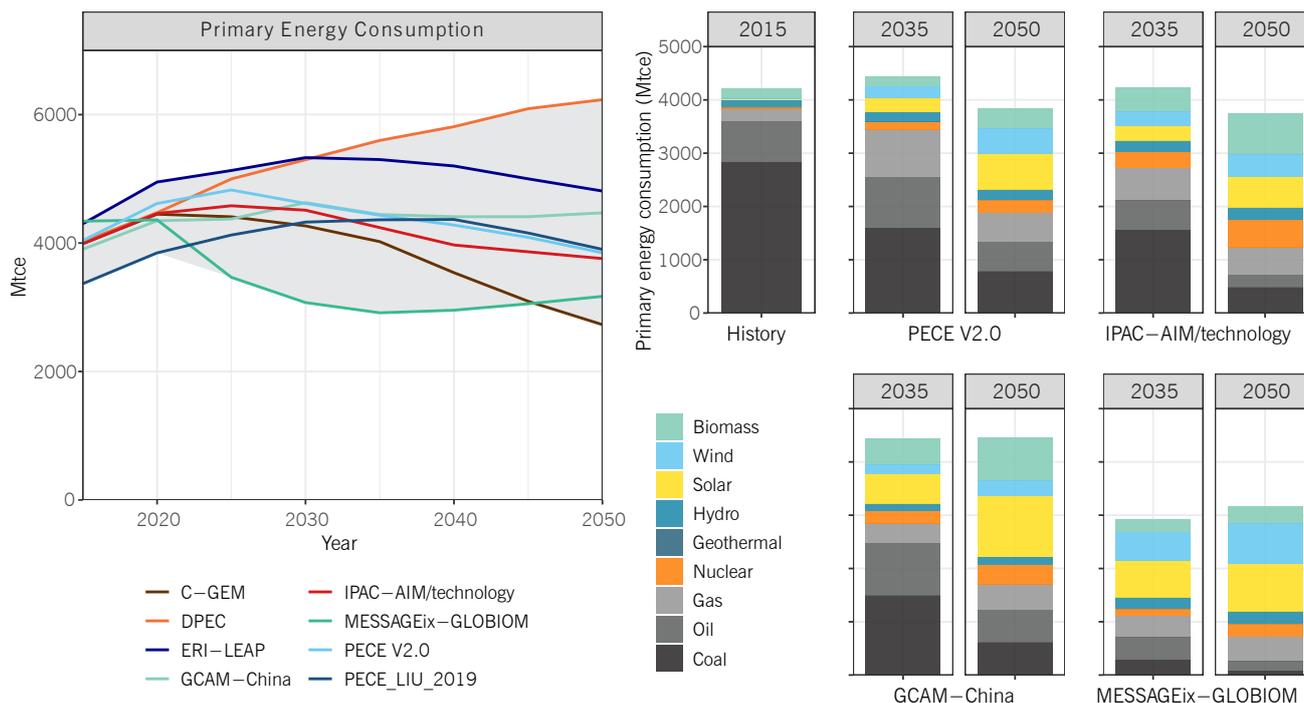
30-65% and 70-85% of total primary energy use by 2035 and 2050, respectively, to meet limit warming to 1.5°C. Implementation of these strategies will also lead to a change in energy carriers used in building,

industry, and transportation. Fundamental to all of these strategies is the need to phase out the use of coal without CCUS across all sectors. This foremost

affects the electricity and industry sectors where coal constitutes a large fraction of fuel input.

FIGURE 3. PRIMARY ENERGY IN 1.5°C SCENARIOS.

The left panel shows the time path for multiple models; the right panel shows examples of the distribution of primary energy sources in 2035 and 2050 for four selected models. Primary energy in this report is estimated based on the direct equivalent method, different from the method used in Chinese statistics.



Several cross-cutting strategies emerge both from the economy-wide scenarios synthesized here and other studies of deep decarbonization. Different sectors will put different emphases on these cross-cutting strategies (Table 2). In order to limit warming to 1.5°C or 2°C, these decarbonization strategies will need to be complemented by comparable actions to reduce non-CO₂ emissions. Cross-cutting decarbonization strategies include the following:

- ▶ **Promoting sustainable demand** in all end-use sectors while maintaining high living standards through more efficient use of energy, structural change, urban planning, and lifestyle changes.
- ▶ **Decarbonizing electricity generation** by phasing out coal power generation without CCUS and rapidly increasing generation from a diverse portfolio

of technologies dominated by renewables and supplemented by nuclear and fossil or bioenergy with CCUS.

