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China Energy Outlook 2060

2025 Edition

中国石化集团经济技术研究院有限公司
中国石化咨询有限责任公司
编著

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China Energy Outlook 2060 (2025 Edition) Editorial Board

Abstract

Macro-environmentally, the global economy maintains sluggish growth amid persistent inflation risks. Developed economies are intensifying global geopolitical and economic complexities through accelerated deployment of carbon-centric green trade barriers. While China's economy remains fundamentally sound with long-term growth prospects, its current structural adjustment phase coincides with strong short-to-medium term energy demand from both traditional and emerging sectors. The energy transition faces dual pressures: surging non-fossil energy supplies confront absorption bottlenecks while low-carbon technology competition escalates globally, potentially accelerating industrial transformation. This technological rivalry may ultimately clarify optimal decarbonization pathways. To facilitate effective low-carbon competition and energy substitution while advancing carbon neutrality goals, policy frameworks are evolving along three dimensions: regulatory focus shifting from energy consumption to carbon emissions, policy instruments transitioning from direct subsidies to target-based mechanisms, transition drivers moving from government mandates to market forces.

This report outlines three decarbonization pathways - Coordinated Development, Security Challenge, and Green Drive - all targeting China's dual carbon goals (2030 peak, 2060 neutrality). Key projections in the Coordinated Devolopment Scenario:

China's primary energy consumption growth is decelerating amid intensifying competition within the energy sector. In 2024, total energy consumption reached 5.97 Billion tonnes of coal equivalent (Btce), marking a 4.3% year-on-year increase. Notably, non-fossil energy consumption surpassed oil for the first time, rising to 19.7% of the total. Projections indicate sustained growth until 2030, after which consumption will plateau, with non-fossil energy contributing over 80% to incremental demand. From 2035 to 2060, total energy consumption is expected to decline from a peak of 6.94 Btce to 5.95 Btce.

China's coal consumption is approaching a plateau. In 2024, coal use rose to 4.85 billion tonnes but declined to 54% of total energy consumption. This volume is projected to stabilize above 4.8 billion tonnes annually through 2029, while its usage structure shifts rapidly: coal allocated to power generation will increase from 54% to 58%. By 2060, total coal consumption is anticipated to fall below 0.5 billion tonnes.

China's oil consumption is entering a plateau phase. In 2024, total oil use fell to 750 million tonnes , driven by weak industrial demand, slowing fuel-vehicle growth, and rapid substitution by renewables and LNG. During the 14th Five-Year Plan period, oil consumption is projected to stabilize above 770 million tonnes, peaking at 790-800 million tonnes, supported by chemical industry demand. By 2060, it is expected to drop to 260 million tonnes.

Natural gas consumption has rebounded to medium-high growth. In 2024, gas use reached 430 billion cubic meters (Bcm) and is projected to rise by over 110 Bcm during the 14th Five-Year Plan, peaking at 620 Bcm between 2035-2040. Industrial coal-to-gas switching and LNG trucks remain key drivers. By 2060, consumption is forecast to decline to 420 Bcm.

China's renewable energy sector faces absorption challenges despite rapid expansion. In 2024, non-fossil energy supply rose to 1.18 Btce, led by wind and solar. Installed wind/solar capacity hit 1380GW, generating 1800TWh. Short-term growth hinges on rate adjustments, while long-term solutions like green hydrogen, ammonia, and energy storage will address grid integration. Non-fossil energy is projected to reach 3.5 Btce (50% share) by 2045 and 4.7 Btce (80% share) by 2060.

Final energy consumption is transforming rapidly through digitization and electrification. In 2024, final consumption reached 4.26 Btce, with a projected peak above 4.6 Btce by the mid-2020s. Electricity is set to surpass coal as the largest terminal energy source during the 14th Five-Year Plan. Electrification and hydrogen adoption rates will rise from 32% (2024) to 71% (2060).

Energy-related carbon emissions are plateauing. In 2024, CO_2 emissions hit 10.65 billion tonnes (excluding chemical product carbon fixation), with a peak above 10.8 billion tonnes expected by the mid-2020s. Declining coal/oil use and carbon sequestration from industrial feedstocks will drive reductions. By 2060, residual emissions (2.1 billion tonnes) will require CCUS and carbon sinks for neutralization.

Contents

Chapter 1 Macro trends

- **International Economy** The global economy continues to experience slow growth. Coupled with the strengthening of the new green trade barriers, it brings new challenges to China's economic and energy transition

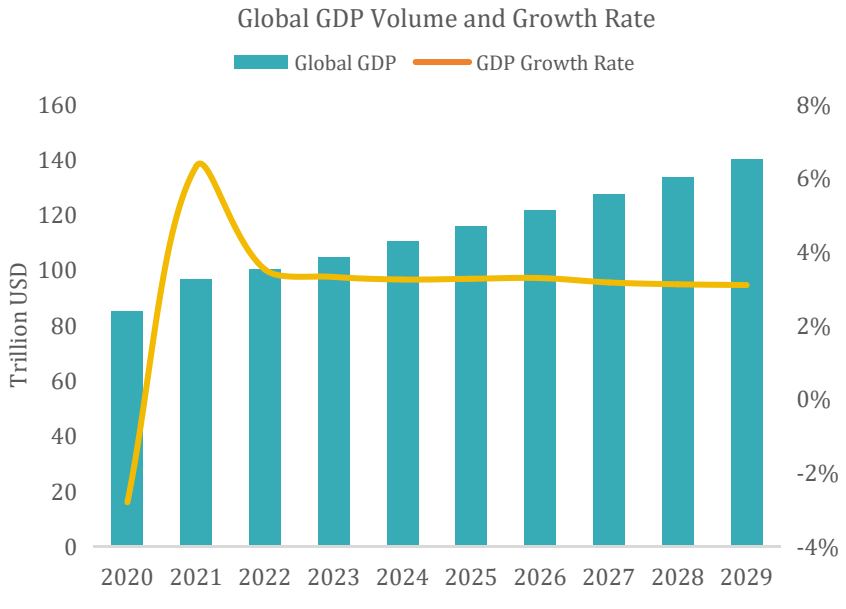
- **Domestic Economy** China's economic and social development has entered a stage of high - quality development. In the near and medium term, the role of energy consumption growth in boosting economic development will remain significant

- **Low - carbon Industry** The competition in technological paths is quietly intensifying, aiming to quickly break through the bottleneck of non - fossil energy absorption and accelerate and empower the deep decarbonization of the energy system

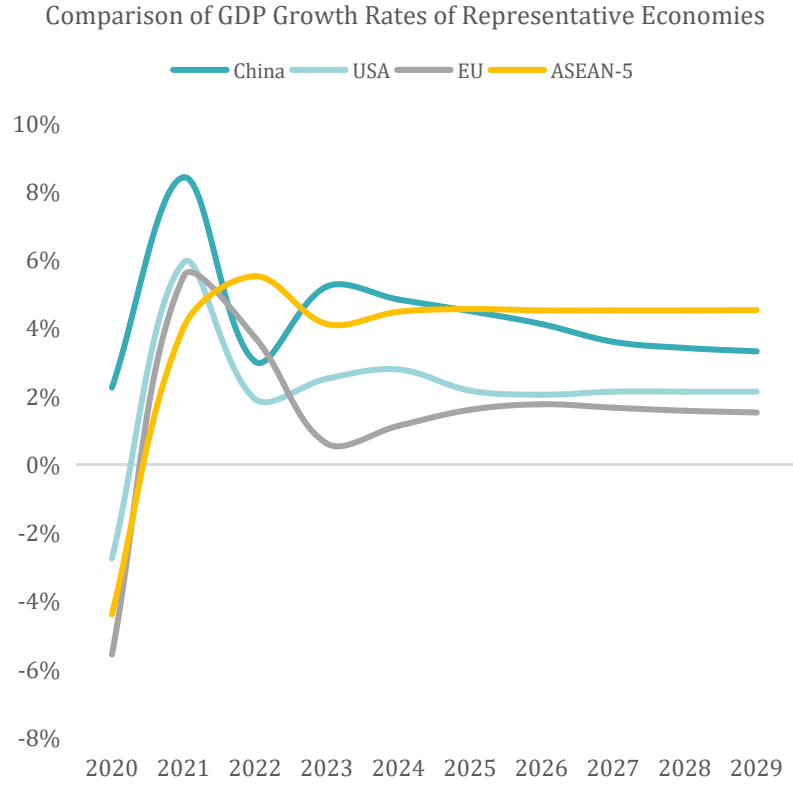
- **Policy Orientation** Actively and steadily promoting carbon peaking and carbon neutrality will present new trends in aspects such as control priorities, policy measures, and transition drivers

- **Transition Scenarios** In the near and medium term, the tensions within the energy trilemma will become more prominent. There are three possible paths for energy transition: Coordinated Development Scenario(CDS), Security Challenge Scenario(SCS), Green - Driven Scenario(GDS)

International Economy The global economy continues to experience slow growth. Coupled with the strengthening of the new green trade barriers, it brings new challenges to China's economic and energy transition



Total GDP	84.9	96.5	100.1	104.5	110.1	115.5	121.3	127.2	133.4	139.6
Growth rate	-2.8%	6.3%	3.5%	3.3%	3.2%	3.2%	3.3%	3.2%	3.1%	3.1%



In the near to medium term, the global economy will continue to exhibit a low - growth trend. Inflation risks remain, and the uncertainty of fiscal and other policies is on the rise. Meanwhile, developed economies are accelerating the buildings of new - type green trade barriers centered around carbon emissions. The energy and environmental policies of the United States under the Trump "New Deal" may face a shift, with trade policies becoming stricter. This will pose new challenges to the development of China's traditional manufacturing industries such as steel, as well as the "new trio", which are the main drivers of export growth. The external political and economic environment is becoming increasingly complex.

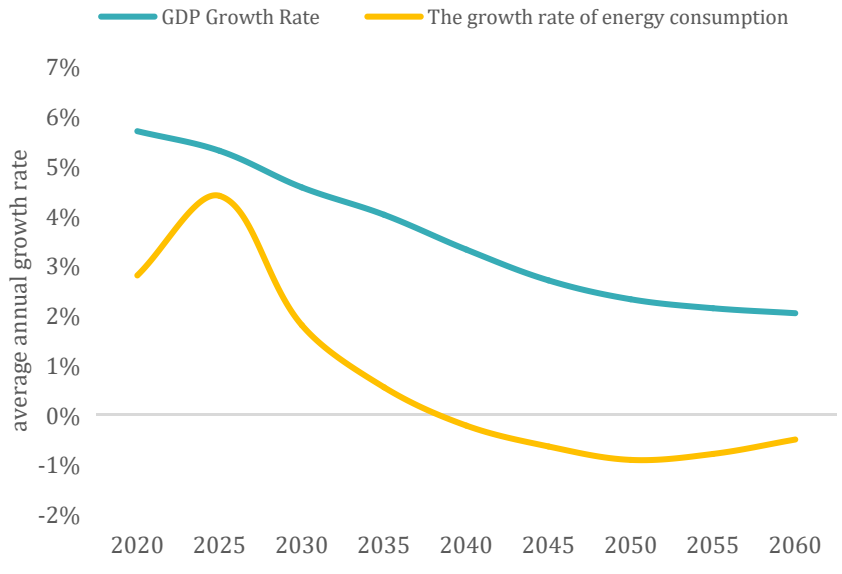
- **The low - growth trend of the global economy will persist. The decline in inflation is slowing down, policy uncertainty is increasing, and the risks in the external development environment are rising.** During the 15th Five - Year Plan period, due to the combined effects of factors such as population aging, a decrease in new employment, and rising geopolitical risks, the potential economic growth rates of major economies will continue to slow down. Developed economies face further challenges in reducing inflation, with increased upward pressure on the US dollar. Emerging and developing economies will also be subject to adverse spill - over effects. As debt rises, economic growth slows, and deficits increase, the debt situations of some countries are not optimistic. The multilateral trading system is under challenge, and policy uncertainty has increased significantly.

- **Developed economies are significantly accelerating the formulation of carbon - trading policies, and carbon - trading barriers pose new challenges.** Developed economies are constructing new - type green trade barriers with carbon emissions at the core to dominate the formulation of a new round of international economic and trade rules. The gradual implementation of policies such as the EU's Carbon Border Adjustment Mechanism, the EU's "New Battery Law", and the US "Inflation Reduction Act" will pose new challenges to the exports of China's traditional manufacturing industries and clean industries such as the "new trio".

- **The energy and environmental policies of the United States under the Trump "New Deal" may face a shift, with trade policies becoming stricter, presenting both opportunities and challenges.** On the one hand, policies that encourage the development of fossil energy, support shale oil and gas exploration, and relax the approval restrictions on LNG export projects will boost the increase in global oil and gas supply, which is beneficial to China's oil and gas import needs. On the other hand, under the concepts of "America First" and "manufacturing reshoring", the United States may adopt more aggressive tariff policies, posing challenges to China's export trade and potentially accelerating the transfer of relevant industrial chains.

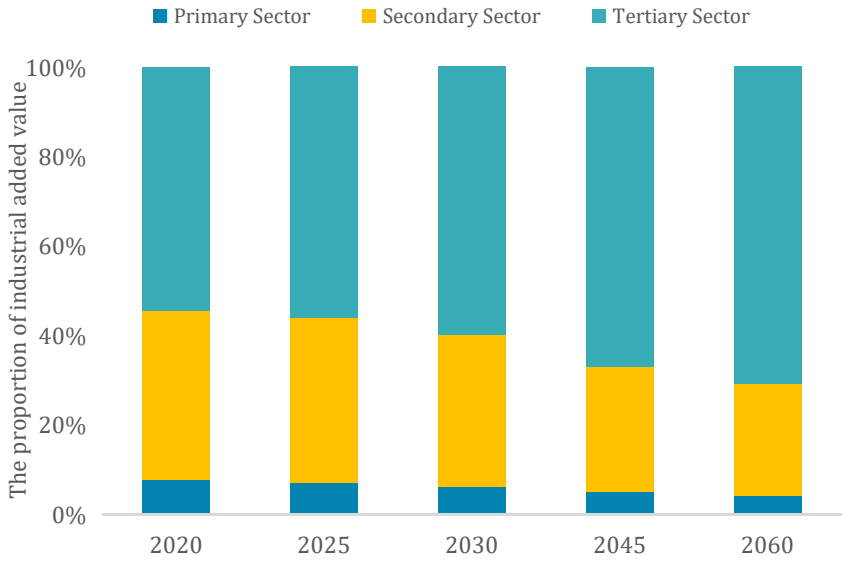
Domestic Economy China's economic and social development has entered a stage of high - quality development. In the near and medium term, the role of energy consumption growth in boosting economic development will remain significant

Perspectives on China's GDP Growth Rate and Energy Consumption Growth Rate



GDP Growth Rate	5.7%	5.3%	4.6%	4.0%	3.3%	2.7%	2.3%	2.1%	2.0%
Energy Consumption Growth Rate	2.8%	4.3%	1.8%	0.6%	-0.2%	-0.6%	-0.9%	-0.8%	-0.5%

The evolutionary trend of China's industrial structure



The share of the secondary sector	39%	37%	34%	28%	25%
The share of the tertiary sector	55%	56%	60%	67%	71%

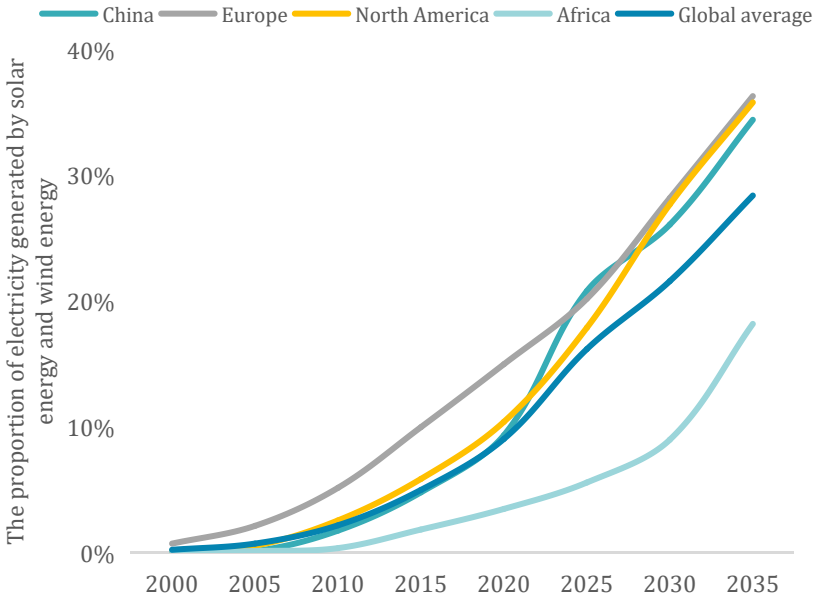
China's economic and social development has entered a stage of high - quality development. Although internal and external uncertainties persist, the long - term positive trend remains unchanged. The shift in the drivers of economic growth, the acceleration of the new - type industrialization process, and the rapid development of new quality productive forces have injected new impetus into the transformation and development of the energy sector.

- **China's economy is at a critical juncture of structural adjustment, transformation, and upgrading, with high - quality development being the key to unlocking the situation.** In terms of the development trend, the fundamentals of China's economic development remain intact. As the effects of existing policies continue to unfold, especially with the introduction and implementation of incremental policies, market expectations have notably improved. The introduction of a raft of incremental policies places greater emphasis on enhancing the quality of economic development, while coordinating high - quality development with high - level security. These policies not only address the prominent contradictions at present but also strive to promote the stable upward movement of the economy, optimize its structure, and sustain a positive development trend. The accelerated advancement of the "two priorities" and "two new initiatives", along with measures like increasing local debt - resolution resources by 10 trillion yuan, have formed a "combination of measures" for debt resolution, reducing the burden on local development and boosting its momentum.

- **Despite the continued existence of internal and external uncertainties, the shift in economic growth drivers and the accelerated development of new - quality productivity mean that the growth rate of energy consumption will rebound slightly in the short term and enter a decelerating and peaking trajectory in the medium - to - long term.** From now until 2030, China will make every effort to achieve high - quality economic development, stable GDP growth, high - level urbanization, and an expansion of the population with higher education. All these require a further expansion of the scale of energy supply and demand. Given the persistent risks of external environmental uncertainties and relatively insufficient effective domestic demand, it is expected that before 2030, China's secondary industry will still need to play a stabilizing role in the overall macro - economy. Its added value will account for approximately 30% of GDP, supporting the total energy consumption. The internal structural adjustment of industries will have a significant impact on the volume and structure of energy consumption. The accelerated development of high - end manufacturing, strategic emerging industries, coupled with the upgraded development of producer services, will contribute to improving energy utilization efficiency in the industry sector. The transformation of the endogenous driving force of economic growth and the accelerated development of new quality productive forces will gradually propel China's economic development into a new stage of high - quality development.

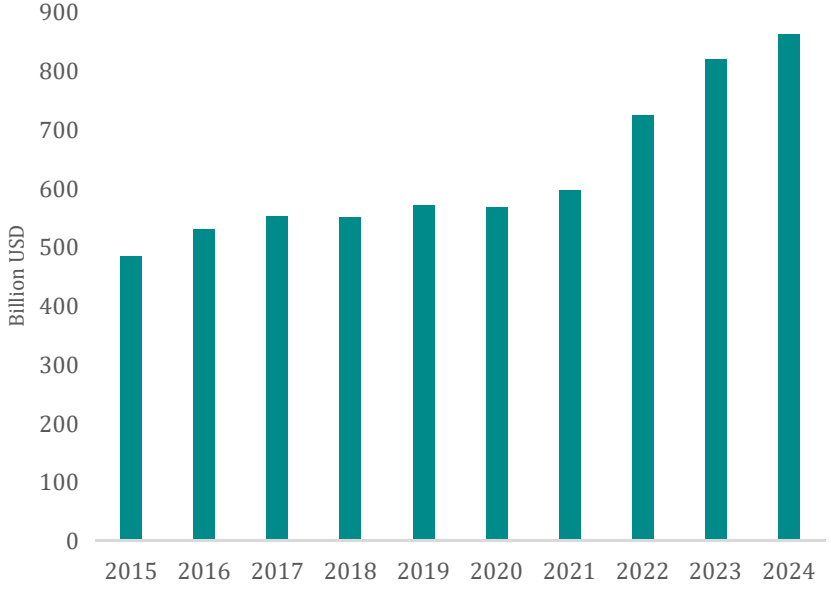
Low - carbon Industry The competition in technological paths is quietly intensifying, aiming to quickly break through the bottleneck of non - fossil energy absorption and accelerate and empower the deep decarbonization of the energy system

The rapid development of renewable energy



Source：2024 Energy Institute Statistical Review of World Energy

Energy investments in China in recent years



Source：IEA World Energy Investment 2024

With the surge in non - fossil energy supply and the bottleneck in its absorption, the debate over China's energy transition path has resurfaced. Correspondingly, the competition in low - carbon technologies is quietly intensifying.

- **China's low - carbon industry started relatively late but has developed rapidly. Achieving a safe, orderly, green, and low - carbon transformation of the energy system faces greater difficulties and challenges.** Take solar and wind power generation as examples. According to statistics from the Energy Institute (EI) in the UK, by the end of 2023, the cumulative installed capacity of wind and photovoltaic power in China reached 1.05TW, accounting for 43% of the global total. The combined power generation of wind and photovoltaic power was 1.47PWh, accounting for 37% of the global total and 16% of China's total power generation. Ten years ago (in 2013), the cumulative installed capacity of wind and photovoltaic power in China was only 90GW, accounting for 21% of the global total. The power generation of wind and photovoltaic power was only 0.15PWh, accounting for 19% of the global total and less than 3% of the national total power generation. To accelerate the solution of the bottleneck in non - fossil energy absorption and development problems, the state has introduced a series of policies and measures.

- **Investment plays an indicative role in the direction of energy transition. China is the economy with the largest scale of energy investment, with the proportion of investment in renewable energy power generation exceeding 40%, approximately twice that of fossil energy**. According to statistics from the International Energy Agency (IEA), in 2024, China's energy investment scale reached as high as $0.86 trillion, accounting for nearly 28% of the global total energy investment, about 1.5 - 2 times that of the United States and the European Union. Compared with 2019, China's investment in the fossil energy field has decreased, while investment in renewable energy power generation, energy efficiency improvement, etc. has increased by about 70%. However, the investment growth in power grids and energy storage is less than 10%, which is not in line with the growth rate of power sources. During the same period, the EU's investment in power grids and energy storage is slightly higher than that in renewable energy power generation. To achieve the goals proposed at the COP28 conference, such as achieving net - zero emissions in the energy sector by 2050, tripling the installed capacity of renewable energy power generation by 2030, and doubling energy efficiency, according to the prediction of the IEA, globally, by 2030, it will be necessary to invest twice as much as in 2023 in renewable energy power generation, power grids, and energy storage. For China, the total investment in energy transition in 2030 will exceed $1 trillion.

Policy Orientation Actively and steadily promoting carbon peaking and carbon neutrality will present new trends in aspects such as control priorities, policy measures, and transition drivers

Target constraint category

- Decision of the CPC Central Committee on Further Comprehensively Deepening Reforms and Advancing Chinese Modernization
- Guidelines on Accelerating the Comprehensive Green Transition of Economic and Social Development
- Work Plan for Accelerating the Development of a Dual-Control System for Carbon Emissions
- 2024–2025 Action Plan for Energy Conservation and Carbon Reduction
- Guidelines on Accelerating the Development of a Waste Recycling System

Regulating competition category

- Measures for the Administration of Natural Gas Utilization
- Notice on Doing a Good Job in the Accommodation of New Energy and Ensuring the High-Quality Development of New Energy
- Guiding Opinions on Vigorously Implementing the Renewable Energy
- Notice on Promoting the Grid Connection and Scheduling Operation of New Energy Storage
- Work Plan for Improving the Carbon Emissions Statistical Accounting System

Subsidy and support category

- Several Measures for Vigorously Supporting Large-Scale Equipment Upgrades and the Trade-in of Consumer Goods for New Ones
- Implementation Plan for Promoting Equipment Upgrades in the Industrial Field
- Implementation Plan for Large-Scale Equipment Upgrades in Key Energy Areas
- Administrative Measures for Special Central Budgetary Investment in Energy Conservation and Carbon Reduction

By reviewing and analyzing recently introduced energy - related policies, we believe that in the coming period, the policy orientation of China's energy transition will, based on a firm commitment to the "dual - carbon" goals, exhibit three new trends.

- **Trend 1: The focus of institutional control shifts from energy consumption to carbon emissions, controlling intensity first and then total quantity.** Currently, China regards the reduction of energy consumption intensity as a binding target for national economic and social development. According to the "Work Plan for Accelerating the Establishment of a Dual - Control System for Carbon Emissions", starting from the 15th Five - Year Plan period, China will implement a dual - control system for carbon emissions that mainly focuses on intensity control and supplemented by total amount control. After carbon peaking, a dual - control system for carbon emissions that mainly focuses on total amount control and supplemented by intensity control will be implemented. This policy shift will directly guide the green and low - carbon transformation of energy use in various fields and industries, accelerate the substitution of non - fossil energy consumption and the peaking and phasing - out of fossil energy, promote the "diversification" of energy consumption and carbon emissions, and support high - quality economic and social development with clean energy services.
- **Trend 2: Policy measures will focus on target constraints, encourage market competition, and weaken direct subsidies.** With the rapid increase in the proportion of new energy in the energy system, problems such as stable energy supply, time - space scheduling, and full absorption have continuously emerged. Currently, it seems that any low - carbon transformation plan has more or less issues regarding reliability or economy. With the change in policy measures, it is expected that the goals for promoting transformation in various fields and industries will be clearer and the constraints more powerful. At the same time, there will be greater freedom in choosing the specific paths for implementing the transformation. The path and direction of China's deep energy transition will gradually become clearer in this market competition.
- **Trend 3: The systematicness and synergy of policies will be enhanced again, and the driving force for energy transition will shift from policy - led to industry - driven.** With the large - scale and market - oriented development of the new energy industry on the supply side and the implementation of large - scale equipment renewal on the demand side, China's energy transition will be more closely integrated with industrial upgrading and economic growth, providing a more robust internal driving force from the industry for green and low - carbon transformation and development.

