

壳牌能源远景

Shell Scenarios *Sketch*

ACHIEVING A CARBON-NEUTRAL ENERGY SYSTEM IN CHINA BY 2060

中国能源体系2060碳中和

2015

2025

2035

2045

2055

2060

Mallika Ishwaran, Georgios Bonias

Chief Economist, Senior Energy Analyst
Shell Scenarios, Group Strategy, Shell International

www.shell.com/scenarios
#ShellScenarios



**LENSES ON ENERGY TRANSITIONS
REGIONAL AND COUNTRY**

Uncertainties Ahead: 未来的不确定性

This scenario starts with data from Shell's Sky scenario. In developing this scenario, we have assumed that China's energy system reaches net-zero CO₂ by 2060, consistent with President Xi Jinping's statement to the United Nations General Assembly in September 2020. We then worked backwards to see how this could occur. Of course, there are many possible paths for China to travel to a net-zero CO₂ energy system, but this is what we believe to be a technically possible path while maintaining a growing Chinese economy. While this scenario is more aggressive in its goal and assumptions than our Sky scenario, we believe, while extremely challenging it is still today technically possible. However, we believe the window for success is quickly closing and without significant action it may take longer for China to achieve a net-zero CO₂ energy system.

Shell scenarios, including this scenario, should not be confused with Shell strategy or business plan. When developing Shell's strategy, our scenarios are only one variable among many that we consider. Ultimately, whether society meets its goals to decarbonise, is not within Shell's control. While we intend to travel this journey in step with society, only governments can create the framework for success. Shell's operating plan, outlook and budgets are forecasted for a 10-year period and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next 10 years. Accordingly, Shell's operating plans, outlooks, budgets and pricing assumptions do not reflect our net-zero emissions target. In the future, as society moves towards net-zero emissions, we expect Shell's operating plans, outlooks, budgets and pricing assumptions to reflect this movement.

The companies in which Royal Dutch Shell plc directly and indirectly owns are separate legal entities. In this report "Shell", "Shell Group" and "Royal Dutch Shell" are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to Royal Dutch Shell plc and its subsidiaries in general or to those who work for them. These terms are also used where no useful purpose is served by identifying the particular entity or entities. "Subsidiaries", "Shell subsidiaries" and "Shell companies" as used in this report to refer to entities over which Royal Dutch Shell plc either directly or indirectly has control. Entities and unincorporated arrangements over which Shell has joint control are generally referred to as "joint ventures" and "joint operations" respectively. Entities over which Shell has significant influence, but neither control nor joint control, are referred to as "associates". The term "Shell interest" is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in an entity or unincorporated joint arrangement, after exclusion of all third-party interest. This report contains forward-looking statements (within the meaning of the U.S. Private Securities Litigation Reform Act of 1995) concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as "aim", "ambition", "anticipate", "believe", "could", "estimate", "expect", "goals", "intend", "may", "objectives", "outlook", "plan", "probably", "project", "risks", "schedule", "seek", "should", "target", "will" and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this report, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, or delays or advancements in the approval of projects and delays in the reimbursement for shared costs; (m) risks associated with the impact of pandemics, such as the COVID-19 (coronavirus) outbreak; and (n) changes in trading conditions. No assurance is provided that future dividend payments will match or exceed previous dividend payments. All forward-looking statements contained in this report are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Royal Dutch Shell's Form 20-F for the year ended December 31, 2020 (available at www.shell.com/investor and www.sec.gov). These risk factors also expressly qualify all forward-looking statements contained in this report and should be considered by the reader. Each forward-looking statement speaks only as of the date of this report January 17, 2022. Neither Royal Dutch Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this report. We may have used certain terms, such as resources, in this report that the U.S. Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website www.sec.gov.

Shell's operating plans and budgets do not reflect Shell's net-zero Emissions target. Shell's aim is that, in the future, its operating plans and budgets will change to reflect this movement towards its new net-zero Emissions target. However, these plans and budgets need to be in step with the movement towards a net-zero Emissions economy within society and among Shell's customers.

Why scenarios? 为什么要做能源远景分析?

Stretch mindsets for better-informed decisions

Help to improve judgment in the face of radical uncertainties

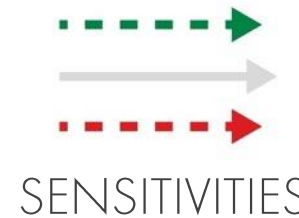
The present



The path



The future



A carbon-neutral China energy system by 2060

中国能源体系2060碳中和

什么需要改变

**What needs
to change**

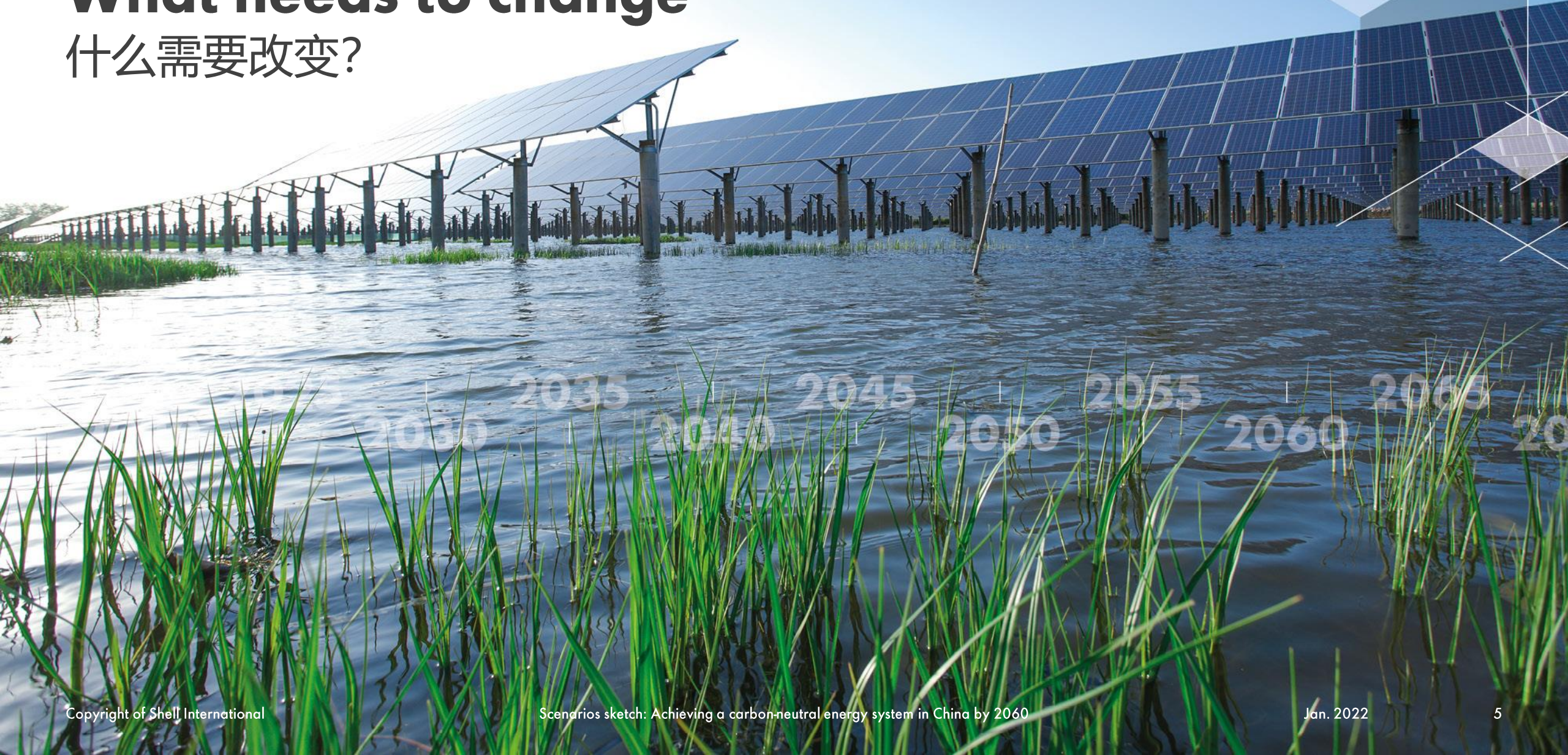
2060碳中和能源体系
**A carbon-neutral
energy system
by 2060**