- ▶ **Electrifying end-use sectors** by increasing electric vehicles, using electricity for low-temperature heat in industrial applications, and transitioning to electric space and water heating in buildings.
- ▶ **Switching to low-carbon fuels** like hydrogen and biomass in industry (as fuel or feedstock) and transportation (e.g., long-haul trucking, shipping, and aviation) when electrification is not feasible or economically viable.
- ▶ **Sequestering carbon** in natural systems (e.g., forest and soil) or through CO₂ removal technologies to facilitate carbon neutrality even if emissions do not reach zero in some hard-to-decarbonize applications such as air travel or high temperature process heat.

TABLE 2. MITIGATION STRATEGIES TO REACH CARBON NEUTRALITY IN CHINA.

MITIGATION MEASURES

Sector	Sustainable Demand	Low-carbon Generation	Electrification	Fuel Switching	Carbon Sequestration
 Electricity		✓			✓
 Buildings	✓	✓	✓	✓	
 Industry	✓	✓	✓	✓	✓
 Transportation	✓		✓	✓	
 Agriculture, Forestry, and Other Land Use	✓				✓

Implementing China’s carbon neutrality goal will require both long-term strategic goals and clarity on key near-term priorities. Based on the analysis and assessment in this project, a clear set of long-term strategies and near-term priorities has emerged (see summary tables below).

While it is useful to view decarbonization through the lens of sectoral strategies, the carbon neutrality goal will also require actions that cut across sectors. For example, electrifying transport can reduce vehicle emissions, but decarbonization of electric power will need to be tackled simultaneously with reductions in production and end-of-life vehicle emissions to achieve net system-wide emission reductions. Similarly, there are important interactions between the energy and land systems, particularly in the context of bioenergy as a substitute for fossil fuels in energy and material applications. Cross-cutting policies such as carbon prices may prove valuable as part of a policy portfolio.

More broadly, decarbonization will require a shift in investment away from fossil-intensive assets and toward those associated with decarbonization, and this will require rethinking fiscal and monetary policies. It will also require realigning incentives in the financial system to advance these long-term transitions. Similarly, technology is fundamental to the transformation that lies ahead and to China’s economic leadership in the new, green economy; investments in technology and innovation will therefore be an essential part of China’s strategy that can support action across sectors.

SECTORAL STRATEGIES: The Pathway to Carbon Neutrality

Electricity



Emissions peak and start to decline immediately; they reach zero or are negative by 2050.



- Rapid electrification in all end-use sectors.
- Conventional coal-fired power plants without CCUS are nearly phased out by 2040 or 2045.
- Renewable power generation contributes around 70% of generation by 2050.
- CCUS and nuclear are retained as complementary options to complement renewable power.
- The flexibility of the power grid is significantly improved through flexible generation, improved grid infrastructure, demand side response, and deployment of storage technologies.

Buildings



Emissions peak immediately and decline by around 90% in 2050 relative to 2015.



- Around 75% of buildings energy use is supplied by electricity by 2050.
- Most district heating systems in northern urban China are decarbonized by 2050.
- Embodied energy in buildings is reduced by extending building lifetimes through retrofits and/or using higher-quality building materials.
- The scale of the building stock is controlled while continuing to improve the standards of living.

Industry



Emissions peak immediately and decline by around 90% by 2050 relative to 2015.



- A modernized industrial sector constrains the overall scale of industrial energy demands and reduces carbon intensity.
- Energy efficiency improvements, material substitution, and the circular economy reduce energy demand.
- Industry electrification continues through digital transformation and switching from fossil fuels to electricity.
- Zero-carbon hydrogen or biomass substitute for fossil fuels in hard-to-electrify applications.
- CCUS is applied to exhaust gases in applications with high CO₂ concentrations.

Transportation



Emissions peak between 2025 and 2035 and then decline by around 80% by 2050 relative to 2015.



- Transportation transitions to low-carbon energy, including electricity, sustainable biofuels, and hydrogen.
- Comprehensive transportation planning increases energy efficiency and use of low-carbon transport modes.
- Increased integration of innovative technologies, such as big data, 5G, artificial intelligence, blockchain, supercomputers with infrastructure and vehicles to build an electrified, smart, and shared transportation system.

Agriculture, Forestry, and Other Land Use (AFOLU)



Non-CO₂ emissions dramatically decline and AFOLU sectors offset emissions as a carbon sink.



- Technical mitigation options (e.g., anaerobic digesters) and structural mitigation options (e.g., improved manure management) are broadly implemented.
- China transitions to a healthier and more sustainable diet with lower environmental impact.
- Forest carbon sink is sustained and enhanced through continued afforestation and reforestation efforts; increase the forest area by 35 Million hectares in 2050 relative to 2015.