Transition Scenarios In the near and medium term, the tensions within the energy trilemma will become more prominent. There are three possible paths for energy transition: Coordinated Development Scenario(CDS), Security Challenge Scenario(SCS), Green - Driven Scenario(GDS)

Schematic Diagram of the Energy Balance Triangle

Safe and stable

Certainty: By 2035, socialist modernization will be basically achieved, and there will be a rigid growth in energy demand.
Uncertainty: The abundance of various energy resources, as well as the stability of the operation of the energy system.

Green and low-carbon

Certainty: China will achieve the "dual carbon" goals as scheduled by constructing a new type of energy system.
Uncertainty: The reliability and economic efficiency of various low-carbon technologies, as well as the implementation path of energy transition.

Economical and efficient

Certainty: The energy transition will not deviate from the economic reality, and the transition costs will be borne fairly and reasonably.
Uncertainty: The direction of industrial structure adjustment, as well as the situation of industrial transfer and spatial layout.

In the past few years, China's low-carbon industry has developed rapidly, the supply and demand of clean energy have showed a cooperative increase, and historic achievements have been made in energy transition. The critical moments of reaching carbon peak and energy consumption peak will come one after another. In the process of the continuous transformation between the new and old energy systems, the balance of the energy trilemma is facing increasingly severe challenges. First, the connotation of energy security is being expanded, and the operational safety of the energy system, especially the power system, has attracted much attention. Second, there are multiple possible paths to achieve the green and low-carbon goals, but they are not perfect in terms of reliability, economy, etc. Third, the energy utilization cost increases with the increase of processing and conversion links and the rise of storage and dispatching requirements. How to bear the energy transition cost fairly and reasonably in the whole society is becoming a major issue.

To maintain the dynamic balance of the energy trilemma and achieve the high-quality economic and social development goals and the "dual-carbon" goals, we believe that there are the following three scenarios for China's energy transition environment and paths.

- **Coordinated Development Scenario**

The global landscape maintains fundamental stability with orderly restructuring of industrial chains, while localized geopolitical incidents exert manageable impacts on bulk commodity trade. China's economy continues its high-quality development trajectory, accelerating the establishment of modern industrial frameworks. Natural gas emerges as a critical bridge fuel during this transition phase. Crucially, projections indicate that green hydrogen solutions, advanced energy storage systems, and CCUS technologies will achieve cost parity by the mid-2030s, ensuring the timely realization of all decarbonization objectives.

- **Security Challenge Scenario**

Amid sustained geopolitical tensions and deepening divisions, the global economic recovery faces persistent headwinds. Domestic pressures intensify in stabilizing economic expectations, sustaining growth, and maintaining employment. Challenges in electrification infrastructure and non-fossil energy integration exacerbate delays in peaking coal consumption and prolong fossil fuel phase-outs.

- **Green-Driven Scenario**

Against a backdrop of relative international stability and heightened global climate governance coordination, China accelerates the cultivation of new quality productive forces. This momentum drives simultaneous advancement in emerging sector development and traditional industry modernization, with breakthroughs in green technology R&D and commercialization gaining momentum.

Chapter 2 Overall Outlook

- **Primary energy** China's total energy consumption peak will be delayed and increased under the combined effect of “strong inertia” and “new momentum”

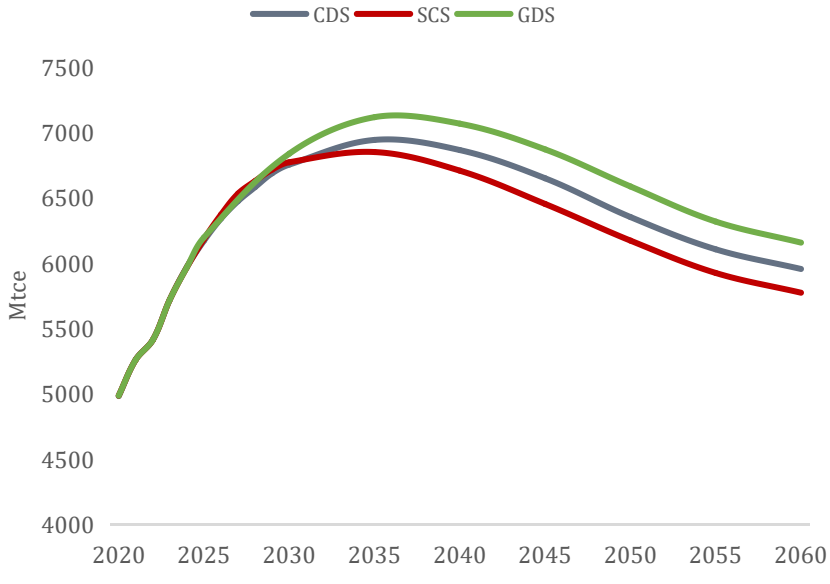
- **Final energy** China's total final energy consumption will enter a platform period in the middle and late 15th Five-Year Plan, and the contribution of power consumption growth in the peak phase is expected to be close to 100%

- **Transition path** China's energy transition is about to transition from incremental sharing to stock competition, and consumption bottlenecks have become the main reason affecting the transition path in the near to medium term

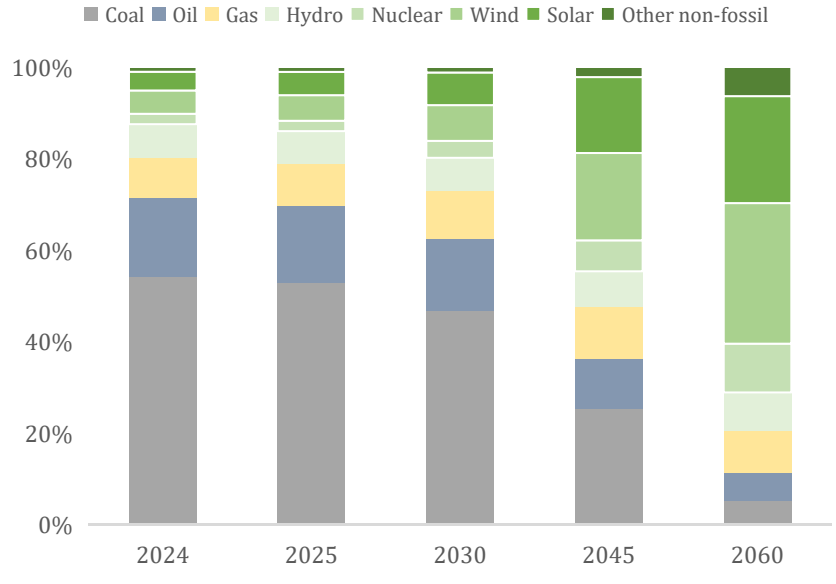
- **Carbon emissions** China's carbon emissions related to energy activities are entering a plateau period, with a high probability of realizing the carbon peak target in the mid-to-late 15th Five-Year Plan period

Primary energy China's total energy consumption peak will be delayed and increased under the combined effect of "strong inertia" and "new momentum"

China's Primary Energy Consumption Forecast



Primary Energy Consumption Mix（CDS）



SCS	4980	6183	6771	6849	6706	6451	6171	5923	5772
CDS	4983	6187	6775	6938	6861	6651	6356	6111	5963
GDS	4983	6195	6836	7116	7066	6869	6585	6316	6155

Non-fossil	20%	21%	27%	52%	80%
Coal	54%	53%	47%	25%	5%

In 2024, China's total primary energy consumption will reach 5.97 Btce, a year-on-year increase of 4.3%; the proportion of non-fossil energy consumption will exceed that of oil for the first time, increasing to 19.7%. Compared with the previous version of the Compared with the previous version of the forecast, China's energy consumption will peak later and at a higher level.

- **The growth rate of China's total energy consumption is characterized by a "3-4-2-1" phase**

"3" During the 13th Five-Year Plan period, benefit form the rapid optimization of industrial structure and energy structure, the average annual growth rate of China's primary energy consumption dropped to less than 3%.

"4" During the 14th Five-Year Plan period, on the one hand, affected by the economic cycle and transition stage, the energy consumption intensity of traditional industries rebounded; on the other hand, the new productivity created new momentum for economic growth and energy consumption, which made China's average annual growth rate of energy consumption rebound to more than 4%.

"2" During the 15th Five-Year Plan period, it is expected that the growth in energy demand driven by new kinetic energy will be faster than the suppression of energy use brought about by the transition of traditional industries, and the total energy consumption will keep growing, but the growth rate is expected to fall back to around 2%.

"1" During the 16th Five-Year Plan period, China will enter a platform period of peak energy consumption with an average annual growth rate of less than 1%. In the CDS, total primary energy consumption is expected to increase to a peak of around 6.94 Btce in 2035, when the proportion of non-fossil energy reaches 35.6%, close to that of coal (39.4%).

- **Looking ahead, the decline in the total amount of primary energy and the structural evolution of China's primary energy will be mainly influenced by the substitution of electric hydrogenation and the structural transition of power generation.**

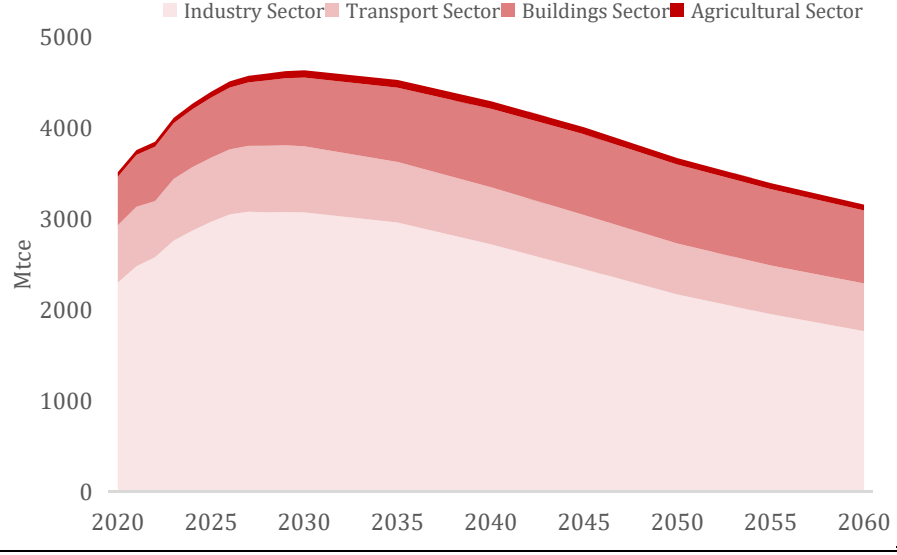
From 2035 to 2060, the share of energy used for electricity generation in China's primary energy consumption will increase from about 60% to more than 80%. In the CDS, electricity will become the top end-use energy variety in China by 2030, the share of renewable energy generation will exceed 50% by 2040, and the share of non-fossil energy consumption will increase to 50% by 2045. China's total primary energy consumption will decline relatively rapidly from 2045 onwards, to 5.95 Btce by 2060, a 14 per cent decline from the peak level.

- **Throughout the outlook period, China's energy intensity continues to decline and per capita energy consumption maintains its growth**

By 2060, energy intensity will be reduced to 1/3 of the current level, and per capita energy consumption will increase by 25% from the current level (excluding energy use as feedstocks and non-fossil energy consumption).

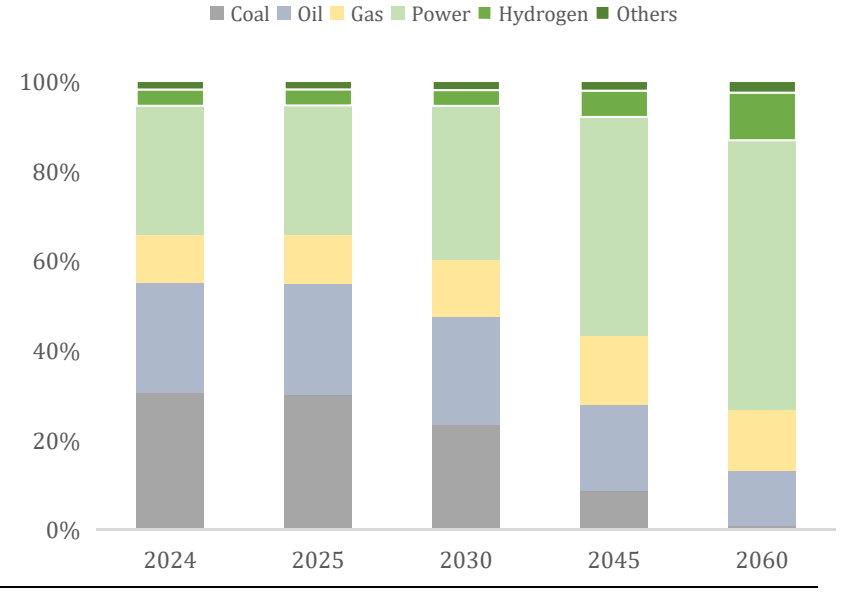
Final energy China's total final energy consumption will enter a platform period in the middle and late 15th Five-Year Plan, and the contribution of power consumption growth in the peak phase is expected to be close to 100%

China's Final Energy Consumption Forecast（CDS）



	2020	2025	2030	2035	2040	2045	2050	2055	2060
Total	3504	4389	4602	4515	4284	3997	3658	3384	3148
Industry Sector	2291	2961	3040	2948	2711	2439	2160	1944	1758
Transport Sector	629	704	726	666	627	594	560	535	524

Final Energy Consumption Mix（CDS）

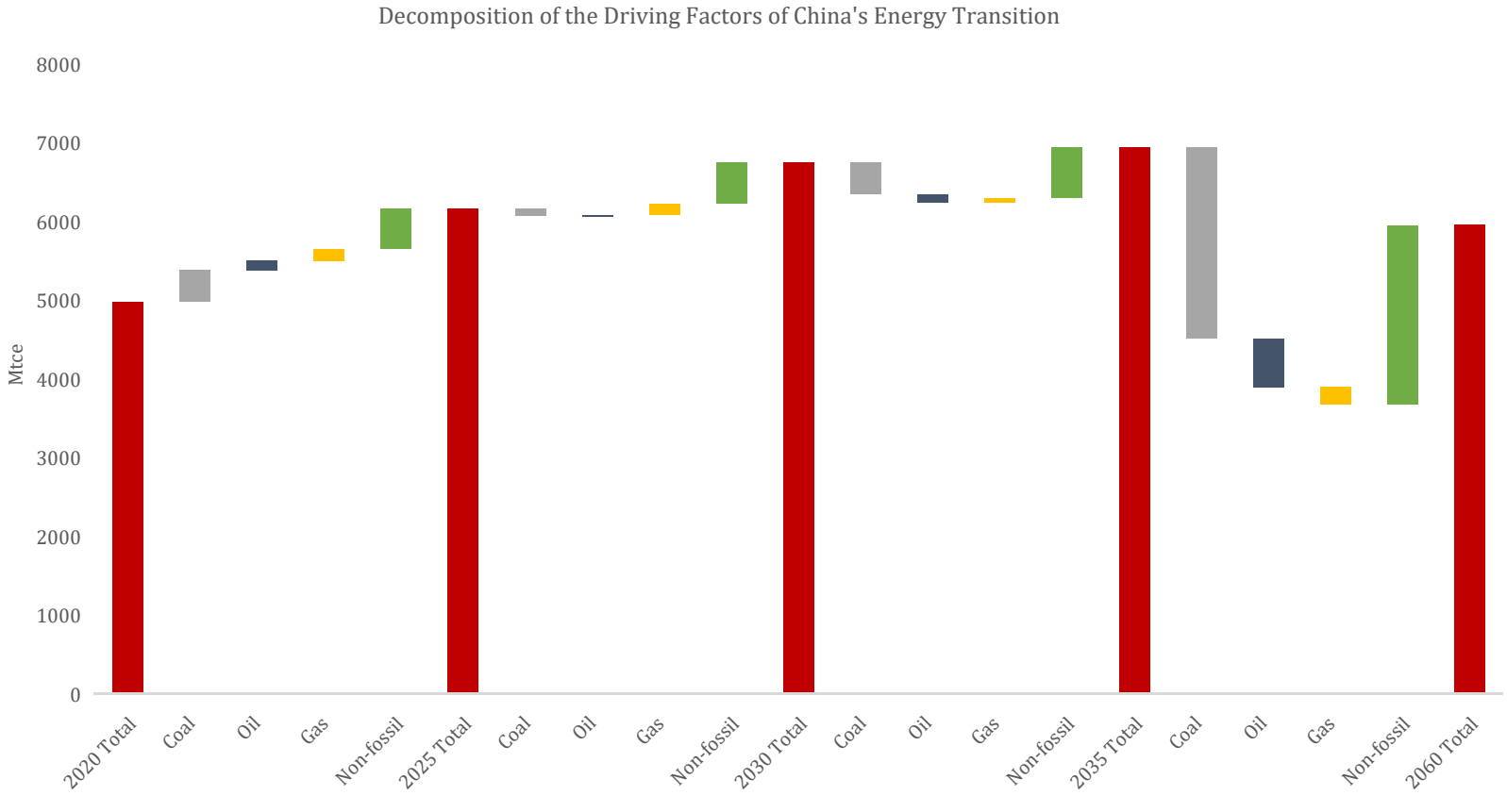


	2024	2025	2030	2045	2060
Gas	11%	11%	12%	15%	14%
Power	28%	29%	34%	49%	60%
Hydrogen	3%	3%	3%	6%	10%

In 2024, China's total final energy consumption will be 4.26 Btce, a year-on-year increase of 3.8%, with the electrification rate rising to 28.5%. It is expected that China's total final energy consumption will enter a platform period in the middle of the 15th Five-Year Plan, and peak around 2030, with a peak of over 4.6 Btce, and the contribution of electricity to the growth of total final energy consumption during the peak phase will be as high as 99.5%. By 2060, it is expected that China's total final energy consumption will drop to 3.15 Btce, by which time China's electrification rate will have reached 60 per cent and the rate of electric-hydrogenation will have reached 71 percent.

- **Electricity consumption is expected to overtake coal during the 15th Five-Year Plan period, becoming the largest final energy source and the primary driver of total final energy consumption growth and peaking.** In the CDS, with the combined effect of stock substitution and incremental stimulus, China's social electricity consumption will grow at an average annual rate of 4.7% from now to 2030. It is expected that China's social electricity consumption will reach 10.4, 13.0 and 15.0 PWh in 2025, 2030 and 2035, respectively, by the beginning of the 15th Five-Year Plan period, electricity will become the first end of the first major energy varieties, accounting for an increase to 30%, to 2030, the proportion of electricity consumption will be further increased to 34%.
- **Under the coordinated China's final fossil energy consumption will peak in the middle of the 15th Five-Year Plan ahead of its total final energy consumption, and its share will fall to 50 percent around 2040.** China's total end-use coal, oil and natural gas direct utilization will reach 2.81 Btce in 2024, accounting for 66% of the total, and is expected to increase by about 100 Mtce, reaching its peak around 2027, with its share dropping to about 64%. By 2040, China's end-use natural gas consumption peaks at 15%, when total end-use fossil energy consumption falls to 2.1 Btce, or a combined share of 50%. By 2060, total final fossil energy consumption is projected to fall to 800 Mtce, with a combined share of 27%, of which natural gas consumption accounts for more than 50%.
- **There is a tension between the "low-carbon" and "cost-effective" dimensions of energy transition.** China's per capita final energy consumption will reach 3.0 tce in 2024, and is expected to peak at around 3.3 tce around 2035, before falling to around 2.8 tce in 2060. However, as mentioned earlier, China's per capita primary energy consumption remains on the rise throughout the outlook period. The main reason for this is that, with the deepening of the electric-hydrocarbon transition, the scale and share of end-use non-fossil energy consumption will grow rapidly after 2030, making the tension between the green and low-carbon effects of the energy transition and the efficiency of processing and conversion even more pronounced.

Transition path China's energy transition is about to transition from incremental sharing to stock competition, and consumption bottlenecks have become the main reason affecting the transition path in the near to medium term



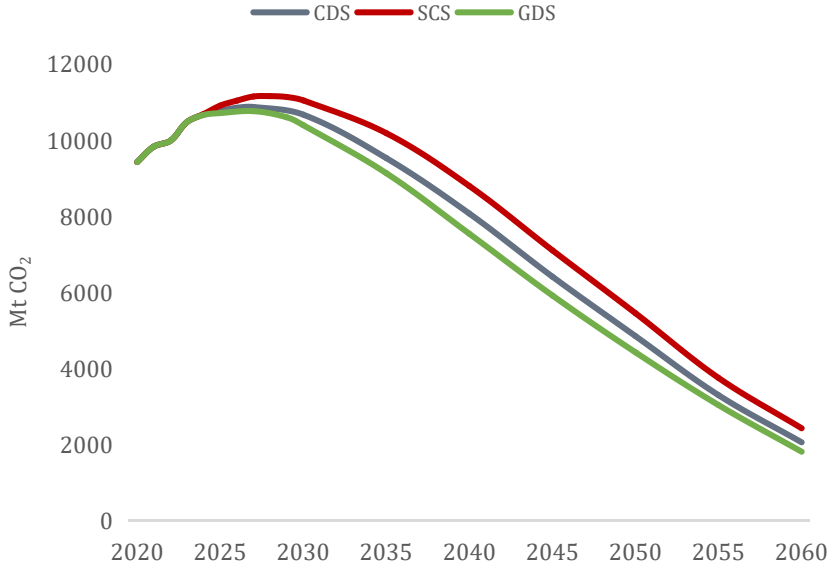
As the growth rate of total energy consumption slows down and narrows, China's energy transition will transition from incremental sharing to stock competition. In the near to medium term, due to the technical and economic limitations of the large-scale consumption of solar energy, wind energy and other clean energy, in the CDS, it is expected that the average annual growth rate of China's non-fossil energy consumption will be reduced from 10% during the 14th Five-Year Plan period to 7% during the 15th Five-Year Plan period.

- **Coal and oil consumption will peak and "be abolished" during the 15th Five-Year Plan period.** From the consumption ratio, China's share of coal and oil in the total primary energy consumption has been in a declining range. From the consumption scale, by the iron and steel, building materials and other traditional manufacturing industries to accelerate the decline in coal consumption and power generation coal consumption to maintain the growth of the superposition of the impact of China's total coal consumption will be in the 14th Five-Year Plan at the end of the period to enter the peak platform, and the 15th Five-Year Plan period to begin to decline throughout the 15th Five-Year Plan period;the over-expected penetration of new-energy vehicles will make China's transport oil peak in 2024, followed by a relatively rapid decline, and it is expected that China's total oil consumption will continue to grow until the middle of the 15th Five-Year Plan period.

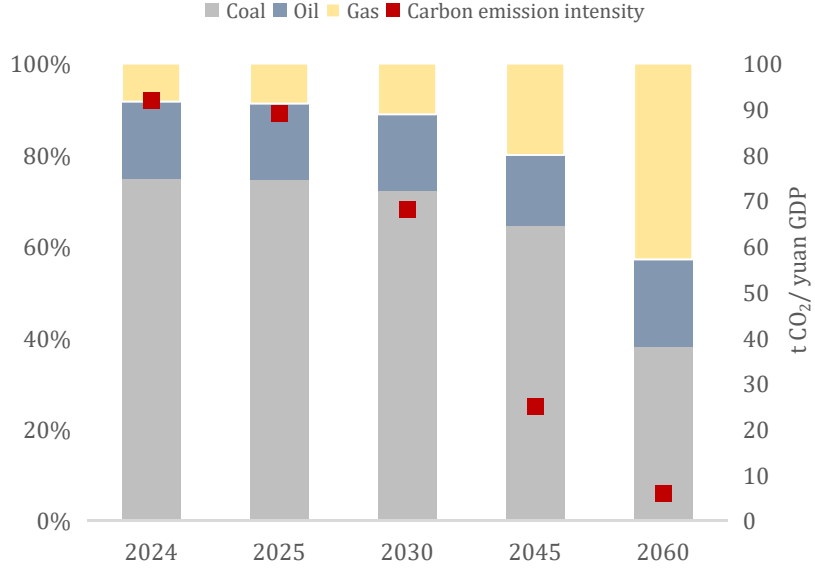
- **To achieve large-scale integration of solar, wind, natural gas and other clean energy sources, addressing consumption challenges has become crucial.** China's wind and photovoltaic power generation reached 1810 TWh in 2024, representing a 2.5-fold increase from 2020. Their share in total power generation climbed to 17.9%, marking an 8.5 percentage point growth over 2020 levels. However, the rapid expansion of intermittent renewable energy has intensified grid stability concerns and consumption bottlenecks. Industry projections indicate that the growth rates of grid-connected wind/PV capacity and power generation will progressively moderate in the near-to-medium term, potentially slowing the expansion pace of non-fossil energy consumption. During China's energy demand peak phase (2024-2035), non-fossil energy consumption is expected to grow by 1.3 Btce, exceeding 100% growth. This would contribute 130% to total energy consumption growth, primarily through meeting incremental electricity demand and displacing existing high-carbon power sources. As a transitional "bridge fuel", natural gas demonstrates significant potential. Key development areas include industrial coal substitution, transportation oil replacement, and gas-fired power generation. Nevertheless, challenges persist in cost competitiveness (particularly gas pricing economics) and supply security. Forecasts suggest natural gas consumption will surge from 430 Bcm to 606 Bcm during 2024-2035, contributing 24% to overall energy consumption growth.