如何推动进步

**How to make
progress**

What needs to change

什么需要改变?



Fundamental change in how energy is produced and consumed

能源生产和消费方式需要彻底改变

ACCELERATE CLEAN TECHNOLOGIES AND FUELS

- Increase electrification with low-carbon energy
- Commercialise new fuels: hydrogen, advanced bioenergy

SUPPORT ENERGY-EFFICIENT AND LOW-CARBON CHOICES

- Realise full energy efficiency potential
- Ramp up carbon pricing using market and regulatory mechanisms

REMOVE CARBON EMISSIONS

- Deploy carbon capture, utilisation and storage (CCUS) at scale, including negative emissions through BECCS
- Determine additional role for natural carbon sinks

With infrastructure investment to support more and early action



ACCELERATE
CLEAN
TECHNOLOGIES
AND FUELS

加快发展清洁技术

SUPPORT ENERGY-
EFFICIENT AND
LOW-CARBON
CHOICES

支持高能效和低碳选择



REMOVE
CARBON
EMISSIONS

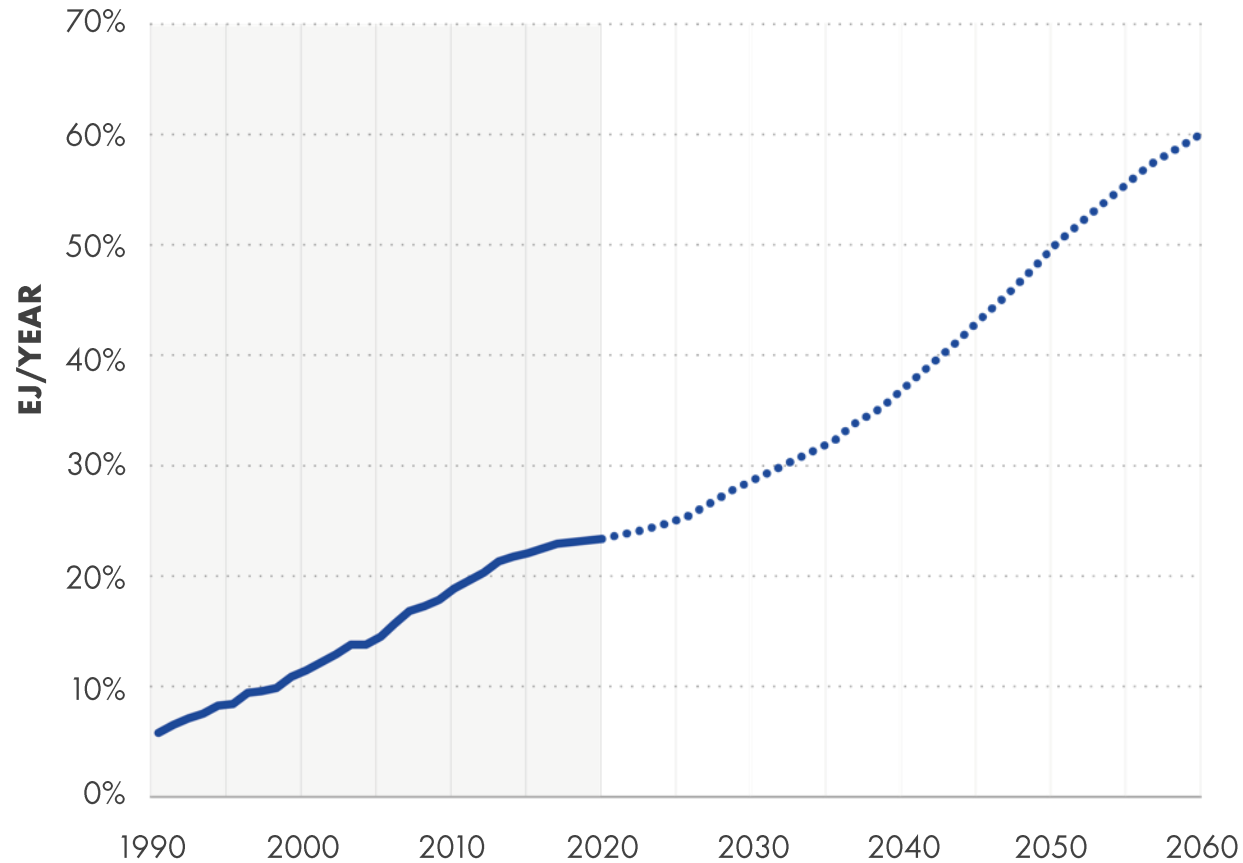
实施碳移除



Rewire China's economy

中国经济电气化

China - Electricity as a % of final energy use



Source: Shell analysis based on historical IEA data

Copyright of Shell International

Scenarios sketch: Achieving a carbon-neutral energy system in China by 2060

