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on Environment and Development

SPECIAL POLICY REPORT

China's Pathways for Achieving Carbon Neutrality and Global Climate Governance



2024

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Executive summary

The special policy study on the China's Pathways for Achieving Carbon Neutrality and Global Climate Governance is one of the research topics under the task force of Innovation in Global Environmental Governance of China Council for International Cooperation on Environment and Development (CCICED) from 2023 to 2024. This year's research aims to offer policy recommendations for the 15th Five-Year Plan of China and the renewal of China's Nationally Determined Contributions (NDCs). It also seeks to provide decision-making support and a dialogue platform for international cooperation in advancing the green and low-carbon transition of developing countries, as well as global investment and trade in green products.

The 15th Five-Year Plan period marks a crucial phase in China's dual carbon process, during which carbon emissions will peak and begin to decline. Achieving this turning point in carbon emissions trends will require further refinement of carbon emission management and policies. Future energy consumption in China is anticipated to increase, predominantly driven by rising electricity demand, which in turn will necessitate greater reliance on non-fossil energy sources such as wind and PV power. Consequently, it is imperative to further promote the consumption of wind and PV power. Concurrently, climate issues are becoming increasingly complex as geopolitics, security concerns, and trade issues intersect with the green transition process. Therefore, innovative approaches are needed to develop solutions that integrate domestic industrial policies, trade measures, and investment strategies to create a new market equilibrium. These measures should facilitate global climate investment, financing, and trade collaboration while accelerating the green transformation of developing countries, ensuring the alignment of climate goals with economic prosperity and security concerns.

This report explores the latest developments in climate governance both domestically and internationally, compiling and analyzing China's progress and challenges in achieving a comprehensive green and low-carbon transition. It also examines China's contribution to the global green and low-carbon energy transition and the development of green supply chains, while identifying the current challenges to international cooperation on green and low-carbon issues. Additionally, the report addresses gender equality and offers recommendations for promoting gender mainstreaming in climate governance. Finally, it provides policy recommendations for the renewal of China's NDCs and effectively implementing the dual carbon goals in the 15th Five-Year Plan to support the global green and low-carbon transition.

The main findings and conclusions of the research are as follows:

(1) Despite a volatile global geopolitical environment, addressing climate change remains a critical area for international cooperation. However, climate issues are increasingly intertwined with broader concerns such as trade and security, leading to greater uncertainty in climate policy.

(2) China has been making steady progress in its energy transformation, with rapid growth in renewable energy capacity. This trend positions renewable energy as a primary source for meeting rising electricity demand. However, challenges remain in the consumption and integration of these renewable energy sources.

(3) Through technological innovation, industrial policy, and strong supply chain management, China has provided the world with high-quality renewable energy products. These contributions have significantly reduced costs and facilitated the large-scale deployment of global green and low-carbon technologies.

(4) While China has the strategic resolve to achieve its dual carbon goals, the transition process is fraught with challenges. There is a need to further tap into the potential of markets, technologies, and policies to overcome these obstacles.

(5) Gender issues in global climate governance are gaining prominence. There is a pressing need to further promote multilateral cooperation to ensure equal rights and opportunities for women in addressing climate challenges.

Based on the above analysis, the report offers several recommendations for the 15th Five-Year Plan and the renewal of NDCs:

(1) Propose an absolute carbon dioxide reduction target for 2035 in the NDCs renewal. Ambitious targets should be integrated with pragmatic actions, sending positive signals for global climate governance.

(2) Promote the consumption of wind/PV power through measures such as green industry classification, market mechanism, and subsidies. Support should also be provided for low-carbon technological innovation and industrialization tailored to local conditions.

(3) Promote the implementation of the dual control system for carbon emissions and enhance the integration of total carbon emissions and the carbon market. A study should be conducted on establishing a total carbon market control target for the power industry, with a focus on achieving a ten-year decline in the total amount of carbon emissions.

(4) Foster the localization and internationalization of the “New Three” industrial supply chains. Actively advocate for and promote the liberalization and facilitation of global trade and investment.

(5) Actively participate in and promote the reform of the international financial architecture, incorporating climate considerations into export credit policies and overseas investment and financing decisions.

Key words: carbon neutral, climate change, green and low-carbon transition, NDCs, the 15th Five-Year Plan, global climate governance

CONTENTS

1 FOREWORD	1
2 ANALYSIS OF GLOBAL CLIMATE GOVERNANCE SITUATION	2
2.1 COP28 HAS RESULTED IN A STRENGTHENED, BALANCED AND HISTORIC PACKAGE OF CLIMATE ACTIONS, AND FUTURE CLIMATE GOVERNANCE NEEDS TO EMPHASIZE A BALANCE OF AMBITION AND PRAGMATIC SOLUTIONS	2
2.2 COMPLEXITY AND UNCERTAINTY IN CLIMATE GOVERNANCE INCREASE DUE TO INTERSECTION WITH TRADE, GREEN SUPPLY CHAINS, AND OTHER ISSUES	3
2.3 DECOUPLING AND BREAKING OF GREEN AND LOW-CARBON INDUSTRIAL TECHNOLOGIES IS INTENSIFYING, AND THE PACE OF THE GLOBAL LOW-CARBON TRANSITION IS UNDER ATTACK	4
2.4 GLOBAL CLIMATE LEADERSHIP LANDSCAPE IS CHANGING DUE TO KEY NATIONAL AND REGIONAL ELECTIONS ..	4
2.5 CLIMATE RISK HAS BECOME ONE OF THE MOST IMPORTANT RISKS AFFECTING HUMAN SOCIETIES, AND THE SHIFT FROM A “HIGH-CARBON SYSTEM” TO A “LOW-CARBON/ZERO-CARBON SYSTEM” IS IRREVERSIBLE. THE FIGHT AGAINST CLIMATE CHANGE REPRESENTS A VITAL AVENUE FOR INTERNATIONAL COOPERATION	5
3 PROGRESS IN CHINA’S COMPREHENSIVE GREEN AND LOW-CARBON TRANSITION AND CHALLENGES AHEAD	7
3.1 HIGH-QUALITY ECONOMIC AND SOCIAL DEVELOPMENT AND “DUAL CARBON” EFFORTS ARE SYNERGISTICALLY PROMOTED, AND GREEN AND LOW-CARBON INDUSTRIES HAVE BECOME A NEW DRIVING FORCE FOR ECONOMIC GROWTH.	7
3.2 THE DUAL CARBON “1+N” POLICY FRAMEWORK HAS BEEN COMPLETED AND IMPLEMENTED, AND A NEW MECHANISM FOR THE COMPREHENSIVE TRANSITION TOWARD CONTROLLING BOTH THE AMOUNT AND INTENSITY OF CARBON EMISSIONS TO CONTROLLING BOTH THE AMOUNT AND INTENSITY OF ENERGY CONSUMPTION IS ESTABLISHING	9
3.3 PROGRESS IN THE ENERGY TRANSITION HAS BEEN REMARKABLE, AND THE DEVELOPMENT OF A NEW POWER SYSTEM IS ADVANCING STEADILY	12
3.4 ENERGY-SAVING AND CARBON-REDUCING UPGRADES AND TRANSFORMATION OF INDUSTRIES, PRODUCTS AND EQUIPMENT IN KEY AREAS ARE ACCELERATING	15
3.5 CARBON MARKET ARE IMPROVING AND WILL PLAY A GREATER ROLE IN THE DUAL CARBON SYSTEMS IN THE FUTURE	17
3.6 A TOP-LEVEL DESIGN DOCUMENT FOR METHANE EMISSIONS CONTROL ISSUED, SETTING QUANTITATIVE TARGETS FOR METHANE RECOVERY AND UTILIZATION IN ENERGY, AGRICULTURE AND WASTE SECTORS	18
3.7 STRENGTHENING SYNERGIES WITH BIODIVERSITY CONSERVATION EFFORTS AND STEADY INCREASING ECOSYSTEM CARBON SINKS	19
3.8 CHINA’S GREEN AND LOW-CARBON TRANSITION PROCESS STILL FACES MULTIPLE CHALLENGES AND NEEDS	

TO UNLOCK MARKETS, TECHNOLOGIES AND POLICIES POTENTIAL	20
4 CHINA’S CONTRIBUTION TO AND OBSTACLES IN PROMOTING A GLOBAL GREEN AND LOW-CARBON TRANSITION	23
4.1 CHINA’S CLEAN ENERGY PRODUCTS CONTRIBUTE SIGNIFICANTLY TO LOWERING GLOBAL COST OF CLEAN ENERGY USE, ACCELERATING LOW-CARBON TECHNOLOGIES DEPLOYMENT AND IMPROVING ENERGY ACCESSIBILITY	23
4.2 CHINA ACTIVELY ENGAGES IN THE INTERNATIONAL SUSTAINABLE TRADING SYSTEM AND PARTICIPATES IN AND LEADS THE DEVELOPMENT OF A GLOBAL GREEN VALUE CHAIN FOR SOFT COMMODITIES	25
4.3 CHALLENGES IN INTERNATIONAL COOPERATION ON THE GREEN LOW-CARBON TRANSITION	26
5 PATHWAYS TO GENDER MAINSTREAMING IN CLIMATE CHANGE ANALYSIS	29
5.1 IMPORTANCE OF GENDER ISSUES IN ADDRESSING CLIMATE CHANGE AND GLOBAL CLIMATE GOVERNANCE ..	29
5.2 GENDER ISSUES IN GLOBAL CLIMATE GOVERNANCE CONTINUE TO BE HIGHLIGHTED, AND MULTILATERAL COOPERATION NEEDS TO BE FURTHER PROMOTED TO ENSURE WOMEN’S EQUAL RIGHTS AND INTERESTS IN CLIMATE ISSUES	30
5.3 PROMOTING A JUST DOMESTIC TRANSITION AND ENHANCING GREEN JOBS FOR WOMEN IN THE TRANSITION	31
5.4 PROMOTING GENDER EQUALITY IN THE GREEN AND JUST TRANSITION OF DEVELOPING COUNTRIES, AND UTILIZING CHINA’S LEADING ROLE IN GLOBAL CLIMATE GOVERNANCE	32
6 POLICY RECOMMENDATIONS	34
6.1 TAKING THE NDC UPDATE AS AN OPPORTUNITY TO EXERCISE CLIMATE LEADERSHIP AND COMBINE AMBITIOUS GOALS WITH CONCRETE ACTIONS	34
6.2 PROMOTING THE CONSUMPTION OF WIND/PV POWER BASED ON LOCAL CONDITIONS, AND SUPPORTING MORE LOW-CARBON TECHNOLOGY INNOVATION AND INDUSTRIALIZATION THROUGH A COMBINATION OF MEASURES SUCH AS GREEN INDUSTRY CLASSIFICATION, MARKET MECHANISMS, AND SUBSIDIES	35
6.3 FACILITATING THE IMPLEMENTATION OF THE “DUAL CONTROL” POLICY FOR CARBON EMISSIONS AND CONSTANTLY IMPROVING THE “DUAL CARBON” POLICY SYSTEM	36
6.4 PROMOTING THE LOCALIZATION AND INTERNATIONALIZATION OF THE INDUSTRY CHAIN AND SUPPLY CHAIN FOR THE “NEW THREE” PRODUCTS, AND ACTIVELY SUPPORTING AND PROMOTING THE LIBERALIZATION AND FACILITATION OF GLOBAL TRADE AND INVESTMENT	37
6.5 ACTIVELY PARTICIPATING IN AND CONTRIBUTING TO THE REFORM OF THE INTERNATIONAL FINANCIAL ARCHITECTURE, AND INCORPORATING CLIMATE INTO EXPORT CREDIT POLICIES AND OVERSEAS INVESTMENT AND FINANCING DECISIONS	38
ACKNOWLEDGMENTS	42

China's Pathways for Achieving Carbon Neutrality and Global Climate Governance

1 Foreword

Climate change has escalated into a global crisis, presenting an urgent challenge that requires collective action from all humanity. Despite the uncertainties in the current international landscape that impact global climate governance, many developments remain positive, and the outlook for combating climate change is promising. The COP28 goal of “transition away from fossil fuels in energy systems, in a just, orderly and equitable manner” underscores the validity of the global climate multilateral process. The global goal of triple renewable power capacity and double energy efficiency by 2030 provide clear signals for green innovation and investment worldwide. The U.S.-China Sunnylands Statement further emphasizes the crucial role of international cooperation in accelerating the energy transition. Therefore, it is essential to maintain high climate ambition and confidence, accelerate the restructuring of energy systems, expedite the green and low-carbon transition of our industries, and foster collaboration between corporations and local governments to achieve these goals through enhanced actions.

In the face of global economic recessionary pressures, it is important to cultivate green industry as a new driving force for green growth. Green innovation should drive investment, production, and construction, thereby fostering economic growth through investment, so as to realize a win-win situation for both carbon reduction and growth. This approach offers a clear path for China, the global community, and particularly for developing countries, to achieve green transformation while pursuing development.

As China is preparing for the next round of Nationally Determined Contributions (NDCs), promoting the integration of the 15th Five-Year Plan with the renewal of the NDCs is essential. The year 2035 serves as a pivotal milestone for China, marking the target year for basically realizing modernization, the first Five-Year Plan period for the transition to carbon neutrality after carbon peak, and the deadline for the next round of NDCs. Setting a robust 2035 target will clarify the transition pathway and accelerate action in the coming years, laying a solid foundation for the transition to carbon neutrality.

Against this backdrop, the special policy research group on “China’s Pathway to Carbon Neutrality and Global Climate Governance” aims to assess the current state and evolving dynamics of global climate governance, analyzing the progress of China’s and the global climate action and summarizing China’s experience. The group will explore new scenario of green finance, green investment, trade, and supply chains in the context of international uncertainty, and enhance understanding and consensus through the Track II Dialogue. Additionally, the group will conduct research on gender equality in climate issues. The group also propose policy recommendations suitable for China’s national conditions for renewal of the NDCs, the 15th Five-Year Plan, and participating in the international cooperation on climate change.

This report is divided into six parts. Part I is introduction. Part II is analysis of the latest trends in global climate governance. Part III reviews China’s progress in industrial structure adjustment, dual carbon “1+N” policy framework, energy transition, effectiveness of energy

conservation and carbon emission reduction in key areas, carbon emission reduction market mechanism reforms, methane emission reduction, and the carbon sink capacity of ecosystems improvement, and analyzes the challenges in China's green and low-carbon transition. Part IV summarizes China's contribution to the global green low-carbon transition and the current obstacles to international cooperation. Part V clarifies the role of women in climate change efforts and recommendations for gender mainstreaming in climate governance. Part VI proposes policy recommendations for renewal and implementation of the NDCs, the 15th Five-Year Plan, and participating in the international cooperation on climate change.

2 Analysis of global climate governance situation

2.1 COP28 has resulted in a strengthened, balanced and historic package of climate actions, and future climate governance needs to emphasize a balance of ambition and pragmatic solutions

COP28 under the *Paris Agreement*, finalized consultations on the first global stocktake, the Adaptation Committee, and the mitigation work programme, culminating in the *UAE Consensus*. Under the global stocktaking agenda, parties agreed for the first time on a roadmap for a “transition away from fossil fuels in energy systems, in a just, orderly and equitable manner”, signaling the beginning of “beginning of the end” of the fossil fuel era. The conference also set global 2030 targets for renewable energy development and energy efficiency, with a strong focus on reducing non-CO₂ greenhouse gases, especially methane. A historic agreement was reached in establishing the climate loss and damage fund. Countries were also encouraged to renew their NDCs by 2025 with ambitious economy-wide emission reduction targets that cover all greenhouse gases, sectors, and categories, aligning with the 1.5 °C temperature control goal. However, the conference did not reach consensus on several key issues, including Sharm el-Sheikh joint work on implementation of climate action on agriculture and food security, mechanisms under Article 6.2 and 6.4 under *Paris Agreement*, and Action for Climate Empowerment (ACE).