Carbon emissions China's carbon emissions related to energy activities are entering a plateau period, with a high probability of realizing the carbon peak target in the mid-to-late 15th Five-Year Plan period

Forecast of Carbon Emissions Related to Energy Activities



Carbon Emission Mix（CDS）



SCS	9414	10900	11030	10170	8780	7100	5440	3740	2420
CDS	9414	10763	10673	9541	8060	6403	4843	3292	2056
GDS	9414	10700	10380	9120	7530	5910	4420	3030	1810

CO_2 intensity	0.85	0.82	0.64	0.24	0.06

In 2024, China's total carbon dioxide emissions related to energy activities amount to 10.65 billion tonnes (excluding the portion of carbon sequestered in chemical products), and are entering a plateau period. In the three major scenarios, it is expected that China will be able to achieve the carbon peaking target by 2030, with carbon emissions peaking at 10.8 billion to 11.2 billion tonnes. By 2060, in all three scenarios, China will need to retain a certain amount of fossil energy consumption demand, which will generate 1.8-2.4 billion tonnes of CO_2 emissions related to energy activities, and will need to use CCUS, ecological carbon sinks, and other measures to achieve the carbon neutrality target. The development of carbon emissions from energy activities in China can be divided into three stages.

- **Peak carbon emissions (current-2030)**

The peak point, peak level and duration of China's energy-related carbon emissions are mainly related to the transition of coal consumption, which contributes 75% of China's carbon emissions, and which is mainly influenced by the growth trend of electric coal and the prospect of industrial coal reduction. In the CDS, it is expected that China's total carbon emissions related to energy activities will peak in the mid- to late-15th Five-Year Plan period at about 10.9 billion tonnes, with a peak plateau period of 3-5 years. In the SCS, China's coal-fired power generation will continue to grow until 2035, delaying the peak of total carbon emissions from energy activities until the latter part of the 15th Five-Year Plan, with a peak close to 11.2 billion tonnes.

- **Dual-driven carbon reduction period (2031-2035)**

Declining fossil energy consumption is the primary factor contributing to the reduction of carbon emissions associated with energy activities, and in the CDS, the decline in China's coal and oil consumption during this period will reduce carbon dioxide input by a total of 1.2 billion tonnes. At the same time, the growth in energy use of chemical feedstocks increases the carbon sequestration effect of products, which also plays a positive role in driving down the carbon emissions associated with China's energy activities, and in the CDS, the amount of carbon sequestered in China's chemical products will continue to grow until 2035, peaking at more than 900 million tonnes.

- **Comprehensive and accelerated decarbonization period (2036-2060)**

In the CDS, the development and change of China's carbon emissions related to energy activities in this period present three major features: first, the total amount of accelerated decline, due to the accelerated decline in the consumption of fossil energy, the average annual rate of decline of China's carbon emissions related to energy activities has increased from 3% to 9%. Second, the intensity of accelerated decline, the average annual rate of decline has increased from 6% to 11%, implying the accelerated "differentiation" of economic growth and carbon emissions. Third, the rate of carbon sequestration is increasing, with the rate of chemical sequestration expected to increase from 8.7% to 17.7% due to the increasing feedstock attributes of fossil energy sources.

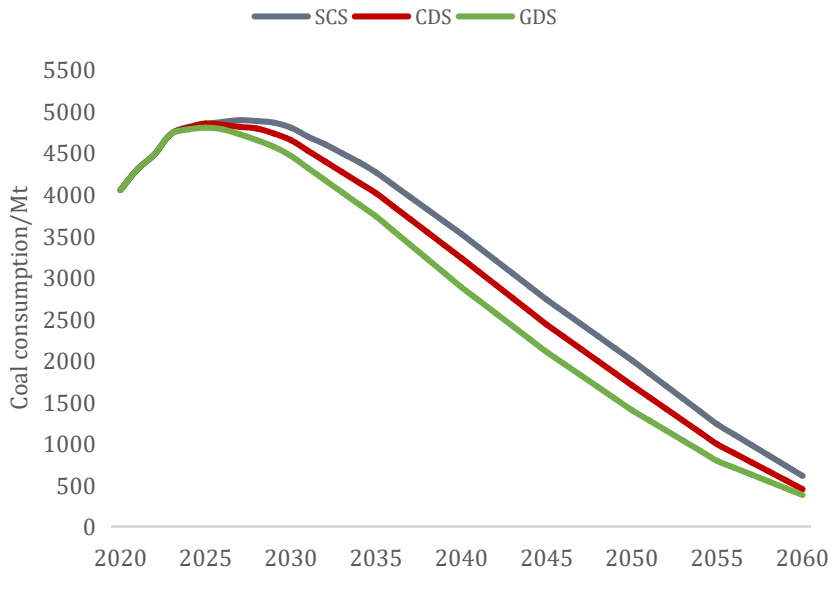
Chapter 3 Coal

- The total consumption of coal will enter a plateau period by the end of the 14th Five-Year Plan, and the consumption structure is accelerating adjustment

- The peak scale and the duration of the plateau period of China's coal consumption are directly influenced by the development trend of coal-fired power

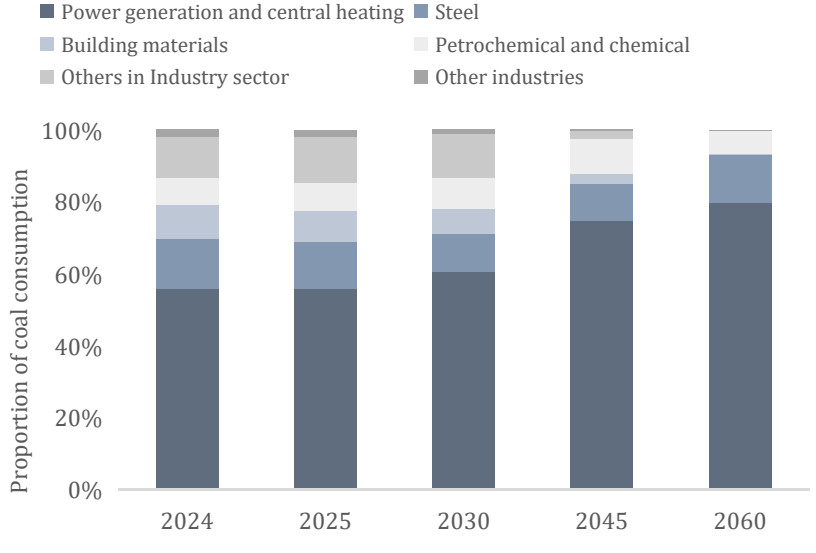
The total consumption of coal will enter a plateau period by the end of the 14th Five-Year Plan, and the consumption structure is accelerating adjustment

Coal Consumption Forecast



SCS	4049	4860	4800	4260	3520	2730	2000	1230	610
CDS	4049	4852	4711	4058	3246	2442	1707	988	450
GDS	4049	4800	4460	3730	2880	2100	1400	790	380

Consumption Mix of Coal by Industry（CDS）



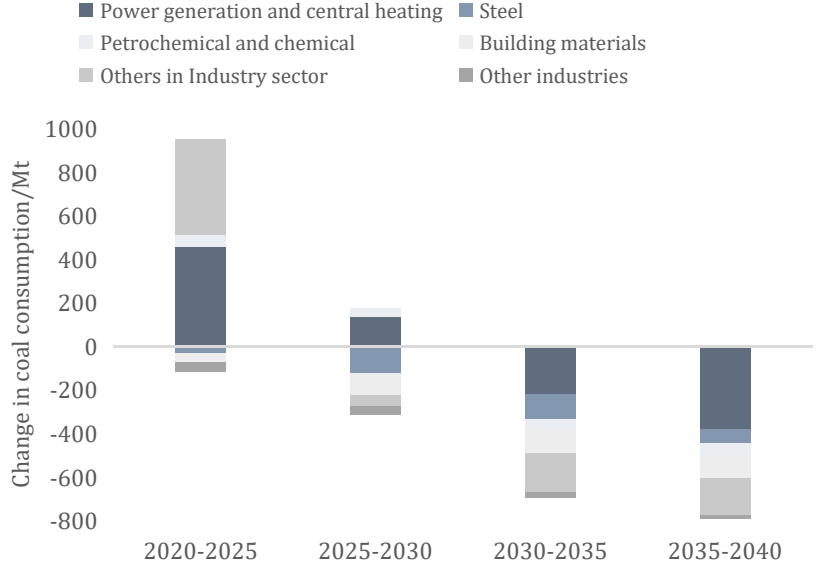
Power Generation	54%	54%	59%	73%	85%
Industry	42%	42%	37%	25%	14%

The transformation of coal consumption is the key to achieving China's "dual carbon" goals. Currently, there are three "difficulties" regarding coal in the buildings of China's new energy system. That is, it is difficult to change China's energy structure which is dominated by coal in the short term; it is difficult to replace the role of coal as the "ballast stone" and "stabilizer" in ensuring energy security; and it is difficult to change the transitional and backup responsibilities of coal. As the energy consumption structure undergoes a steady transformation, coal will gradually change from being the main energy source to an energy source for ensuring supply and providing support. Power generation, steel, building materials, and the chemical industry will remain the main sectors of coal consumption for a long time.

- **Coal consumption will evolve through three distinct phases: peak-plateau stabilization, accelerated reduction, and strategic reserve transition during the forecast horizon.** In the CDS, the period from now until 2030 will be the peak and plateau period. After coal consumption reaches its peak, it will decline slowly at an average annual rate of 0.8%. The period from 2031 to 2050 will be the period of rapid decline, with the average annual decline rate of consumption reaching 5% and the average annual reduction amount being approximately 150 million tonnes. The period from 2051 to 2060 will be the period of significant reduction, during which coal will only maintain the bottom-line demand.
- **During the Plateau Phase (2023-2030), coal maintains its position as China's primary energy anchor, serving as a critical ballast for grid stability while transitioning toward cleaner alternatives.** Coal used for power generation is the main growth point of coal consumption, accounting for over 50% of the proportion of coal consumption and continuing to increase. Coal used for power generation and the chemical industry drives a slight increase in coal consumption in the early stage. After reaching the peak, it will decline slowly. By 2030, the total coal consumption proportion in primary energy consumption will fall to 46.3%.
- **During the period of rapid decline (2031-2050), coal will transform from being the dominant energy source into a supportive energy source.** The coal used for power generation will decline rapidly. Natural gas and hydrogen energy will accelerate the replacement of coal used in industry. Coal is transforming from its role as a fuel to that of feedstocks, and its characteristic as a raw material is becoming more and more prominent. Coal consumption will decline rapidly, and its proportion in the energy consumption structure will decrease significantly. By 2040, the proportion of non-fossil energy consumption will exceed that of coal.
- **During the period of significant reduction (2051-2060), coal will be transformed to a supplementary energy.** The proportion of non-fossil energy will reach 80%. Coal will play a greater role in power peaking and providing a bottom-line guarantee for energy security. Its proportion will drop to 5.2%.

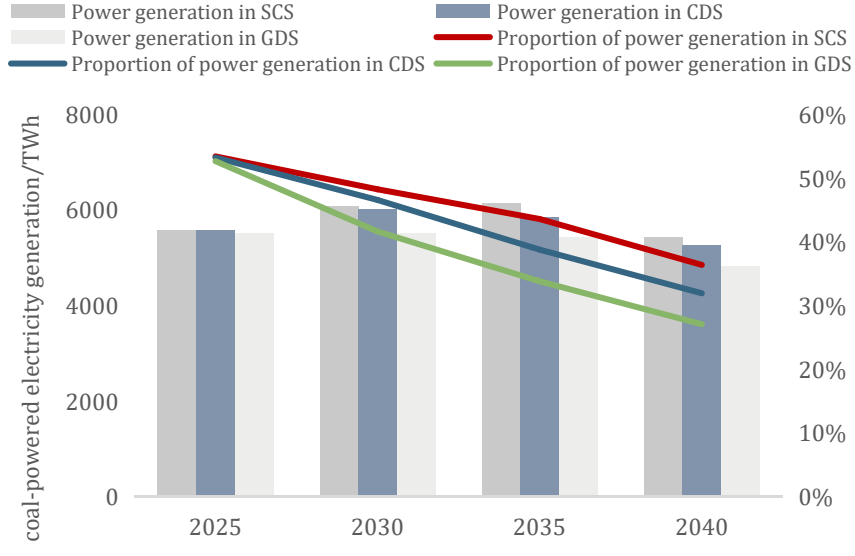
The peak scale and the duration of the plateau period of China's coal consumption are directly influenced by the development trend of coal-fired power

Forecast of Coal Demand Changes by Industry（CDS）



	2020-2025	2025-2030	2030-2035	2035-2040
Power Generation	458.1	133.2	-220.1	-383.2
Industry	420.0	-235.5	-452.0	-394.0

Forecast of the Scale and Proportion of Coal - fired Power Generation



	2025	2030	2035	2040
Electricity generation（CDS）	5551	6044	5846	5254
Proportion of electricity generation	52%	46%	39%	32%

In recent years, the new energy power generation in China has witnessed rapid growth. To ensure the security and stability of the power system, it is urgently necessary for coal-fired power to play a better role in providing support and regulation.

- **The duration of the peak and plateau periods of coal consumption mainly depends on the relationship between the increase in coal used for power generation and the decrease in coal used in other industries.** In the industry sector, it is expected that coal consumption will start to decline during the 15th Five-Year Plan period. It is expected that during the 15th Five-Year Plan period, industrial coal consumption will be reduced by more than 235 million tonnes, which will restrain the growth of the total amount of coal. In the power sector, national policies have clearly defined the functional positioning of coal-fired power as a basic guarantee and a power source for system regulation. If "energy storage + new energy" is insufficient to support the power demand of the entire energy system safely and reliably, coal-fired power will continue to grow, pushing up the peak of coal consumption and extending the duration of the plateau period. Conversely, coal used for power generation will decline steadily while maintaining a certain level, the time for coal to reach its peak will be relatively advanced, and the duration of the plateau period will be relatively shortened.
- **In the near to medium term, the growth of installed capacity of coal-fired power plants, the flexibility modification of units, and the increase in the power generation volume of coal-fired power will continue to drive the growth of coal used for power generation.** Wind and photovoltaic power are projected to constitute 27% of electricity generation by 2030, yet their limited capacity cannot meet rapidly growing energy demand. To ensure stable supply, coal power installations and output will continue expanding through the 15th Five-Year Plan period. Concurrently, coal power's role is transitioning from baseload provision to flexible regulation, with its utilization hours declining steadily. Its share in total generation is expected to drop below 50% by 2030, marking a pivotal phase in China's power mix restructuring..
- **In the long term, the installed capacity of coal-fired power will gradually decline later than its power generation volume, and coal-fired power will complete its transformation into a regulating power source.** Driven by rapid renewable energy capacity growth and expanding energy storage deployment, non-fossil power generation is projected to surpass coal-fired electricity around 2030, becoming the primary power source. By the outlook period's conclusion, coal power will transition into a "base guarantee + grid regulation" resource, providing emergency backup and peaking support, thereby serving as critical infrastructure for the new power system.

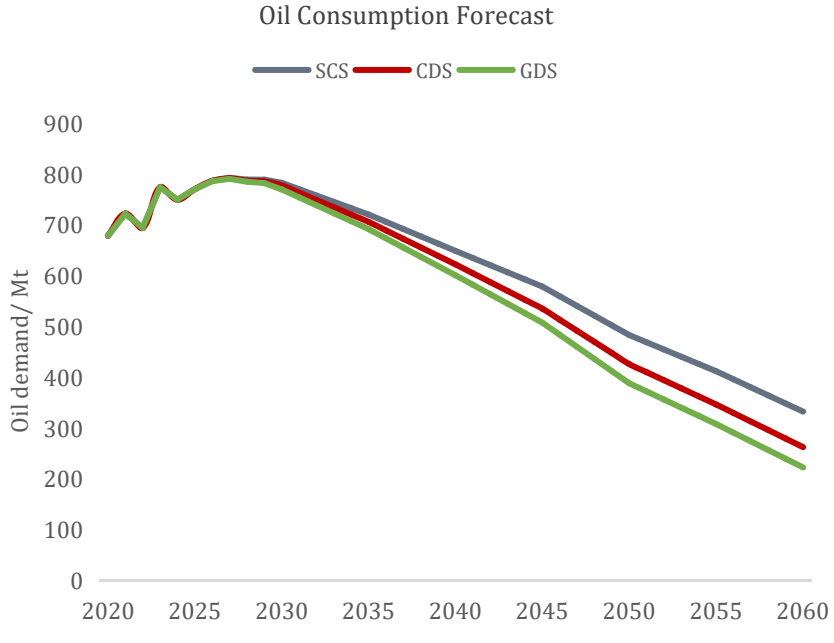
Chapter 4 Oil

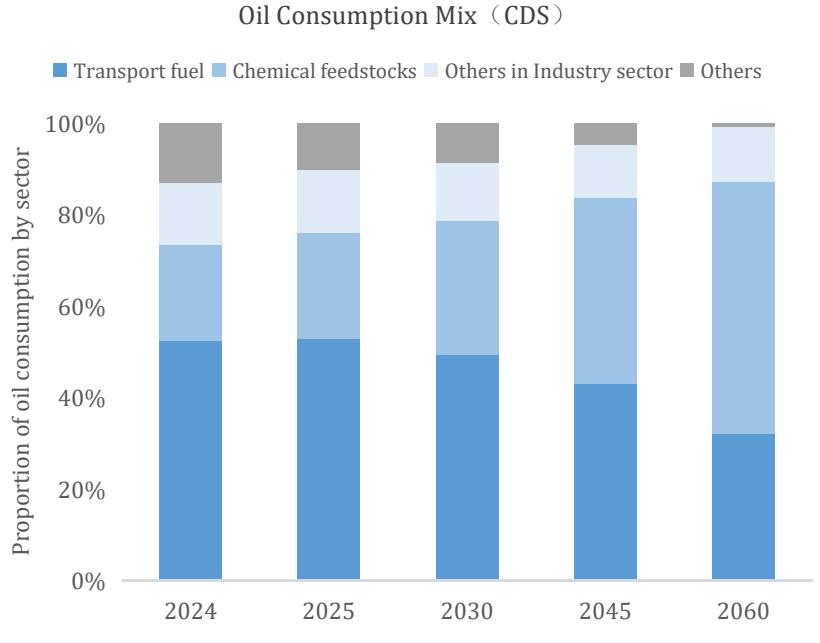
- The characteristics of the plateau period for China's oil consumption are becoming increasingly evident, and it is expected to reach its peak around 2027

- China's automobile industry has entered the late stage of growth, and new energy vehicles have begun to replace the existing stock of fuel vehicles

- This super expansion cycle of the chemical industry is still continuing, and the structural surplus in the petrochemical industry has become even more prominent

The characteristics of the plateau period for China's oil consumption are becoming increasingly evident, and it is expected to reach its peak around 2027





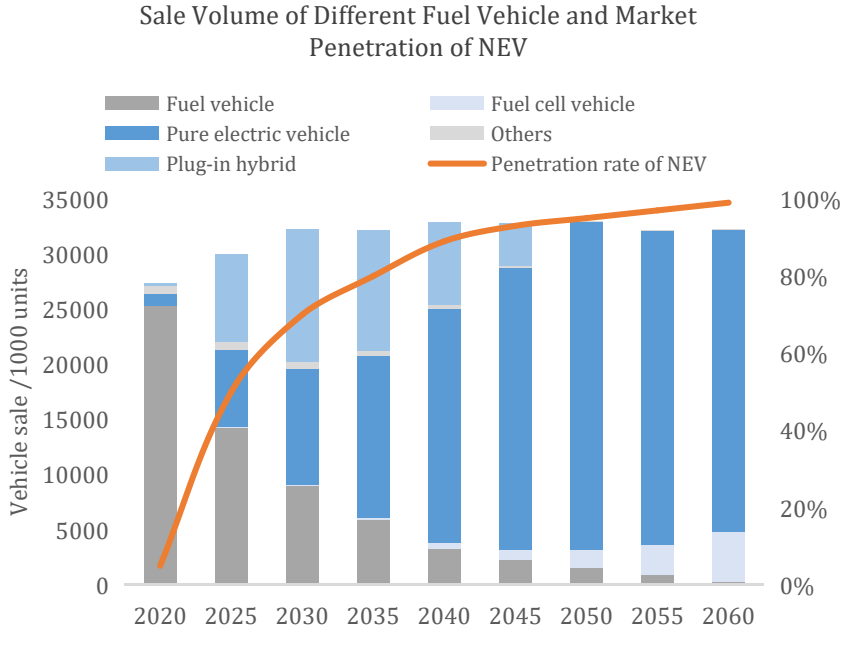
SCS	678	770	782	720	648	578	482	411	332
CDS	678	770	777	705	622	534	425	346	262
GDS	678	770	770	691	600	507	388	307	222

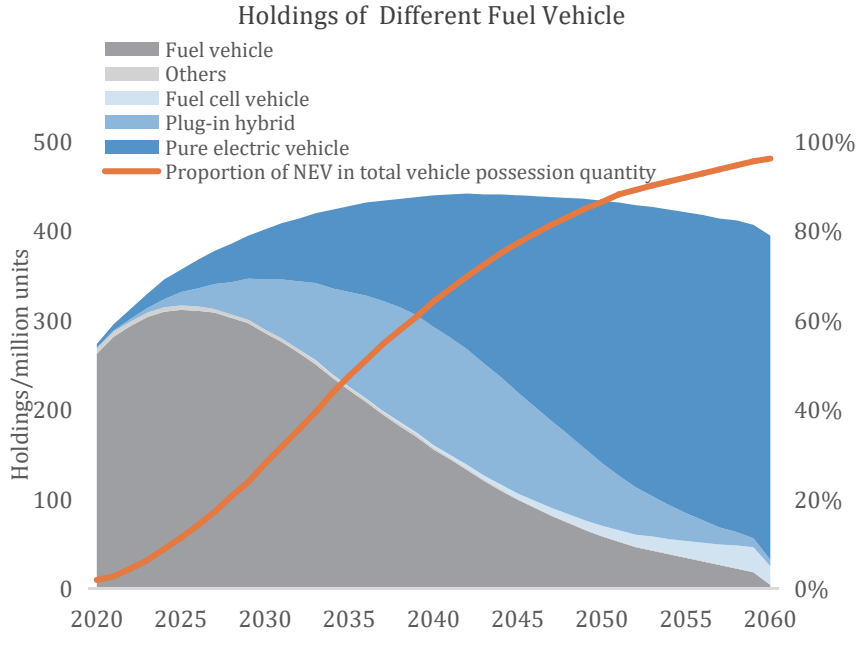
Transport fuel	52%	53%	49%	43%	32%
Chemical feedstocks	21%	23%	29%	41%	55%

Although China's oil consumption witnessed a rare decline in 2024, we still believe that China's oil consumption will reach a peak of between 790 million and 800 million tonnes during the period from 2025 to 2030, and the growth in oil consumption for the chemical industry will be the main driving factor.

- **The characteristics of the plateau period in China's oil consumption are becoming increasingly obvious.** In 2024, China's oil consumption was 750 million tonnes, which was the second time that oil consumption had declined in the past 20 years. There are three main reasons for the decline in oil consumption. Firstly, the domestic real estate sector is still in the bottoming-out period of in-depth adjustment, and the domestic economic cycle is not running smoothly. As a result, there is an imbalance between supply and demand in the manufacturing and industry sector, effective demand remains insufficient, and the marginal effect of supporting economic growth has weakened. Secondly, China's automobile industry has entered the late stage of growth. The number of automobiles per 1,000 people in China has exceeded 200. The growth rate of the automobile ownership has dropped from around 10% before 2020 to the current 3% - 5%. Among them, the growth rate of the ownership of fuel vehicles is only 2%, showing obvious characteristics of an inflection point. Thirdly, new energy and LNG vehicles have witnessed rapid development and are accelerating the replacement of gasoline and diesel vehicles.
- **It is expected that during the 15th Five-Year Plan period, China's total oil consumption will remain in a peak plateau period of more than 770 million tonnes.** New energy vehicles have begun to impact the stock market of traditional fuel vehicles. The ownership of fuel vehicles will reach its peak in 2025, and the consumption of oil in the transport sector will decline slightly. Multiple sets of ethylene plants will be put into operation, driving the continuous growth of oil consumption in the chemical industry and offsetting the decline in the consumption of refined oil products. During the 15th Five-Year Plan period, It is expected that the peak scale will be between 790 million and 800 million tonnes.
- **After 2030, with the slowdown and peak decline of oil consumption for chemical industry, the rate of decrease in China's total oil consumption will gradually accelerate.** It is expected that from 2030 to 2040, there will be an average annual decline of about 2%, with the growth in oil consumption for the chemical industry offsetting part of the decline in transport oil consumption, and the proportion of chemical oil consumption will be roughly equal to that of transport; from 2040 to 2050, there will be an average annual decline of about 4%, from 2050 to 2060, there will be an average annual decline of about 5%.