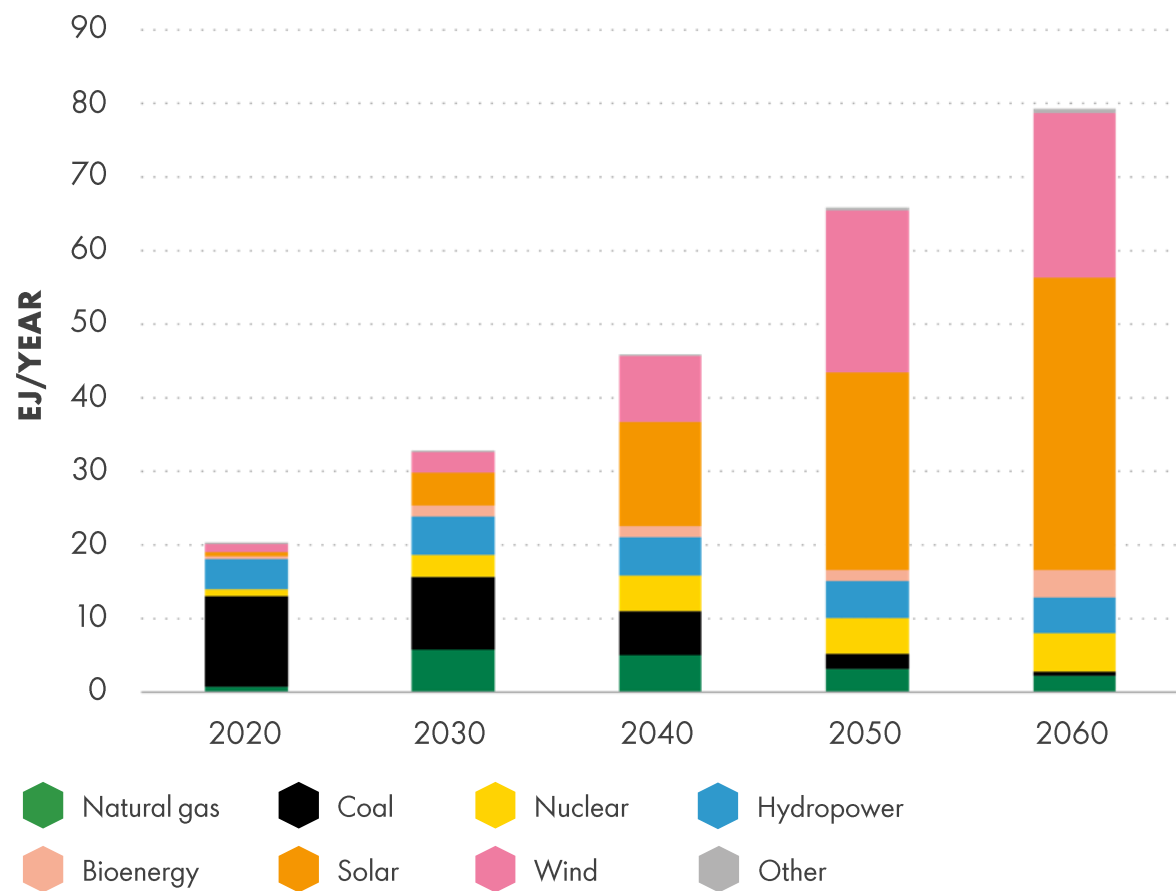


- Increase the size of the electricity system by almost four times today's size to meet demand for end use and to produce hydrogen
- Raise the already fast pace of electrification since 1990 – 6% per decade – to 9% in each of the next four decades
- Significantly expand power transmission and distribution infrastructure to connect demand centres to renewables-rich areas
- Upgrade to smart transmission and distribution networks

Use more and cleaner electricity

使用更多更清洁的电力

China - Electricity total final consumption, for end use and to produce hydrogen, by source



Source: Shell analysis based on historical IEA data

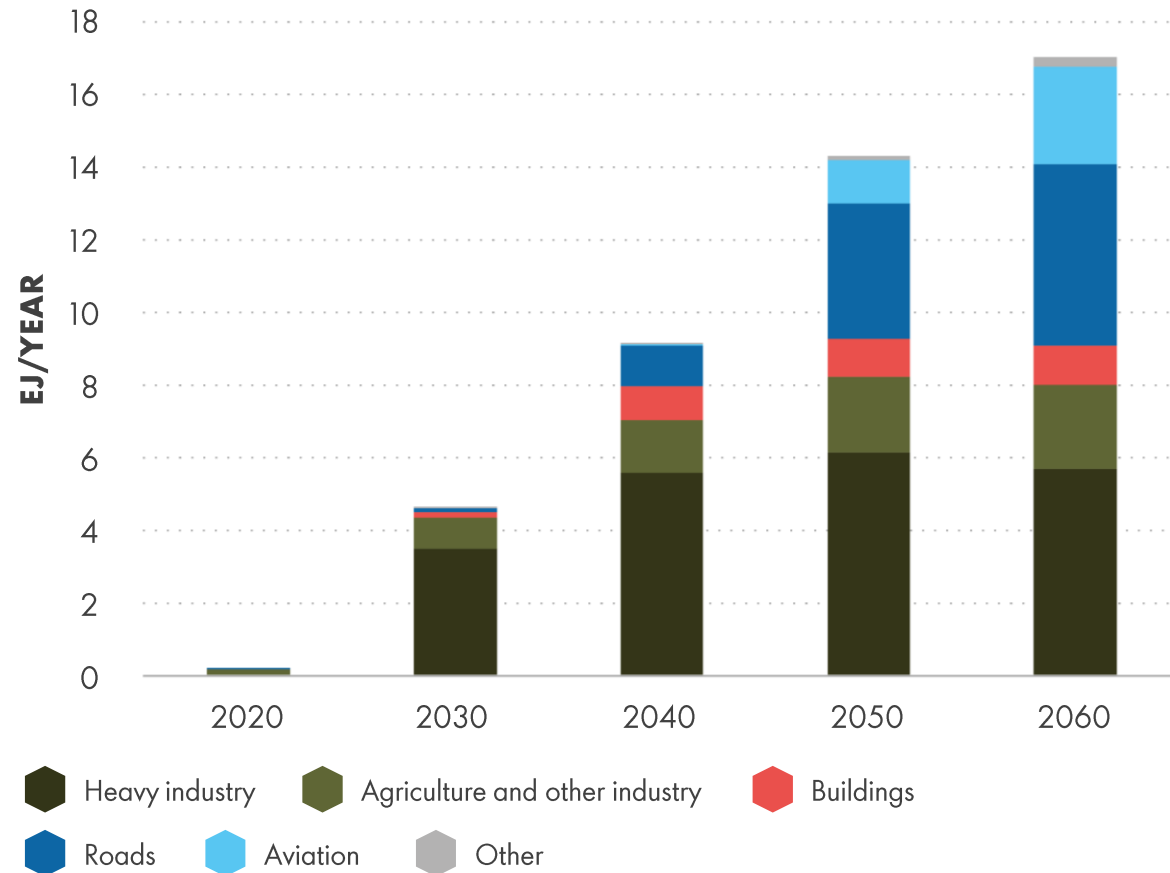


- Transform the electricity mix from fossil- to renewables-dominated
- In 2060, wind and solar are 80% of the generation mix; important roles for hydropower, nuclear and bioenergy with carbon capture and storage (BECCS)
- Phase down coal in the electricity system; any remaining fossil fuels fitted with CCUS
- Connect regional power markets to better manage variable renewables generation