SECTORAL ACTIONS TODAY

Electricity



- Stop new construction of conventional coal-fired power plants without CCUS.
- Identify and quickly close a small fraction of the old, dirty, and inefficient coal plants.
- Continue to increase the share of non-fossil generation (to around 45% by 2025).
- Establish electricity spot markets.
- Increase interprovincial trade on green electricity through power market reform.
- Enhance CCUS policies to promote CCUS-ready in new fossil fuel plants and/or CCUS retrofit in existing facilities.

Buildings



- Continue to enhance building design standard for energy efficiency by improving requirements, including electrification and renewable energy integration.
- Continue to improve energy efficiency standards and labeling schemes of appliances to incorporate smart-enabling technologies and address system energy savings opportunities.
- Phase out coal use in rural residential buildings by promoting onsite PV and efficient biomass use.
- Encourage the use of passive technologies, such as natural ventilation and lighting, by developing small-sized commercial buildings and reducing the focus on large-size commercial buildings.
- Deploy smart technologies in order to improve demand side response and grid flexibility.

Industry



- Further remove excess capacity, increase concentration, and optimize industry structure in order to improve efficiency and increase innovation.
- Improve the relevant processes and standards of environmental impact assessment and energy technology assessment to guide investment and control capacity expansion in high energy consuming industries.
- Implement demand management measures to control the output of industrial products and lower total energy demand.
- Prioritize energy efficient technology deployment to control total energy demand.
- Increase electrification, particularly to replace coal consumption.

Transportation



- Accelerate the adjustment of long-distance freight transport by supporting the use of railways and waterways.
- Accelerate the improvement of the green travel system, focusing on "public transportation and cycling/walking".
- Improve the level of clean technology, promoting the transition to new energy vehicles.
- Vigorously develop intelligent transportation.
- Significantly improve overall energy efficiency.
- Strengthen the innovation in transportation demand management policies.

Agriculture, Forestry, and Other Land Use



- Continue to embrace sustainable agriculture by promoting circular agriculture, recycling of waste reduction, and increased resource use efficiency.
- Encourage the integration of new technologies and innovation, such as climate smart agriculture and artificial intelligence in the agricultural sector.
- Continue to implement and enforce sustainable forest management to sustain and enhance the forest sink.
- Implement actions that provide synergies and actively consider the links between agriculture, water, pollution, biodiversity, diets, and greenhouse gas emissions.

THE ROAD AHEAD

China is poised to accelerate its movement on a new growth pathway toward a clean, vibrant economy that provides broadly shared benefits across China—and in doing so, it can also lead internationally on delivering solutions and making a major contribution to address global climate change. China's carbon neutrality goal makes clear the ultimate destination for this new growth pathway, and China's existing vision for an ecological civilization and its broad development objectives provide additional guideposts for how to reach this goal.

Nevertheless, the goal remains challenging, and will require significant planning, analysis, and policy actions to set the course and build the new economy to achieve the vision. In this context, the actions that China takes today will be critical to successfully implement this strategy. Opportunities for accelerating this transition exist across all sectors of the economy.

KEY ISSUES FOR FUTURE RESEARCH

- ▶ **Shared vision for a new growth pathway.** China's new growth pathway will be most successful if benefits to China's development objectives are well understood and shared across the country and the economy.
- ▶ **Industrial transitions.** China's industrial transition on a new growth pathway and associated efforts to reduce industrial emissions will take place in the context of industrial modernization, China's overall economic strategy, and an evolving role in international markets.
- ▶ **Full economy coal phaseout.** New opportunities exist to achieve a structured phase-out of coal fired electricity. A full phase will require eliminating coal in other sectors, such as industry, and addressing just transitions across the full coal supply chain.
- ▶ **Sustainable finance.** Mobilizing finance within China will be critical for green growth and will depend on the development of energy, fiscal and monetary, and financial policies.
- ▶ **Technology and technology transitions.** Successful technology development and deployment is at the heart of climate mitigation. Many technologies are already changing the emissions and economic landscape, while others are on the horizon and hold great promise.
- ▶ **Non-CO₂ gases.** Multiple opportunities exist to reduce China's overall emissions from greenhouse gases other than CO₂, including methane, nitrous oxide, and HFCs.
- ▶ **Province-level strategy and actions.** Cutting across all of these dimensions is the need to understand opportunities, strategies, and actions in the provinces. As China continues to build policies that help it transition toward a green economy, the provinces will be a critical link to implement them.



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