The urgency of achieving the 1.5 °C target continued to be emphasized at COP28. The urgency of achieving the 1.5 °C target was a central theme, with the first global stocktake emphasizing that limiting temperature increases to 1.5 °C would significantly reduce climate risks and impacts, and the importance of taking action. The COP28 Presidency hopes this stocktake will narrow the gap between countries' NDCs targets, which will lead to a cycle of target enhancement. In the *UAE Consensus* agreed at the end of the conference, the UAE, Azerbaijan and Brazil Presidencies will take forward the 1.5 °C Mission Roadmap and encourage countries to submit economy-wide NDCs in 2025, develop action plans aligned with the 1.5 °C temperature control goal, take additional actions to enhance adaptive capacity, provide additional funding, improve transparency and accelerate implementation.

However, more and more countries are realizing the need for pragmatic climate action, rather than simply setting ambitious targets. This includes enhancing the development and utilization of renewable energy, improving energy efficiency, and promoting innovation in green technologies. More and more countries are coming to realize that targets are not enough. Implementable actions

are truly needed to move societies in a sustainable direction.

COP29, to be hosted in Azerbaijan in 2024, will focus on establishing a new collective quantified goal on climate finance (NCQG). Current climate finance flows fall short of what is needed to support the clean energy transition and the implementation of national climate plans in developing countries. According to an OECD report, the developed countries' commitment to developing countries to annually provide \$100 billion in climate finance from 2009 to 2020 onwards was met in 2022, but contentious issues such as the definition of climate finance persist. The NCQG will help support the implementation of a new round of country-owned contributions, starting from a baseline of \$100 billion per year. The collective quantified targets for climate finance and the reform of the international financial system are expected to dominate the international community's agenda in the area of global climate governance.

2.2 Complexity and uncertainty in climate governance increase due to intersection with trade, green supply chains, and other issues

On January 31, 2024, the Biden Administration appointed John Podesta as the new Special Presidential Envoy for Climate. Unlike former Special Envoy John Kerry's climate policy, which emphasized the independence of climate issues from trade policy, Podesta proposes a synergistic approach to climate and trade. He proposed the establishment of a Climate and Trade Working Group within the White House. This group will focus on developing climate and trade policy tools, mastering relevant data, and assisting businesses, thereby bringing geopolitical competition to the international climate arena and prioritizing climate cooperation with U.S. allies and partners as a clear strategy.

The European Union's Carbon Border Adjustment Mechanism (CBAM) is currently in its transition phase and will enter a full implementation phase from 2026. In the short term, CBAM's impact on China's, particularly in sectors like steel and aluminum, is manageable. However, in the medium to long term, CBAM is expected to expand its scope, gradually reducing free allowances in the EU carbon market. Meanwhile, the institutional design of CBAM has a lot of flexible adjustment space. These factors will exert continued pressure on the trade systems of major manufacturing countries like China.

In fact, the carbon border adjustment mechanism has faced considerable controversy since its proposal. The varied economic structures, energy endowments, and policies across different countries complicate the establishment and development of uniform carbon markets, making it challenging to accurately reflect advanced emission reduction efforts through CBAM. This could result in even the most advanced industries facing additional carbon taxes, which contradicts Just Transition principle. Furthermore, developing countries, which often rely on high-carbon product exports, may be disproportionately burdened by unilateral carbon tariff policies, imposing unfair emission reduction responsibilities through trade. Critics argue that CBAM, while ostensibly a carbon emission reduction system, is essentially a form of unilateral trade protectionism. During the BASIC Ministerial Meeting on Climate Change on July 21, 2024, ministers opposed the discriminatory and unfair "carbon border adjustment mechanism" being implemented by some developed countries under the pretext of climate action. They also determined to work together to ensure that developing countries are not adversely affected by these unilateral measures that undermine multilateralism and threaten sustainable development.

In addition, developed economies are keen on establishing “climate alliances”, such as the G7 “Climate Club”, which plans to form a climate alliance centered on an “international target carbon price” and impose a uniform carbon tariff on imports from non-participating countries. They are also attempting to use economic and trade influence to expand the mechanism and supporting standards globally, potentially dominating global carbon pricing rules.

The green transformation of natural and agri-food systems is also crucial to achieving global climate goals. Soft commodities like soybeans, beef, palm oil, paper are major drivers of global deforestation and land-use change, the second largest source of global greenhouse gas emissions. Recent legislation in various countries has increased the legal and sustainability requirements for these commodities, pushing trade towards more environmentally friendly and sustainable practices. For example, the *EU Zero Deforestation Regulation* (EUDR), introduced in June 2023, aims to eliminate the import and export of products involving deforestation at any stage of the supply chain by 2024 to promote the production and consumption of forest-friendly products. These measures have also sparked discussion about the distribution of responsibilities between developed and developing countries. For China, the greening of the value chain for soft commodities, though increasing production costs and pressure on exporters to meet higher environmental and sustainability standards, also presents opportunities for enterprises to transform and upgrade. China could leverage this trend to enhance domestic production chain regulation, promote trade liberalization and economic globalization, and provide a more convenient policy environment for trade in commodities.

2.3 Decoupling and breaking of green and low-carbon industrial technologies is intensifying, and the pace of the global low-carbon transition is under attack

Low-carbon technologies are critical to addressing climate change, and cost reduction is essential for their large-scale deployment. However, some countries are currently promoting decoupling and localization of green and low-carbon areas under the guise of national security and supply chain stability. Industrial technology decoupling and breaking threatens to undermine efforts to reduce the cost of low-carbon technologies.

International cooperation in the low-carbon field has significantly reduced climate governance costs. Research shows that between 2008 and 2020, compared with localized supply chains, the globalized market for photovoltaic module production saved China a total of \$26 billion to \$45 billion in photovoltaic installed capacity, the United States \$19 billion to \$31 billion, and Germany \$5 billion to \$9 billion. Achieving global climate goals requires the rapid and extensive deployment of renewable energy installations, but reliance on domestic production alone will drive up costs and delay this process, undermining climate goals, which will in turn affect the achievement of climate change targets. According to the scenario studied, if countries gradually shift to domestic production of photovoltaic modules between 2020 and 2030, the production cost may increase by 20% to 30% by 2030, directly slowing down deployment^[1].

2.4 Global climate leadership landscape is changing due to key national and regional elections

2024 is a big year for global elections. According to incomplete statistics, 76 countries and

regions will hold general elections in 2024, involving over 100 election campaigns and covering 4.17 billion people, representing 41% of the global population and 42% of GDP^[2]. Major political elections in North America, Europe, Russia, South Asia, and Africa will create an uncertain outlook, becoming a crucial variable in global climate governance.

The outcome of the U.S. presidential election will be particularly decisive for climate policy. A democratic victory would likely result in the United States increasing its emissions reduction targets, strengthening climate policies, and continuing the Biden administration's focus on the energy transition and the *Inflation Reduction Act*. It would be believed that the United States can develop a clean energy economy while continuing to produce fossil fuels. If the Republican candidate is elected, the United States is expected to reduce its focus on climate and increase its support for fossil fuels. It will also attempt to repeal the *Inflation Reduction Act* or hinder the success of the *Inflation Reduction Act* by removing funding or erecting administrative barriers. Internationally, it would reduce participation in climate cooperation, potentially withdrawing from the *Paris Agreement* again.

EU parliamentary elections saw a rise in seats for right-wing and populist parties, with the Conservatives remaining the biggest winners. Climate policy will most likely remain stable and continuous for the next five years under Ursula von der Leyen's leadership. The EU will seek to balance between accelerating the green transition, ensuring supply chain resilience and economic competitiveness. The EU will release the Clean Industrial Deal, which pours investment into infrastructure and industry in the hope of building localized green capacity, but with small subsidies and high localization costs. The EU will also continue to influence external policies through stringent climate and environmental regulations and standards. In addition, the UK's Labour Party won the general election with an overwhelming majority, and the new British government is expected to support a stronger green agenda.

At the same time, the landscape of global climate negotiations is becoming increasingly complex and fragmented, with deeply polarized national interests making consensus harder to achieve. Various groups and alliances are exploring alternative cooperation mechanisms outside the formal treaty framework to address their diverse interests, leading to the emergence of mechanisms beyond the *UNFCCC*'s scope.

2.5 Climate risk has become one of the most important risks affecting human societies, and the shift from a “high-carbon system” to a “low-carbon/zero-carbon system” is irreversible. The fight against climate change represents a vital avenue for international cooperation

The Global Risks Report 2024, published by the World Economic Forum, highlights that extreme weather events are poised to become the foremost global risk. Concurrently, escalating environmental risks may reach a point of no return, while international cooperation on global issues remains insufficient. The report underscores that over the next decade, environment-related risk types will emerge as the primary source of threats, intricately linked with multiple systems. If these risks are exacerbated, they could trigger a vicious cycle that threatens economic and social stability, food and water security, public health, and, ultimately, global stability and the survival of civil societies. In light of the volatile geopolitical landscape and the ongoing slowdown in global economic growth, combating climate change represents a vital avenue for international

cooperation, necessitating the rebuilding of trust and collective action to address the climate crisis.

The political will of major countries and groups in climate governance and international cooperation remains significant. Europe and the United States continue to seek collaborative efforts with the global South countries, including emerging powers such as China. On the eve of the COP28, China and the United States jointly issued the *Sunnylands Statement on Enhancing Cooperation to Address the Climate Crisis*, announcing the relaunch of the China-U.S. Energy Efficiency Forum (EEF). It will support the active participation by local governments and multinational corporations in both countries. In early May 2024, the new China-U.S. respective special envoys for climate met for the first time to discuss the areas of cooperation outlined in the Sunnylands Statement and to address multilateral issues related to the success of COP29 in Baku, Azerbaijan. At the end of May, the China-U.S. High-Level Event on Subnational Climate Action was held in California, marking an important step towards institutionalizing, concretizing, and pragmatizing China-U.S. cooperation on climate change. In May, leaders from China, France, and the European Union reached a consensus on cooperation in addressing climate change through a tripartite meeting.

Investment in global climate governance and clean energy transition has shown strong growth momentum. Although there are multiple crises, the clean energy transition is resilient. In 2023, global investment in the low-carbon energy transition increased by 17% to a new record of \$1.77 trillion^[3]. Of these, electrified transportation, the largest area of energy transition spending, grew by 36% to \$634 billion; investment in the renewable energy sector grew by 8% to \$623 billion; and grid investment, the third largest area of energy transition investment, reached \$310 billion. Emerging sectors such as hydrogen and Carbon Capture and Storage (CCS) technologies achieved investment growth of 200% and 100% respectively, while energy storage investment grew by 76% (Fig.1). In 2023, investment in the global clean energy supply chain, which includes equipment factories and battery metal production for energy technologies, set a new record of \$135 billion. Under the investment plans announced so far, this amount is expected to soar further over the next two years, rising to \$259 billion by 2025.

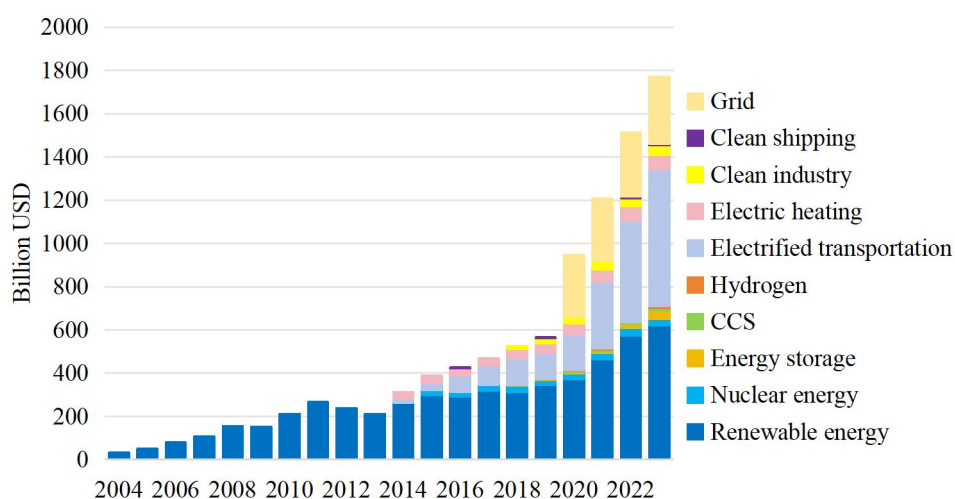


Fig.1 Global Energy Transition Investment Profile by Sector, 2004-2023

Source: Bloomberg NEF¹.

¹Starting years vary by industry, but all industries have statistics starting in 2020, with nuclear data starting in 2015 and

In conclusion, addressing the climate crisis is a global issue that requires concerted efforts from all countries. It is imperative to promote multilateral and bilateral climate dialogues in the shared interest of humanity to seek consensus on cooperation and to actively implement the agreements and commitments reached within these frameworks.

3 Progress in China’s comprehensive green and low-carbon transition and challenges ahead

3.1 High-quality economic and social development and “dual carbon” efforts are synergistically promoted, and green and low-carbon industries have become a new driving force for economic growth.

China remains a key engine of global growth. In 2023, China’s gross domestic product (GDP) exceeded 126 trillion yuan, reflecting a 5.2% increase from 2022 in constant prices. It ranks among the world’s major economies (Fig.2) and is expected to contribute over 30% to global economic growth.

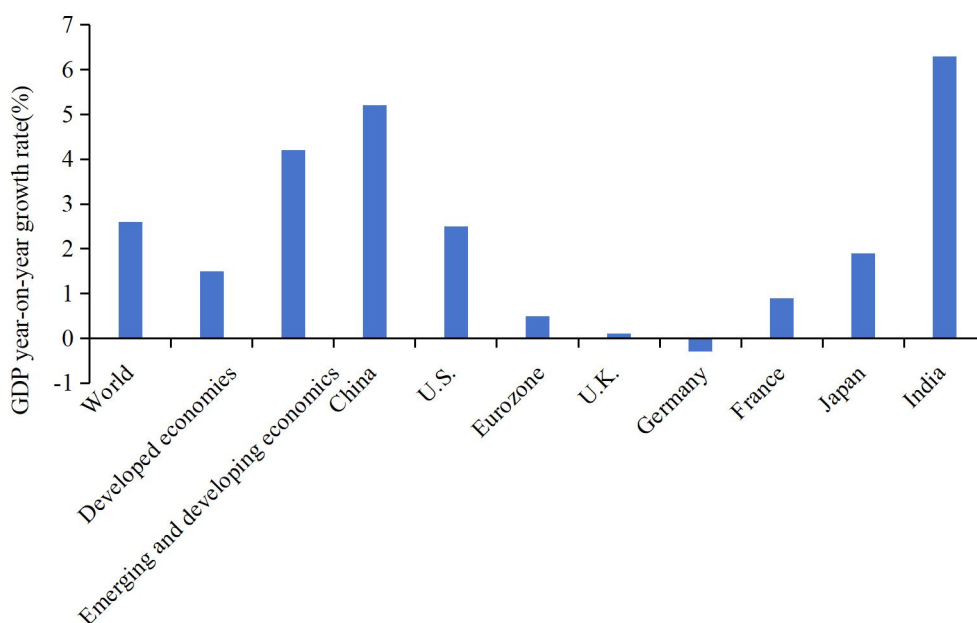


Fig.2 Comparison of Economic Growth Rates among major Global Economies in 2023

Sources: Global and Indian data from the World Bank report released in January, other data from the National Bureau of Statistics of China, U.S. Department of Commerce, UK Office for National Statistics, Japan’s Cabinet Office, Germany’s Federal Statistical Office, France’s National Institute of Statistics and Economic Studies, and Eurostat.

