China Renewable Energy Outlook 2019

Energy transition towards 2050

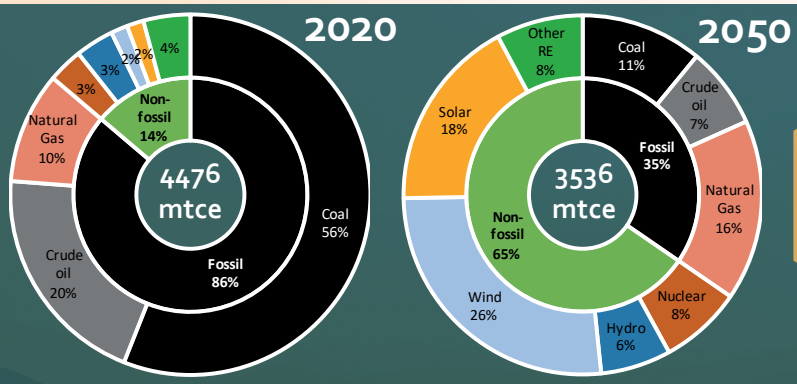
China Renewable Energy Outlook 2019 (CREO 2019) analyses a feasible path for a smooth transition to a clean, low-carbon, safe, and efficient energy system in China. The outlook is prepared by China National Renewable Energy Centre/Energy Research Institute under NDRC with strong support from its international partners.

In this leaflet, the main results from the Outlook's Below 2 °C Scenario for 2050 are presented in short form. **In accounting for primary energy the physical energy content method is applied.**
Find more about CREO 2019 on our website www.boostre.cnrec.org.cn

FROM COAL TO RE

The current Chinese energy system is dominated by fossil fuels - coal, oil and natural gas. In 2018 fossil fuels covered 90% of the total energy consumption and in 2020 the fossil fuel share will be 86%.

In 2050 in the Below 2°C Scenario the fossil fuel share will be 35% (coal 11%, oil 7% and natural gas 16%). The power sector has a 91% non-fossil share.



65%
Non-fossil fuel share

FUEL MIX.

FROM FOSSIL FUELS TO ELECTRICITY

↑24pp Industry

- In a low-carbon energy system, the end-use sectors use electricity instead of fossil fuels.
- In industry, the electrification rate increases by 24 percentage points (pp), the share of electrolytic hydrogen is 4% and the share of scrap-based electric furnace steel reaches 65% in 2050.

↑28pp Buildings

- Building electrification rate grows by 28pp.
- Residential electricity consumption grows by 180%.
- Electricity consumption in commercial buildings grows by 200% - main growth from data centres.

↑37pp Transport

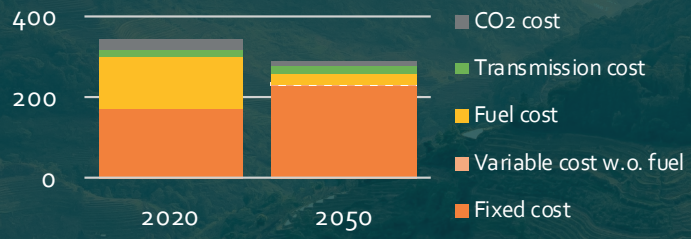
- Transport electrification rate grows by 37pp with around 490 million electric vehicles on the road.
- Less energy insensitive, more electrified mode will dominate freight.

66%
Electrification rate

ELECTRIFICATION.

LOWER POWER SYSTEM COSTS

Average electricity cost (RMB/MWh)



- The transition is cost efficient but requires more upfront investment and a new approach to institutions, regulations and management.
- Electricity cost in 2050 drops to 65% of the 2018 level, mainly due to cost reductions in renewables and storage.
- All cost-effective sources of flexibility are deployed, including storage, industrial load shifting, smart EV charging, V2G, thermal flexibility retrofits, hydro, and efficient grid expansion and operation.

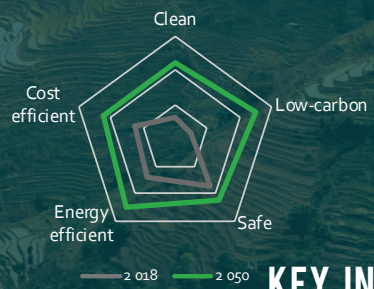
Power costs ↓35%

POWER SYSTEM COSTS.

A CLEAN, LOW-CARBON, SAFE, EFFICIENT ENERGY SYSTEM

The energy transition results in strong overall economic growth and job creation. In 2050 the GDP is 4.2 times the level in 2018 with stable energy consumption due to decoupling of economic growth and energy consumption. China's overall energy intensity in 2050 is less than 1/5 of that in 2018.

The decoupling is caused by economic restructuring from heavy industry to light industry and services, strong implementation of energy efficiency measures and a more efficient supply system with electrification and green power supply. Primary energy consumption declines to 19% of the 2018 level by 2050, while renewables become the backbone of the energy system.

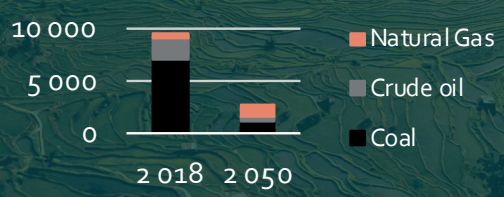


GDP ↑x 4.2

KEY INDICATORS.

ENERGY CO_2 EMISSIONS DECREASE 73% BY 2050

CO_2 (million tons)



In the Below 2 °C Scenario, China's energy-related CO_2 emissions fall from 9.5 Gt in 2018 to 2.5 Gt in 2050 for an emissions pathway compatible with the 2 °C target of the Paris Agreement. CO_2 emission per capita will fall by 3/4 from 2018 to 2050.