Accelerate the commercialisation of hydrogen

加速氢能商业化

China - Hydrogen total final consumption, by sector



Source: Shell analysis based on historical IEA data

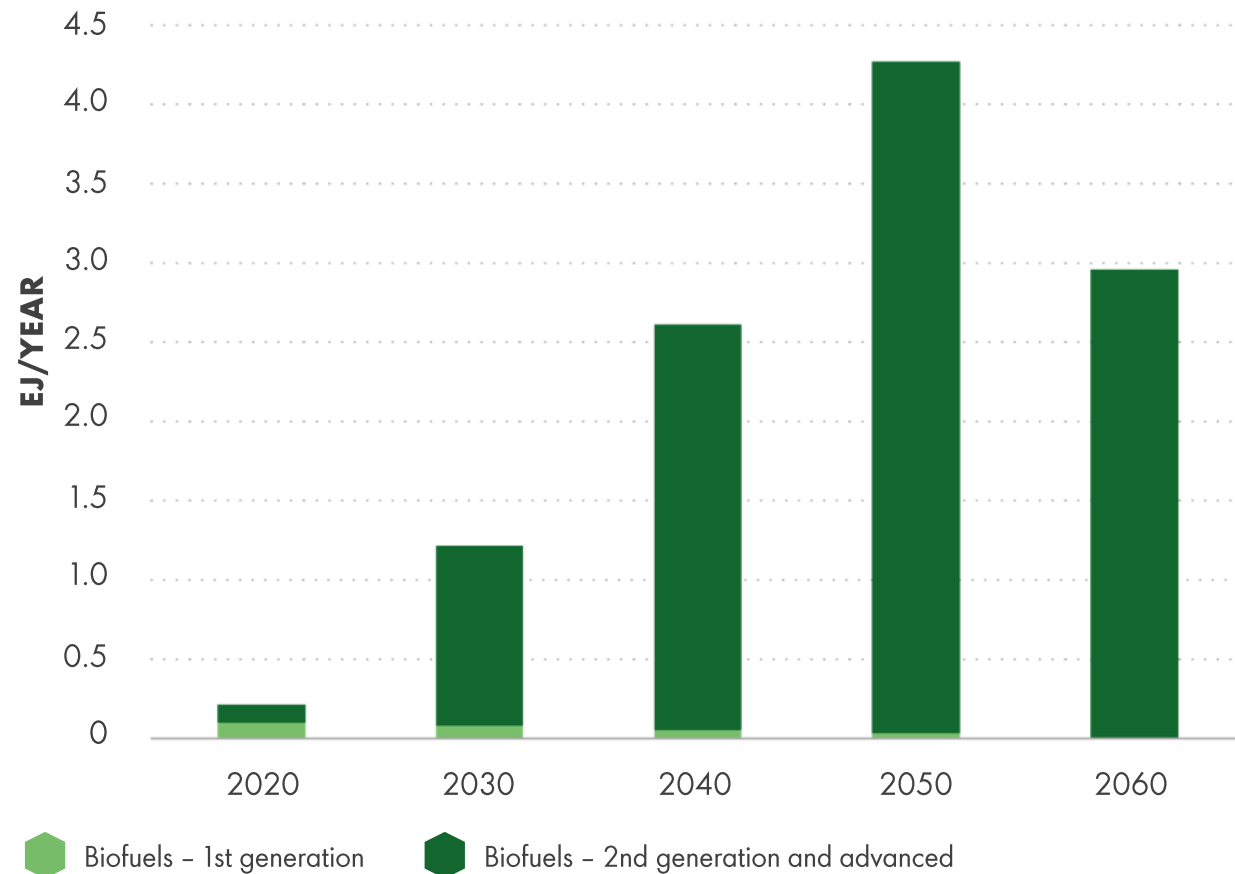


- Hydrogen 16% of final energy use in 2060, as a fuel for industry and long-distance transport
- Starting this decade, infrastructure investment is required to support the development of a hydrogen economy
- By 2050, hydrogen is the fuel on which almost 40% of the truck fleet kilometres are driven