China's automobile industry has entered the late stage of growth, and new energy vehicles have begun to replace the existing stock of fuel vehicles





NEV Sales	1370	15000	22600	25700	29300	30300	31300	31500	32000
Penetration rate of NEV	5%	50%	70%	80%	89%	93%	95%	97%	99%

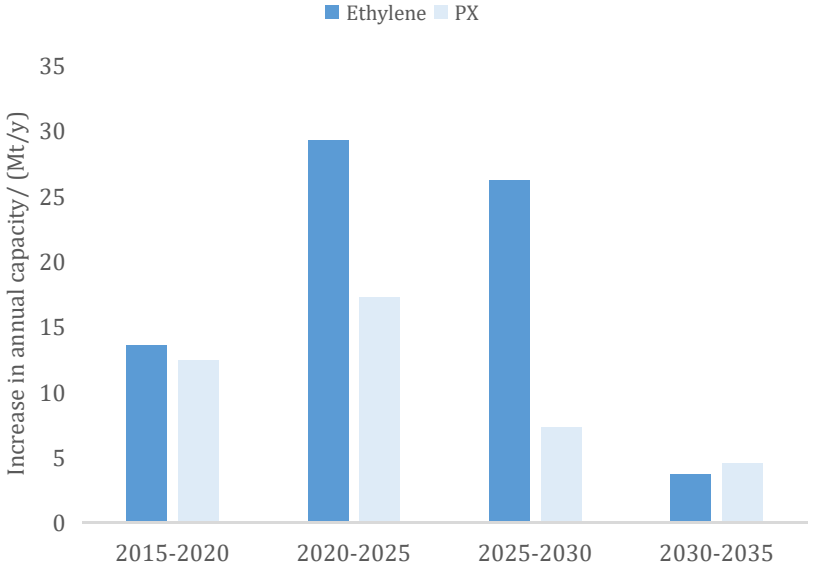
NEV holdings	11	45	116	206	284	340	375	386	390
Proportion of NEV	2%	12%	31%	53%	69%	79%	87%	92%	99%

Compared with the previous version of the forecast, we have raised the medium- and long-term penetration rate of new energy vehicles in China, emphasizing the role of hybrid vehicles in driving the development of new energy vehicles.

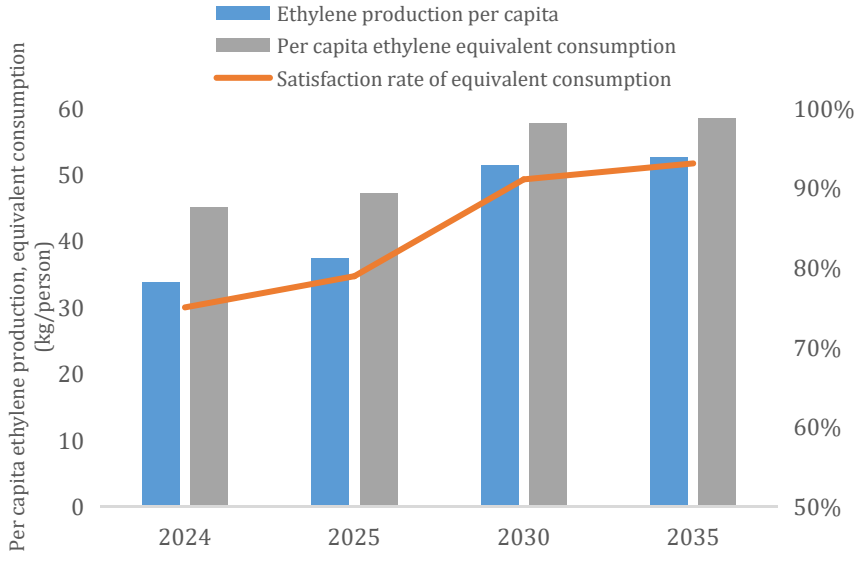
- **The automobile industry has entered the late stage of growth, and the energy consumption for road transport has entered the final growth stage.** According to the forecasts of authoritative institutions, the saturation value of Chinese passenger vehicles is between 300 and 400 per 1,000 people. the growth rate of the number of vehicles in possession has slowed down significantly. It is expected that during the 15th Five-Year Plan period, the number of passenger vehicles per 1,000 people will increase to 250. During this period, the annual average growth rate of the number of automobiles in possession will be about 3%, and the total number will reach 400 million. After 2030, the number of automobiles in possession will gradually reach its peak, with the peak value being around 450 million.
- **Fuel vehicles have entered a downward trend, and the consumption of oil for transport is expected to reach its peak.** It is expected that the number of fuel vehicles in possession will reach a peak of 310 million in 2025. During the 15th Five-Year Plan period, the annual average decline rate of the number of fuel vehicles in possession will be 2%, and by 2030, it will drop back to the level of 2021. A three-way split between fuel, hybrid and pure electric vehicles in 2040.. It is expected that only some inter-city logistics diesel heavy-duty trucks will remain by 2060.
- **New energy vehicles such as pure electric vehicles and plug-in hybrid electric vehicles continue to achieve high growth, further squeezing and replacing oil product consumption.** In 2025, the penetration rate will be increased to approximately 50%, and the proportion of ownership will rise to 12%. By 2030, the number of vehicles in possession will be 120 million, and the proportion will increase to 31%. In recent years, plug-in hybrid electric vehicles have shown strong performance. The proportion of their sales in new energy vehicle sales has increased from 18% in 2020 to 40% in 2024. They have effectively addressed the pain point of range anxiety of pure electric vehicles and boosted the sales of Class A vehicles among new energy vehicles, the proportion is expected to continue increasing before 2030.
- **Fuel cell vehicles are developing relatively slowly, and their impact on China's oil consumption and transport energy transition is limited.** It is expected that the number of fuel cell vehicles in possession will be between 30,000 and 50,000 units in 2025. During the 15th Five-Year Plan period, hydrogen energy transport will still be in the incubation stage. After 2030, the economic advantages of fuel cell vehicles will gradually become apparent. It is expected that 49-tonnes fuel cell heavy-duty trucks and 12-meter fuel cell buses will achieve price parity competition with diesel vehicles around 2035.

This super expansion cycle of the chemical industry is still continuing, and the structural surplus in the petrochemical industry has become even more prominent

Increase in Ethylene and PX Capacities



Per capita ethylene production, equivalent consumption and equivalent consumption satisfaction rate



End-of-period ethylene capacity	34.8	64.0	90.2	93.9
End-of-period PX capacity	26.3	43.5	50.8	55.3

Per capita ethylene equivalent consumption	45.0	47.2	57.6	58.4
Equivalent consumption satisfaction rate	75%	79%	90%	93%

- **Under the combined effect of insufficient feedstocks supply and sluggish downstream demand, the low profits in China's chemical industry chain will persist for a relatively long period of time.** It is expected that during the 15th Five-Year Plan period, China's chemical market will face the dual pressures of a severe shortage of feedstocks supply and sluggish downstream demand. The consumption of bulk chemicals has dropped from the previous high-speed growth rate of 8% - 10% to a medium and low-speed growth rate of 3% - 4%. The chemical industry chain will face a situation of "multiple contradictions" where production facilities lack feedstocks, production capacity expands substantially, and terminal demand remains continuously sluggish. It will be difficult for the profits of the industry chain to be significantly restored.
- **There is room for growth in the export of chemical products, which brings opportunities for the capacity expansion and growth of China's chemical industry.** The restructuring of the global industrial chain has brought opportunities for China's exports. The Russia-Ukraine conflict has led to a decline in Europe's competitiveness. The development of the manufacturing industry has driven an increase in the demand gap in Southeast Asia, India-Pakistan and South America. Even the United States has to import a large number of plastic products.
- **The problem of structural surplus of bulk chemical commodities in China has already emerged, and a large number of backward production capacities are facing elimination.** Considering multiple factors such as the rapid development of plastic recycling and regeneration technologies, industrial transfer, and the continuous sluggishness of the domestic real estate industry, which are all pulling down the growth potential of chemical product consumption, it is expected that from 2030 to 2035, China's per capita ethylene equivalent consumption will increase from the current 45 kilograms to around 58 kilograms, and the per capita PX consumption will rise from 27 kilograms to 32 kilograms, still leaving considerable room for growth. To meet the development needs of the domestic petrochemical industry, China has witnessed the largest wave of capacity expansion for chemical plants in history since 2020. If we take into account that a considerable number of downstream products of imported ethylene are difficult to be replaced by domestic ones, including cheap products from North America or the Middle East and high-end products from Europe, then the domestic ethylene capacity satisfaction rate has already exceeded 100%. Against the backdrop of the rapid growth in domestic supply, the production capacities of ethylene and PX have shifted from being insufficient to having a structural surplus, and a large number of backward production capacities may face accelerated elimination.

Chapter 5 Natural Gas

- Affected by the energy transition stage and the market supply and demand pattern, the growth rate of natural gas consumption has increased and the peak value has been revised upward

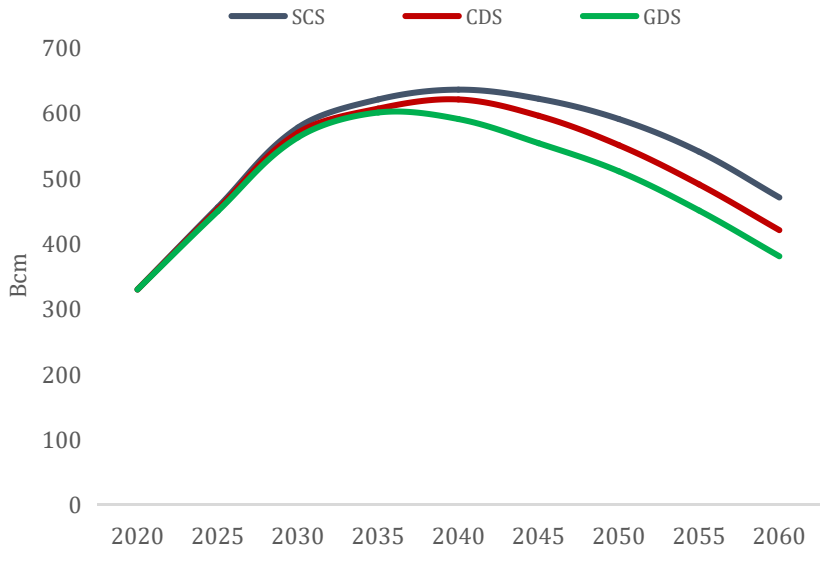
- In the near to medium term, the increase in LNG heavy-duty truck refueling in the transport sector is key growth highlight for natural gas

- In the near to medium term, natural gas will replace coal consumption deeply on a large scale in the industry sector

- The upper limit of the gas power generation industry is affected by other flexible power sources. It is expected that the installed capacity of gas power will remain above 200GW for a long time

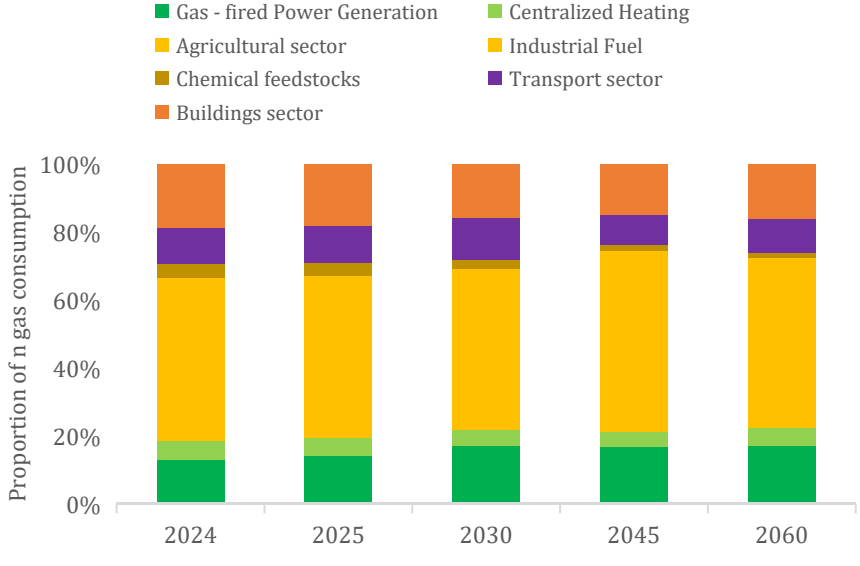
Affected by the energy transition stage and the market supply and demand pattern, the growth rate of natural gas consumption has increased and the peak value has been revised upward

Forecast of China's Total Natural Gas Consumption



SCS	329	460	577	620	635	621	590	540	470
CDS	329	452	569	606	620	595	550	490	420
GDS	329	450	562	600	590	553	510	450	380

Forecast of China's Natural Gas Consumption Mix (CDS)

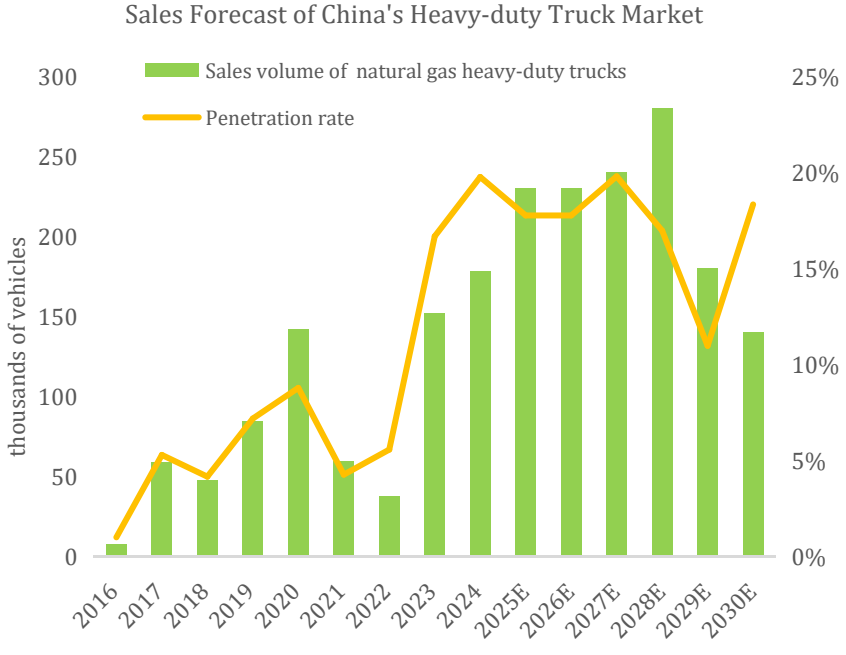


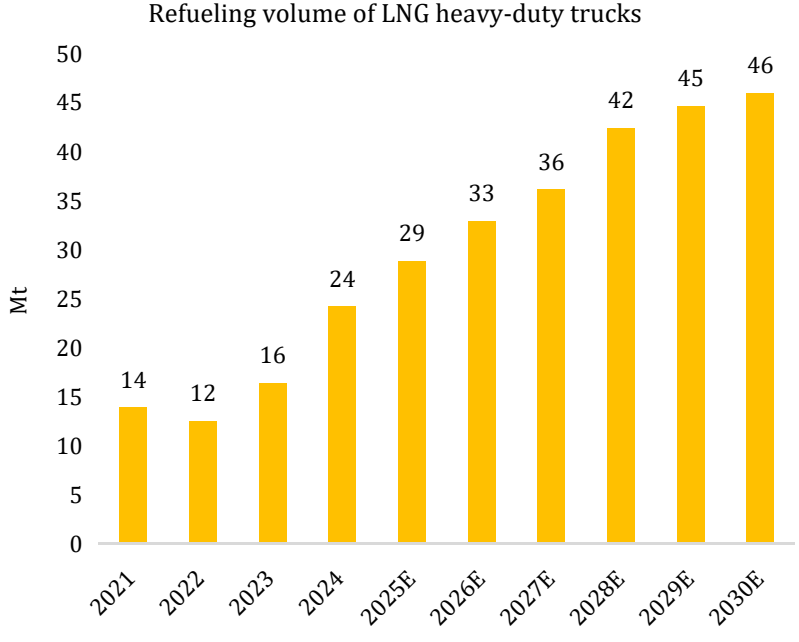
industrial fuel	50%	50%	49%	54%	51%
power generation	14%	15%	18%	17%	17%

China's natural gas demand is projected to peak at 620 Bcm (11.4% of primary energy) between 2035-2040, then stabilize at 420 Bcm (9%) by 2060. Forecasts were revised upward due to post-2023 demand recovery and favorable global oil & gas market trends. Fossil fuels' enduring role amid intermittent renewables supports gas growth, though accelerated energy transition could curb its expansion. Energy security considerations and renewable substitution dynamics will shape consumption trajectories.

- **In the near to medium term, natural gas demand has resumed a moderate growth trajectory.** Since 2023, the recovery pace of China's domestic natural gas market has gradually accelerated. Natural gas consumption is projected to reach 430 Bcm in 2024, marking a year-on-year increase of approximately 9%, and rise further to 452 Bcm by 2025, achieving the targets set in the 14th Five-Year Plan. This highlights the strong resilience of China's natural gas market. With the rapid development of renewable energy, growing pressure to meet carbon peaking goals, and declining import costs for natural gas, it will continue to play a critical role in areas such as the management of small boilers and kilns. By 2030, natural gas consumption is expected to reach around 569 Bcm, accounting for 10.6% of China's primary energy consumption.
- **In the medium-long term, electricity will become the primary substitute for natural gas, complemented by hydrogen in niche applications, curbing gas demand growth.** Coal-to-gas transitions in sectors like building materials have neared saturation, limiting further substitution potential. Natural gas demand will stabilize before declining as industries pivot to electrification. Concurrently, hydrogen breakthroughs (e.g., hydrogen-powered trucks, industrial fuel applications) will accelerate decarbonization in hard-to-abate sectors. These dual trends – electrification dominance and hydrogen adoption – will phase out natural gas demand post-plateau, driven by energy transition priorities.
- **China's natural gas consumption structure will continue to evolve with diversified and multi-tiered development trends.** Natural gas demand growth will vary by sector, with industry and power generation emerging as key drivers. Industrial demand is surging through coal-to-gas transitions, particularly in regions with strong policy support for phasing out coal-fired facilities. For the power generation sector, natural gas remains critical in electricity generation, especially for peak shaving and supply assurance in gas-fired power plants.

In the near to medium term, the increase in LNG heavy-duty truck refueling in the transport sector is key growth highlight for natural gas





Penetration rate of natural gas heavy-duty trucks	2016	2020	2024	2025	2030
	1%	9%	20%	18%	18%

Penetration Refueling volume of LNG heavy-duty trucks	2021	2024	2025	2030
	13.8	24.1	28.7	45.9

Note: The vehicle scale is calculated based on diesel heavy-duty trucks with an average annual mileage of 88,000 kilometers and a scrapping threshold of 700,000 kilometers.

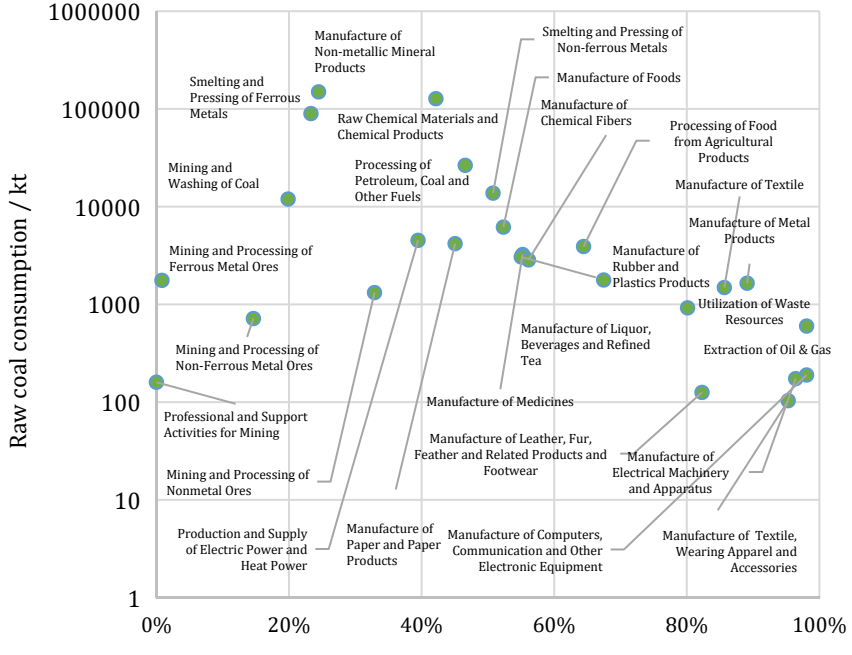
The key driver for LNG heavy-duty truck development is their economic advantage over diesel counterparts. Since 2023, the rapid decline in the gas-to-diesel price ratio (vehicle LNG vs. diesel prices) has spurred a new round of robust 'explosive' growth for LNG trucks. Looking ahead to the near to medium term, the gas-to-diesel price ratio is expected to remain favorable for LNG truck adoption, with refueling volumes projected to nearly double by 2030.

- **The heavy-duty truck market is poised to enter a phase of robust demand growth.** In recent years, with the increasing share of long-haul logistics in overall freight transportation, the average replacement cycle for heavy-duty trucks has significantly shortened to approximately 7 years. Notably, within the heavy-duty truck segment, LNG trucks have an even shorter average replacement cycle. Based on these market assumptions, the total domestic heavy-duty truck replacement volume is projected to exceed 7 million units between 2025 and 2030. Meanwhile, sustained economic growth will generate annual incremental demand of approximately 100,000 units. Additionally, the government's 'trade - in' policy will further accelerate the retirement of aging diesel trucks. Under the combined effect of these factors, it is foreseeable that China's heavy-duty truck market will experience a sales boom from 2025 to 2030, with LNG truck penetration expected to rise rapidly.

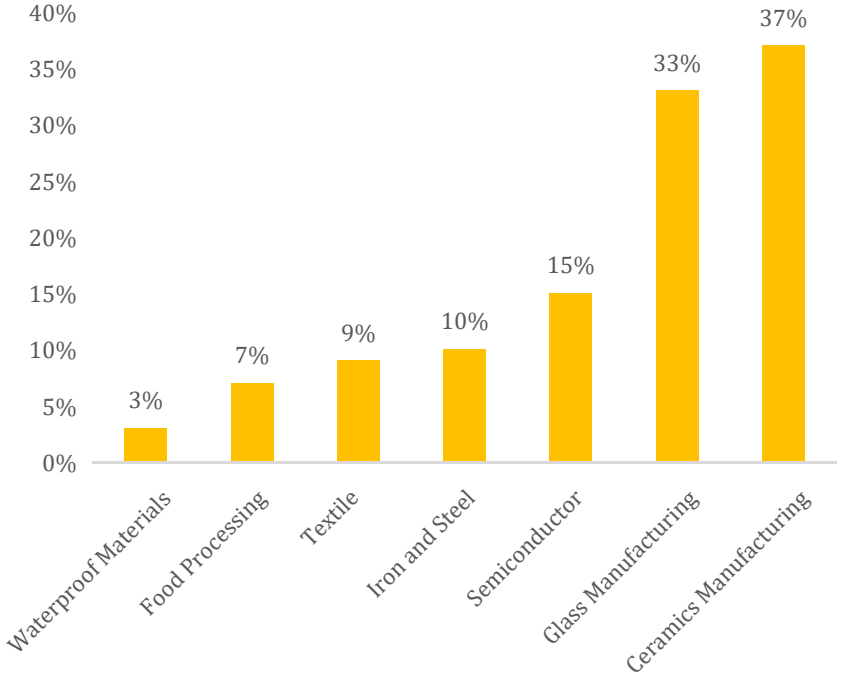
- **An appropriate diesel-to-LNG price ratio plays a crucial role in promoting the growth of LNG heavy-duty truck refueling demand.** In 2023 and 2024, the average diesel-to-LNG price ratio at domestic retail stations (operated by major fuel suppliers) stood at 72% and 70%, respectively. Correspondingly, the penetration rate of LNG heavy-duty trucks reached 17% and 23% during these periods. Based on baseline scenario projections for oil and gas prices from 2025 to 2030, the retail diesel-to-LNG price ratio (at major fuel stations) is expected to remain around 70%—generally below the critical threshold (75%) required for LNG to replace diesel. Meanwhile, considering projections for international natural gas prices and domestic LNG supply dynamics, the price differential between coastal and inland LNG markets is likely to narrow and may even reverse. This will accelerate the trend of LNG heavy-duty truck market expansion toward southern regions. These factors indicate that LNG heavy-duty trucks will maintain high penetration rates in the future commercial vehicle market, thereby accelerating the growth of LNG truck fleets. By 2030, the LNG heavy-duty truck is projected to surge from the current 700,000+ units to over 1.6 million units, with refueling demand expected to rise sharply from approximately 24 million tonnes in 2024 to around 45 million tonnes.