China’s industrial structure is continuously being optimized towards greening and decarbonization. From 2014 to 2023, the share of China’s tertiary industry value added in GDP

grid data starting in 2021.

has increased annually. In 2023, the value added by China’s tertiary industry amounted to 68.8 trillion yuan, a year-on-year growth rate of 5.8%, accounting for 54.6% of the country’s total GDP—an increase of 6.3 percentage points compared with 2014 (Fig.3).

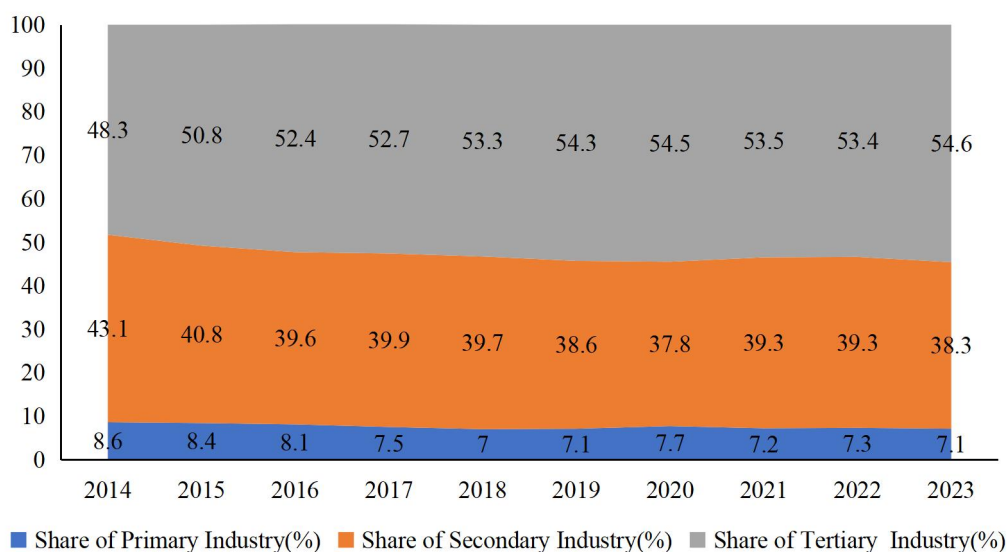


Fig.3 Changes in the value added by China’s three major industries as a proportion of GDP, 2014–2023

Source: National Bureau of Statistics of China.

Strategic emerging industries in China are experiencing robust growth. Since the *Decision on Accelerating the Fostering and Development of Strategic Emerging Industries* was issued in 2010, these industries have been developing steadily for over a decade, presenting a significant progress in key fields, emergence of new growth points, leaps in innovation capacity, and enhanced competitiveness. These industries have become a new force driving industrial transformation and long-term economic stability. Between 2014 to 2023, the share of strategic emerging industries value added in China’s GDP increased from 7.6% to over 13%^[4]. China’s strategic emerging industries have become the main power source to promote the transformation and upgrading of industrial structure and lead China’s economy to the stage of high-quality development.

The innovation capacity and industrial strength of new energy industry have been greatly improved, leading to the development of the world’s largest, most comprehensive, and most competitive clean energy industry chain^[5]. China now produces 60% of the world’s wind turbines, with six Chinese companies ranking among the top ten globally. The localization rate of major components has reached 95%^[6]. Benefited from relevant policies, China’s new energy vehicle industry is also booming, with 2023 production and sales reaching 9.587 million and 9.495 million units respectively, reflecting year-on-year growth of 35.8% and 37.9%. These vehicles now account for more than 60% of the global sales, with exports totaling 1.203 million units, a 77.6% increase year-on-year, reaching over 180 countries across Europe, Asia, Oceania, the Americas, and Africa^[7].

New energy storage, hydrogen energy and other industries are developing rapidly. In 2023, global new installed capacity of new energy storage hit a record high, with China accounting for nearly 50%. According to the China’s National Energy Administration data, as of the end of 2023,

the cumulative installed capacity of new energy storage projects that has been built and put into operation in China reached 31.39 million kilowatts/66.87 million kilowatt-hours, the average storage duration of 2.1 hours. In 2023 alone, China added approximately 22.6 million kilowatts/48.7 million kilowatt-hours of new installed capacity, marking an increase of over 260% compared to the end of 2022 and nearly ten times the installed capacity at the end of the 13th Five-Year Plan period. From the point of view of the scale of investment, since the 14th Five-Year Plan, new installed capacity of new energy storage has directly driven more than 100 billion yuan in economic investment, further expanding the upstream and downstream industry chain and becoming a new driver of China's economic development. As the world's largest producer and consumer of hydrogen energy, China has built and operated 36 renewable energy-based hydrogen production projects by the end of 2022, with a total capacity of approximately 37,000 tons per year. Additionally, over 300 green hydrogen projects are being planned, with an expected capacity of 3.5 million tons per year^[8]. According to China Hydrogen Alliance, China's hydrogen production in 2023 was approximately 35.5 million tons, with supply and demand in balance.

Progress has been made in the green transformation of the service industry. Through integration with digital technology, a variety of new business modes and forms, such as mobile payment and platform economy, have been innovated and developed, reducing energy consumption and carbon emissions in production, consumption, and distribution. These innovations have improved resources utilization rate, and strongly promoted green consumption. With intelligence, greening, and integration as the direction, the technological level, productivity, quality and efficiency of the modernized service industry system have been further enhanced.

3.2 The dual carbon “1+N” policy framework has been completed and implemented, and a new mechanism for the comprehensive transition toward controlling both the amount and intensity of carbon emissions to controlling both the amount and intensity of energy consumption is establishing

At present, China's dual carbon “1+N” policy framework has been completed. The “1” of the dual carbon “1+N” policy framework consists of the *Working Guidance* and the *Action Plan*, while the “N” comprises implementation programs for key areas and industries, as well as the relevant policy support programs. The dual carbon “1+N” policy framework provides comprehensive, multi-level guidance for China's dual carbon efforts, characterized specific features: 1) The policy design covers all key areas and sectors related to carbon emissions, including energy, industry, urban and rural construction, transportation, pollution reduction and carbon reduction, as well as key industries such as steel, non-ferrous metals, petrochemicals, building materials. 2) It emphasizes practical support for dual carbon efforts through scientific and technological innovation, financial backing, price reform, talent cultivation and other supportive measures. 3) It embodies the broad societal participation, reflecting the modernization of China's system and capacity for governance. The main stakeholders involved include government ministries and commissions, local governments, industries, industrial parks, enterprises and individuals. 4) The policy design also seeks to promote broader cooperation, including energy green development under the Belt and Road initiative, and the development of international

cooperation policies across various industries and sectors. The dual carbon “1+N” policy framework provides an overall framework and focus for near- and medium-term dual carbon efforts. However, the long-term and challenging nature of achieving dual carbon goals requires pathways and policies to be resilient to changes in domestic and international situations and to be dynamically adjusted over time.

Therefore, during the 14th Five-Year Plan period, with carbon reduction as a key strategic direction, China proposes to further refine the dual control system for energy consumption and steadily shift to dual control system for carbon emissions (carbon amount and carbon intensity control), to explore the development potential of renewable energy and promote the comprehensive green transition of the socio-economic structure. The Five-Year Plan outlines the implementation of a system that “based on carbon intensity control, supplemented by carbon amount control”. On October 24, 2021, the CPC Central Committee and the State Council emphasized in their *Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy* that “Adhering to a conservation-first energy development strategy, we will strictly control energy consumption and CO₂ emission intensity, appropriately control total energy consumption, and establish a system to control the amount of CO₂ emissions”. On October 26, 2021, the State Council’s *an Action Plan for Peaking Carbon Emissions Before 2030* proposed “Implementing a system that based on carbon intensity control, supplemented by carbon amount control and gradually establishing a systematic and comprehensive evaluation and assessment system for carbon peaking and carbon neutrality”. The Central Economic Work Conference in December 2021 advocated “Creating conditions for the early realization of shift from dual control for energy consumption to dual control for carbon emissions, to promote China’s energy system in the direction of more consistent with the implementation of the dual carbon goals”. The Report to 20th National Congress of the Communist Party of China in October 2022 pointed out that “We will exercise better control over the amount and intensity of energy consumption, particularly of fossil fuels, and transition gradually toward controlling both the amount and intensity of carbon emissions” In July 2023, the *Guidelines on Promoting the Gradual Transition from Dual Control for Energy Consumption to Dual Control for Carbon Emissions*, reviewed and approved on the second session of the CCP Central Comprehensively Deepening Reforms Commission, put forward the idea of promoting the shift from dual control for energy consumption to dual control for carbon emissions in a planned and step-by-step manner. marking that after the improvement of the dual control policy system for energy consumption, and preliminary working basis for shifting to dual control for carbon emissions. *Resolution of the Central Committee of the Communist Party of China on Further Deepening Reform Comprehensively to Advance Chinese Modernization*, issued on July 21, 2024, mentions “New mechanisms will be put in place to facilitate the transition from controlling the total amount and intensity of energy consumption to controlling the total amount and intensity of carbon emissions”. In August 2024, the *Work Plan to Accelerate the Establishment of a Dual Control System for Carbon Emissions* proposed that, “During the 15th Five-Year Plan period, implement a system that based on carbon intensity control, supplemented by carbon total amount control, establish a comprehensive evaluation and assessment system for carbon peak and carbon neutralization, and develop the capacity of carbon emission accounting in key areas and industries... Develop a product carbon footprint management system and a product carbon labeling certification system suitable for China’s national conditions, and ensure that the

goal of carbon peaking is achieved on schedule” (Table 1), marking significant progress in the comprehensive transition from controlling the total amount and intensity of energy consumption to controlling the total amount and intensity of carbon emissions.

The transition from controlling the total amount and intensity of energy consumption to controlling the total amount and intensity of carbon emissions is essential for achieving the dual carbon goals. Implementing dual control system for carbon emissions enables simultaneous energy conservation and climate change mitigation, promotes the continuous optimization of energy structure, and serves as a vital guarantee for accelerating the comprehensive green transformation of economic and social development, and is also a starting point for China to achieve the dual carbon goals. Therefore, it is crucial to actively advance the construction of a dual control system for carbon emissions, explore the development potential of renewable energy, and promote the overall green transformation of the social-economic structure.

Table 1 Policy lineage of dual control of carbon emissions

Policy Documents	Issuance Date	Policy Content
<i>Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy</i>	October 2021	Strictly control energy consumption and CO ₂ emission intensity, appropriately control total energy consumption, and establish a system to control the amount of CO ₂ emissions
<i>An Action Plan for Peaking Carbon Emissions Before 2030</i>	October 2021	Implementing a system that based on carbon intensity control, supplemented by carbon amount control and gradually establishing a systematic and comprehensive evaluation and assessment system for carbon peaking and carbon neutrality.
The Central Economic Work Conference	December 2021	Creating conditions for the early realization of shift from dual control for energy consumption to dual control for carbon emissions
The Report to 20th National Congress of the Communist Party of China	October 2022	We will exercise better control over the amount and intensity of energy consumption, particularly of fossil fuels, and transition gradually toward controlling both the amount and intensity of carbon emissions
<i>Guidelines on Promoting the Gradual Transition from Dual Control for Energy Consumption to Dual Control for Carbon Emissions</i>	July 2023	Promoting the shift from dual control for energy consumption to dual control for carbon emissions in a planned and step-by-step manner
<i>Resolution of the Central Committee of the Communist Party of China on Further Deepening Reform Comprehensively to Advance Chinese Modernization</i>	July 2024	New mechanisms will be put in place to facilitate the transition from controlling the total amount and intensity of energy consumption to controlling the total amount and intensity of carbon emissions
<i>Work Plan to Accelerate the Establishment of a Dual Control System for Carbon Emissions</i>	August 2024	By 2025, the statistical accounting system for carbon emissions will be further improved. During the 15 th Five-Year Plan period, a dual control system for carbon emissions will be implemented with intensity control as the main focus and total amount control as a supplement. A comprehensive evaluation and assessment system for carbon neutrality will be set up for carbon peaks. After the carbon peaks, a dual control system for carbon emissions will be implemented with amount control as the main focus and intensity control as a supplement, and a system for evaluating and assessing the carbon neutrality targets will be set up. Establish a carbon neutrality target evaluation and assessment system

3.3 Progress in the energy transition has been remarkable, and the development of a new power system is advancing steadily

The proportion of clean energy consumption has increased significantly, accelerating the green and low-carbon transition. According to the Statistical Communique of the People’s Republic of China on the 2023 National Economic and Social Development published by the National Bureau of Statistics, China’s total energy consumption in 2023 was 5.72 billion tons of standard coal, reflecting a 5.7% increase from the previous year. Among the components of this consumption, coal consumption increased by 5.6%, crude oil consumption by 9.1%, natural gas consumption by 7.2%, and electric power consumption by 6.7%. Over the decade from 2014 to 2023, China’s coal consumption share declined from 65.8% to 55.3%, while the share of non-fossil energy consumption rose from 11.3% to 17.7% (Fig.4).

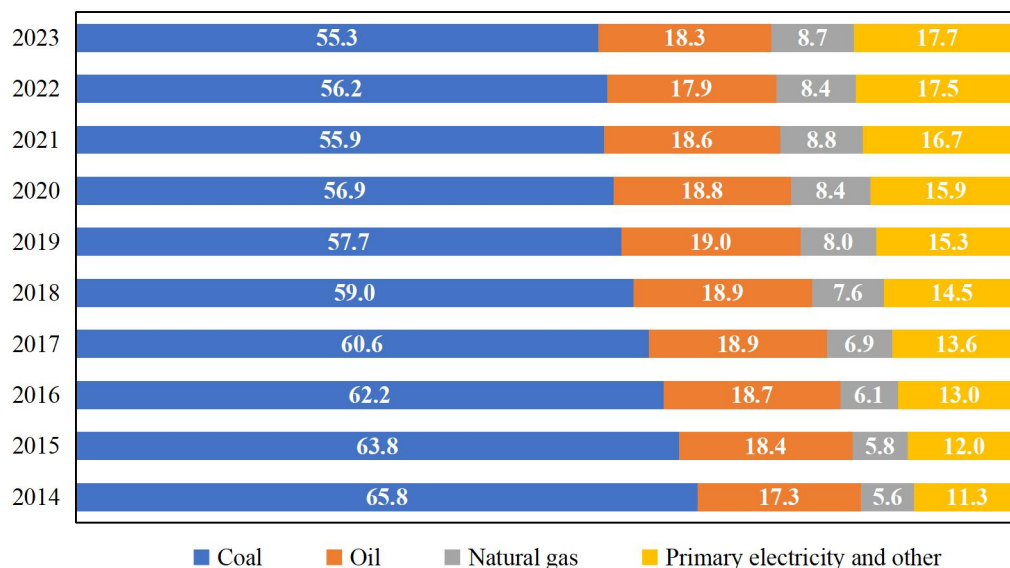


Fig.4 Structure of energy consumption in China, 2014–2023 (%)

Source: National Bureau of Statistics of China.