The role of advanced biofuels

先进生物质燃料的作用

China - Biofuels total primary energy, by source



Source: Shell analysis based on historical IEA data

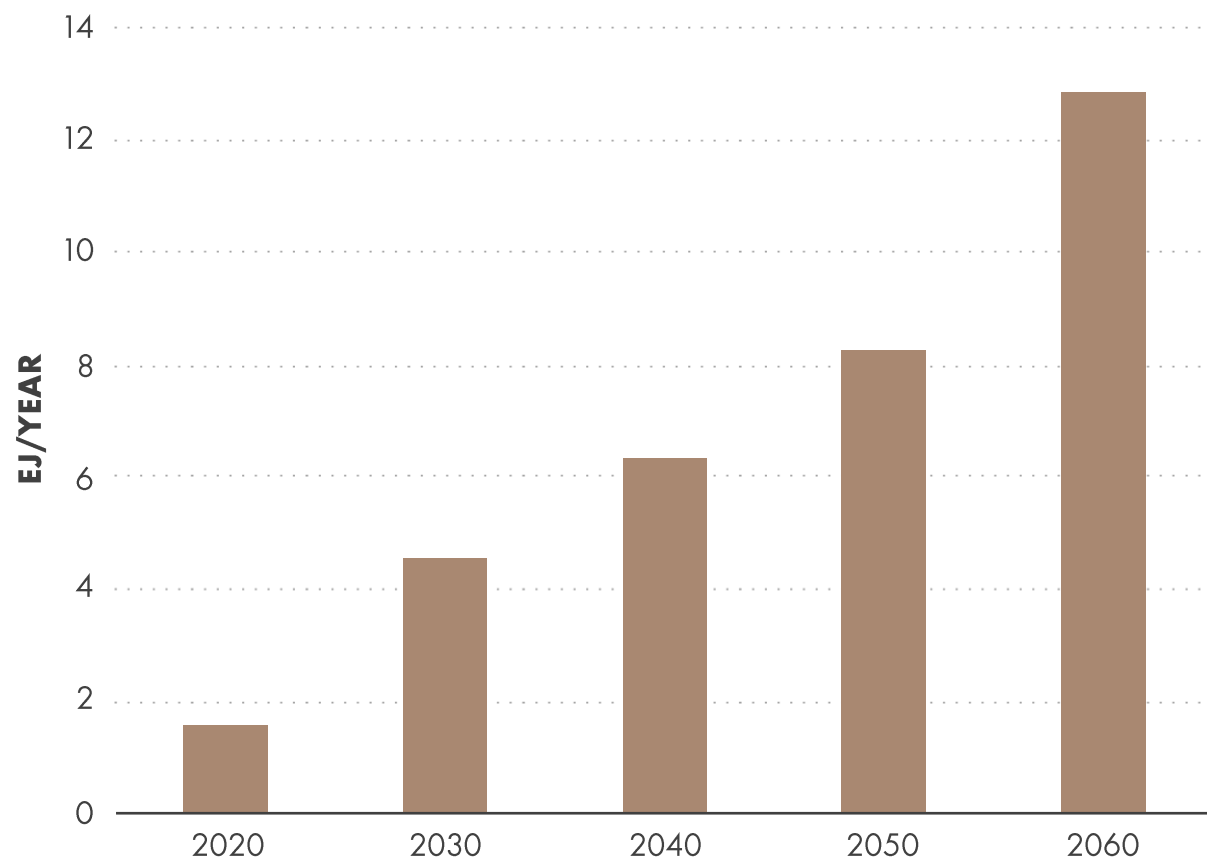


- Demand for biofuels increases to more than 4 EJ in the next 30 years, then declines due to greater electrification and hydrogen use
- Biofuels increasingly used for hard-to-abate sectors like aviation and chemicals
- Shift from 1st generation biofuels to more advanced biofuels

Increase modern biomass in the energy mix

在能源系统中增加现代生物质

China - Biomass total primary energy



Source: Shell analysis based on historical IEA data



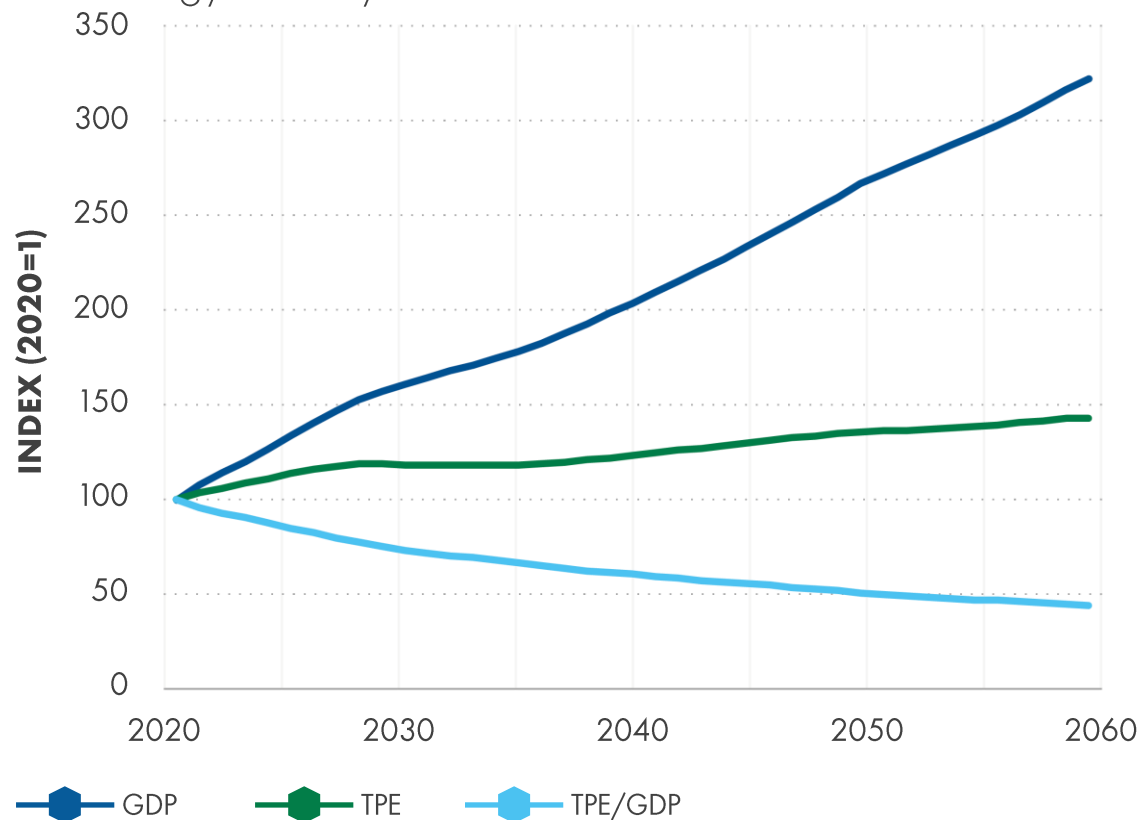
ACCELERATE CLEAN TECHNOLOGIES AND FUELS

- Significant sustainable biomass potential
- Almost eightfold increase in biomass use
- Use of residential biomass declines, while that of commercial biomass increases substantially, primarily in industry and power
- Large source of negative emissions through bioenergy with CCS (or BECCS)

Improve energy efficiency of the economy by >50% by 2060

经济的能源效率到2060年提高50%以上

Trends in gross domestic product (GDP), total primary energy (TPE) and energy intensity of GDP