In the near to medium term, natural gas will replace coal consumption deeply on a large scale in the industry sector

The promotion potential of natural gas in the industrial terminal



The proportion of natural gas costs in the total costs of some industry sectors



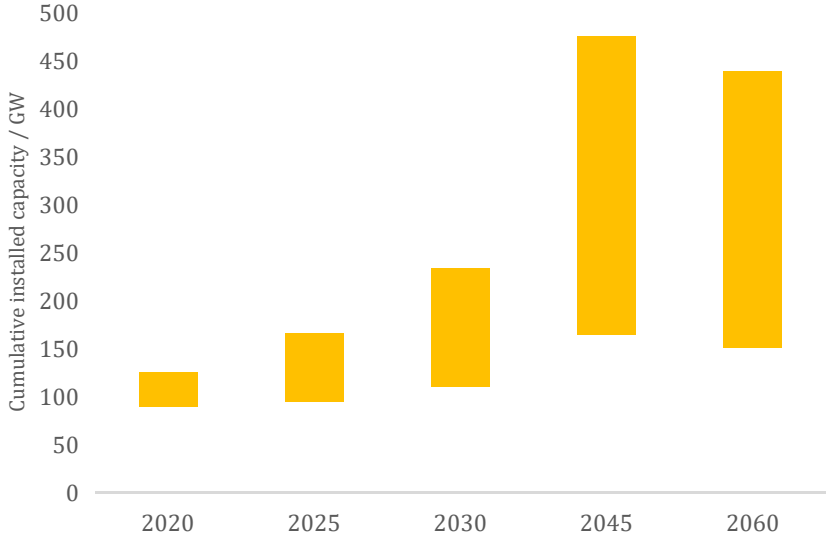
Note: Compiled from China Energy Statistical Yearbook 2023

The international oil and gas market is entering a loose phase. Falling oil and gas prices will reduce China's natural gas usage costs, providing great conditions for expanding natural gas use. Domestic natural gas market competition is intensifying. Suppliers are ramping up marketing and exploring customers' gas - consumption potential, which will further boost natural gas application in the industry sector.

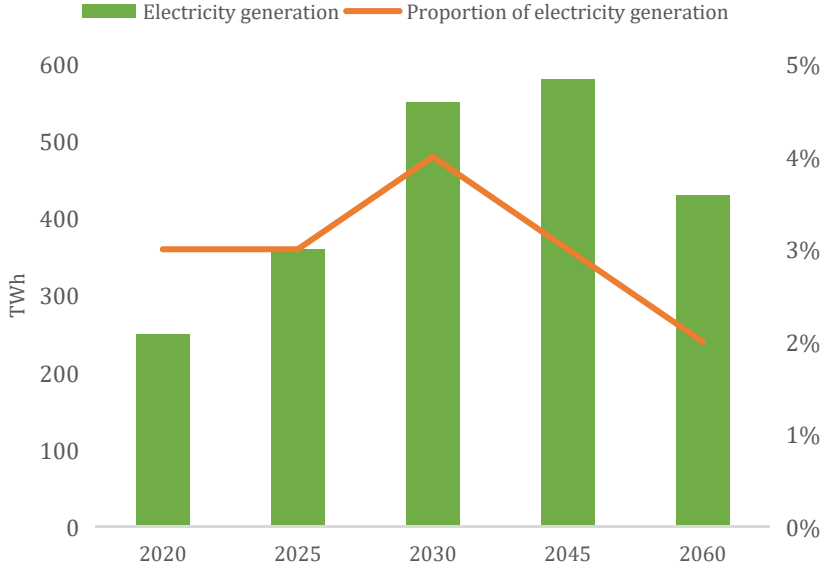
- **China's industrial clean energy transition retains expansion potential.** Government-led bulk coal governance has phased out outdated, polluting equipment (e.g., small coal-fired boilers/kilns) while promoting alternatives like natural gas. By 2022, industrial raw coal consumption remained at ~460 million tonnes, with bulk coal still prevalent. Among 26 high-consumption industries, only 8 sectors (textiles, electronics, etc.) achieved >90% natural gas adoption, while 11 industries (non-metallic minerals, papermaking, etc.) had <50% gas penetration.
- **Clean substitution of bulk coal will continue to drive growth in industrial natural gas consumption.** In China, certain industrial end-users are highly sensitive to natural gas price fluctuations due to its significant share in their cost structures. Based on projections for China's natural gas supply structure and costs from 2025–2030, the average price of domestic pipeline gas is expected to decrease by approximately 10% compared to 2024, directly stimulating increased natural gas usage. Meanwhile, as the 'carbon peak' target approaches, environmental and decarbonization policies will become more binding and stringent, accelerating emission reduction efforts across regions, industries, and sectors. Looking ahead, expanding regional coal reduction policies and stricter elimination standards will continue to drive rising demand for clean energy in the industry sector. In China's current industrial economic structure, natural gas—a clean and efficient energy source—holds significant practical importance and distinct substitution advantages.
- **Market competition dynamics will further boost industrial gas consumption growth.** Based on global natural gas supply-demand forecasts, Northeast Asian spot LNG prices are expected to range between $7–9/MMBtu from 2025–2030—a price likely to be lower than existing domestic long-term oil-indexed LNG import contracts. Combined with enhanced LNG receiving capacity and ongoing pipeline network expansion, second- and third-tier buyers are expected to become more active. Fierce market competition will further facilitate natural gas penetration in the industry sector.

The upper limit of the gas power generation industry is affected by other flexible power sources. It is expected that the installed capacity of gas power will remain above 200GW for a long time

Installed Capacity Potential of Gas-Fired Power Generation Forecast



China's Gas-Fired power generation Forecast



gas-fired power installed capacity(CDS)	100	150	220	230	180

gas-fired power generation(CDS)	250	360	550	580	430

In 2024, China's gas-fired power installed capacity and electricity generation reached approximately 140GW and 0.33 PWh respectively. As one of the most promising segments of natural gas consumption, gas-fired power will undergo two phases: rapid growth followed by a gradual decline, with installed capacity remaining above 200GW over the long term. By 2060, the installed capacity is projected to range between 150GW and 450GW.

- **Rapid Growth Period (2024–2045): With the rapid expansion of variable power sources and bottlenecks in other flexible generation, gas-fired power will enter a development window marked by fast capacity growth.** Gas-fired power will experience rapid growth as rising wind/solar penetration amplifies grid volatility and peak-valley gaps, driving demand for flexible peaking capacity. Limited coal power flexibility, geographical pumped storage constraints, and energy storage limitations position gas-fired plants as premium grid stabilizers, especially for demand-side peak shaving. Policy support, technological advancements, and favorable gas prices will enhance cost competitiveness. Cumulative installed capacity is projected to peak around 226 GW by 2045 in the CDS, though delays could occur if coal phase-out accelerates while pumped storage/energy storage/hydrogen development lags.
- **Slow Decline Period (2046–2060): As energy storage and other technologies mature, peak shaving pressure on the power system will ease, while carbon emissions will emerge as a constraint on gas-fired power development, leading to gradual capacity reduction.** During this phase larger wind turbines and improved generation efficiency will further lower the levelized cost of wind/solar power, reducing curtailment requirements and slowing the growth of grid fluctuations, thereby moderating demand for flexible generation.Rapid advancements in energy storage, demand-side response, and coal power + CCUS models will further compress gas-fired power's peak shaving role.As the "carbon neutrality" goal nears realization, carbon emissions from gas-fired power will increasingly limit its deployment.Gas-fired power installed capacity will decline gradually, with projections in the CDS suggesting a reduction to approximately 180GW by 2060. Additionally, the increasing share of daily peak shaving during this period will drive down capacity utilization rates and a steady reduction in gas consumption for power generation.

Chapter 6 Non-Fossil Energy

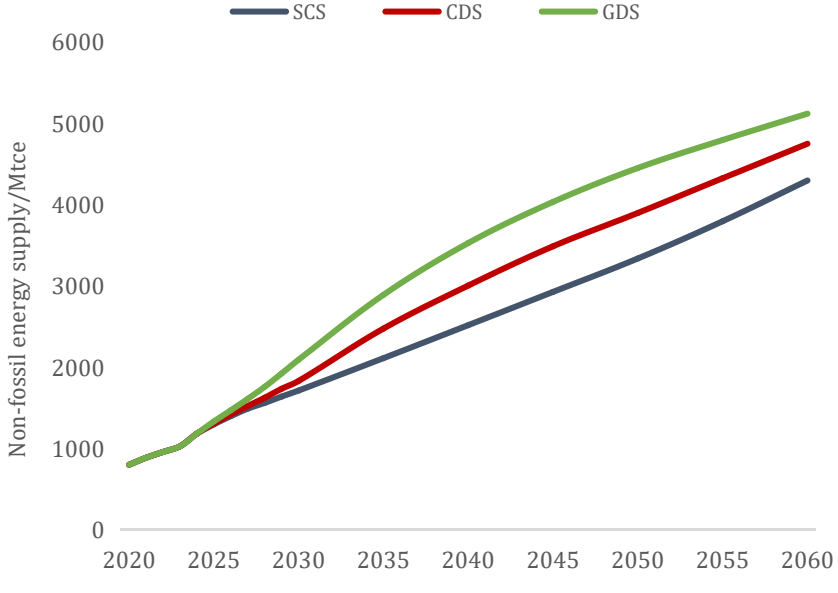
- Non-fossil energy's share in both power installation and electricity generation is gradually increasing, and it will become the dominant energy in China

- The development of the solar and wind power industries is about to reach an "inflection point," with a shift in growth rates, yet the increase remains significant

- Green hydrogen, ammonia, and alcohol are important forms of non-fossil energy accommodation. The current industrial development mainly faces two major issues: technical-economic viability and spatial mismatch

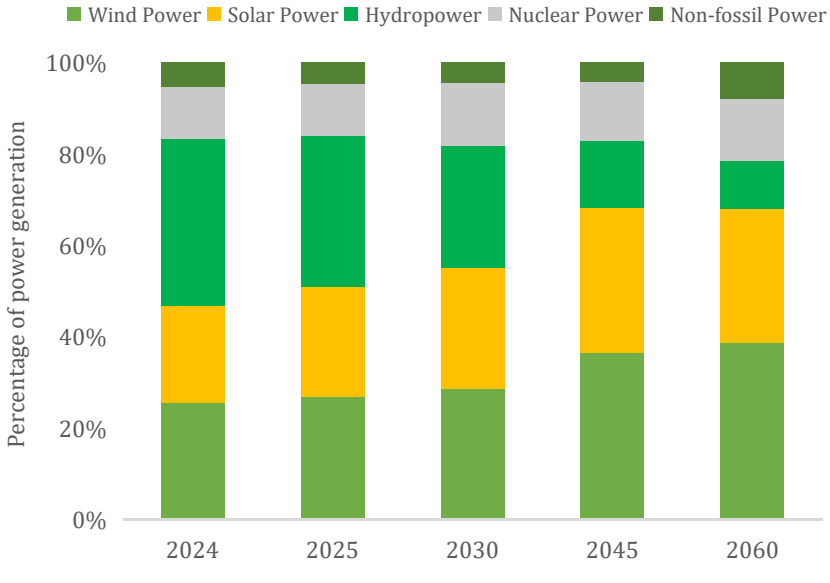
Non-fossil energy's share in both power installation and electricity generation is gradually increasing, and it will become the dominant energy in China

Forecast of Non-Fossil Energy Supply



SCS	790	1290	1710	2100	2510	2920	3330	3790	4290
CDS	790	1320	1840	2460	3000	3490	3900	4320	4700
GDS	790	1330	2090	2880	3520	4030	4440	4790	5110

Forecast of Non-Fossil Energy Supply Mix（CDS）



Hydropower	36%	33%	27%	15%	11%
Wind power	25%	27%	29%	36%	39%
Solar power	21%	24%	26%	32%	29%

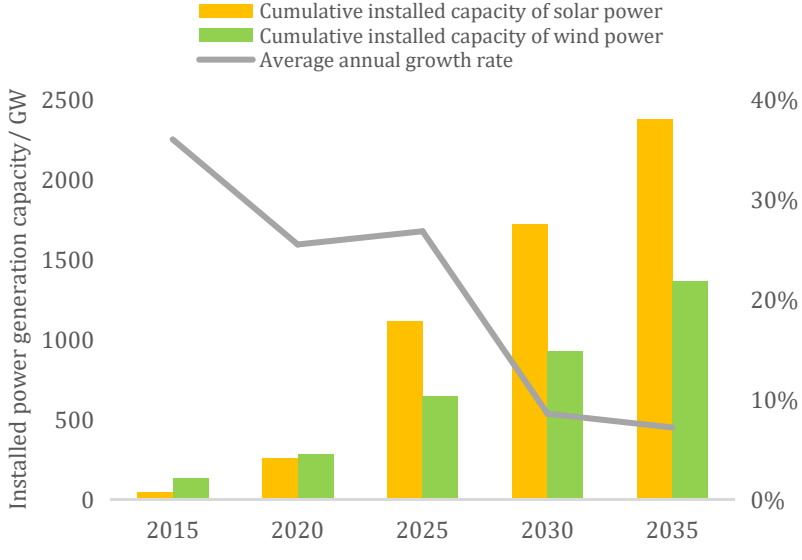
In 2024, the total supply of non-fossil energy in China increased to 1.18 Btce, with electricity being the main form. Among them, the electricity generation from hydropower, nuclear power, wind power, and solar power reached approximately 1.44 PWh, 0.45 PWh, 1.00 PWh, and 0.81 PWh, respectively. The installed capacity and electricity generation of non-fossil energy, as well as its share in the total primary energy, are steadily increasing, becoming the primary contributor to the incremental growth in China's energy system, and will become the dominant energy in the long term.

- **From a holistic perspective, non-fossil energy is becoming the main driver of growth in China's energy system and is expected to surpass the electricity generation of fossil fuels around 2030. The issue of energy absorption has become a key factor in the development of non-fossil energy.** It is projected that by 2030 and 2040, China's non-fossil energy electricity generation will increase to 6.15 PWh and 10.41 PWh, respectively, gradually becoming the main source of electricity supply. The installed capacity of non-fossil energy power generation is expected to increase to 3.39 TW and 5.8 TW, respectively. In the long term, as the new energy system is constructed and perfected, the absorption issue of non-fossil energy will be resolved, and the utilization rate will increase, making it the dominant energy in China. By 2060, China's non-fossil energy electricity generation will exceed 17 PWh, accounting for 91% of the total electricity generation, with the installed capacity of non-fossil energy exceeding 8.4 TW.

- **Within the non-fossil energy sector, solar and wind power have become the mainstay of non-fossil electricity installation, with their share in electricity generation gradually increasing. The share of hydropower in electricity generation is gradually decreasing. Nuclear power is developing steadily.** Thanks to resource, cost, and scale advantages, and driven by the buildings of large wind and solar energy bases, wind and solar power have developed rapidly, accounting for more than 70% and 60% of non-fossil energy installation and electricity generation respectively for a long period. Hydropower installation still has some growth, with an increase to 682 GW by 2040, and pumped storage accounting for 85% of the increase. Hydropower will play an important role in peak regulation in the power system, with its share in electricity generation gradually decreasing, dropping to around 11% by 2060. Coastal nuclear power is developing steadily, supporting the stable growth of nuclear power, with an estimated electricity generation of about 2.31 PWh by 2060, accounting for about 13% of non-fossil energy. Other non-fossil energy sources are developing rapidly under the guidance of policies and technological progress, with both installation and electricity generation growth rates exceeding 10%. However, due to factors such as limited resource base or high development difficulty, their share in the non-fossil energy system is relatively small, and it is expected to reach around 8% by 2060.

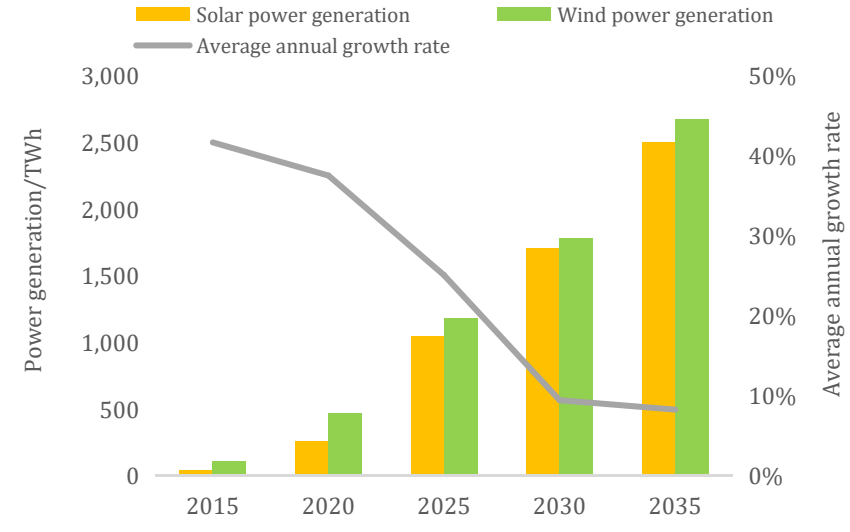
The development of the solar and wind power industries is about to reach an "inflection point," with a shift in growth rates, yet the increase remains significant

Development of Cumulative Installed Capacity of Wind Power and Solar Power



	2015	2020	2025	2030	2035
Installed capacity of Solar power	43.0	253.6	1115.0	1720.0	2375.0
Installed capacity of Wind power	129.0	281.7	640.0	925.0	1364.3
Average annual growth rate	36%	25%	25%	9%	7%

Development of Grid-Connected Wind and Solar Power Generation



	2015	2020	2025	2030	2035
Solar power generation	39.2	261.0	1109.8	1732.4	2500.2
Wind power generation	109.1	466.9	1168.0	1737.2	2687.2
Average annual growth rate	42%	37%	25%	9%	8%

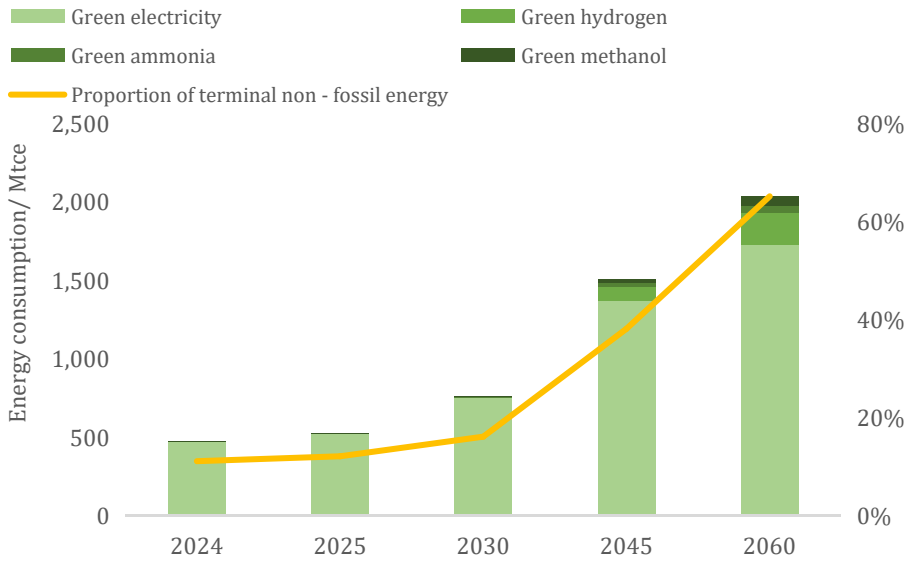
During the 15th Five-Year Plan period, the development of China's wind and solar power industries is expected to see a significant increase, but it will also reach an "inflection point" where the growth rate shifts and the driving factors transition.

- **The driving factors for the solar and wind power industries are shifting, with the driving role of electricity supply and demand diminishing, while the internal driving force within the industry chain is strengthening.** From the perspective of electricity supply and demand, with industrial upgrading and technological progress, the average annual growth rate of electricity consumption in China will drop from over 6% during the 14th Five-Year Plan period to within 5% during the 15th Five-Year Plan period, with a narrowing increase, thus reducing the driving force for the growth of the solar and wind power industries. Looking at the industry chain, on one hand, to fully absorb China's new energy manufacturing capacity and counteract the adverse effects of the European Solar Charter and the United States' "double anti" policies, there is significant potential for growth in China's solar and wind power installations, with an expected combined total of over 2625GW by 2030 and 3739 GW by 2035. On the other hand, the new energy industry is becoming an internal driving force for China's energy transition and a new growth point for promoting high-quality economic development. According to the plan, by 2030, the total installed capacity of large-scale wind and solar energy bases, focusing on desert, Gobi, and desert regions, will reach 455GW.

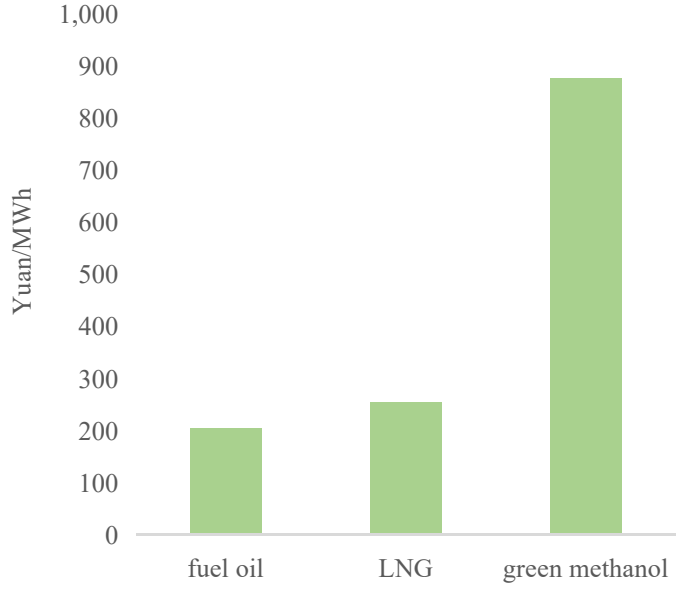
- **The issue of integrating fluctuating power sources into the grid is becoming more prominent, leading to a deceleration in the growth rate of electricity generation from wind and solar power.** As the proportion of fluctuating power sources such as solar and wind power exceeds 20% by 2025, the contradictions of temporal and spatial mismatches in power supply will become more pronounced, and the tension in grid accommodation capacity will lead to a slowdown in the growth rate of grid-connected electricity. On one hand, as the proportion of wind and solar power generation surpasses 20%, the storage and scheduling costs of the power supply chain will climb stepwise. Power generation companies, grid companies, and other supply chain entities, even large industrial users, will bear higher green electricity costs, thereby forcing the optimization of the solar and wind power industries. In the near to medium term, the growth rate of solar and wind power installations will slow down, and the utilization rate of power generation will significantly decrease, causing the growth rate of grid-connected power generation to decline before the installation growth rate. On the other hand, the increase in peak-valley differences and the progress of flexible power layout will affect the accommodation of solar and wind power. By 2030 and 2035, the daily peak-valley differences in electricity will reach approximately 1100GW and 1600GW, respectively; in 2030, the short-term, medium-term, and long-term flexible demand will reach 320GW, 800GW, and 970GW, respectively.

Green hydrogen, ammonia, and alcohol are important forms of non-fossil energy accommodation. The current industrial development mainly faces two major issues: technical-economic viability and spatial mismatch

Forecast of End-Use Non-Fossil Energy Consumption （CDS）



Comparison of Fuel Power Costs



Non-fossil Terminal Utilization(Mtce)	467	521	755	1504	2032
Green Hydrogen Production (Kt)	100	140	2560	35040	76800

China has proposed "two shifts" to promote energy transition: First, the shift in clean energy production and supply from centralized development and large-scale unified distribution to a balance between regional self-balance and cross-regional optimized allocation; Second, the shift in terminal energy consumption from primarily electric substitution to a diversified clean substitution involving electricity, hydrogen, ammonia, and more.

- **From the perspective of the accommodation of non-fossil energy in the terminal sector, the electricity will dominate in the near to medium term, and green hydrogen, ammonia, and alcohol will begin to scale up and substitute after 2035.** The accommodation of non-fossil energy in China's terminal sector will exhibit a two-stage characteristic. In the first stage (before 2035), the total consumption of non-fossil energy in China's terminal sector will increase from less than 500 Mtce to over 1 Btce, with non-fossil energy contributing more than 75% to the peak growth of terminal energy use.In the second stage (2036-2060), the accommodation of non-fossil energy in China's terminal sector will show diversification, with the green hydrogen, ammonia, and alcohol industry achieving scaled and market-oriented development. It will contribute to a 25% increase in the total consumption of non-fossil energy with less than 15% of the consumption share, and the proportion of non-fossil energy in China's total terminal energy consumption will increase from 23% to 65%.

- **Lack of economic viability is the main bottleneck constraining the expansion of green hydrogen, ammonia, and alcohol applications and increasing accommodation in the near to medium term.** If carbon emission costs are not considered, from the supply side, when green electricity is priced at 0.3 yuan/(kWh) and green hydrogen at 22 yuan/kg, the production costs for green methanol and green synthetic ammonia are 5520 yuan/t and 4400 yuan/t, respectively, both more than twice the cost of coal-based methanol and coal-based synthetic ammonia. From the demand side, taking the shipping scenario as an example, without considering ship buildings and operating costs, only comparing fuel power costs, the cost of green methanol is approximately 875 yuan/(MWh), which is three times that of LNG [255 yuan/(MWh)] and four times that of fuel oil [180 CST 205 yuan/(MWh)]. In the near to medium term, the main factors driving the reduction of green hydrogen, ammonia, and alcohol costs and the expansion of scale are as follow. First, the increased demand for energy conservation and carbon reduction in industrial fields such as chemical engineering; second, the emission reduction targets and constraints in the international shipping sector; and third, the pressure from carbon emission costs and product carbon footprint requirements.

