Shell Scenarios Sketch

ACHIEVING A CARBON-NEUTRAL ENERGY SYSTEM IN CHINA BY 2060

LENSES ON ENERGY TRANSITIONS
REGIONAL AND COUNTRY

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OVERVIEW

The Shell Scenarios team has developed a possible pathway for China to achieve a carbon-neutral energy system before 2060, in line with President Xi Jinping's pledge to the United Nations General Assembly in September 2020. This is a highly challenging goal. China will need extensive reforms to decarbonise while meeting the energy needs of its expanding economy.

Still, we believe it is economically and technically possible for China to achieve its ambitions – if it acts swiftly with a goal-oriented approach. But the window for success is quickly closing. Without significant action taken before the end of this decade, it may well take longer for China to achieve a net-zero energy system.

This scenario sketch sets out a deep and rapid decarbonisation pathway which relies on electrifying as much of the economy as possible with low-carbon and no-carbon sources of power generation. Low-carbon hydrogen and biofuels will be needed for hard-to-electrify sectors. To realise its full potential for energy efficiency, China will also need to drive consumer and business choices towards low-carbon alternatives, while massively scaling up its carbon capture, utilisation and storage (CCUS) capacity.

Societal and policy preferences will determine how much effort is made to accelerate clean technologies and fuels; support choices based on energy efficiency and low-carbon emissions; and carbon removal. This may lead to variations in the pathway, but every scenario must still involve concerted action across all these fronts.

HOW TO MAKE PROGRESS

While the transition to a lower-carbon energy system in China is well under way, the pace of change over the next 40 years must accelerate.

Understand the impacts of the energy transition

A clear grasp of the macroeconomic, regional, sectoral, social and international effects of China's transition is critical to enhance its positive effects, while managing any negative impacts to achieve the depth and speed of decarbonisation required.

COMPREHENSIVE, COHERENT AND CREDIBLE POLICY FRAMEWORKS

Success will rely on a comprehensive policy framework to drive economy-wide change, accelerate sectoral transitions and create societal support. Industrial policy can play a transformative role in:

- promoting the development of new industries, such as the manufacture of solar panels, wind turbines, batteries and hydrogen electrolysers;
- developing low-carbon industrial processes and transforming heavy industry by, for instance, producing green steel by using hydrogen, applying CCUS to cement production facilities, and making chemicals with bioenergy; and
- developing supplies of and supply chains for low-carbon energies such as hydrogen and bioenergy; and developing low-carbon and digital consumer and business solutions.

Sectoral coalitions for action

Speeding up the pace of transition in hard-to-electrify sectors will require the entire sectoral ecosystem – energy suppliers, technology manufacturers, energy end users and infrastructure owners – to come together to pursue net-zero emission pathways.

Cities as incubators of change

Cities are crucial to China's energy transition; 75% of China's population is expected to be living in cities by mid-century. They are a microcosm of the wider societal energy transition, illustrating the opportunities and challenges it presents.

Shell Scenarios *sketch*

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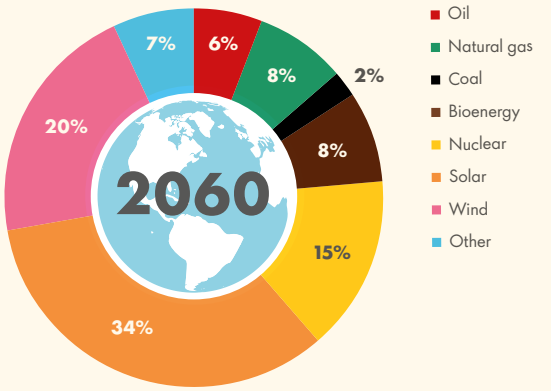
Changes in how energy is produced are matched by a transformation in how energy is consumed. There is large-scale electrification of end-use sectors such as buildings, passenger road transport and light industry. Difficult-to-electrify sectors are decarbonised with a combination of low-carbon fuels like clean hydrogen, advanced bioenergy and technologies like CCUS.

In this sketch, China achieves net-zero CO_2 emissions in its energy system by 2060, with all sectors getting as close to zero CO_2 emissions as possible. Any remaining emissions are mitigated by carbon removal technologies.

China's energy use transformation

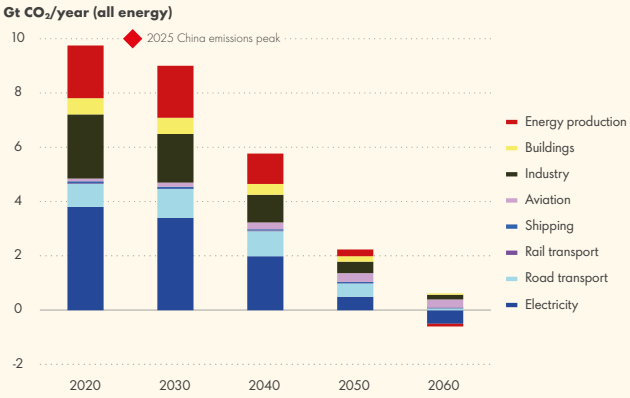
From fossil-dominated today to renewables-dominated in 2060



Source: Shell analysis based on historical IEA data

Decline in energy CO_2 emissions

China energy-related CO_2 emissions by sector



Source: Shell analysis based on historical IEA data

ACT QUICKLY

Five key areas for action in this decade:

1. Invest in reliable, renewables-based electricity networks.
2. Position China as the market leader in low-carbon manufacturing.
3. Demonstrate technologies that transform heavy industry through hydrogen, bioenergy and CCUS.
4. Begin an orderly transition out of coal.
5. Drive system-wide change through polices that integrate policy vision, alignment and coordination.

AREAS OF ACTION IN THE NEXT 40 YEARS

Accelerate clean technologies

1. Triple electricity generation for end use.
2. Quadruple the size of the electricity system for end use and hydrogen production.
3. Increase wind and solar's share of the energy mix to 80%.
4. Raise hydrogen's share of final energy consumption from negligible today to 16%.
5. Increase the use of bio-resources for energy eightfold and significantly raise the use of biomass commercially.

Support energy-efficient and low-carbon choices

6. Invest in energy efficiency improvements to halve the energy intensity of the economy over the next four decades.
7. Ramp up the government-led carbon price by at least fourfold between 2030 and 2060.

Remove carbon emissions

8. Scale up CCUS capacity by more than 400-fold in the next four decades.

In developing this scenario sketch, Shell has assumed that the energy system in China is carbon neutral by 2060 – consistent with President Xi Jinping's statement to the United Nations General Assembly in September 2020. The scenario starts with data from Shell's Sky scenario. It is rooted in stretching but realistic development dynamics today, but explores a goal-oriented way to achieve that ambition. We worked backwards in designing how this could occur, considering the realities of the situation today and taking into account realistic timescales for change. Although highly challenging in its goal and assumptions, we believe today it is still a technically and economically possible path that supports China's developing economy in a sustainable way. 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 energy system. Of course, there are other possible paths for China to take towards a carbon-neutral energy system – these depend on the technologies and policies the country prioritises. For China, this scenario sketch is more ambitious in its goal and assumptions than Shell's Sky scenario. Shell believes different places and sectors will move towards net-zero emissions at different paces, and all should move as fast as possible for society to achieve the goal of the Paris Agreement. This scenario sketch is not intended to be projections or forecasts of the future. Shell scenarios, including this scenario, are not Shell's strategy or business plan. When developing Shell's strategy, our scenarios are one of many variables 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. 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.