Energy utilization efficiency has significantly improved. From 2012 to 2023, an average annual energy consumption growth rate of 3% in China supported an average annual economic growth of over 6%, leading to a 26.8% reduction in energy consumption per unit of GDP.

The development of renewable energy has attracted worldwide attention and is increasingly becoming the mainstay of meeting new electricity demand. By the end of 2023, China’s total installed capacity for renewable energy generation is 1.45 billion kilowatts, accounting for more than 50% of the total installed power capacity, historically exceeding thermal power installed capacity. The combined installed capacity for wind/PV power has exceeded 1 billion kilowatts, and it is anticipated that the original NDCs targets for wind/PV power installed capacity will be surpassed by 2030. In the first three years of the 14th Five-Year Plan period, China’s new grid-connected installed capacity for photovoltaic and wind power grew at an average annual rate of 93.9% and 26.3%, respectively (Fig.5). According to the National Energy Administration, in 2023, China’s new installed renewable energy capacity exceeded 300 million kilowatts, accounting for

85% of total new installed capacity. The International Energy Agency report highlighted that in 2023, the global new installed renewable energy capacity was 510 million kilowatts, with China's contributing to more than half of the growth in global renewable energy power generation.

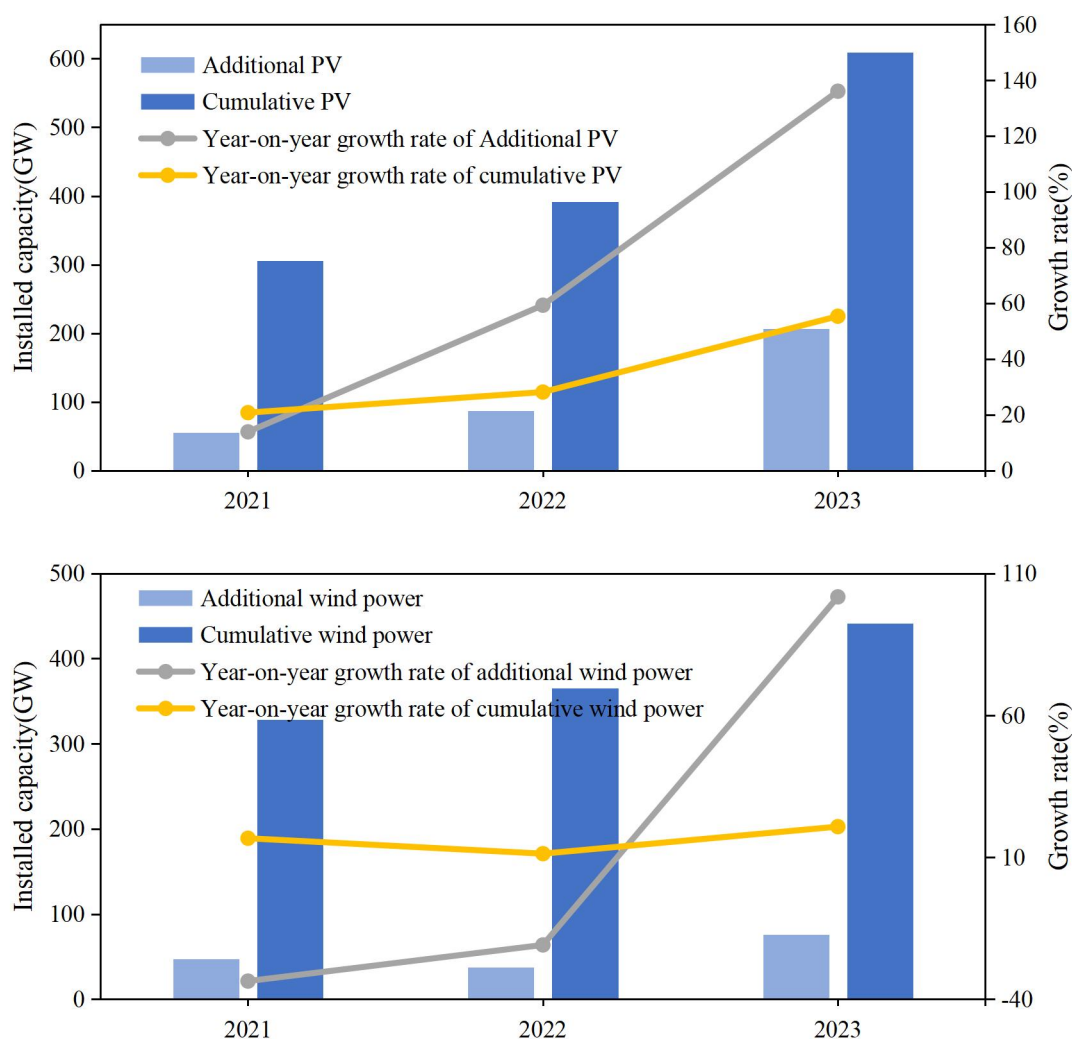


Fig.5 New and total installed capacity of grid-connected PV and wind power in China and its Growth Rate, 2021–2023

Source: National Bureau of Statistics of China.

China's power system is evolving into a new type of power system characterized by being clean and low-carbon, safe and controllable, flexible and efficient, open and interactive, and intelligent and convenient. In terms of top-level design, the Second Meeting of the Central Comprehensively Deepening Reforms Commission held in July 2023 passed the *Guiding Guidelines on Deepening Power System Reform and Accelerating the Development of a New Power Industry*. This document emphasizes the need to deepen the electric power system reform and accelerate the development of a new system that is clean, low-carbon, safe, abundant, economically efficient, synergistic between supply and demand, and flexible and intelligent, so as to advance the revolution in energy production and consumption while safeguard national energy security. In September, the National Development and Reform Commission and the National Energy Administration jointly issued the *Guiding Opinions on Improving the Stabilization of the Power System under the New Circumstances*, which outlines strategies for ensuring the stability of

electric power system under the new circumstances^[9]. In practice, first, new energy storage technologies continue to emerge, with applications expanding to promote new energy development and consumption, improve the safety and stability of the system operations, and enable users to flexibly and efficiently use energy. This development strongly supports the development of a new type of power system. At present, although lithium-ion battery energy storage still dominates, other technologies, such as compressed air energy storage, redox flow battery energy storage, flywheel energy storage and other non-lithium energy storage technologies have gradually achieved breakthroughs in application. These advancements provide more technological options for the development of a new type of electric power system and diversified user-side scenarios. By the end of 2023, lithium-ion battery energy storage accounted for 97.4% of operational energy storage, while lead-carbon battery storage accounted for 0.5%, compressed air energy storage accounted for 0.5%, redox flow battery energy storage accounted for 0.4%, and other new types of energy storage technologies accounted for 1.2%^[10]. During the first three years of the 14th Five-Year Plan period, new installed energy storage capacity grew rapidly. In 2023, with a 22.6 million kilowatt increase, representing a more than 260% rise from the end of 2022. (Fig.6). Second, power grid enterprises play a fundamental and pioneering role in accelerating the development of new power systems, serving major national strategic needs. In recent years, the State Grid has made comprehensive breakthroughs in UHV power transmission technology and launched several UHV projects. The company also built up a complete UHV test and research system, led in building a complete UHV test, research, and technical standard system, and developed the world's first set of fully controllable phase-change technology converter valves, independently developed a prototype of the UHV converter tap-changer project, and built a new generation of electromagnetic transient simulation platforms. Given the intermittent and unstable nature of wind/PV power generation, the China Southern Power Grid promotes the development of digital grid, enabling the sensing, predictability, and controllability of various power resources, thus supporting the safe and stable operation of complex power grids. Currently, the short-term prediction accuracy for wind/PV power generation in the South China Power Grid stands at 85% and 91%, respectively, which has reduced the need for millions of kilowatts of regulated power supply. Additionally, the State Grid is promoting the development of large-scale wind power bases and energy storage facilities. As of now, the total grid-connected capacity of wind/PV power within the State Grid's operating area is nearly 870 million kilowatts, with a utilization rate exceeding 97%. Furthermore, the application of customer-side energy measurement data exchange protocols on smart meters is gradually expanding within the State Grid's operating area, enhancing the level of interconnectivity within the power consumption information collection system and the capability of data exchange capabilities.

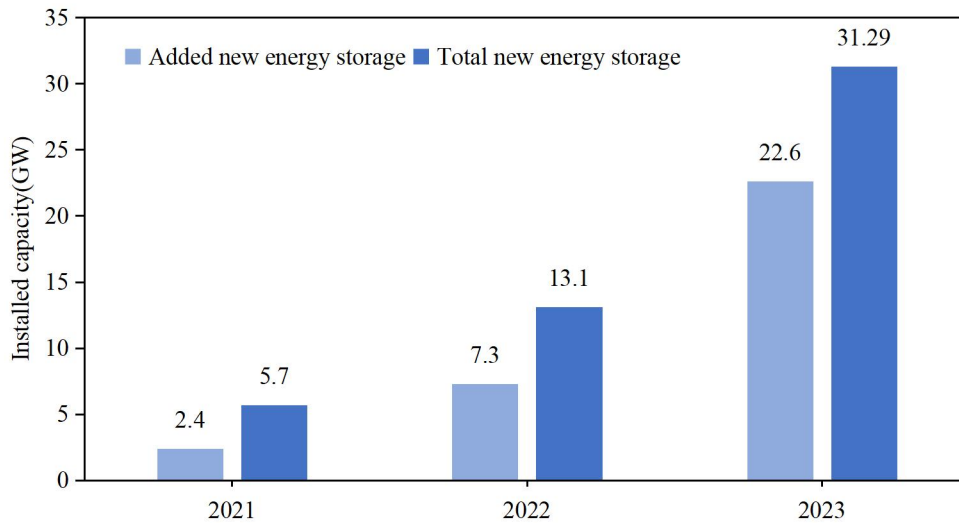


Fig.6 New and total Installed New Energy Storage Capacity and Growth Rate in China, 2021–2023

Source: National Bureau of Statistics of China.

3.4 Energy-saving and carbon-reducing upgrades and transformation of industries,

products and equipment in key areas are accelerating

The effectiveness of energy conservation and consumption reduction in the industrial sector is gradually emerging. Since the 14th Five-Year Plan, China has accelerated energy-saving and carbon reduction initiatives in key areas. These measures include the cleaner coal usage, the elimination of outdated production capacity industries such as steel, petrochemicals, non-ferrous metals, and building, and the upgrading and technological renovation of production equipment, energy storage equipment and energy-using equipment. In the steel industry, the “extreme energy efficiency” project proposed by the Iron & Steel Industry Association is being implemented. In the building materials industry, the construction of “six-zero” factories is being promoted, namely “six zero” demonstration factories with zero purchased electricity, zero fossil energy, zero primary resources, zero carbon emissions, zero waste emissions, and zero employees. In the non-ferrous metals industry, efforts are underway to improve energy utilization efficiency. In the chemical industry, the development of new materials, high-end specialty chemicals and other strategic emerging industries are accelerated. The energy and water consumption of some key large and medium-sized enterprises has reached the world’s advanced level, and the energy efficiency indicators for some products, such as cement, electrolytic aluminum, crystalline silicon, oil refining and ethylene, are leading the world. Statistics show that from 2021 to 2023, China completed energy-saving and carbon-reducing transformations in coal power, flexibility enhancement, and heating system upgrades totaling more than 700 million kilowatts with the average coal consumption for thermal power generation lowered by 0.9%. And the proportion of capacity meeting benchmark or higher energy efficiency levels in industries such as steel, electrolytic aluminum, cement, oil refining, ethylene, and synthetic ammonia increased by an average of 6 percentage points^[11].

The green transition in the construction sector has been effective. To accelerate energy-saving and carbon reduction efforts in the building sector, the Ministry of Housing and Urban-

Rural Development issued the *14th Five-Year Plan for Building Energy Saving and Green Building Development* in 2022, which sets specific targets for building energy-saving transformations by 2025. Since the beginning of the 14th Five-Year Plan period, China has completed 2.4 billion square meters of energy-saving and carbon-reducing renovations in existing buildings and has accelerated the development of ultra-low-energy, near-zero-energy buildings, and prefabricated buildings. By the end of 2023, a total of approximately 11.85 billion square meters of green building area had been constructed in urban areas across China, with more than 27,000 projects receiving Green Building Labels. In 2023 alone, approximately 2.07 billion square meters of new green building area was constructed, accounting for 94% of the newly built urban area^[12].

The construction of a green and low-carbon transportation system is advancing rapidly. In terms of transportation restructuring, China has continued to shift bulk and medium and long-distance cargo transportation from roads to railway and waterways. From 2018 to 2023, the proportion of freight transported by rail and waterway increased from 25.2% to 26.3%, while the share transported by road decreased from 74.8% to 73.7%. In terms of diversifying transportation energy sources, China has been improving the charging infrastructure along highways and promoting the application of new and clean energy. By 2023, the national ownership of new energy vehicles accounted for more than half of the global total, the proportion of new energy buses and trams in urban areas exceeded 77%. In some cities, buses and trams have achieved “full electrification”, and the proportion of new and clean energy vehicles in road freight transport has continued to rise^[13]. In the development of green transportation facilities, accelerating green investment in transportation and developing green finance in transportation are also progressing. By the end of 2023, China had built 8.596 million charging units, creating the world’s largest and most comprehensive charging infrastructure system in terms of the number of units, coverage area, and service capacity^[14]. In terms of lifestyle transformation, China is advocating for simple, moderate, green and low-carbon transportation and travel modes, with significant achievements in urban public transportation and green travel. The *Action Plan to Launch a Large-scale Renewal of Transportation Equipment*, released in June 2024, proposed measures to further reduce carbon intensity in the transportation sector and lower the total volume and intensity of pollutant emissions by 2028 through financial subsidies for the elimination and renewal of outdated mass transportation facilities.

The upgrade of energy efficiency in energy-using products and equipment is steadily advancing. Data shows that China has over 5 billion units (sets) of major energy-using products and equipment in operation, accounting for approximately 80% of the country’s total energy consumption, with many of these devices having low energy efficiency and significant potential for upgrading and transformation^[15]. To meet the binding targets of the 14th Five-Year Plan for reducing energy consumption intensity, the National Development and Reform Commission (NDRC) issued the *Advanced Level, Energy-Saving Level and Access Level of Energy Efficiency of Key Energy-Using Products and Equipment (2024 Version)* and the *Action Plan for Promoting Large-Scale Equipment Renewal and Consumer Goods Trade-In* in 2024. These initiatives deploy works to expand the coverage of energy-efficiency levels, raise energy-saving and carbon reduction standards, and promote the renewal and recycling of products and equipment. This will help to promote the production and use of advanced equipment and increase the proportion of advanced production capacity, thereby driving the green transformation and high-quality

development of industries.