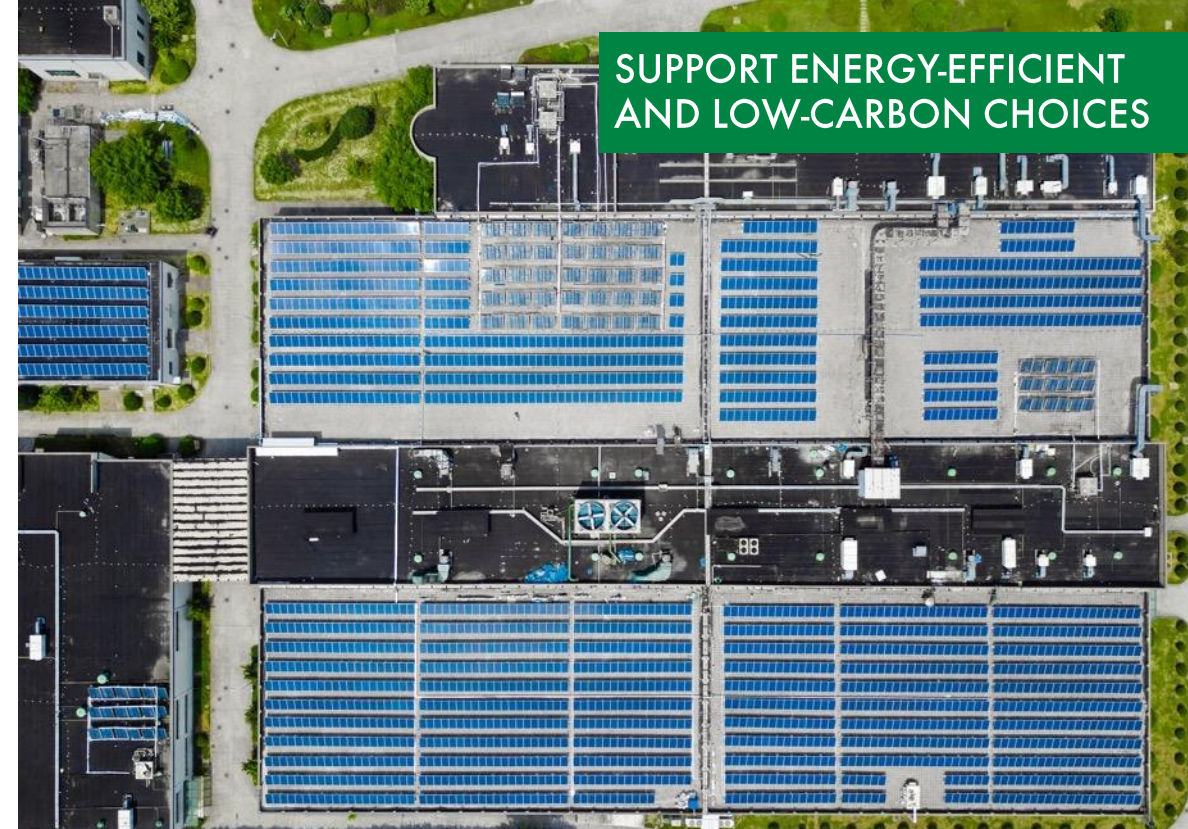


Source: Shell analysis

Copyright of Shell International

Scenarios sketch: Achieving a carbon-neutral energy system in China by 2060

SUPPORT ENERGY-EFFICIENT AND LOW-CARBON CHOICES

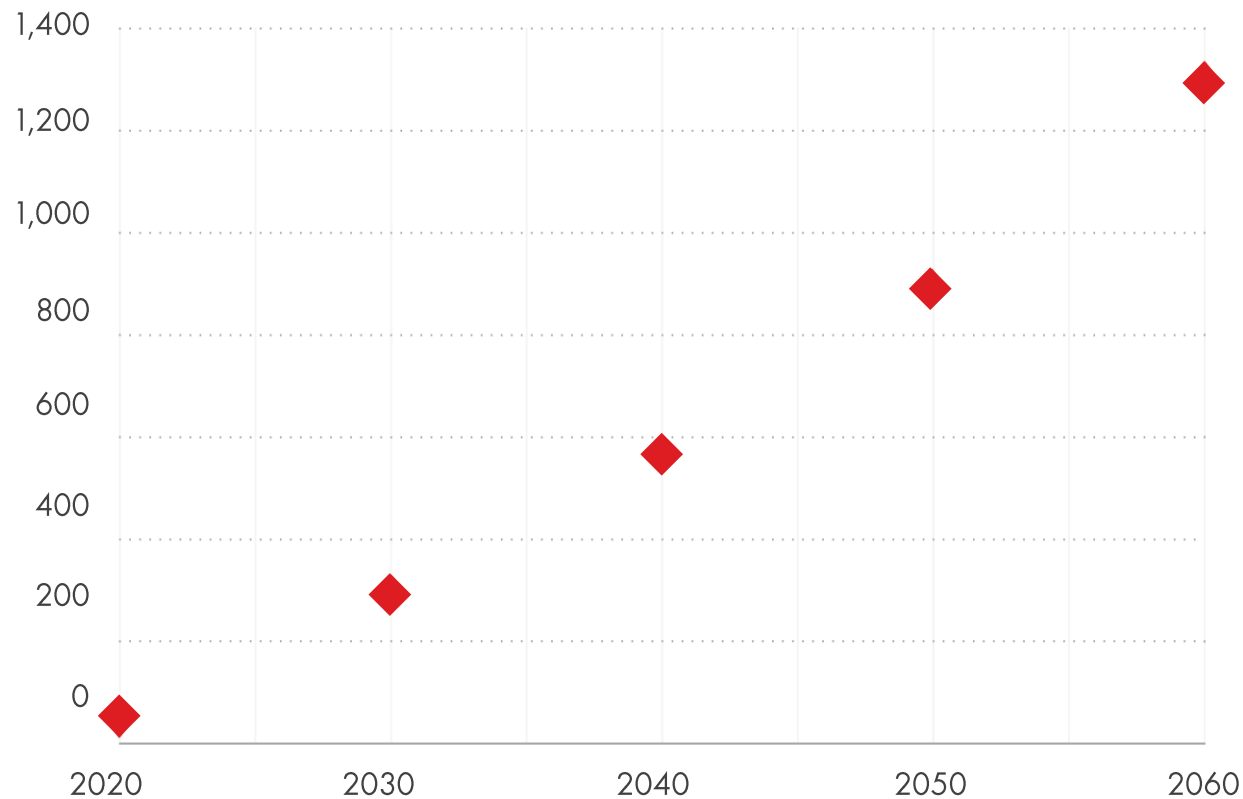


- China's primary energy demand has almost tripled since 2000, even as the economy grew fivefold
- Consequently, the energy intensity of GDP has declined by around 45% over the past 20 years
- Looking ahead, there is significant potential for further energy efficiency improvements
- Economic activity decouples relative to energy use, with GDP outpacing energy demand growth over the next 40 years

Carbon price is a key lever for change

碳价是变革的重要抓手

CNY/tonne CO₂



Source: Shell analysis

Copyright of Shell International

Scenarios sketch: Achieving a carbon-neutral energy system in China by 2060

SUPPORT ENERGY-EFFICIENT
AND LOW-CARBON CHOICES

- Progressively raise the government-led carbon price in China – slowly in the next decade, then more quickly to reach CNY 1,300/tCO₂e in 2060
- Carbon pricing drives the reallocation of capital and resources to support the commercialisation of new fuels and technologies
- Carbon pricing incentivises low-carbon consumer choices
- Carbon pricing is complemented with sectoral technology and infrastructure policies