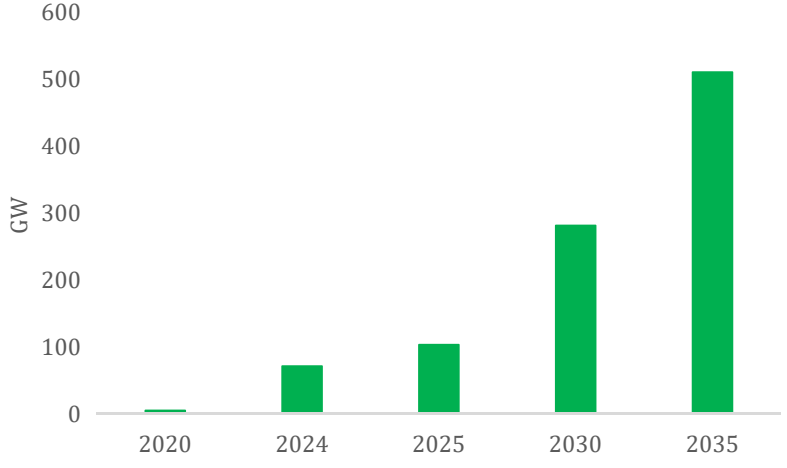
Chapter 7 Energy Storage and CCUS

- New energy storage industry is accelerating, lithium-ion battery technology still dominates

- The large-scale promotion of CCUS in China faces technical and economic challenges, and the growth rate is expected to be relatively stable in the near to medium term

New energy storage industry is accelerating, lithium-ion battery technology still dominates

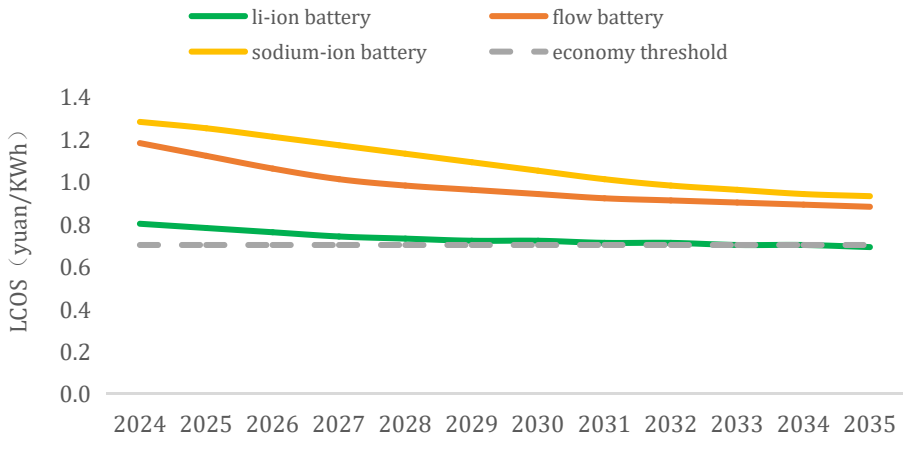
Forecast of cumulative installed capacity of new energy storage in China



Cumulative installed capacity	4	70	102	280	509

Note: The cost of charging the new energy storage is based on the November 2024 national average of the valley electricity price of 0.363 Yuan/kWh

China's electrochemical energy storage technology economic prediction

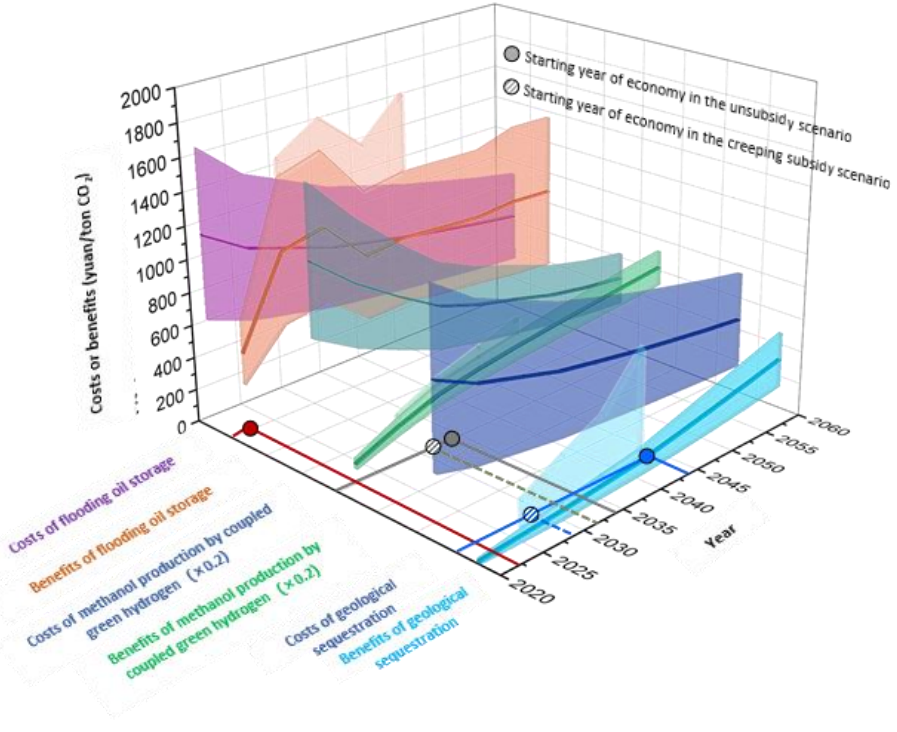


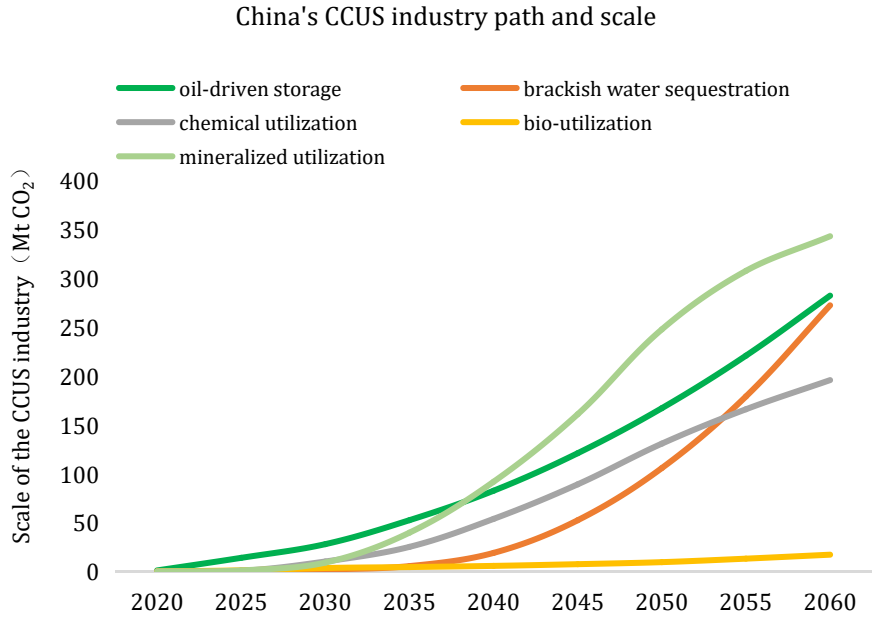
	2024	2025	2030	2035
li-ion battery LCOS	0.8	0.78	0.72	0.69

Driven by policy support and technological progress, China's new energy storage industry is developing rapidly.As of the end of 2024, China has built and put into operation a new type of energy storage project with a cumulative installed capacity of 74GW/168GWh, of which lithium-ion batteries accounted for about 97%.

- **The "new energy + energy storage" policy effect is further enhanced, it is expected that China's new storage.** The installed capacity of China's new energy storage is expected to increase rapidly. At the policy level, the national 14th Five-Year Plan new energy storage development implementation plan" put forward to promote the scale of new energy storage, industrialization, market-oriented development; there are 26 provinces and municipalities, local governments have formulated the end of 2025, the new energy storage installed capacity target, the total size of 86.6 GW. At the Industrial level, in order to protect the security and stability of the power system and alleviate the problem of wind and power abandonment, the energy system of new types of energy storage faster development of the demand for more urgent.It is expected that the scale effect and technical economy of China's new energy storage will be synergistically improved.During the 15th Five-Year Plan period, the cumulative installed capacity of new energy storage will reach 280 GW, with an average annual growth rate of 36 GW; during the 16th Five-Year Plan period, the cumulative installed capacity of new energy storage will exceed 500 GW, with an average annual growth rate of 46 GW.
- **Improvement in the economics of new energy storage technologies is mainly influenced by the decline in unit investment costs.In the near to medium term, the economics of various energy storage technologies are improving, with sodium-ion batteries and liquid flow batteries reducing costs relatively faster.**Comparison of different technology paths, sodium-ion battery energy storage technology is in the demonstration project stage, the maturity of the technology is not as good as other electrochemical energy storage technology, and liquid current battery in the vanadium material cost is higher, the two unit cost is higher than the stage of large-scale application of lithium-ion batteries and lead storage batteries, with the technological advances and the scale effect of the emergence of the cost advantages of the two will be gradually enhanced.
- **China's new energy storage technology will be overall to a long time, large-scale characteristics of development.Lithium-ion battery energy storage installed share is still the highest.** *The Action Plan for High-Quality Development of the New Energy Storage Manufacturing Industry* pointed out that develop diversified energy storage ontology technology, develop compressed air and other long-time energy storage technology, and appropriately lay out the layout of ultra-long-term energy storage technology, such as hydrogen energy storage, ahead of the time.

The large-scale promotion of CCUS in China faces technical and economic challenges, and the growth rate is expected to be relatively stable in the near to medium term





Driven oil sequestration is projected to be potentially profitable from current to 2035, but is affected by crude oil prices.Coupled green hydrogen to methanol and geologic sequestration have struggled to achieve profitability.

- **Economic aspects of technology paths**

1.The overall cost of the whole process of **oil-driven storage** is lower than the income of this stage, and it can achieve profitability, so that projects with cost advantages can be selected to carry out large-scale demonstration and realize commercialization as early as possible.The net return on oil drive sequestration is very dependent on crude oil prices and needs to be risk-proofed against a possible decline in oil prices.

2.The cost of **coupling green hydrogen to methanol** is higher than the revenue of this stage, and it is not possible to realize profit for the time being, and this stage focuses on cost reduction and efficiency improvement.Coupled green hydrogen to methanol has the highest sensitivity to green hydrogen and synthesis cost, and the decrease of green hydrogen feedstock price is the key to promote the scale application of coupled green hydrogen to methanol.

3.Geological storage is expected to yield positive returns of 2-110yuan/tCO_2 around 2030 as technological advances and energy savings achieve results and carbon prices rise.After 2035, some of the lower-cost geologic sequestration, especially of depleted reservoirs, could also be profitable as costs fall and carbon prices rise.

- **Industry development path and scale aspects:**

1.Domestic CO_2 driven oil storage is now in a critical period of expanding industrial demonstration scale and moving towards commercial application.After 2030, different types of domestic oil reservoirs will successively realize the commercial application of CO_2 driven oil storage.It is expected that in 2035 its scale will reach 52.5 million tonnes per year.

2.The buildings and manufacturing industry chain of **saline aquifer storage** technology is more complete, million-tonnes industrial demonstration projects have been landed, and the scale of CO_2 saline aquifer storage in the Ordos Basin and other regions is expected to reach 2.1 million tonnes per year by 2030.The future rise in carbon prices and cost reductions brought about by technological advances will continue to incentivize the development of saline aquifer storage, especially after 2035 the business layout will continue to accelerate.

3.CO_2 conversion and utilization technology scale application promotion and buildings efforts continue to strengthen, chemical and bio-utilization projects scale industrial demonstration and initial commercial application at the same time.Phosphogypsum mineralization CO_2 co-production of high value-added products and steel slag and other solid waste mineralization of building materials business has also accelerated the development of the business. It is expected that in 2035, the scale of domestic CO_2 chemical, biological and mineralization utilization will reach 25.2 million tonnes, 4.55 million tonnes and 39.75 million tonnes per year, respectively.

Chapter 8 Final energy Sectors

- **Transport Sector** Oil and gas will continue to hold an important position in transport energy for a long time, with a share of more than 90% before 2030

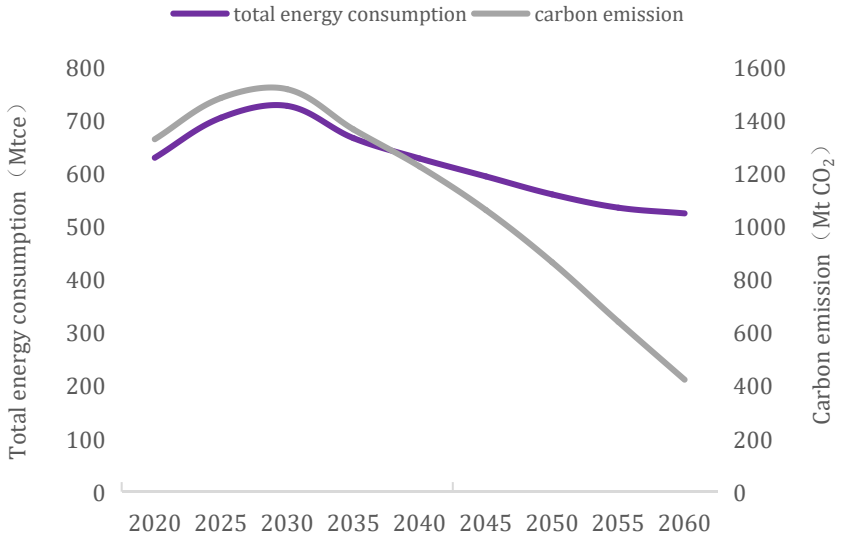
- **Transport Sector** In the field of road transport, electric vehicles and fuel cell vehicles are developing in a complementary manner. It is expected that medium and light-duty vehicles will be the first to achieve electrification, heavy-duty vehicles will mainly transitioning to fuel cell vehicles

- **Industry Sector** In the near to medium term, the new energy manufacturing industry and the commercialization of new energy will create additional energy demand. Both energy consumption and carbon emissions in the industry sector are expected to enter a plateau phase around 2025

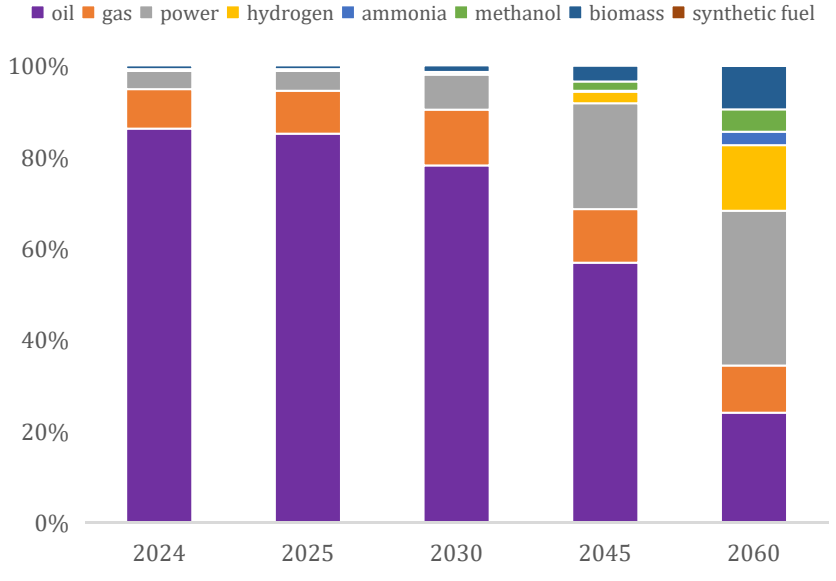
- **Buildings Sector** AI empowers a new revolution in productivity, providing a strong engine for the continuous growth of energy consumption in the buildings sector

Transport Sector Oil and gas will continue to hold an important position in transport energy for a long time, with a share of more than 90% before 2030

Projections of total energy consumption and carbon emissions in the transport sector



Forecast of energy consumption mix in the transport sector



Total energy consumption	629	704	726	666	627	594	560	535	524
Total carbon emissions associated with energy activities	1327	1482	1520	1365	1224	1060	864	640	422

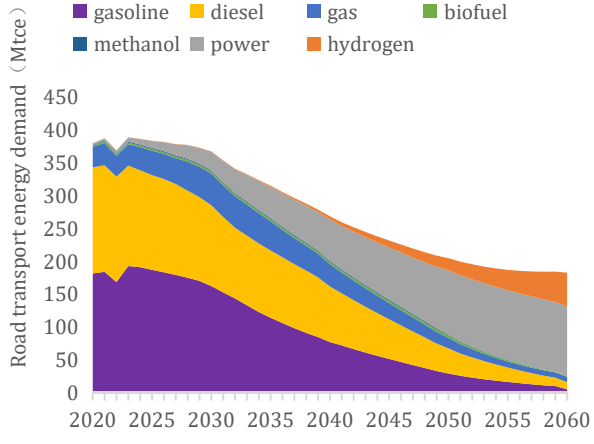
Oil and gas ratio	95%	94%	90%	68%	33%
Electricity ratio	4%	4%	8%	24%	34%

China's transport sector has seen a rapid recovery in growth; in 2024, the total energy consumption of China's transport sector is projected to reach approximately 700 Mtce, marking a 3% year-on-year increase and accounting for about 16% of the total terminal energy consumption. Correspondingly, carbon dioxide emissions from the transport sector are estimated at 1.47 billion tonnes, comprising 14% of China's total energy-related carbon emissions. The electrification of transport and the development of rail transit are the main paths to reduce transport energy consumption and carbon emissions.

- **During the 15th Five-Year Plan period, the consumption of oil and gas in the transport sector is anticipated to demonstrate a clear plateau trend.** Specifically, the growth in consumption of aviation kerosene and natural gas offsets the decline in consumption of gasoline and diesel. In particular, as the international natural gas resource rebalancing pattern forms during the 15th Five-Year Plan, the spot price in Northeast Asia will fall back to $7-9/MMBtu, and LNG trucks will maintain good economic performance, with the stock expected to increase from approximately 740,000 in 2024 to 1.6 million, underscoring natural gas's critical role as a transitional energy source.
- **During the 15th Five-Year Plan period, the consumption of electricity in the transport sector is projected to grow rapidly.** In 2024, the electricity used for transport is about 230 TWh, with approximately 100 TWh allocated to electric vehicles . During the 15th Five-Year Plan period, the annual average growth of electricity consumption is expected to be 14%, reaching 500 TWh, accounting for 9% of the total transport energy. By 2030, the penetration rate of new energy vehicles (NEV) in China is anticipated to reach 70%, with the stock of new energy vehicles reaching 120 million units. Vehicle charging demand is projected to range from 300 to 400 TWh, driving the total electricity consumption of the transport sector to exceed 470 TWh, accounting for 4% of the total electricity consumption of the whole society.
- **Sustainable energy sources such as biomass remain in the initial stage of policy-driven development.** Currently, the development of the sustainable energy industry mainly faces problems such as immature technology, high costs, and insufficient feedstock availability. In addition, domestic development is constrained by an underdeveloped market mechanism, the lack of internationally recognized product standards, and green certification systems. A case in point is renewable methanol, which lacks a universally recognized definition and certification system worldwide, and EU standards are too stringent.

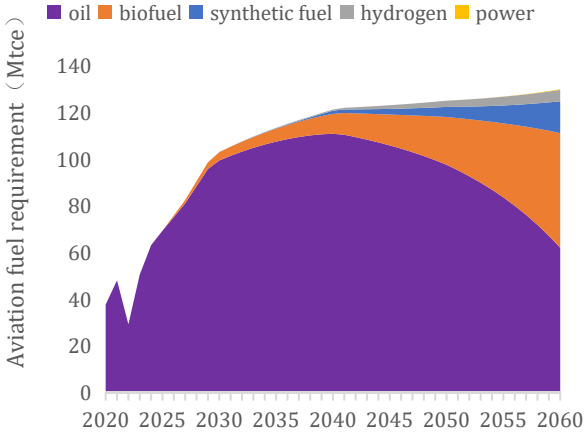
Transport Sector In the field of road transport, electric vehicles and fuel cell vehicles are developing in a complementary manner. It is expected that medium and light-duty vehicles will be the first to achieve electrification, heavy-duty vehicles will mainly transitioning to fuel cell vehicles

Road transport energy demand



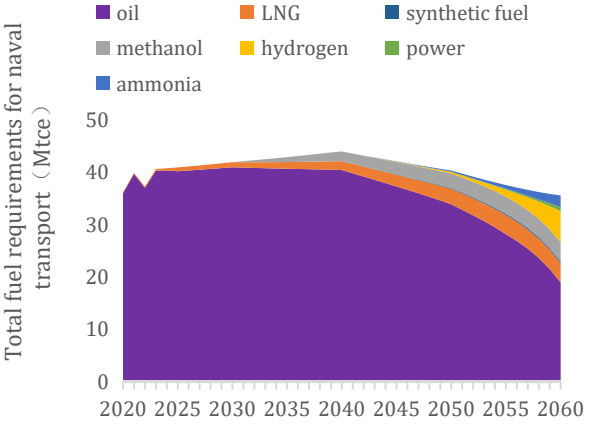
	2020	2025	2030	2035	2040	2045	2050	2055	2060
Oil ratio	90%	86%	77%	68%	59%	47%	32%	20%	8%
Power ratio	1%	3%	8%	15%	24%	34%	47%	56%	58%
Hydrogen ratio	0%	0%	0%	1%	2%	5%	9%	17%	29%

Aviation energy demand



	2020	2025	2030	2035	2040	2045	2050	2055	2060
Oil ratio	100%	100%	96%	95%	90%	84%	75%	62%	43%
Biofuel and methanol ratio	0%	0%	3%	5%	9%	15%	23%	35%	54%

domestic water transport energy demand



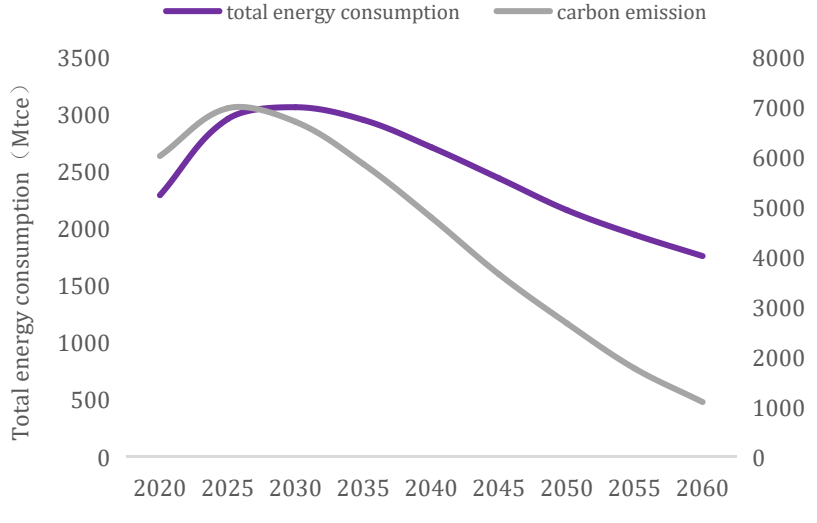
	2020	2025	2030	2035	2040	2045	2050	2055	2060
Oil ratio	100%	98%	98%	95%	92%	89%	84%	75%	53%
Power ratio	0%	0%	0%	2%	4%	6%	7%	9%	11%
Hydrogen ratio	0%	0%	0%	0%	0%	0%	1%	5%	23%

In 2024, China's transportation structure is characterized by " stable railways, growing water transportation, and declining highway transportation." Under the policy drive of "road to rail" and "road to water," the proportion of railway freight and water transportation has increased, while the proportion of road transport has decreased. Meanwhile, aviation and pipeline transport have seen little change due to limitations in cargo space and types.

- **Electricity is accelerating the replacement of oil in road transport.** Improved transportation efficiency has driven a rapid decline in road transport energy consumption since the 15th Five-Year Plan. The rapid popularization of electric vehicles has shifted travel habits away from fuel-powered vehicles, with per-vehicle use intensity down over 5% versus pre-pandemic levels, causing transport oil demand to peak earlier, which has plateaued over the past three years and is projected to decrease by approximately 3% annually during the 15th Five-Year Plan period.
- **Aviation energy consumption holds significant growth potential.** Post-pandemic consumption of aviation kerosene recovered quickly, projected to reach 39 million tonnes in 2024. In the medium to long term, aviation kerosene will remain dominant in the sector's energy mix. During the 15th Five-Year Plan period, SAF blending ratios are estimated at 3-5% by 2030 (constrained by feedstock availability and costs), while aviation kerosene demand is expected to grow at 7% annually, reaching 60 million tonnes.
- **The overall demand for water transport fuel is projected to grow marginally in the medium to long term.** TThe shipping industry remains one of the sectors facing significant challenges in emission reduction. In terms of foreign trade ship fuel, sustained economic growth is expected to drive the expansion of trade volumes. Coupled with the increasing share of ship fuel bunkering at Chinese ports, maritime fuel demand is projected to rise steadily. During the 15th Five-Year Plan period, environmental policies will accelerate LNG/methanol commercialization and initial deployment of ammonia - powered ships, with bonded marine fuel consumption projected to reach 28 - 30 million tonnes. In terms of domestic trade ship fuel, the "road - to - water" policy continues to boost demand for ship fuel, with alternative fuel penetration trailing foreign trade, and the consumption of domestic trade ship fuel showing a stable and slightly increasing trend.