3.5 Carbon market are improving and will play a greater role in the dual carbon systems in the future

China's national carbon market has been in formal operation since 2021. To date, the national carbon market covers annual carbon dioxide emissions of approximately 5.1 billion tons includes 2,257 key emission units, making it the largest carbon market globally in terms of greenhouse gas emissions. As of December 31, 2023, the cumulative trading volume of carbon emission allowances in the national carbon market reached 442 million tons, with a cumulative transaction value of 24.919 billion yuan.

The *Interim Regulation on the Administration of Carbon Emission Trading*, which took effect on May 1, 2024, provides a clear legal foundation for the operation and management of the national carbon emission trading market. The *Regulation* focus on data quality management, effectively elevating the legislative framework for the national carbon emissions trading market and forming a complete institutional system. The regulations standardize the management of greenhouse gas emissions data quality, define illegal activities related to carbon emissions trading, and establish legal responsibilities, thus providing robust legal support for building a high-level carbon emissions data quality management mechanism and a high-standard market system.

In early 2024, China launched a nationwide voluntary GHG emission reduction trading market^[5]. As an institutional innovation designed to mobilize society-wide participation in greenhouse gas emission reduction efforts, the voluntary emission reduction trading market is expected to promote the formation of a complementary and interconnected mandatory and voluntary carbon market. Between March 30 and April 30, 2023, the Ministry of Ecology and Environment publicly solicited over 300 proposals for CCER (Chinese Certified Emission Reduction) methodologies, ultimately formulating and releasing the first batch of four methodologies, including those for afforestation carbon sinks, grid-connected solar thermal power generation, grid-connected offshore wind power generation, and mangrove restoration. Looking ahead, the expansion of the carbon market is expected to materialize in 2024 – 2025.

On December 27, 2023, the *Guidelines on the CPC Central Committee and the State Council on Advancing the Beautiful China Initiative* outlined the comprehensive deployment of the construction of the national carbon market, calling for the further development of the national carbon market, steadily expanding industry coverage, diversifying trading products and modes, and developing a perfect national voluntary greenhouse gas emission reduction trading market^[16]. In 2024, Report on the Work of the Government explicitly set expansion of the national carbon market as a key task for the year^[17]. In February 2024, Zhao Yingmin, Vice Minister of Ministry of Ecology and Environment, revealed at a routine policy briefing held by the State Council Information Office that a special study on the expansion of the national carbon market had been conducted. The drafting of relevant technical documents has nearly complete, and the Ministry of Ecology and Environment is actively promoting the first expansion of China's carbon emissions trading market as soon as possible, which will then include key industries such as power generation, steel, building materials, non-ferrous metals, petrochemicals, chemicals, paper, and aviation, which account for about 75% of China's carbon dioxide emissions^[18]. In March and April 2024, the Ministry of Ecology and Environment released draft guidelines for carbon

emission accounting, reporting and verification for the aluminum smelting and cement clinker industries^[19] ^[20]. On May 1, 2024, the *Interim Regulation on the Administration of Carbon Emission Trading* released by the State Council came into force, further supports the orderly development of the carbon market^[21].

The *Work Plan for the inclusion of the Cement, Iron and Steel, and Aluminum Industries in the National ETS (Draft for Comments)*, issued on September 9, 2024, proposes to follow a "phased implementation and continuous improvement" approach, dividing the work into two stages to prepare the cement, steel, and aluminum industries for inclusion in the national carbon emissions trading market, and expanding the national carbon emissions trading market coverage in a proactive and orderly manner. Looking forward, the national carbon emissions trading market will continue to optimize its institutional framework, expand to cover more high-emission industries, guide production factors to low-carbon and green practices, and fully unlock high-quality production capacity within industries. This will enhance the carbon market's effectiveness in reducing emissions and optimizing industrial structure.

3.6 A top-level design document for methane emissions control issued, setting quantitative targets for methane recovery and utilization in energy, agriculture and waste sectors

China has long been actively working to control methane emissions, adopting various policies and economic measures to manage emissions across the energy, agriculture, and waste sectors. According to the *Third Biennial Update Report on Climate Change in China*, China's methane emissions totaled 64.113 million tons in 2018, equivalent to 1.346 billion tons of CO₂e. Among them, energy activities are the largest source of methane emissions, primarily from coal mining, accounting for approximately 44.7% of total methane emissions. Agricultural activities were the second-largest source, contributing 37.2% of emissions, followed by waste disposal, which accounted for 11.9% of total methane emissions.

China emphasizes methane emission reduction under the dual carbon goals. The "1+N" policy framework of carbon peaking and carbon neutrality includes the *Implementation Plan for Agricultural and Rural Emission Reduction and Carbon Sequestration*, as well as key policy documents such as the *China's National Plan for Responding to Climate Change*, the *Work Plan for Greenhouse Gas Emission Control during the 12th Five-Year Plan Period*, the *Work Plan for Greenhouse Gas Emission Control during the 13th Five-Year Plan Period*, and the *13th Five-Year Plan for the Protection of Ecological Environment*. These documents set requirements for methane emission control. *Policies such as the Guidelines on Deepening the Reform of the Country's Ecological Compensation Mechanism*, the *Catalogue of Projects Supported by Green Bonds (2021 Version)*, and the *Catalogue for Guiding Industry Restructuring (2019 Version)* have strengthened the use of economic measures to support methane emission control.

In November 2023, eleven departments, including the Ministry of Ecology and Environment, jointly released the *Action Plan for Methane Emission Control*, which sets quantitative targets for methane recovery and utilization in the energy, agriculture, and waste treatment sectors, summarized in Table 2. As a top-level design document for China's methane emission management and control, the *Action Plan for Methane Emission Control* outlines the main objectives of methane emission control sector-specific targets for 2025 and 2030. It deploys the strengthening methane emission monitoring, accounting, reporting, and verification systems, focusing on the

advancement of the methane emission control in the energy, agriculture, and waste and sewage treatment sectors, the strengthening of the It has deployed eight key tasks. including developing methane emission monitoring, accounting, reporting and verification systems, promoting methane emission control in energy, agriculture, garbage and sewage treatment, strengthening the synergistic control of pollutants and methane, and strengthening technological innovation and methane emission control supervision. On the basis of the existing subsidies and tax incentives for the recovery and utilization of methane resources (mainly high-concentration coal mine gas and coalbed methane), the *Plan* improves the economic incentive policies for other key emission control areas, including the inclusion of methane emission reduction projects into ecology-oriented development projects, the study of agricultural methane emission reduction incentives and compensation policies, as well as re-emphasis on the inclusion of eligible methane utilization and emission reduction projects into the Chinese Certified Emission Reduction (CCER)^[22].

Table 2 Some quantified targets in the *Action Plan for Methane Emission Control*

Industry	Target
Energy	<ul style="list-style-type: none"> • By 2025, the annual utilization rate of coal mine gas will reach 6 billion cubic meters • By 2030, the collection rate of oilfield associated gas will reach the international advanced level
Agriculture	<ul style="list-style-type: none"> • By 2025, the comprehensive utilization rate of livestock and poultry excrement will reach 80% or more, and by 2030, it will reach 85% or more
Waste and sewage treatment	<ul style="list-style-type: none"> • By 2025, the resource utilization rate of urban life waste in China will reach around 60% • By 2025, the rate of safe disposal of urban sludge will reach 90% or more

3.7 Strengthening synergies with biodiversity conservation efforts and steady increasing

ecosystem carbon sinks

Climate change and biodiversity have a close and complex coupling relationship. Aligning efforts to address climate change with biodiversity conservation has become an essential task in both international and domestic environmental governance. Richer biodiversity enhances an ecosystem’s ability to recover, store, and absorb carbon, making biodiversity protection critical for mitigating and adapting to climate change. As of 2021, the biomass of forest vegetation in China amounted to 21.886 billion tons, and the total carbon stock of forest and grassland vegetation reaching 11.443 billion tons. Among them, forest vegetation accounted for 10.723 billion tons, and grassland vegetation for 720 million tons. The annual carbon sequestration of forest and grassland vegetation is 349 million tons, equivalent to absorbing 1.280 billion tons of carbon dioxide^[23]. In April 2023, China completed the comprehensive delineation of the national ecological protection red line, encompassing the vast majority of important natural ecosystems. In the same month, the *Implementation Plan for Consolidation and Enhancement of Ecosystem Carbon Sequestration* was released, outlining the main objectives and key tasks for strengthening ecosystem carbon sinks by 2025 and 2030. Significant progress has been made in enhancing forest and grassland carbon sinks, wetland carbon sinks, and farmland soil carbon sinks, further stabilizing the role of ecosystems in carbon sequestration.

With regard to the legal system and policy framework, China has established a system of laws and regulations focused on biodiversity conservation and sustainable utilization. This system

is based on the Environmental Protection Law, the Wildlife Protection Law, the Forestry Law, the Regulations on the Conservation of Wild Plants, and the Regulations on Nature Reserves. As the President of the 15th Conference of the Parties to the *Convention on Biological Diversity* (COP15), China has continued to promote the implementation of the Kunming-Montreal Global Biodiversity Framework (GBF) and has issued the *China's National Biodiversity Conservation Strategy and Action Plan (2023–2030)*. This plan clearly defines the biodiversity conservation strategy for the new era, focusing on areas such as mainstreaming biodiversity, addressing the threat of biodiversity loss, sustainable use and benefit-sharing of biodiversity, and modernization of the governance capacity of biodiversity. It also lays out priority actions for each of these areas, providing guidance for various departments and regions to advance biodiversity conservation. At present, China has developed a relatively complete ecosystem protection system to safeguard wildlife populations and biogenetic resources comprehensively, which is crucial for conservation of biodiversity. Additionally, through the implementation of refined land spatial planning strategies, the scope of nature reserves is clearly defined, and ecosystems are scientifically categorized into specific functional areas. This approach rationally determines land development and utilization intensity and mode, promoting the maximization of ecosystem functions and significantly enhancing the ecosystem's capacity for self-recovery and adaptation to external risks, such as climate change. This foundation is vital for building ecological security, achieving harmonious coexistence between humans and nature, and continuously enhancing resilience against climate risks.

Moreover, China has been a strong advocate for supporting developing countries in protecting and restoring biodiversity. At COP15, China committed to take the lead in contributing 1.5 billion yuan to establish the Kunming Biodiversity Fund and formally signed the cooperation agreement for the Kunming Biodiversity Fund in May 2024. The official launch of the Kunming Biodiversity Fund will contribute China's strength to support the successful implementation of the Kunming-Montreal Global Biodiversity Framework (GBF) and accelerate the synergistic governance of global climate change and biodiversity.

3.8 China's green and low-carbon transition process still faces multiple challenges and needs to unlock markets, technologies and policies potential

The targets for energy consumption and carbon emissions in the 14th Five-Year Plan have not been accomplished as effectively as those in the 13th Five-Year Plan. As of now, more than half of the timeline and half of the overall tasks for the implementation of the *Outline of the 14th Five-Year Plan* have been completed. The *Mid-term Assessment Report on the Outline of the 14th Five-Year Plan (2021–2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China*, issued by the National Development and Reform Commission, indicates that the progress of four out of 20 key indicators in the *Outline* is lagging behind expectations. Two of these indicators are critical for the low-carbon transition: the reduction of energy consumption per unit of GDP and the reduction of carbon dioxide emissions per unit of GDP. The 2024 Report on the Work of the Government explicitly states that one of the main expected development targets for this year is to reduce energy consumption per unit of GDP by about 2.5% and to continue improving the quality of the ecological environment. This quantitative target will further promote the transformation of China's energy structure, industrial

structure and energy efficiency. However, in the coming period, China's total energy consumption will continue to grow, posing challenges in meeting the binding targets of the 14th Five-Year Plan to reduce national energy consumption and carbon emissions intensity.

Energy and electricity consumption remain in a phase of rigid growth. China's economy is still in a stable growth stage, and there is room for growth in energy and electricity consumption before carbon emissions peak. In 2023, China's per capita primary energy consumption was 4.09 tons of standard coal, about one-third of Canada's, two-fifths of the U.S.'s, and 87.4% of German's per capita primary energy consumption, indicating potential for further energy consumption growth^[24]. In 2023, China's energy and electricity consumption elasticity coefficients exceeded 1 (Fig.7). On the one hand, the national electrification level of end-use energy is being promoted, with the *Blue Book on the Development of New Electric Power Systems* proposing an increase in end-use energy electrification to about 35% by 2030. The demand for terminal electricity substitution will continue to drive the electricity consumption growth. On the other hand, the rapid proportion growth in GDP of emerging industries such as photovoltaic, new energy vehicles, and artificial intelligence is likely to sustain high elasticity in power consumption.

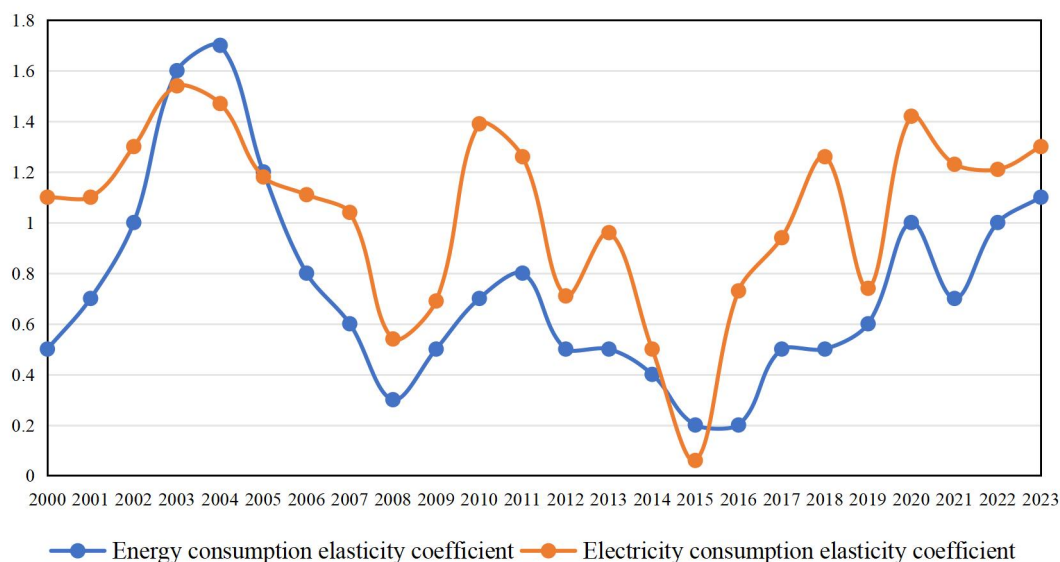


Fig.7 Trends in China's energy consumption and electricity consumption elasticity coefficients, 2000–2023

Source: National Bureau of Statistics of China.

Renewable energy consumption will become the focal point of the low-carbon transition in the coming period. As shown in Fig.8, China's installed renewable energy capacity and its share of power generation have been increasing annually, but the growth rate of renewable energy generation is much slower than the growth rate of installed capacity. Between 2015 and 2023, China's installed renewable energy capacity as a share of total installed capacity rose from about 30% to 50%, an increase of approximately 20 percentage points over the decade. Meanwhile, the share of renewable energy generation in total electricity consumption increased from about 20% to about 30% (Fig.8). In the context of energy transition, wind/PV power are currently the power sources with the best conditions and possibilities to support the growth of China's electricity demand. However, challenges such as insufficient consumption by distributed renewable energy users, inadequate grid acceptance capacity, poor transmission corridors, and the absence of a cost-

sharing mechanism for energy storage must be addressed. On the one hand, a comprehensive system transformation is needed to match large-scale renewable energy, and on the other hand, further development of renewable energy technologies is needed.