Achieving this ambitious goal requires fast and firm implementation of the right policy measures to ensure an early peak of CO_2 emissions and a quick reduction thereafter.

CO_2 ↓73%

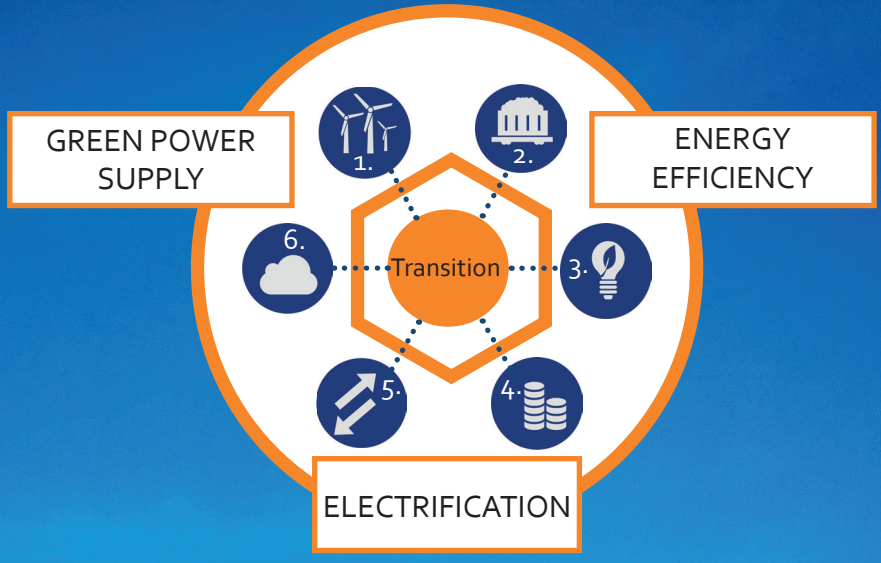
CO_2.

Transition DRIVERS

Energy efficiency improvement is a key pillar to drive down the overall energy demand.

Electrification and market reforms will change rules of the game on the demand side and displace fossil fuels form energy consumption.

With technological progress and cost reduction, large-scale deployment of RE will make it possible to provide the bulk of power demand (87%).



1. RE promotion

RE is the backbone of the 2050 energy system. Wind (49%) and solar (24%) dominate the electricity mix.
Cost reduction in these technologies are a key driver. Stable investment framework needed.

2. Coal consumption control

China's coal consumption must drop by 85% between 2018 and 2050, through limiting coal use in industry power and heating. New coal-fired power plants must be stopped, and existing plants provide flexibility.

3. Energy efficiency

End-use efficiency measures (including electrification) provide a potential of 1835 Mtce energy saving. Savings are necessary to ensure timely supply side replacements.

4. Power markets

Cost efficient merit order dispatch accounting for marginal CO_2 abatement costs and externalities, driven by dynamic pricing in well-functioning spot markets.

5. Flexible power system

Flexibility is a prerequisite for large scale wind and solar integration. The transition is cost-efficient through utilization of all cost-effective sources including generation, demand, grid and storage.

6. Efficient ETS

Achieving the GoCs ambitions for a low carbon energy system requires fast and firm implementations policy measures to peak CO_2 emissions in time. A strong carbon price could be the measure.

Green power supply

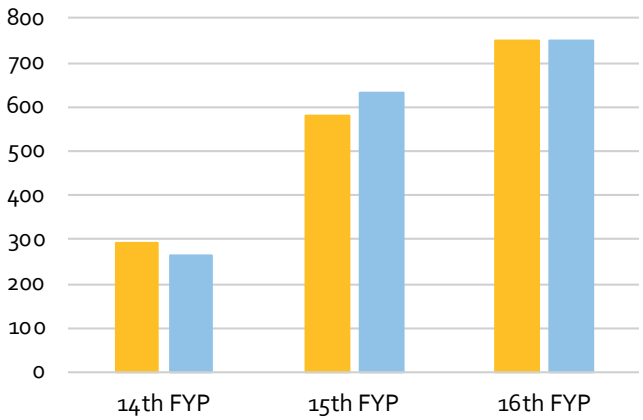
RE-based power supply is core to the energy transition. To ensure that renewable electricity by 2035 is at the core of the energy system, it is important to set steps for the 14th-16th FYP period.

For renewable electricity deployment, the next 3 five-year plans must follow a pattern of three steps:

14th FYP: Industry scale-up
Wind power installations should average 53 GW per year, while the average yearly solar installations should be 58 GW
15th FYP: Establish
New wind installations should average 127 GW per year and solar achieve 116 GW per year.
16th FYP: Revolutionise
Annual installations of wind and solar should peak at around 150 GW per year.

By 2025, wind power cumulative installed capacity exceeds 500 GW, and annual generation of approximately 1350 TWh of electricity. Solar power cumulated installed capacity should reach 530 GW, and contribute electricity generation of around 690 TWh.

New wind & solar during next 3 FYPs (GW)



A dynamic power system

Cost efficient VRE integration is a central challenge of the energy transition. All technologies should contribute their flexibility. Diverse resource conditions shall be connected.

China's electricity market should be able to mobilize existing flexibility through efficient price signals and market services; and guide investments to bring flexibility sources through the market design.

The power system should be structured to efficiently dispatch so fluctuations and uncertainties can be handled without interfering with system security. This requires integrated market operation, deep participation in spot, balancing and ancillary service markets; and a process to connect, provincial, regional and national resources seamlessly.

A clear market design target model is needed, which will enable operating the power system of the future.

From provincial pilots to unified national market