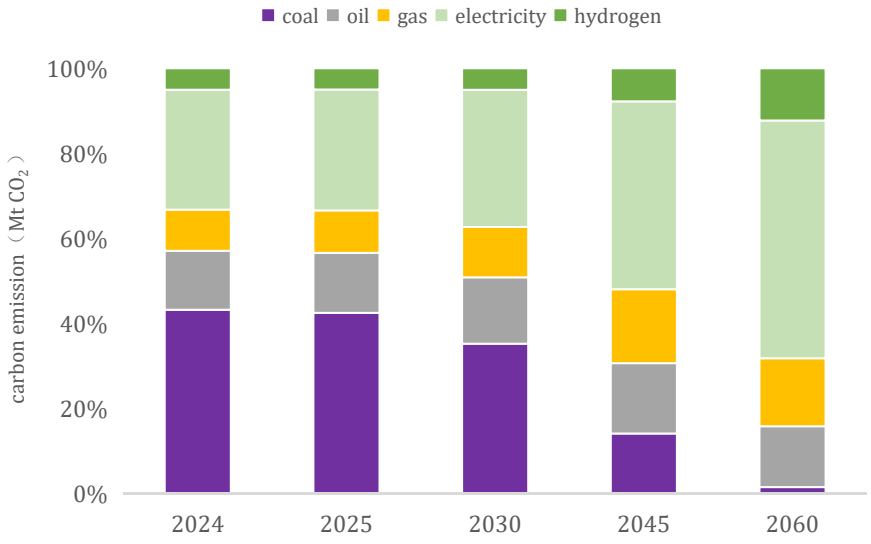
Industry Sector In the near to medium term, the new energy manufacturing industry and the commercialization of new energy will create additional energy demand. Both energy consumption and carbon emissions in the industry sector are expected to enter a plateau phase around 2025

Projections of total energy consumption and carbon emissions in the industrial sector



Total energy consumption	2290	2960	3040	2950	2710	2440	2160	1940	1760
Total carbon emissions associated with energy activities	6022	6983	6668	5876	4791	3651	2671	1765	1095

Forecast of energy consumption mix in the industrial sector



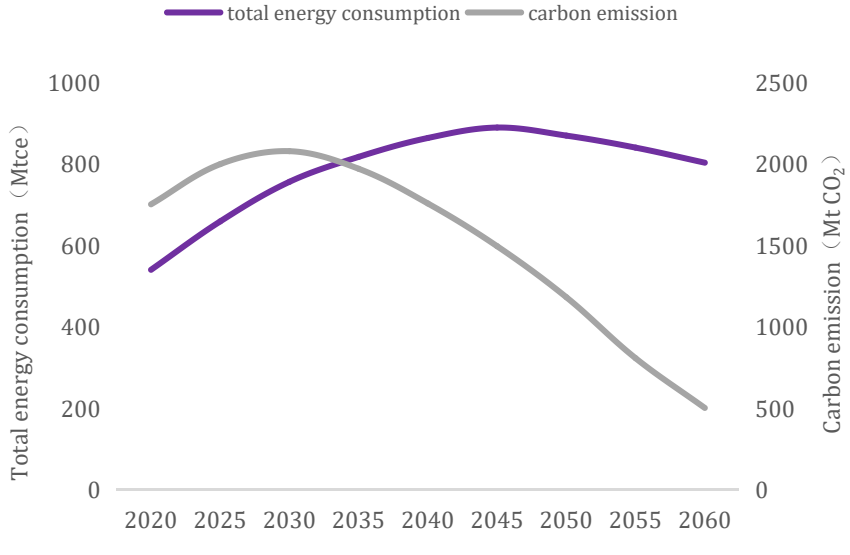
Coal ratio	43%	42%	35%	14%	1%
Electricity ratio	28%	28%	32%	44%	56%

The industry sector is the largest consumer of final energy and the biggest carbon emitter in China. In 2024, it consumed 2.86 2.86 Btce, accounting for 67% of the nation's total final energy consumption, while emitting 6.93 billion tonnes of CO_2 (65% of the total energy-related carbon emissions). Both industrial carbon emissions and energy consumption are projected to peak before 2030. Post-peak, these metrics will decline steadily, falling to 1.76 Btce and 56% of national totals by 2060.

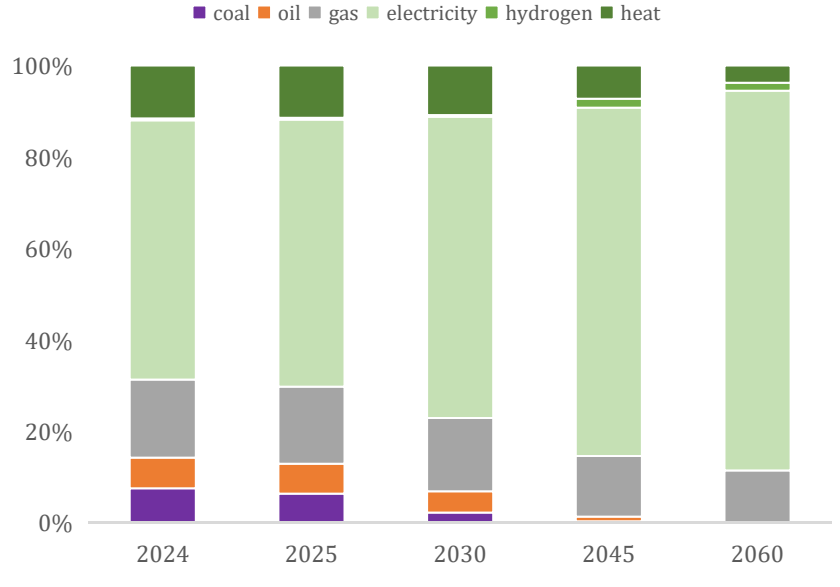
- **Throughout the outlook period, the energy transition of China's industry sector can be divided into three stages.** The first is the growth and peak period (2024-2030), during which the energy-related carbon emissions of the industry sector will peak at the start of the 15th Five-Year Plan. Total energy consumption will plateau during the period, and the growth contribution rates of electricity, chemical oil, and natural gas are projected to be approximately 90%, 50%, and 40% respectively. The second is the substitution and adjustment period (2031-2040), during which its energy consumption will decline at an average annual rate of 1%. The third is the reduction and greening period (2041 - 2060), when the average annual decline in energy consumption of the industry sector will increase to more than 2%, hydrogen is the only energy type with growing consumption, and the rate of electrification and hydrogenation is expected to increase from 46% to 68%.
- **The new energy manufacturing industry and the commercialization of new energy are important factors driving industrial energy consumption growth in the near to medium term.** From an industry-wide perspective, between 2024 and 2030, the energy consumption demand from the new energy manufacturing industry represented by solar cells, lithium batteries, and new energy vehicles, as well as the commercialization of new energy represented by green hydrogen and ammonia, is expected to climb significantly at an average annual rate of 10%. The proportion of energy consumption in the total energy consumption of the industry sector will increase from 5.2% to 8.6%, contributing up to 56% to the growth of the total energy consumption in the industry sector.
- **Large-scale equipment renewal plays a critical role in curbing the growth of energy consumption in the industry sector and advancing energy conservation efforts in the near to medium term.** In March 2024, the State Council promulgated the "Action Plan for Promoting Large-Scale Equipment Renewal and Consumer Goods Replacement," implementing four major actions: equipment renewal, consumer goods replacement, recycling, and standard enhancement. These actions are conducive to promoting continuous upgrades in energy-saving and carbon reduction levels from the source, thereby curbing the high peak of energy consumption in the industry sector.

Buildings Sector AI empowers a new revolution in productivity, providing a strong engine for the continuous growth of energy consumption in the buildings sector

Projections of energy consumption and total carbon emissions in the buildings sector



Forecast of the energy mix in the buildings sector



Total energy consumption	533	660	755	816	862	888	868	839	802
Total carbon emissions associated with energy activities	1776	1999	2122	2009	1791	1520	1192	806	500

Electricity consumption/PWh	2.9	3.1	4.0	5.5	5.4
Electricity ratio	57%	59%	66%	76%	83%

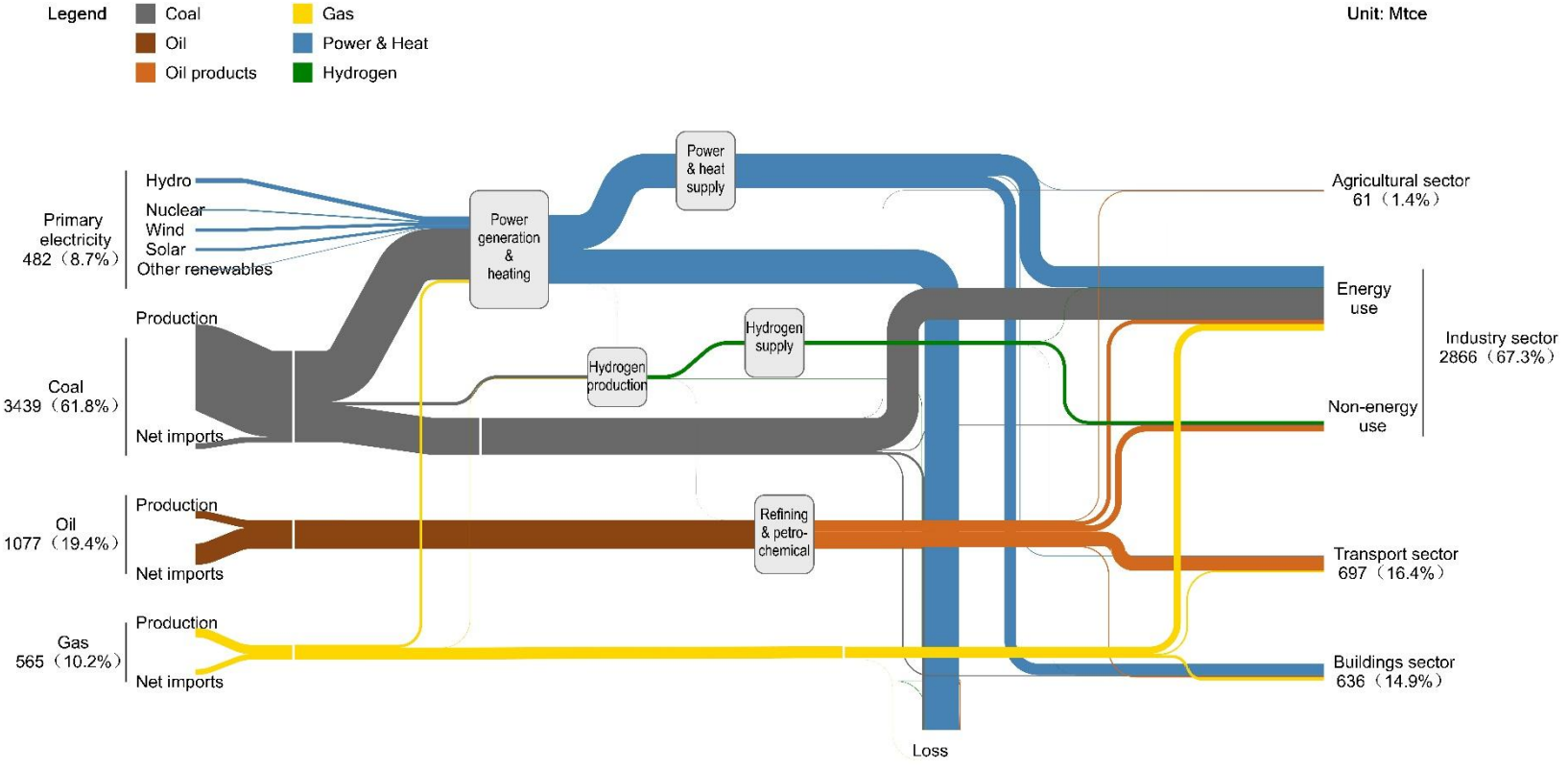
In 2024, the total energy consumption of China's buildings sector reached 640 Mtce, accounting for 15% of the total terminal energy consumption, with an electrification rate of 57%; the total carbon emissions related to energy in the buildings sector increased to 1.99 billion tonnes, accounting for 19% of the total energy-related carbon emissions in China. It is expected that China's buildings sector will achieve carbon peak around 2030 and total energy consumption peak around 2045, but the proportion of energy consumption and carbon emissions in the buildings sector will both show an increasing trend.

- **Looking at the industry, digital transition is driving the development of the tertiary industry, and urbanization is bringing about an improvement in people's welfare. These factors jointly drive the growth of energy consumption in the buildings sector in the near to medium term.** It is expected that between 2024 and 2030, the added value of China's tertiary industry will grow by nearly 50%, driving the energy consumption of commercial buildings from 235 Mtce to 313 Mtce, contributing more than 65% to the growth of the total energy consumption in the buildings sector. It is expected that between 2024 and 2030, China will add more than 60 million urban residents, driving the growth of residential building energy consumption by 42 Mtce.
- **In terms of energy - type categorization, electrification is the primary path of of energy transition in the buildings sector, making electricity the key factor driving energy consumption growth.** From 2024 to 2030, the electricity consumption of the buildings sector is expected to increase from less than 3 PWh to more than 4 PWh, contributing up to 115% to the growth of the total energy consumption. Meanwhile, thanks to the further coverage and interconnection of natural gas pipelines. The consumption of natural gas in the buildings sector will also enter its final growth phase, increasing from 81.5 to 91 Bcm and contributing about 11% to the growth of the total energy consumption in the buildings sector.
- **Looking into the long term, to meet people's aspirations for a better life, it is expected that the buildings sector will be the final sector with the slowest decline and the smallest reduction after energy consumption peaks.** It is expected that around 2045, the per capita energy consumption and the total electricity consumption of the buildings sector will peak, and then remain at a high level of more than 680 kilograms of standard coal and about 5.5 PWh, respectively. This will result in an average annual decline of less than 1% in the total energy consumption of the buildings sector from 2045 to 2060, with a total reduction of less than 10%.

Chapter 9 Appendix

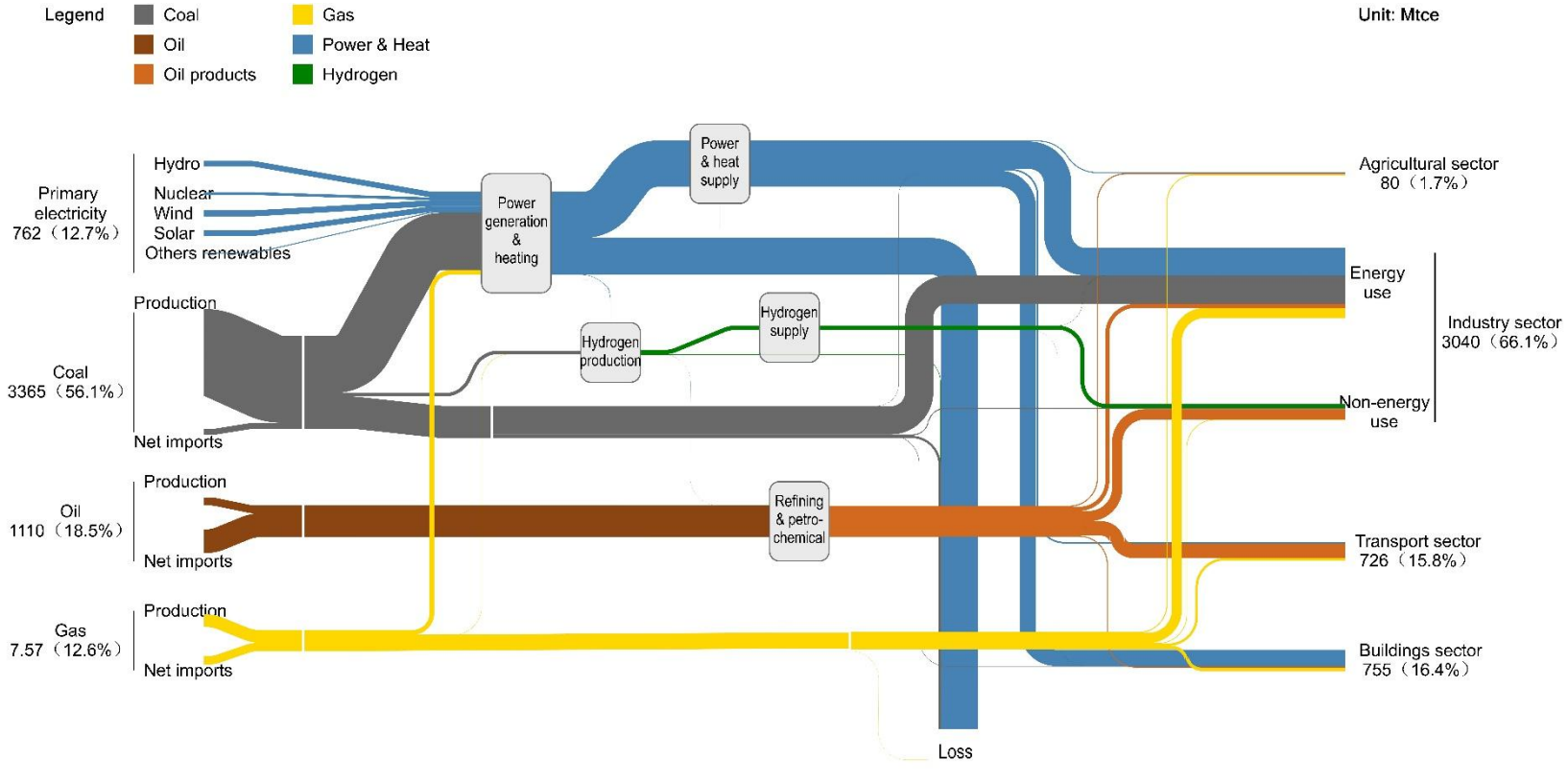
- **Energy Sankeys**
- **Carbon Sankeys**
- **Data Tables**
- **Additional Notes**

Energy Sankey of China in 2024



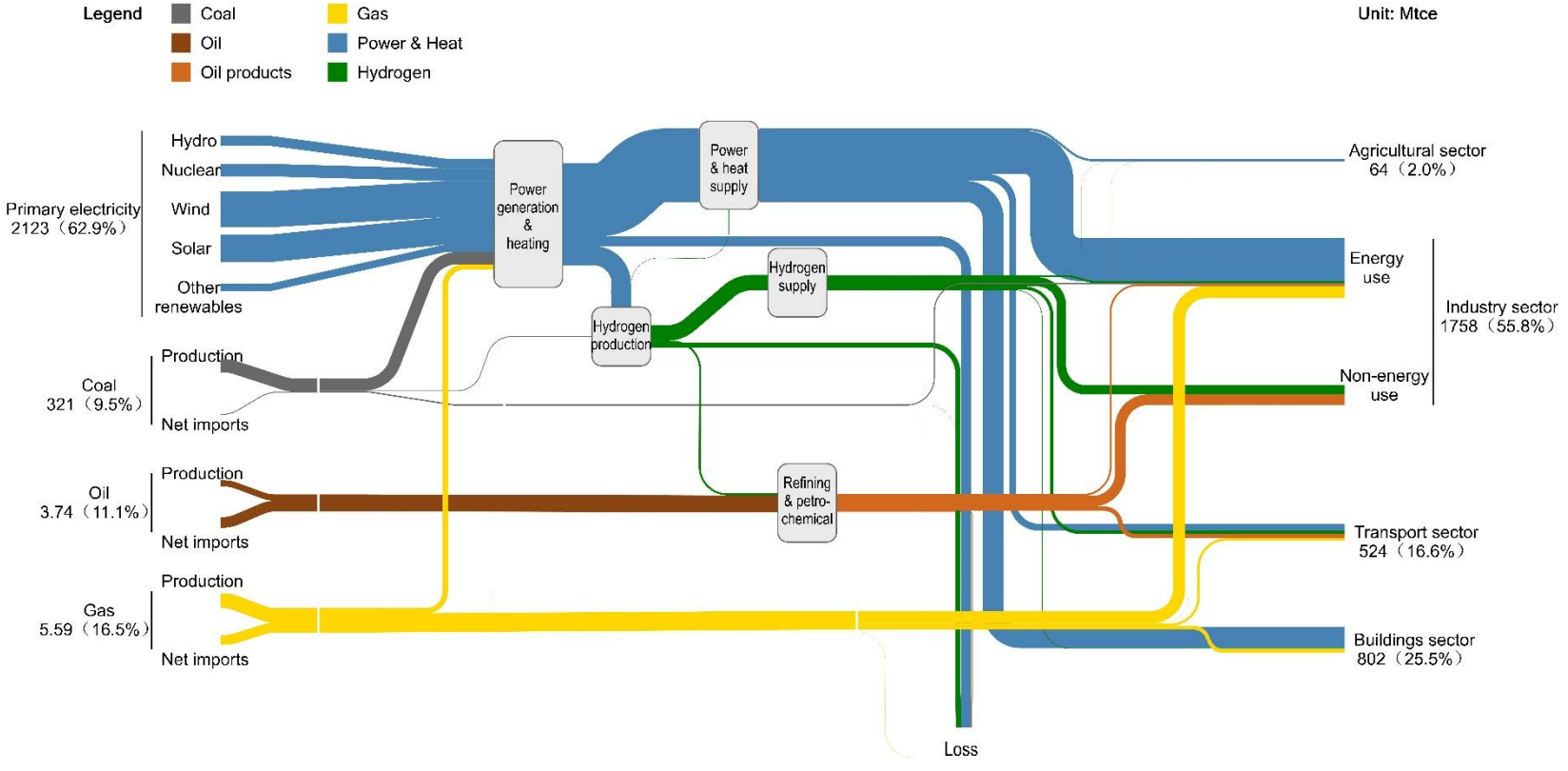
The figure is drawn using data from the CDS.

Energy Sankey of China in 2030



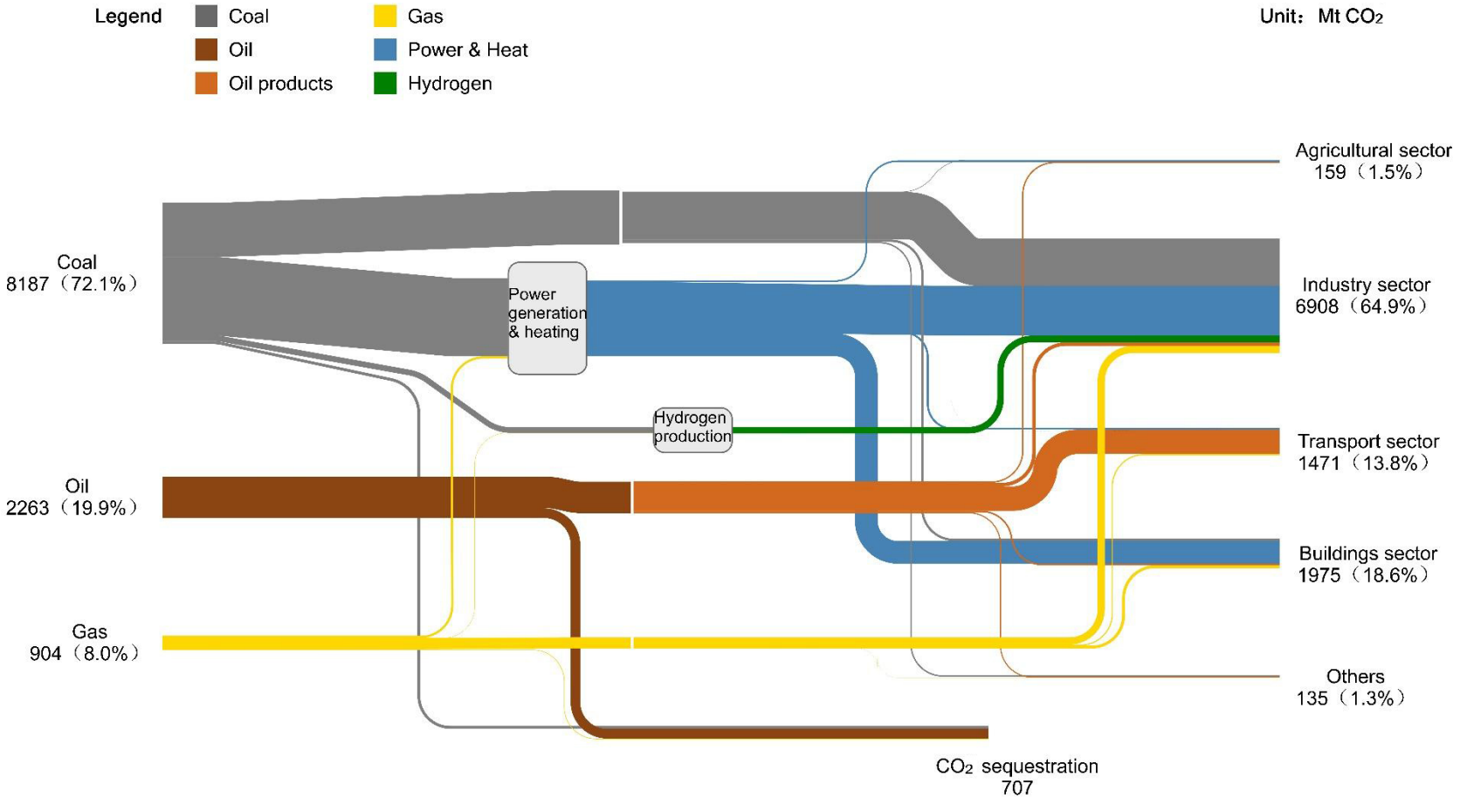
The figure is drawn using data from the CDS.