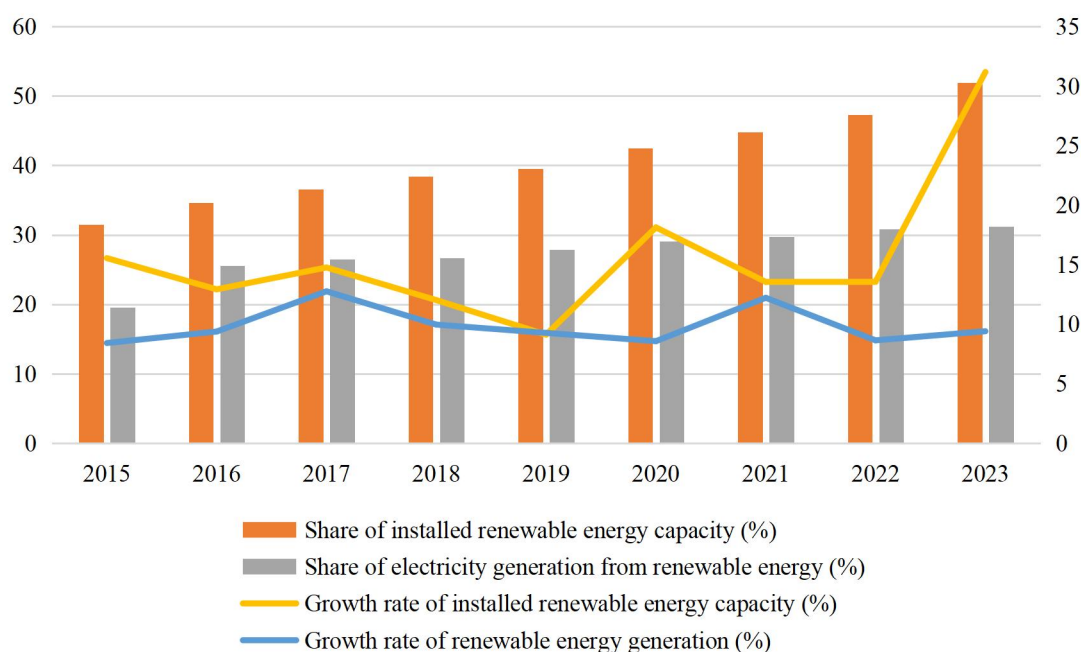


Fig.8 Renewable Energy Installed Capacity and Electricity Generation in China, 2015–2023

Source: National Energy Administration of China, IRENA.

Basic research and development capacity needs to be strengthened, and there is an inadequate stock of key low-carbon, zero-carbon, and carbon-negative technologies. China’s original scientific and technological achievements are relatively few, and there has been insufficient attention to disruptive systemic low-carbon, zero-carbon and negative-carbon technologies. Institutional mechanisms have hindered the transformation of scientific and technological achievements, and innovation factors have yet to be efficiently configured. Technological innovation is the core and key to achieving deep emission reduction. However, as international economic interests and trade protectionism intensify, technology transfer and cooperation will face greater challenges, and in the future, with the deepening of the game of international economic interests and trade protection, technology transfer and cooperation will face greater resistance.

The institutional system to support carbon peaking and post-peaking emissions needs further improvement. First, a basic legal system to support carbon peaking and carbon neutrality is lacking. A specialized legal framework related to climate change and dual carbon goals has not yet been established, and the “Energy Law” is still under development. Meanwhile, laws relevant to climate change, such as the *Electricity Law*, *Coal Law*, *Renewable Energy Law*, and *Energy Conservation Law*, have not yet included carbon emission reduction as a key institutional arrangement. Second, carbon emissions trading, as an important market-based tool for achieving the dual carbon goals, has not yet been effectively linked to the overall goal of controlling total carbon emissions. Third, as the new energy industry enters a new stage of development, the

financial and tax policy system needs to be optimized and improved. This include timely elimination of inefficient subsidies, with industrial policy should be more supportive of green low-carbon innovation, rather than capacity expansion. Local policies should also be formulated and implemented with a focus on fairness and consistency.

4 China's contribution and obstacles to promoting a global green and low-carbon transition

4.1 China's clean energy products contribute significantly to lowering global cost of clean energy use, accelerating low-carbon technologies deployment and improving energy accessibility

In 2023, global clean energy experienced significant growth, with 510 million kilowatts of installed new renewable energy capacity — an increase of 50% over the previous year. China contributed more than half of this increase². While achieving its own clean and low-carbon development, China has also provided high-quality renewable energy products and production capacity to support the global energy transition and the combat climate change. This has allowed renewable energy to be widely applied globally, especially in developing countries. By exporting wind/PV products to nearly 200 countries and regions, China is helping the vast number of developing countries gain access to clean, reliable and affordable energy. According to statistics, in 2022, China's renewable energy power generation was equivalent to reducing domestic carbon dioxide emissions by approximately 2.26 billion tons. Additionally, China's exported wind/PV products reduced carbon dioxide emissions in other countries by about 573 million tons, resulting a combined emission reduction of over 2.8 billion tons — accounting for about 41% of the global carbon emission reduction from renewable energy during that period^[25]. China's exports of electric vehicles, lithium batteries, photovoltaic products, and other clean energy products have not only enriched the global supply chains and eased inflationary pressure but also made great contributions to the global efforts to address climate change and promote green, low-carbon transitions.

The positive externalities of China's green technology and products are evident, with continuous breakthroughs in clean energy technology innovation providing a critical boost for the global green and low-carbon transition. Since 2012, China has continuously promoted innovation in clean energy technologies. In the field of equipment manufacturing, China has cultivated several world-class energy equipment manufacturing enterprises, with four Chinese enterprises ranking among the top five global wind power machine manufacturers and six Chinese enterprises among the top ten electric vehicle battery manufacturers. This has made China a pivotal force in stabilizing the global clean energy supply chain. China leads the world in increasing the scale of installed renewable energy capacity and reducing the cost of renewable energy power generation.

² IEA, Renewables 2023. <https://www.iea.org/reports/renewables-2023/executive-summary>

Over the past decade, the global installed capacities of photovoltaic, onshore wind, and offshore wind has grown, while the weighted average levelized cost of electricity (LCOE) has been decreasing (Fig.9). Among these, the cost of PV power generation has seen the most significant decline, dropping from \$0.45/kWh in 2010 to \$0.049/kWh in 2023—a decrease of 90%.

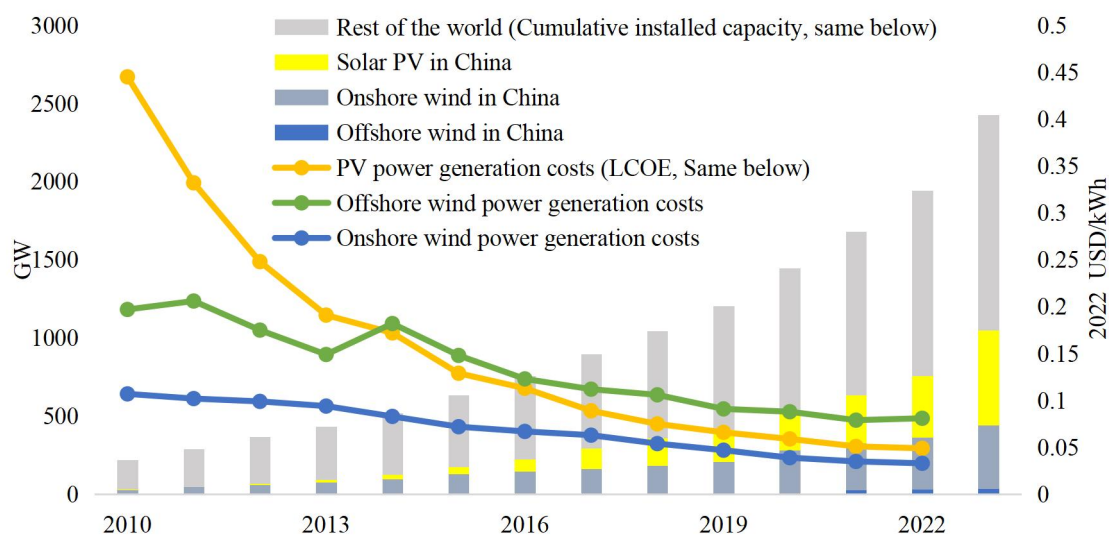


Fig.9 Trends in global installed capacity and power generation costs of solar PV and wind power, 2010–2023

Source: International Renewable Energy Agency.

At COP28, Parties agreed to “triple installed renewable energy capacity by 2030”. Achieving this goal will require a global increase in installed renewable energy capacity of 1,100GW by 2030, which is nearly double the record increase in 2023. However, current projections suggest that this target will be unattainable without urgent policy intervention. In the case of the Group of Twenty (G20) countries, for example, G20 member countries increased their installed renewable power capacity by 416.2 GW, a 15.0% year-on-year increase, bringing the total cumulative installed capacity to 3,084 GW. However, to meet the 2030 renewable energy target, G20 countries would need to add over 900 GW of new renewable power capacity annually by 2030^[26].

China’s progress in international cooperation on renewable energy is closely linked to the high-quality advancement of the Belt and Road Initiative. Countries along the Belt and Road are rich in solar energy resources, with a total annual photovoltaic power generation potential of up to 448.9 trillion kWh. However, nearly 30% of the 675 million people worldwide without access to electricity live in Belt and Road countries, making green power, such as photovoltaic power an important contributor to energy access^[27]. In September 2021, China’s President Xi Jinping stated at the General Debate of the 76th Session of the UN General Assembly that China will vigorously support the green and low-carbon energy development of developing countries and will no longer build new overseas coal-fired power projects. In terms of investment scale, major Chinese companies invested a total of \$31.1 billion in overseas renewable energy projects between 2015 and 2023^[28]. In 2023, Chinese companies signed 727 new overseas power projects, with a total contract value of \$51.364 billion—a 51.1% year-on-year increase—and a total installed capacity of 72.9 GW. Among them, 180 photovoltaic power generation projects were signed, with a project value of \$17.16 billion, reflecting a 72.2% year-on-year increase, which continues to maintain a

high growth rate. The majority of these new projects are concentrated in Asia (77), followed by Africa (45), Europe (39), with fewer projects signed in South America, Oceania, and North America^[29]. China has also partnered with countries like Kazakhstan, Kyrgyzstan and others in developing solar energy resources and the building photovoltaic power plants, providing sustainable energy supply and promoting local economic development. This ongoing international cooperation has expanded “Belt and Road” energy partnerships, with the number of member countries in its energy partnership now reaching 33. China has also established six regional energy cooperation platforms, including the APEC Sustainable Energy Center and the China-ASEAN Clean Energy Cooperation Center^[30], promoting shared development and prosperity in the energy sector.

4.2 China actively engages in the international sustainable trading system and participates in and leads the development of a global green value chain for soft commodities

China holds substantial potential to drive a green and low-carbon transition in the global soft commodities supply chain. As the world’s largest trading nation, China is at the center of the global soft commodities value chain. Driven by factors such as rising economic power and expanding domestic production demand, China’s imports of soft commodities—such as soybeans, forest products, beef, and palm oil—have been steadily increasing. In 2023, China’s annual soybean consumption accounted for about one-third of global production, with soybean imports comprising for about 64% of the world’s totals. In 2019, China became the world’s second-largest importer of palm oil (after India) and the world’s third-largest consumer of palm oil (excluding the EU). China’s beef imports have grown rapidly, making it the largest importer surpassing the United States in terms of volume and second-largest importer after the United States in terms of value since 2018. China is also the world’s largest importer of forest products, with the value of timber (including logs and sawn wood) imports accounting for approximately 40% of the global total in 2022^[31].

China is actively involved in accelerating the green transformation of the soft commodities supply chain. At the strategic level, in October 2021, China and the European Union held the second China-EU High-Level on Environment and Climate Dialogue, issuing a joint communiqué, that highlighted the consensus on strengthening cooperation in areas such as forest resource protection, sustainable supply chains, and combating illegal logging and related trade. China also signed the *Glasgow Leaders’ Declaration on Forests and Land Use* at COP26, committing to halting and reversing global forest loss and land degradation by 2030. During COP26, China and the U.S. jointly issued the *U.S.-China Glasgow Joint Declaration on Enhancing Climate Action in the 2020s*, which included a commitment to jointly support the elimination of illegal deforestation worldwide through effective law enforcement against illegal imports^[32]. Furthermore, China is also actively promoting green supply chain cooperation under the Belt and Road Initiative. In 2017, the Ministry of Ecology and Environment, the Ministry of Foreign Affairs, the Ministry of Commerce and the National Development and Reform Commission jointly issued the *Guidelines on Promoting Green Belt and Road*, emphasizing the need to strengthen green supply chain management and promote green production, procurement and trade, strengthening international cooperation and coordination on green supply chains.

Chinese companies actively participate in international efforts to green the value chain. 2018,

the China Chamber of Commerce of I/E of Foodstuffs, Native Produce and Animal By-Products (CFNA) co-initiated the establishment of the China Sustainable Palm Oil Alliance, which provides a platform for cooperation among stakeholders in the palm oil supply chain and promotes the production, trade, and consumption of sustainable palm oil. In 2021, China's meat industry released the *Specification for Meat Industry Green Trade*, which includes the commitment to avoid sourcing products from areas at high risk of deforestation. A total of 408 Chinese companies joined the Science-Based Targets Initiative (SBTi), committing to climate action and emissions reduction. Among them, 379 companies submitted climate goals and stated that they would prioritize shaping green supply chains, such as conducting carbon inventory on the supply chain and purchasing sustainable certified products. Climate targets submitted by 174 companies have been adopted. China National Cereals, Oils and Foodstuffs Corporation, for example, has provided technical guidance and support to improve agricultural productivity and sustainable development in Belt and Road countries such as Thailand, Cambodia, Myanmar, and Laos, protecting local ecosystems while enhancing agricultural product quality and yields — achieving a win-win for economic and environmental benefits. During the 6th China International Import Expo, COFCO reached an agreement with Modern Farming, a subsidiary of Mengniu Dairy, on the procuring “zero deforestation” Brazilian soybeans. Since entering the Brazilian market in 2014, COFCO International has established a sustainable soybean supply chain with agricultural product traceability as its core by promoting joint action by all parties in the supply chain. Currently, COFCO International has achieved 100% full traceability of soybeans directly purchased from Brazil[33]. The development of sustainable supply chains in industries such as soybeans, beef, timber, and palm oil can reduce the risk of carbon emissions from deforestation and conversion of native vegetation^[33].