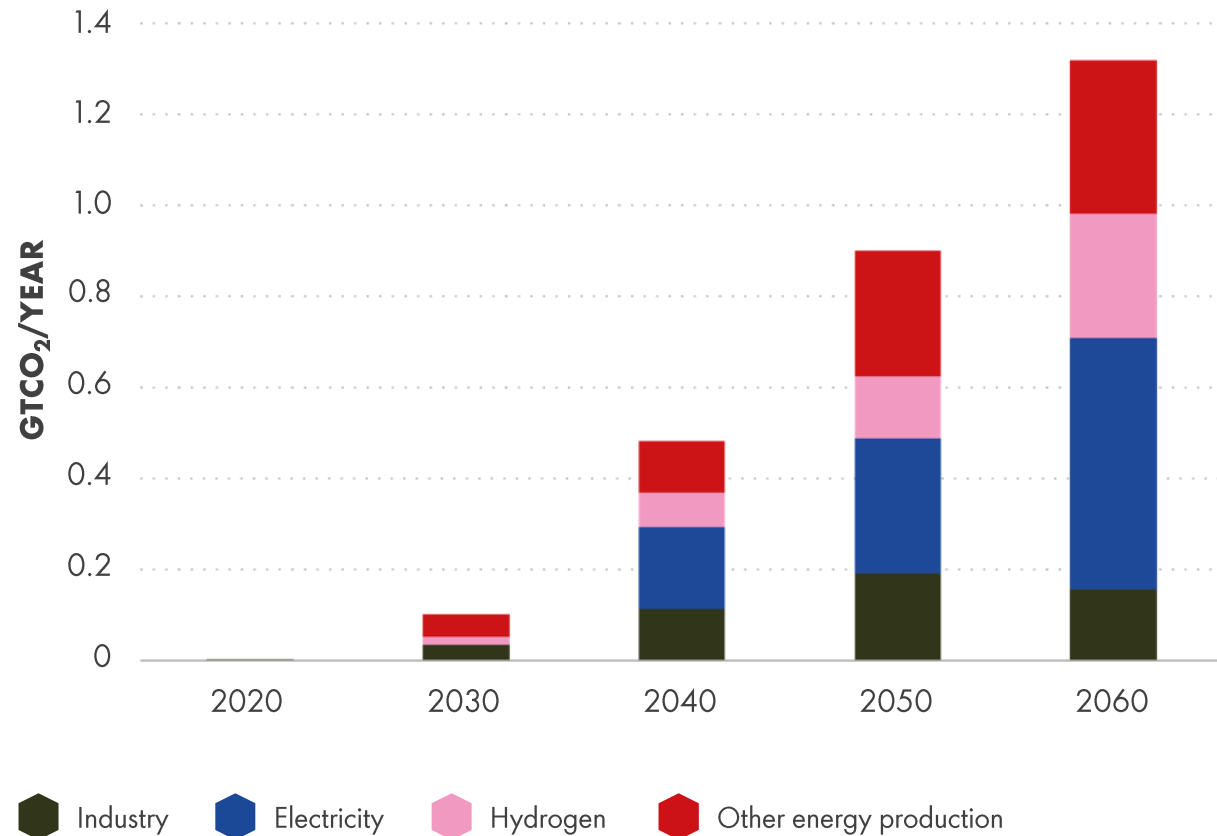
Jan. 2022

13

Deploy carbon capture, utilisation and storage at scale

规模发展碳捕集、利用和封存

CO₂ emissions captured by CCUS from all China energy



Source: Shell analysis

Copyright of Shell International

Scenarios sketch: Achieving a carbon-neutral energy system in China by 2060



- CCUS is essential for industrial processes, creating negative emissions from bioenergy power generation, blue hydrogen production and direct air capture
- Starting from 2025, build five major CCUS facilities in China every year until 2060 (each capturing more than 8 million tonnes per year)
- Utilisation of captured CO₂ is important, but eventually restricted to permanent (or near-permanent) storage

Determine the role of natural carbon sinks

发挥自然碳埋藏作用

- Additional lever to support China's 3060 targets
- They have the potential to reduce CO₂ emissions through reforestation by up to 1 Gt a year
- Use natural carbon sinks to mitigate emissions from fast-growing and hard-to-abate sectors – e.g. aviation and heavy industry – while they transition to net zero
- Monitoring, reporting and verification are important to ensure sinks are of the highest quality and do not undermine carbon mitigation efforts
- Build on the 14th Five-Year Plan target to increase forest and grassland vegetation coverage