Energy Sankey of China in 2060

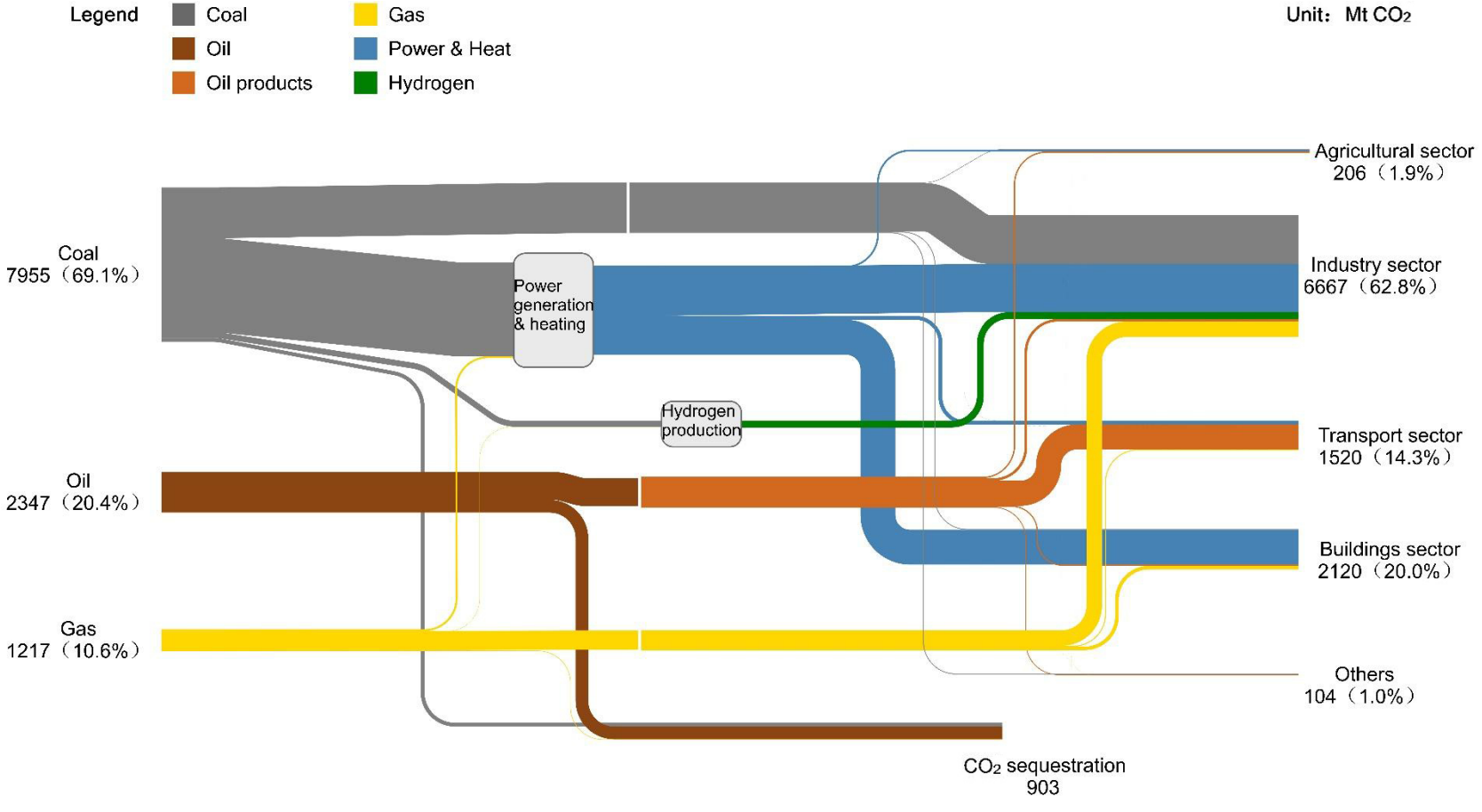


The figure is drawn using data from the CDS.

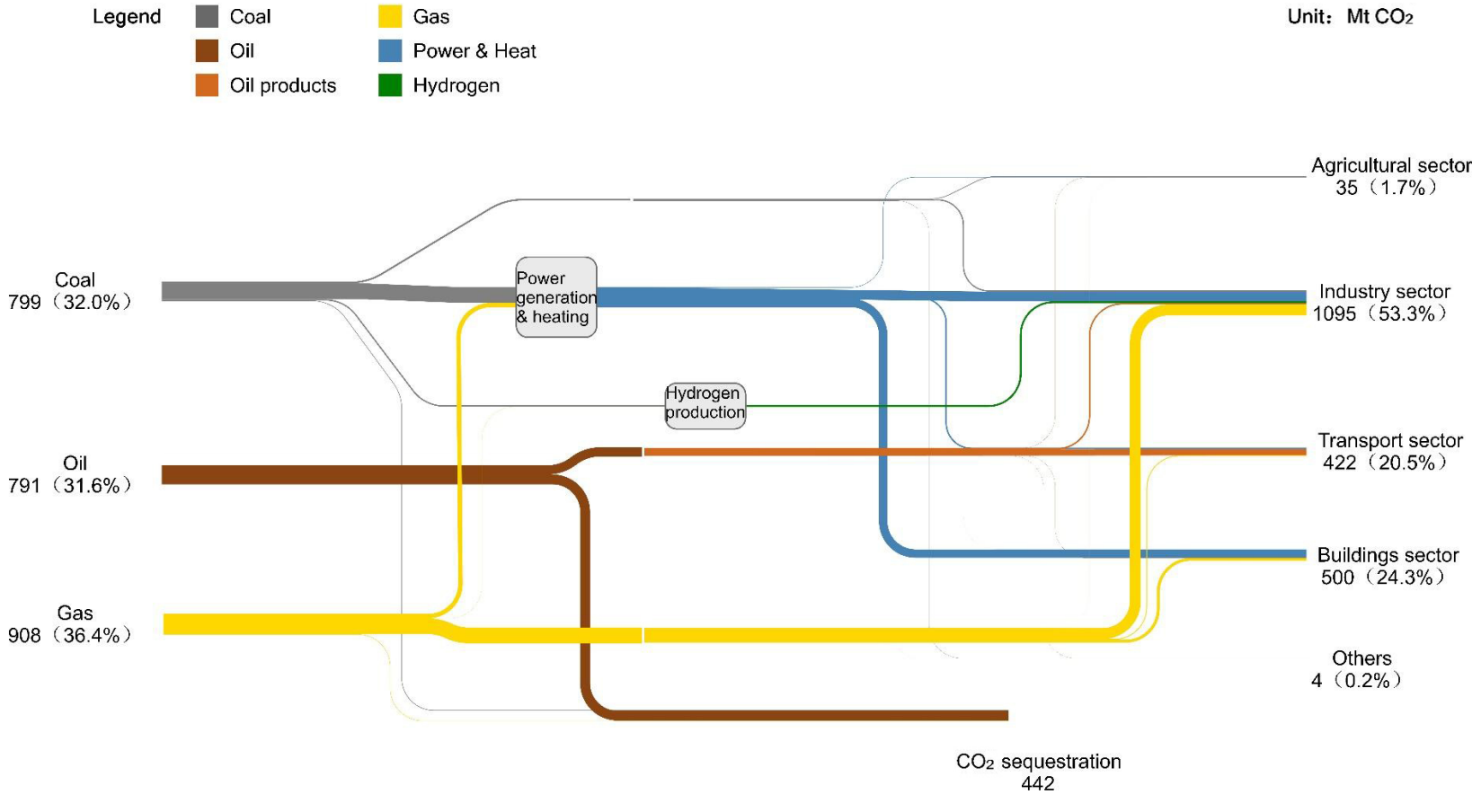
Carbon Sankey of China in 2024



Carbon Sankey of China in 2030



Carbon Sankey of China in 2060



Data Table for China's Primary Energy Consumption (CDS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal	Mt	4048.6	4814.0	4851.9	4711.5	4058.4	3246.1	2441.5	1706.7	988.1	450.0
Oil	Mt	677.8	753.8	769.8	777.2	705.3	621.6	534.4	425.2	345.7	261.8
Natural Gas	Bcm	329.2	424.5	452.0	569.0	606.0	620.0	595.0	550.0	490.0	420.0
Coal	*Mtce*	*2834.0*	*3217.2*	*3242.5*	*3148.7*	*2746.1*	*2223.6*	*1672.4*	*1169.1*	*676.9*	*308.3*
Oil	*Mtce*	*936.8*	*1035.7*	*1060.0*	*1072.5*	*973.3*	*857.8*	*737.5*	*586.8*	*477.1*	*361.2*
Natural Gas	*Mtce*	*418.1*	*526.6*	*562.1*	*712.8*	*762.6*	*784.1*	*756.5*	*704.2*	*632.1*	*541.8*
Hydropower	*Mtce*	*415.4*	*429.7*	*425.1*	*483.5*	*505.1*	*506.9*	*499.7*	*496.0*	*493.9*	*495.6*
Nuclear power	*Mtce*	*112.2*	*135.9*	*143.7*	*237.6*	*321.5*	*387.2*	*450.2*	*518.0*	*582.3*	*635.3*
Wind power	*Mtce*	*143.1*	*300.5*	*351.8*	*515.9*	*790.0*	*1034.1*	*1277.2*	*1480.2*	*1687.8*	*1840.6*
Solar power	*Mtce*	*80.0*	*252.9*	*334.3*	*514.5*	*735.1*	*943.8*	*1110.7*	*1219.2*	*1305.6*	*1400.4*
Others	*Mtce*	*43.6*	*63.3*	*67.8*	*89.1*	*104.0*	*123.8*	*146.7*	*182.5*	*254.8*	*379.5*
Total	Mtce	4983.1	5960.0	6187.3	6774.6	6937.7	6861.3	6651.0	6356.0	6110.5	5962.6
Share of Non-fossil	/	15.9%	19.8%	21.4%	27.2%	35.4%	43.7%	52.4%	61.3%	70.8%	79.7%

Data Table for China's Primary Energy Consumption (SCS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal	Mt	4048.6	4814.0	4860.0	4880.0	4260.0	3520.0	2730.0	2000.0	1230.0	610.0
Oil	Mt	677.8	753.8	769.8	782.2	719.8	648.2	577.9	482.4	411.2	331.8
Natural Gas	Bcm	329.2	424.5	460.0	577.0	620.0	635.0	621.0	590.0	540.0	470.0
Total	Mtce	4983.1	5960.0	6182.5	6770.7	6848.8	6706.1	6451.2	6170.7	5922.8	5771.5
Share of Non-fossil	/	15.9%	19.8%	20.9%	25.2%	30.7%	37.4%	45.3%	54.0%	64.0%	74.3%

Data Table for China's Primary Energy Consumption (GDS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal	Mt	4048.6	4814.0	4800.0	4460.0	3730.0	2876.9	2102.1	1392.3	790.0	380.0
Oil	Mt	677.8	753.8	769.8	769.3	691.0	600.1	506.8	387.5	307.2	221.8
Natural Gas	Bcm	329.2	424.5	450.0	562.0	600.0	590.0	553.0	510.0	450.0	380.0
Total	Mtce	4983.1	5960.0	6195.0	6836.2	7116.0	7066.1	6869.1	6585.3	6316.2	6155.2
Share of Non-fossil	/	15.9%	19.8%	21.5%	30.5%	40.5%	49.8%	58.6%	67.5%	75.8%	83.1%

Data Table for China's Carbon Emissions Related to Energy Activities (CDS)

Unit: Mt CO_2	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Total emissions before carbon sinks	9414.1	10646.9	10763.4	10673.0	9540.8	8060.4	6402.6	4842.6	3291.8	2055.9
By Source										
Coal	7071.0	7983.3	8041.3	7792.9	6820.3	5524.0	4151.9	2924.6	1693.5	775.9
Oil	1666.2	1790.4	1788.5	1689.5	1446.8	1229.3	993.2	750.9	553.8	383.7
Gas	676.9	873.3	933.7	1190.6	1273.6	1307.1	1257.5	1167.2	1044.6	896.4
By Sector										
Power	3803.0	4474.2	4504.6	4901.1	4640.8	4057.3	3383.5	2626.8	1640.6	837.8
Agricultural	134.3	158.7	167.3	206.2	203.3	177.8	140.8	103.2	64.0	34.6
Industry	6022.0	6907.7	6983.3	6686.3	5876.2	4791.2	3651.4	2671.1	1765.5	1095.2
Transport	1326.9	1470.6	1482.3	1519.9	1364.7	1224.2	1060.4	863.9	639.6	421.8
Buildings	1736.5	1975.1	1998.7	2121.6	2008.6	1791.0	1520.3	1192.2	805.6	499.9

Data Table for China's Final Energy Consumption (CDS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal	Mt	1535.8	1817.6	1842.6	1518.0	1180.8	814.8	487.4	235.7	100.1	37.9
Oil	Mt	660.1	749.2	763.6	777.2	705.3	621.6	534.4	425.2	345.7	261.8
Natural Gas	Bcm	260.1	337.7	354.2	431.9	465.4	480.7	461.4	426.2	378.5	321.6
Electricity	PWh	7.5	9.8	10.4	12.8	14.5	15.3	15.9	15.9	15.8	15.4
Hydrogen	Mt	31.4	35.8	36.6	38.7	41.2	46.6	54.4	62.6	65.5	75.1
Coal	*Mtce*	*1097.0*	*1298.3*	*1316.2*	*1084.3*	*843.5*	*582.0*	*348.2*	*168.4*	*71.5*	*27.0*
Oil	*Mtce*	*943.1*	*1070.3*	*1090.9*	*1110.3*	*1007.6*	*888.0*	*763.5*	*607.5*	*493.9*	*374.0*
Natural Gas	*Mtce*	*346.0*	*449.1*	*471.1*	*574.5*	*619.0*	*639.4*	*613.7*	*566.9*	*503.4*	*427.7*
Electricity	*Mtce*	*924.3*	*1209.9*	*1277.2*	*1577.9*	*1776.0*	*1882.2*	*1949.3*	*1959.4*	*1940.6*	*1887.8*
Hydrogen	*Mtce*	*128.8*	*146.8*	*150.1*	*158.6*	*169.0*	*191.1*	*222.9*	*256.6*	*268.3*	*308.0*
Thermal & Other uses	*Mtce*	*64.8*	*82.0*	*83.8*	*96.1*	*99.5*	*101.2*	*99.4*	*99.4*	*106.3*	*123.1*
Total	Mtce	3503.8	4256.3	4389.3	4601.7	4514.5	4283.8	3996.9	3658.1	3383.9	3147.5

Data Table for China's Final Energy Consumption in Agricultural Sector (CDS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal	Mt	22.5	15.1	14.2	10.9	8.2	5.5	3.3	2.0	1.5	1.0
Oil	Mt	17.7	22.8	24.1	26.3	24.2	19.3	13.5	7.8	3.9	2.0
Natural Gas	Bcm	1.3	2.3	2.3	2.8	3.1	3.6	4.0	4.3	4.5	4.7
Electricity	PWh	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.5	0.5	0.5
Hydrogen	Mt	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.4
Coal	*Mtce*	*16.1*	*10.8*	*10.2*	*7.8*	*5.9*	*3.9*	*2.3*	*1.4*	*1.1*	*0.7*
Oil	*Mtce*	*25.2*	*32.5*	*34.4*	*37.5*	*34.5*	*27.6*	*19.3*	*11.2*	*5.6*	*2.9*
Natural Gas	*Mtce*	*0.2*	*0.3*	*0.3*	*0.4*	*0.4*	*0.5*	*0.5*	*0.6*	*0.6*	*0.6*
Electricity	*Mtce*	*9.6*	*17.1*	*19.6*	*34.6*	*44.1*	*50.5*	*53.7*	*55.9*	*57.3*	*58.1*
Hydrogen	*Mtce*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.3*	*0.6*	*1.0*	*1.5*	*1.8*
Total	Mtce	51.1	60.7	64.5	80.2	85.0	82.8	76.5	70.2	66.1	64.1

Data Table for China's Final Energy Consumption in Industry Sector (CDS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal	Mt	1404.9	1735.7	1770.0	1483.9	1162.3	803.8	480.5	231.6	97.2	36.0
Oil	Mt	219.3	277.4	291.9	334.4	331.9	307.0	282.6	240.5	212.3	176.2
Natural Gas	Bcm	155.8	209.6	219.8	270.9	309.8	331.1	319.0	294.2	258.3	211.4
Electricity	PWh	5.2	6.5	6.8	8.0	8.7	8.8	8.8	8.6	8.3	8.0
Hydrogen	Mt	31.0	35.1	35.9	37.8	39.9	42.5	46.3	50.7	49.4	52.7
Coal	*Mtce*	*1003.5*	*1239.8*	*1264.3*	*1060.0*	*830.2*	*574.1*	*343.2*	*165.4*	*69.4*	*25.7*
Oil	*Mtce*	*313.3*	*396.3*	*417.0*	*477.7*	*474.2*	*438.5*	*403.7*	*343.6*	*303.3*	*251.7*
Natural Gas	*Mtce*	*207.2*	*278.8*	*292.3*	*360.3*	*412.1*	*440.4*	*424.2*	*391.3*	*343.5*	*281.2*
Electricity	*Mtce*	*640.0*	*803.3*	*840.1*	*987.6*	*1067.7*	*1084.1*	*1078.2*	*1052.1*	*1025.6*	*983.3*
Hydrogen	*Mtce*	*126.9*	*144.0*	*147.3*	*154.7*	*163.7*	*174.2*	*189.6*	*207.6*	*202.6*	*215.8*
Total	Mtce	2290.9	2862.2	2961.0	3040.3	2947.9	2711.4	2438.9	2160.0	1944.4	1757.8

Data Table for China's Final Energy Consumption in Transport Sector (CDS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Oil	Mt	394.6	419.1	417.5	392.0	330.9	283.2	232.0	175.9	129.5	83.6
Natural Gas	Bcm	32.7	46.3	50.8	69.7	64.3	58.6	53.5	48.7	44.3	41.3
Electricity	PWh	0.1	0.2	0.3	0.5	0.7	0.9	1.1	1.4	1.5	1.5
Hydrogen	Mt	0.0	0.0	0.0	0.2	0.6	1.6	3.7	6.7	11.0	18.6
Ammonia	Mt	0.0	0.0	0.0	0.0	0.0	0.0	1.9	3.8	13.6	24.3
Methanol	Mt	2.2	3.5	3.6	4.5	7.1	12.9	15.9	18.9	24.3	33.6
Biomass	Mt	2.8	4.0	4.0	7.4	8.8	10.9	14.6	20.1	25.3	34.7
Synthetic Fuels	Mt	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4
Oil	*Mtce*	*563.7*	*598.7*	*596.4*	*560.0*	*472.7*	*404.6*	*331.4*	*251.3*	*185.0*	*119.4*
Natural Gas	*Mtce*	*43.5*	*61.6*	*67.6*	*92.7*	*85.5*	*77.9*	*71.2*	*64.8*	*58.9*	*54.9*
Electricity	*Mtce*	*15.7*	*28.5*	*31.1*	*58.2*	*86.6*	*112.3*	*140.6*	*169.5*	*180.6*	*180.2*
Hydrogen & Hydrogen-derived fuels	*Mtce*	*1.7*	*2.8*	*3.0*	*4.5*	*7.8*	*16.5*	*28.9*	*44.5*	*72.8*	*118.1*
Biomass & synthetic fuels	*Mtce*	*4.0*	*5.8*	*5.9*	*10.8*	*12.8*	*15.8*	*21.4*	*29.5*	*37.3*	*51.2*
Total	Mtce	628.6	697.4	704.0	726.2	665.5	627.2	593.5	559.7	534.6	523.9

Data Table for China's Final Energy Consumption in Buildings Sector (CDS)

	Units	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal	Mt	108.3	66.7	58.3	23.2	10.3	5.4	3.6	2.0	1.3	0.7
Oil	Mt	28.6	29.8	30.1	24.6	18.3	12.1	6.3	1.0	0.0	0.0
Natural Gas	Bcm	71.5	81.6	83.4	91.0	91.0	90.6	88.5	82.9	75.5	68.4
Electricity	PWh	2.1	2.9	3.1	4.0	4.7	5.2	5.5	5.5	5.5	5.4
Hydrogen	Mt	0.4	0.7	0.7	0.7	0.7	2.5	4.2	5.0	4.6	3.4
Coal	*Mtce*	*77.4*	*47.6*	*41.7*	*16.5*	*7.3*	*3.8*	*2.5*	*1.4*	*0.9*	*0.5*
Oil	*Mtce*	*40.9*	*42.6*	*43.0*	*35.1*	*26.1*	*17.3*	*9.0*	*1.4*	*0.0*	*0.0*
Natural Gas	*Mtce*	*95.1*	*108.5*	*110.9*	*121.0*	*121.0*	*120.6*	*117.8*	*110.3*	*100.4*	*91.0*
Electricity	*Mtce*	*259.1*	*361.1*	*386.4*	*497.6*	*577.5*	*635.3*	*676.8*	*681.9*	*677.0*	*666.1*
Hydrogen	*Mtce*	*1.8*	*2.7*	*2.7*	*2.8*	*2.9*	*10.1*	*17.4*	*20.5*	*19.0*	*14.0*
Thermal	*Mtce*	*59.0*	*73.5*	*75.2*	*81.8*	*81.2*	*75.3*	*64.5*	*52.8*	*41.4*	*30.2*
Total	Mtce	533.3	636.0	659.8	754.9	816.1	862.4	888.0	868.2	838.7	801.7

Data Table for China's Power Supply-Demand Prediction (CDS)

Unit: PWh	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Total electricity consumption	7.5	9.9	10.4	13.0	15.0	16.5	17.6	18.3	18.6	18.9
Coal-fired Power Generation	4.6	5.5	5.6	6.0	5.8	5.3	4.5	3.6	2.2	1.1
Gas-fired Power Generation	0.3	0.3	0.4	0.6	0.6	0.6	0.6	0.5	0.5	0.4
Hydro Power Generation (including pumped storage)	1.4	1.4	1.4	1.6	1.7	1.8	1.8	1.8	1.8	1.8
Nuclear Power Generation	0.4	0.5	0.5	0.8	1.1	1.3	1.6	1.9	2.1	2.3
Wind Power Generation	0.5	1.0	1.2	1.7	2.7	3.6	4.5	5.3	6.1	6.7
Solar Power Generation	0.3	0.8	1.1	1.7	2.5	3.3	3.9	4.4	4.7	5.1
Other Power Generation	0.3	0.5	0.5	0.6	0.6	0.7	0.7	0.8	1.1	1.5

Data Table for China's Power Generation Installed Capacity Forecast (CDS)

Unit: GW	2020	2024	2025	2030	2035	2040	2045	2050	2055	2060
Coal-fired	1079	1190	1266	1580	1580	1501	1351	1148	919	600
Gas-fired	100	145	157	218	224	225	226	218	202	180
Hydro (including pumped storage)	370	436	453	610	672	682	692	702	712	712
Nuclear	50	61	65	110	142	175	207	242	275	300
Wind	282	521	640	925	1364	1826	2221	2528	2823	3000
Solar	254	887	1115	1720	2375	3035	3501	3793	3998	4200
Other	66	109	118	160	180	192	201	208	229	270
Total	2200	3349	3814	5323	6537	7635	8399	8839	9157	9262

Additional Notes

● Energy Forecasting Model

The forecasting framework adopts a hybrid methodology integrating top-down macroeconomic analysis with bottom-up sectoral energy demand modeling.

Top-Down Macroeconomic Control utilizing key macroeconomic indicators—including GDP growth, demographic trends, industrial composition, and urbanization rates—this approach systematically evaluates energy consumption patterns. Through econometric analysis of these drivers, the model project aggregate energy demand trajectories aligned with macroeconomic development scenarios.

Bottom-Up Sectoral Forecasting conduct granular analysis across four primary energy-consuming sectors: agriculture, manufacturing, transport, and buildings. By establishing sector-specific energy intensity functions that account for technological evolution, policy impact, and behavioral factors, the model generates detailed energy consumption projections.

The STIRPAT model, DEA model, elasticity coefficients, logistic regression, and time series analysis are employed in forecasting.

● Carbon Emission Calculations

Using the emission factor method, the carbon emissions associated with energy activities are the sum of the product of various fossil energy consumption and its emission factor.

$$E_{CO_2} = \sum ADi \times EFi$$

ADi represents the consumption of fossil energy such as coal, oil, natural gas, etc., and this report deducts the part of fossil energy consumption that is used as raw material and has the role of carbon sequestration; EFi represents the carbon dioxide emission factor of various fossil energy sources

● Standard Coal Equivalent Conversion Coefficient

Energy	Average Net Calorific Value	Conversion Coefficient
Raw coal	20,908 kJ/kg	0.7143 kgce/kg
Coke	28,435 kJ/kg	0.9714 kgce/kg
Crude oil	41,816 kJ/kg	1.4286 kgce/kg
Gasoline	43,070 kJ/kg	1.4714 kgce/kg
Diesel	42,652 kJ/kg	1.4571 kgce/kg
Natural gas	38,931 kJ/cbm	1.33 kgce/cbm
Electricity	3,600 kJ/kWh	0.1229 kgce/kWh
Heat	-	0.0341 kgce/MJ
Hydrogen	120,000 kJ/kg	4.0985 kgce/kg

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