4.3 Challenges in international cooperation on the green low-carbon transition

4.3.1 Unilateral trade measures, tariffs and non-tariff barriers increase uncertainty for the global green low-carbon transition

Since the development of CBAM in the EU, trade and climate issues have become increasingly intertwined. The new U.S. special envoy for climate, John Podesta, has placed trade at the center of his administration's strategy, with a strong emphasis on working with allies and partner countries to reduce dependence on the green industrial chain. On May 14, 2024, the White House announced that the Biden administration would continue to retain tariffs imposed by the previous administration and introduce additional tariffs on other Chinese goods. These tariffs cover products such as steel, aluminum, semiconductors, batteries, key minerals, solar cells, and cranes. Notably, import tariffs on Chinese electric cars are set to surge from 25% to 100%. The U.S.'s *Inflation Reduction Act* also stipulates that vehicles made with Chinese battery components will not be eligible for tax credits after 2024, after which the U.S. government announced a two-year grace period for electric vehicle companies and battery manufacturers. In addition, on December 18, 2023, the UK government officially announced that it would implement its own CBAM from 2027 onwards. Countries like Japan and Canada are also conducting CBAM-related research and discussions and are likely to introduce similar policies in the coming years.

Research shows that under current rules, the impact of CBAM on EU trading partners

depends to some extent on how these trading partners respond to the mechanism. In general, the impact on Chinese exports is relatively small, with steel and aluminum being the main sectors affected. But at the same time, it should be recognized that climate trade measures shift the responsibility for consumption and emissions from developed countries to developing countries, raising the burden of emission reduction on the latter. This shift negatively impacts developing countries' exports, industrial transformation and social welfare. Studies have shown that the EU's CBAM will exacerbate global income inequality and widen the welfare gap between developed and developing countries. The imposition of punitive tariffs by the "Climate Club" does not significantly reduce emissions, but instead imposes enormous cost pressures on non-member countries. The impact of CBAM is particularly severe on low- and middle-income countries, leading to a decline in their trade relative to high-income economies and posing serious challenges to job security in the affected sectors. In addition, CBAM may have an impact on multilateral systems such as the World Trade Organization (WTO) and the United Nations Framework Convention on Climate Change, as well as rules such as the principles of "common but differentiated responsibilities".

Non-tariff barriers are also on the rise. For lithium-ion batteries and photovoltaic products, the *Regulation Concerning Batteries and Waste Batteries* of EU also came into force on August 17, 2023. While the regulation aims to establish a sustainable battery management model, it has in fact raised the entry threshold for battery products produced outside the EU and new energy vehicles to the EU market. Since the enactment of the U.S.'s *Uyghur Forced Labor Prevention Act*, U.S. Customs has detained up to 3GW of solar modules.

Unilateral trade measures, particularly high tariffs and various non-tariff barriers, hinder the global flow and optimization of technologies and products. These barriers negatively affect international cooperation and confidence-building, and the decoupling and breaking of industrial and technological chains significantly increasing the cost of global climate governance. To truly promote a global green and low-carbon transition, the international community needs more just and inclusive multilateral trade and environmental policies to ensure that all countries can progress together on the path to carbon reduction.

4.3.2 Developing countries face tight fiscal constraints and high transition costs in meeting climate and sustainable development goals

For developing countries with limited financial resources, combating climate change often conflicts with goals such as poverty eradication. Some developing countries are also in a phase of rapid industrialization and urbanization, leading to high energy demand. Pushing for an accelerated energy transition in these contexts may result in energy supply shortages and higher transition costs. To meet the growing energy demand, these countries must balance economic development with carbon emission reduction, often leading to difficult trade-offs.

Developing countries are grappling with stagnant fiscal revenues, rising borrowing costs, and currency depreciation, all of which increase their debt-servicing burdens and limited their ability to invest in sustainable development. Particularly in countries with high levels of debt denominated in dollars or euros, the monetary tightening by central banks in major developed countries has led to significant spillover effects to developing countries, including high borrowing costs, limited access to international capital markets, and exchange rate depreciation. In the six

months following the Federal Reserve's cessation of net asset purchases in March 2022, the currencies of emerging market economies collectively depreciated by about 9% against the U.S. dollar. The sharp rise in interest rates since the first quarter of 2022 and the tightening liquidity conditions have adversely affected fiscal balances, reviving concerns about fiscal deficits and debt sustainability worldwide. For many developing countries, the narrowing fiscal space limits their ability to invest in sustainable development and respond to the climate crisis. In 2022, more than 50 developing economies spend over 10% of their total government revenues on interest payments, with 25 countries spending over 20%. In the medium term, developing countries face multiple pressures on government budgets, exacerbating fiscal vulnerability due to low growth prospects and the need for increased investment in education, health and infrastructure.

Developing countries have difficulties in securing sufficient external financing to stimulate investment and growth, address climate-related risks, and accelerate the achievement of sustainable development goals. Although global investment in the energy transition has increased since the *Paris Agreement*, there remains a significant gap between developed and developing countries. International investment in renewable energy has nearly tripled since the adoption of the *Paris Agreement* in 2015, but most of this investment is concentrated in developed countries. Developing countries require around \$1.7 trillion annually in renewable energy investment, but only attracted \$544 billion in clean energy foreign direct investment in 2022. The annual financing gap for achieving the Sustainable Development Goals (SDGs) in developing countries is approximately \$4 trillion. Although developed countries say they have just met their pledge to provide \$100 billion annually in climate financing to developing countries has just been met, controversies over the definition of climate finance persist in the international community. Furthermore, higher country risk ratings in developing countries make them less attractive to international private investment. In the context of reduced financial flows and transaction volumes in developed countries due to multiple crises (e.g., the Russia-Ukraine conflict, high food and energy prices, and debt stress), downward pressure on climate transition investments targeting developing countries is expected to continue^[34].

4.3.3 Challenges in equitably distributing benefits from global green value chains

The greening of global value chains promises broader environmental and social benefits, but challenges remain in ensuring an equitable distribution of economic gains among and within countries. Developed countries, due to their early layout of green industries, occupy a relatively high position in the value chain with their technological advantages and capital strength, such as setting technical standards and producing core equipment. While developing and least developed countries are mostly limited to the low end of the value chain, such as the provision of raw materials and primary processing, making it difficult for them to capture corresponding high-value-added gains. From a development perspective, less developed countries have been slow in structurally transforming their economies and remain at a lower position in the global green value chain^[35]. Ecologically, developing countries, including the least developed countries remain net providers of most ecological resources on the global market, contributing to the consumption and carbon emissions of other regions while being at the bottom of carbon-intensive global value chains^[36].

The unequal distribution of costs and benefits is particularly pronounced in global value chains, especially in the area of soft commodities. Exporting countries like Brazil and Argentina

provide large quantities of soybeans and beef but face the risk of ecological damage and resource depletion, with relatively low benefits. Importing countries, may satisfy domestic market demand through the global trade but often find themselves in unfavorable positions within global value chains, facing high costs and low benefits. They also bear significant responsibilities and pressures in promoting the greening of the supply chains. Multinational corporations such as Cargill and Bunge have achieved high profits by controlling the trade and processing links and having the ability to distribute and value profits. These companies have transformed basic raw materials into high-value-added products (such as refined soybean oil and processed beef) through large-scale operations and market monopoly, thus occupying most of the profits in the value chain. This further exacerbates the imbalance in the distribution of costs and benefits in the green value chain for soft commodities.

In addressing this dilemma, it is urgent to strengthen international cooperation and dialogue, enhance supply chain transparency, formulate and implement policies and market mechanisms aimed at balancing the interests of all parties, actively promoting the green transformation of supply chains. At the same time, multinational corporations should also play a key role in promoting the green reshaping of the soft commodity value chain by implementing sustainable procurement policies, establishing environmental management system, and jointly ensuring supply chain transparency and traceability, with a view to realizing a fairer and more sustainable global value chain system.

Emerging green industries offer important opportunities for less developed countries to transform their positions within global value chains. Taking the new energy vehicle industry chain as an example, compared with traditional vehicles, new energy vehicles are no longer restricted by the engine technology system. Its required parts are greatly reduced, and the added value of power batteries in the production process accounts for a relatively high proportion. As a result, the international market share of developing economies in the power battery and new energy automobile sectors has increased significantly. In 2023, China's exports of new energy vehicles reached 1.203 million units, up 77.6% year-on-year, with the growth rate exceeding that of traditional fuel vehicles. China has also led the world in photovoltaic module production for many years, with its global share of production capacity for polycrystalline silicon, silicon wafers, battery wafers, and modules exceeding 80%^[37], providing important development experience for developing economies.

5 Pathways to gender mainstreaming in climate change analysis

5.1 Importance of gender issues in addressing climate change and global climate

governance

Women and girls make up half of the world's population. Gender equality is a fundamental human right and an important prerequisite for realizing the full potential of humankind, advancing sustainable development and ultimately achieving peaceful societies. The empowerment of women is also a catalyst for increased productivity and economic growth.

The different roles and positions of women and men in traditional socio-economic structures affect their access to relevant resources, rights and power, including land resources, investment in

clean energy, and solutions to climate change adaptation, with women often disadvantaged due to discriminatory gender norms. These factors also influence their ability to participate in and lead decision-making processes within the household and public sphere. As a result of their lesser access to resources, rights, and decision-making, women are more vulnerable than men to the impacts of climate change.

Given the sociocultural norms that often assign women greater responsibility for family care, climate change is likely to increase the burden on women in maintaining hygiene and health within the household, exacerbating existing inequalities in women's access to resources. Poorer women, in particular, face heightened risks from natural disasters, severe weather events, and climate change. They are more likely to live in poverty, depend on natural resources for livelihoods, and bear responsibility for the management of these resources. However, they often lack access to, or control over, resources necessary to adapt to or mitigate the impacts of climate change. At the same time, due to their roles in household management and natural resources-dependent livelihoods, women often possess extensive knowledge of local climatic and environmental conditions and can provide practical solutions for climate change adaptation and mitigation. Unfortunately, women and their unique perspectives are frequently marginalized in public and decision-making forums, leading to women's underrepresentation in governance structures. Therefore, it is essential to fully consider women's participation to ensure their perspectives and contributions to climate change efforts are included and to achieve synergies between climate action and gender equality as part of sustainable development goals.

5.2 Gender issues in global climate governance continue to be highlighted, and multilateral cooperation needs to be further promoted to ensure women's equal rights and interests in climate issues

In recent years, gender issues have gained increasing prominence under the *United Nations Framework Convention on Climate Change*. According to the UN, awareness of the linkages between gender and climate change has grown across countries. Over 100 countries have appointed national focal points for gender and climate change. By the end of 2022, 97% of National Adaptation Plans (NAPs) and 77% of Adaptation Communications explicitly mentioned gender^[38]. According to the latest NDCs synthesis report released in 2023, 79% of Parties provided gender-related information in their NDCs, although only 33% of Parties committed to incorporating gender considerations into their climate actions^[42].

Promoting gender equality within multilateral frameworks for climate governance is critical in several ways:

First, international conferences such as the United Nations Climate Change Conference, should ensure proportional representation of women and enable them to increase their voice and influence in the decision-making process. The updated gender architecture report of COP 28^[39] indicates that the percentage of female members in various bodies ranged from 14% in the Technology Executive Committee to 75% in the Adaptation Committee in 2023. Five constituted bodies in 2023 reported that they had achieved their gender balance targets. The percentage of women in all positions in constituted bodies was 39% in 2022 and 38% in 2023.

Second, financing support and capacity-building provided by multilateral international

organizations, can promote the integration of gender equality with climate change and energy transition issues in developing countries and poor regions. These support helps these countries achieve long-term development with environmental and social equity. For example, the Asian Infrastructure Investment Bank has partnered with the Southeast Asia Women’s Economic Empowerment Fund (SWEEF) in a commitment to provide up to \$10 million in financing to small and medium-sized enterprises (SMEs) in Southeast Asia to invest in growth-stage enterprises to bridge the gender gap and promote gender equality in the region. The UN Environment Programme (UNEP) and UN Woman jointly proposed and implemented the “Empower: Women for Climate-Resilient Societies” program in 2018 to promote gender equality in climate change and disaster risk prevention in the Asia-Pacific region. The program has carried out effective and practical work in Bangladesh, Cambodia, Vietnam, the Philippines, Indonesia, and other countries^[40]. This program has developed new livelihood opportunities for vulnerable communities, reduced emissions with renewable energy solutions, and inspired intergovernmental commitments to adopt gender-inclusive policies and actions throughout the region, and will scale up the project for next phase ^[41].

Third, within multilateral mechanisms and international cooperation, it is possible to provide funding to support women’s participation in climate action and access to relevant technical training through the establishment of a gender fund in the climate sector, dedicated to supporting gender equality and climate change response. Alternatively, existing climate funds could increase their allocations to gender equality projects, ensuring that women have the same rights and opportunities as men to participate in climate change mitigation and adaptation.

Fourth, multilateral platforms can promote transnational and cross-regional technical cooperation to help developing countries enhance women’s capacities and skills in the field of new energy and green technology. International training programs could also be established to upgrade women’s technological and managerial capacities in climate change-related fields.

5.3 Promoting a just domestic transition and enhancing green jobs for women in the

transition

In recent years, China has made remarkable progress in promoting gender equality. According to the National Bureau of Statistics of China, the labor force participation rate for women was 61.4 percent in 2020, well above the global average of 47%. The Chinese government has emphasized the importance of gender equality in its policy frameworks, including the *14th Five-Year Plan (2021–2025)*, which stresses gender equality and the need to “promote women’s participation in economic and social development” ^[42]. In addition, the *Outline for Women’s Development in China (2021–2030)* proposes offering diversified vocational training programs for women, especially in high-tech and strategic emerging industries, to create more career development opportunities for women^[43]. However, women often face greater challenges than men during major economic transformations. The green economy transition, driven by the dual carbon goals, presents both new challenges and opportunities. According to the International Energy Agency, the green transition is projected to create an additional 3.6 million jobs in China’s energy sector ^[44]. Targeted policies are needed to safeguard and promote women’s rights and interests in employment and development.

Currently, women are overrepresented in industries that are more susceptible to the impacts

of the green transition. In the coal industry, the proportion of female employment has declined from 21.9% in 2003 to 13.3% in 2020, with women more likely to be employed in supportive jobs such as management, administration, and technical support. Therefore, when the coal industry is facing a transition, female employees are more vulnerable to the risks associated with the transition^[45].

Some studies have noted that China should integrate its approach to climate change with socio-economic policies and incorporate inclusive climate action in support of women's development into transformative policies^[46]. The energy transition can create new jobs while helping affected workers and communities realize a "Just Transition". By capitalizing on the synergies between these policy areas, China can achieve its climate goals while promoting economic development, sustainable growth and women's development. Specific recommendations include:

First, providing retraining and skills upgrading opportunities to help women workers adapt to new green technologies and job requirements. This involves establishing specialized green technology training programs to help women workers master the latest green technologies, offering career transition training for women in traditional industries to prepare them for roles in emerging sectors such as renewable energy, green manufacturing and environmental protection, and developing online training platforms that offer flexible learning modes so that women unable to participate in the training on a full-time basis can have the opportunity to complete the courses.

Second, strengthening social security to provide better protection for female workers affected by the transition, to ensure their stability during the transition period.

Third, creating appropriate policy mechanisms to encourage women's participation in emerging green sectors. This would include education and career guidance, and the establishment of equitable talent attraction mechanisms to encourage and support women's entry into technology-intensive and high-growth green sectors.