A net-zero CO₂ emissions energy system in China

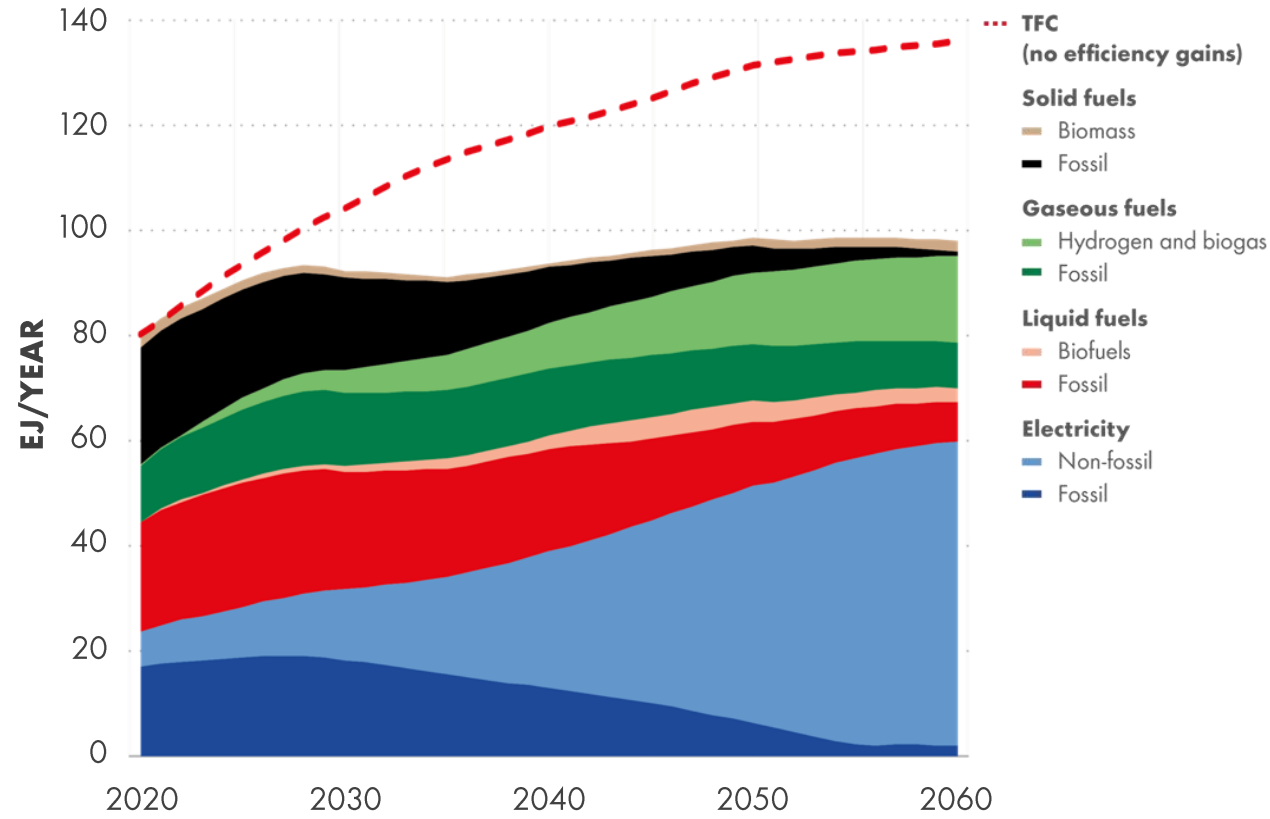
中国能源体系二氧化碳净零排放

2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070

Deep electrification, but molecules remain important

深度电气化，但是燃料仍然很重要

China - Total final consumption, electricity and fuels



Source: Shell analysis based on historical IEA data

Copyright of Shell International

Scenarios sketch: Achieving a carbon-neutral energy system in China by 2060

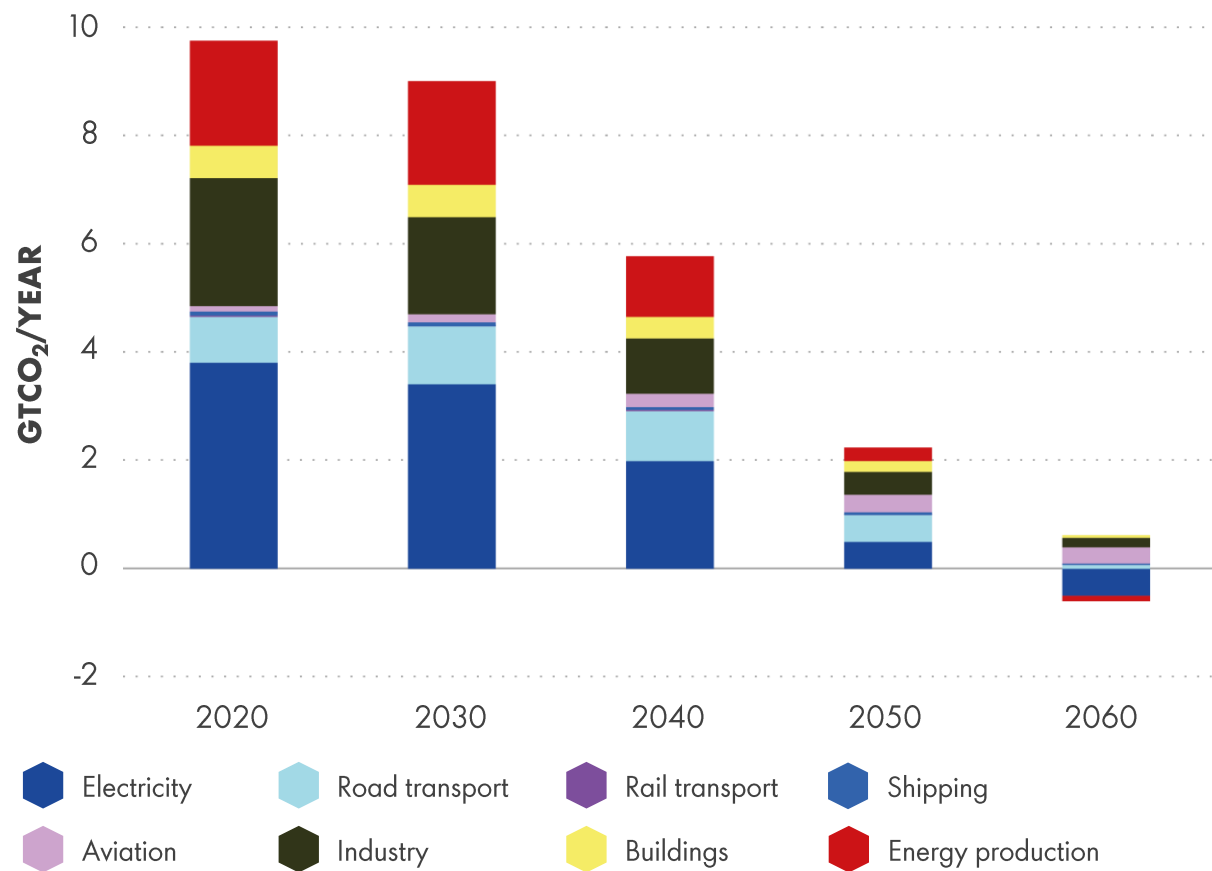


- Final energy demand is 39% lower, through significant energy efficiency gains
- Electricity share grows to almost 60% of energy use
- Molecular fuels meet remaining energy consumption, e.g. crude oil increasingly displaced by advanced biofuels, natural gas by hydrogen, and coal by solid biomass
- Any remaining fossil fuels are fitted with CCUS

Decline in energy CO₂ emissions

能源二氧化碳排放下降

China - CO₂ emissions from all energy, by point of emission



Source: Shell analysis based on historical IEA data



- New low-carbon industrial processes transform industry, e.g. green steel from clean hydrogen
- Emissions from transport decline drastically through electrification, hydrogen and advanced biofuels
- Carbon dioxide removals using carbon capture and storage (CCS) and negative emissions from bioenergy with CCS are needed for the hardest-to-abate emissions

How to make progress

如何推动进步



2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 | 2065 | 2070

Making progress towards carbon neutrality by 2060

向2060碳中和方向推进

Understand the impacts of transition 理解转型带来的影响

- on China's economy, at a regional level, on different sectors, on society, and wider international impacts on the Asia-Pacific region and the world

Making progress steadily and at pace requires enhancing the advantages and managing any disadvantages from the transition

In turn, this will require:

Effective policy frameworks to drive change 有效政策框架推动变革

- a combination of economy-wide policies, sectoral policies and social policies

Sectoral coalitions for action 行业联合行动

- public and private sector participants across the sectoral value chain, supported by government

Cities as incubators of change 城市做为变革的孵化器

- a microcosm of wider societal energy transition, illustrating the opportunities and challenges it presents



A net-zero CO₂ energy system in China by 2060

中国能源体系2060二氧化碳净零排放

ACTIONS TO MAKE PROGRESS THIS DECADE



INVEST in reliable, renewables-based electricity networks



POSITION China as market leader in low-carbon manufacturing



DEMONSTRATE technologies like hydrogen, bioenergy and CCUS that transform heavy industry



BEGIN an orderly transition out of coal



ACCELERATE action through integrated policies, sectoral coalitions, cities as incubators of change

FIND OUT MORE
发现更多

15 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 | 2065 | 2070

POWERING PROGRESS

Our plan for powering progress to a net-zero world can be explored at www.shell.com/powering-progress



Keep in touch