5.4 Promoting gender equality in the green and just transition of developing countries, and utilizing China's leading role in global climate governance

Enhancing the adaptability and influence of women in developing countries and impoverished regions within the green and low-carbon sectors will help to advance global climate transformation goals and ensure gender equality and equity. Rigid gender roles in society often prioritize women's work within the home and men for public-facing and decision-making roles within the community. Currently, women's participation in local climate actions in developing countries remains low due to factors such as lower levels of education and socio-economic status. According to the United Nations, women and children are 14 times more likely to die than men during extreme weather events, mainly due to their limited access to information, mobility, decision-making capacity and resources. Additionally, women are largely excluded from the development of policies, strategies and programs aimed at disaster risk reduction and resilience^[47].

In recent years, as international climate conventions and aid programs have increasingly incorporated gender equality into their climate cooperation mechanisms, developing countries have begun to recognize the importance of gender equality in energy and climate change efforts. These efforts could support a just transition in areas such as energy substitution, climate investment and financing, and green and low-carbon supply chains. Key practices and progress

include:

First, developing countries have successively formulated and introduced policies and legal frameworks related to gender equality, creating a favorable policy environment for integrating gender considerations into climate change action. For example, Vietnam's significant improvement in its gender equality index can be attributed to the implementation of the National Gender Equality Strategy and the establishment of an increasingly comprehensive legal system addressing gender equality.

Second, local governments and civil society organizations have provided education and training resources related to green industries for women in developing countries and impoverished regions. They have also offered financial, technical, and market access support for women entrepreneurs. According to the International Renewable Energy Agency (IRENA), although women constitute 48% of the global labor force, they represent only 22% and 32% of the workforce in traditional and renewable energy sectors, respectively^[48]. The proportion is even lower in developing countries. In highly underdeveloped or rural areas, where energy access is a problem on a large scale, off-grid renewable energy solutions represent opportunities for local women to participate due to their distributed nature. For example, the non-profit organization Solar Sister provides off-grid electricity and clean cooking solutions to underserved communities in sub-Saharan Africa, creating employment opportunities for local women. The program has recruited more than 10,000 local women entrepreneurs, facilitated community-based clean energy products to over 4.3 million people, generated more than \$300 million in economic benefits for off-grid communities, and reduced carbon dioxide equivalent emissions by over 1,433,000 metric tons^[49]. In addition, Indonesia's 2023 establishment of the Nusantara Fund provides climate finance directly to local communities and supports gender equality in practice by providing more training opportunities for local rural women^[50].

Cross-border investment and assistance through bilateral countries must consider the comprehensive economic, social and environmental impact on recipient countries, particularly the vulnerability of local women, so as to avoid creating or reinforcing gender inequality as a result of investment and assistance projects. In the case of China's overseas investment and assistance projects—especially green investments and assistance projects—gender considerations should be incorporated to promote gender equality and avoid the risk of adverse social impacts of the projects, promote the social development of the recipient countries, and enhance China's international reputation as a responsible global leader. Specific recommendations include:

First, developing standards and guidelines for overseas investment and assistance that incorporate gender equality considerations. In terms of environmental protection, the Ministry of Ecology and Environment and the Ministry of Commerce jointly issued the *Guidelines for Ecological and Environmental Protection of Foreign Investment Cooperation Construction Projects* in 2022^[51], which provides guidance and standardization for Chinese enterprises to invest abroad and carry out environmental impact assessment and environmental management. In the future, consideration can be given to issuing guidance on the social impact of overseas investments, and promoting comprehensive assessments of projects' social impact, including the conduct of gender mainstreaming, when Chinese investors make overseas green investments and provide assistance.

Second, considering the integration of gender issues into the information disclosure processes of overseas investment projects through a self-regulatory convention on overseas investment.

When making overseas investments and providing assistance, Chinese enterprises should disclose project-related information to local communities, governments, the public, and other stakeholders, including the project's objectives and plans, as well as possible gender and social impacts, to enhance the sustainability and social impact of their projects. China should consider launching a *Self-Discipline Convention on Overseas Investment by Chinese Enterprises by the Federation of Enterprises*, whereby participating enterprises would voluntarily abide by the Convention and fulfill their social responsibilities and their obligation to be supervised in accordance with the Convention, as well as to incorporate gender issues into the code of conduct and principles of the *Self-Discipline Convention*. This would enhance the social and gender equality impact of investments, as well as the image and competitiveness of Chinese enterprises.

Third, providing women with training and technical support which is tailored to industrial and cultural contexts, and ensuring a significant proportion of female participation. Combining gender equality with project sustainability and localization will promote long-term positive social outcomes from overseas investment projects.

Fourth, promoting knowledge sharing and gender mainstreaming through international cooperation, encouraging more stakeholders to address gender equality issues. COP28 in Dubai, UAE, set up a special theme day on gender equality, focusing on the vulnerability and strength of women in climate issues and highlighting the importance of gender equality in climate action. In the future, China can continue to leverage similar international cooperation mechanisms and platforms to establish similar partnerships on gender issues with local governments, international organizations, NGOs and other stakeholders, ensuring that the social impact and sustainability are fully considered in projects, with better support provided to women and vulnerable groups.

6 Policy recommendations

The 15th Five-Year Plan represents a critical phase in China's dual carbon process, during which carbon emissions are expected to peak and begin to decline. This turning point in the trend of carbon emissions will require further enhancements in carbon emissions management and policy. Simultaneously, the climate issue is becoming more complex as geopolitics, security concerns and trade issues continue to intersect with the green transition. Therefore, more creative thinking and solutions are needed, combining domestic industrial policies, trade measures and investment measures to promote a new market equilibrium that cooperates to achieve synergies between climate goals, economic prosperity and security concerns.

6.1 Taking the NDC update as an opportunity to exercise climate leadership and combine ambitious goals with concrete actions

The rise of increasingly affordable and reliable non-fossil energy sources can meet new electricity demand and gradually replace existing fossil energy stocks. Non-fossil energy not only has the greatest potential for emission reduction but also comes with lower associated costs. Therefore, a strong, rapid push to generate power using non-fossil energy will be a decisive factor in shaping China's overall CO₂ emission trajectory. Over the past decade, advancements in renewable energy and energy storage technologies and associated sectors have presented viable opportunities and will continue to support the achievement of the 2035 targets.

Updated China's NDC targets should align with the country's national conditions by adhering to the "dual carbon" target firmly and unshakably and upholding the principles of "common but differentiated responsibilities" and respective capabilities.

First, it is important to explore and propose an absolute reduction target for CO₂ emissions by 2035, potentially expressed as a specific reduction ratio or range, based on the peak in carbon emissions.

Second, the updated NDC should reflect the reduction efforts across all greenhouse gases. It is suggested that the new round of NDC update incorporate quantified reduction targets and actions for methane emissions alongside the emission reduction actions for other greenhouse gases.

Third, a target of installed capacity of non-water renewable energy by 2035 should be proposed. By acceleration of overseas investment of new energy and leading the development of the global new energy industry, China will support the low-carbon energy transition in developing countries and contribute to achieving the goal of "tripling global renewable energy capacity by 2030".

Fourth, it is essential to study and propose a target for the installed capacity of energy storage or new energy storage by 2035. This will help maintain China's leadership in energy storage development, support the establishment of a renewable energy-based energy system, and ensure the security, stability, and sustainability of the energy supply.

Fifth, studies are needed to propose infrastructure construction targets such as charging, replacing and hydrogenation by 2035 to provide guarantee for new energy vehicles to become the mainstream of new sales vehicles.

Sixth, ambitious goals and practical actions should be well balanced. In addition to specific targets, the NDC update should highlight China's commitment to pragmatically driving domestic low-carbon transformation, engaging in cooperation with developing countries, and promoting stable and long-term global climate governance.

6.2 Promoting the consumption of wind/PV power based on local conditions, and supporting more low-carbon technology innovation and industrialization through a combination of measures such as green industry classification, market mechanisms, and subsidies

First, the research and development, investment, and innovations in business models and institutional mechanisms should be enhanced to address demand-side challenges. This involves resolving issues related to local consumption of wind/PV power and the development of long-distance transport infrastructure in large-scale wind- and solar-powered bases, and supporting the transformation of distribution networks and microgrids for distributed renewable energy. Installing rooftop solar PV systems, energy storage systems, and heat pumps in rural areas, along with promoting the electrification of rural buildings, agricultural machinery, and the wide adoption of electric vehicles, will stimulate new demand. This expansion will create market opportunities for the relatively abundant production capacity of wind/PV equipment in the upstream of the industry chain, providing new momentum for sustained economic growth.

Second, a classification of green industries should be implemented. This involves identifying key technologies commonly applied across various sectors depending on their maturity, complexity, and scale. Special attention should be given to emerging low-carbon technologies

crucial to the supply and value chains, with priority support provided for them. A dynamic adjustment mechanism for green industry classification should be established. Regions with comparative advantages and suitable conditions should be encouraged to develop new green industry clusters and promote best practices. Additionally, attention should be paid to the commercialization of small, decentralized, and customized low-carbon technologies, with support provided for innovative small businesses.

Third, a new set of industrial policies should be deployed for emerging low-carbon technologies. To build competitive advantages in the low-carbon sector, a mix of tax incentives, subsidies, preferential loans, and auctions should be offered. These measures should target the industrialization and scaling of not fully commercialized technologies with significant emission reduction potential and industry impact, such as energy efficiency improvement technologies, industrial heat pumps, and green hydrogen. Technical evaluation standards should be established for regular policy impact assessments, with policy strength adjusted accordingly. Funding for low-carbon technology research and development should be increased. Furthermore, platforms and mechanisms for discussions and exchanges on industrial policies among industry, academia, and government agencies should be created to signal for the selection of advanced technologies, the intensity of support, and the timing of policy withdrawal. Promote a just transition with increasing green employment opportunities for women.

Fourth, emphasis should be placed on aligning new industrial policies with existing ones, converting revenue from carbon emissions trading and energy consumption and carbon emission control policies into competitive subsidies for emerging green and low-carbon industries.

Fifth, assessments of carbon emission indicators at the provincial and municipal levels should be linked to transfer payments.

6.3 Facilitating the implementation of the “dual control” policy for carbon emissions and constantly improving the “dual carbon” policy system

First, a system improvement roadmap should be designed within the total carbon emissions framework, integrating it with the NDC update. During the 15th Five-Year Plan period, the nationwide implementation of the “dual control” policy for carbon emissions will include carbon emissions intensity as a binding target and total carbon emissions as an anticipated target. These targets will be allocated to each province and city, establishing both baseline and incentive targets for carbon emissions intensity. Provinces that meet their incentive targets will be exempt from assessments of total carbon emissions. Post-2030, a dual carbon policy system centered on total carbon emissions control will be established.

Second, the system of laws and regulations related to dual carbon efforts should be improved. This includes continuing the study and advancement of special legislative process for climate change while enacting and revising related laws such as the Environment and Ecology Code, Energy Law, Renewable Energy Law, Energy Conservation Law, and Electric Power Law. These initiatives should facilitate system transformation and enhance the effectiveness of the legal framework for dual carbon efforts.

Third, carbon market reforms should be further advanced. This includes promoting the integration of total carbon emissions with the carbon market. In the near term, efforts should focus on exploring and proposing targets for controlling total carbon emissions within the carbon market

of the power industry, as well as setting a ten-year reduction expectation for total carbon emissions. The carbon market should then be gradually expanded to include key industries in a staged and orderly manner, following the principle of “starting with the low-hanging sectors, with significant emission reduction potentials, substantial impact on international trade, and multiple low-carbon technology options”. It is advisable to accelerate the construction of a national unified large market, strengthen policy coordination of market-oriented mechanisms such as green electricity, green certificates, and carbon trading, avoid double counting and trading of environmental rights and interests in different markets, give full play to the environmental premium of renewable energy, and help achieve China’s dual-carbon goal.

Fourth, the research of and response to the Carbon Border Adjustment Mechanism (CBAM) should be coordinated with the development of China’s carbon market. This involves assessing CBAM’s impact on key industries, working towards aligning domestic carbon market rules with fair and reasonable international rules, and exploring mechanisms for cross-border linkage with the global carbon market. Under the framework of Article 6 of the *Paris Agreement*, it is advisable to work with Belt and Road countries to explore the establishment of a new international carbon credit mechanism.

6.4 Promoting the localization and internationalization of the industry chain and supply

chain for the “New Three” products, and actively supporting and promoting the liberalization

and facilitation of global trade and investment

First, it is advisable to establish an inter-departmental working group to study and advance the coordination between climate and trade policies.

Second, it is crucial to balance the domestic and international markets and effectively manage the domestic and international circulations. Addressing domestic demand challenges will promote the consumption of wind/PV power by integrating supply and demand, thereby creating market opportunities for the relatively abundant production capacity of new energy equipment in the upstream of the industry chain. In the upstream, emphasis should be placed on restructuring industrial organizations, setting appropriate entry thresholds, fostering moderate competition with fair pricing, enhancing industrial efficiency, promoting technological innovation, and ensuring healthy and orderly industrial development.

Third, efforts should be made to internationalize the emerging low-carbon industry chain and supply chain, actively participate in the deployment of global industry chain, and ensure the safety and sustainability of the green and low-carbon supply chain globally. Based on the needs of host countries, the principles of reciprocity and mutual benefit should be followed to transfer low-carbon production capacity and technology to developing countries, ensure low-carbon and sustainable development throughout the entire industry chain during practical operation, support clean growth in developing countries, and accelerate the process of global carbon neutrality. In the process of helping developing countries achieve green transition, China should focus on promoting gender equality and play a leading role in global climate governance.

Fourth, free trade in low-carbon products and technologies should be facilitated. Existing multilateral mechanisms should be utilized to establish exchange platforms for investment and trade in low-carbon industries, fostering dialogue and seeking mutually acceptable solutions.

Active efforts are needed to engage in or initiate negotiations for multilateral and bilateral agreements on investment and trade protection, support the resumption of negotiations on the WTO's *Environmental Goods Agreement* and the expansion of the APEC list of environmental goods, promote trade liberalization and zero-tariff alliances for low-carbon products, facilitate cooperation on international trade, enhance personnel and technology exchange, and expedite global dissemination and adoption of low-carbon technologies.

6.5 Actively participating in and contributing to the reform of the international financial architecture, and incorporating climate into export credit policies and overseas investment and financing decisions

First, climate finance negotiations should adhere to the UNFCCC and its *Paris Agreement* frameworks, with developed countries bearing primary responsibility for financing, to advance productive outcomes in NCQG negotiations.

Second, efforts should focus on actively participating in discussions and practices related to the reform of the international financial architecture. This includes clearly defining climate finance with the international community, enhancing the support of multilateral development institutions for climate finance, and emphasizing its integration with poverty alleviation, infrastructure construction, and other related areas.

Third, it is necessary to collaborate with the international community to explore governance models that incorporate multiple funding sources such as aid, philanthropy, and commercialization, enhance fund utilization capabilities and develop feasible and sustainable business models for various energy transition scenarios and climate solutions.

Fourth, it is important to integrate climate into export credit policies and decisions on overseas investment and financing and strengthen climate information disclosure requirements for overseas projects.

Fifth, it is essential to enhance enterprise capabilities to assess climate risks, conduct climate stress tests on the balance sheets of overseas projects, and integrate climate change risks into credit ratings and insurance designs.

Sixth, financial support and transparency for South-South cooperation on climate change should be reinforced. Banks and investment institutions should be encouraged to increase their support for developing countries in climate change and new energy development. Additionally, departmental coordination should be streamlined for effective statistics and disclosure of the information on climate change-related South-South cooperation projects and funds.

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