APECエネルギー需給見通し第8版
-2050年までの日本のエネルギー動向

経済産業研究所 BBLセミナー
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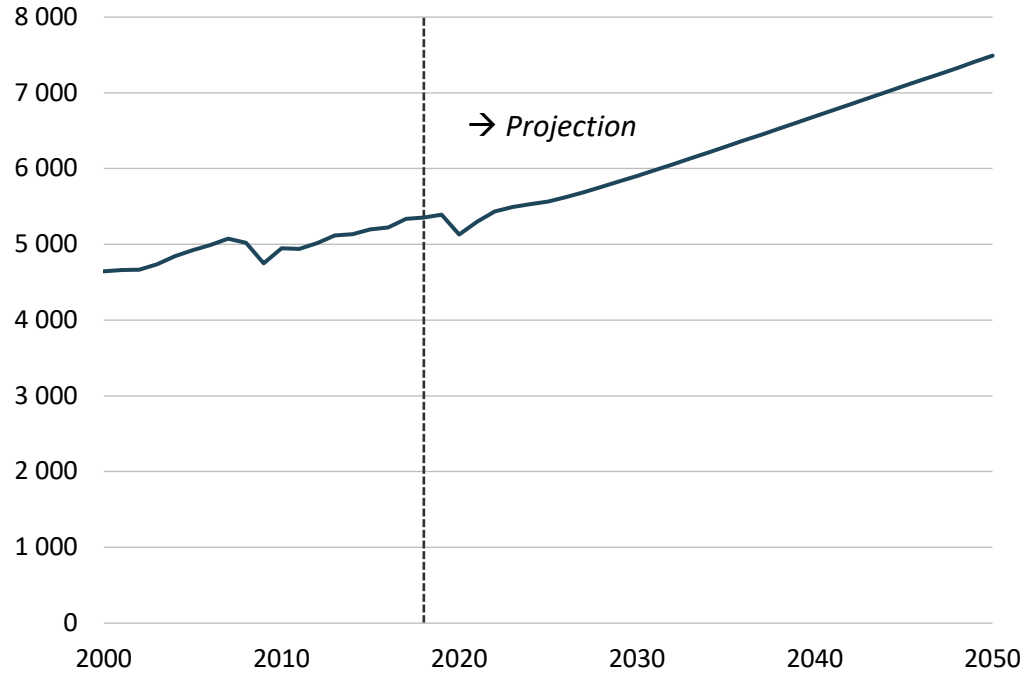
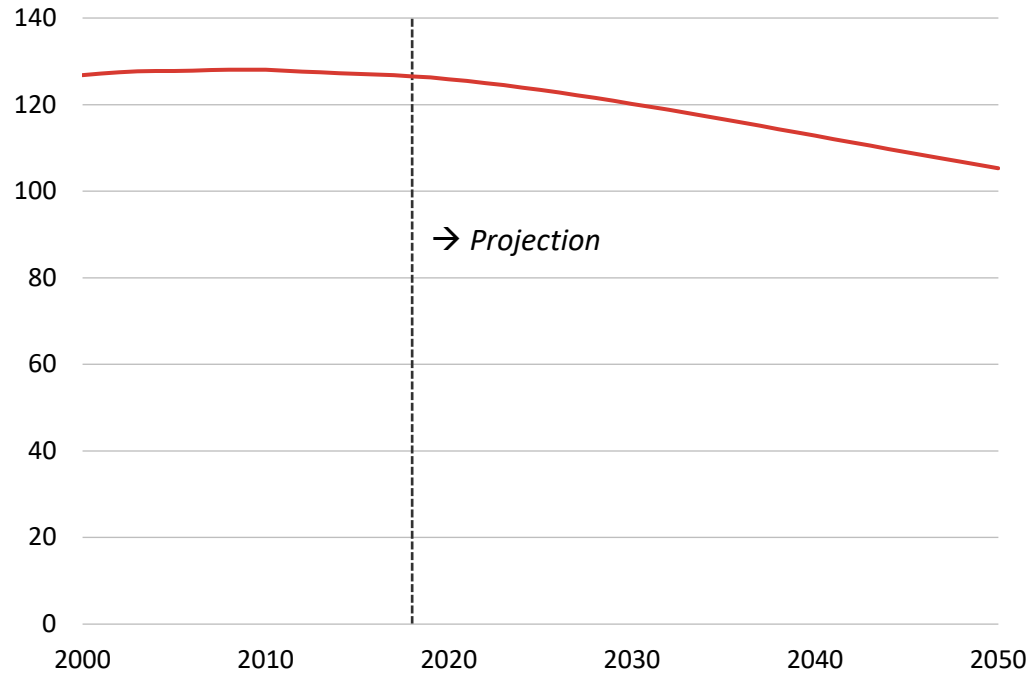
Macroeconomic backdrop

GDP in billion 2018 USD PPP, 2000-2050.



Notes: Historical GDP data from World Bank WDI. GDP projections from OECD and internal analysis. COVID-19 impact on GDP is incorporated in the 2020-2025 timeframe based on IMF projections (May 2021).

Population in millions, 2000-2050.

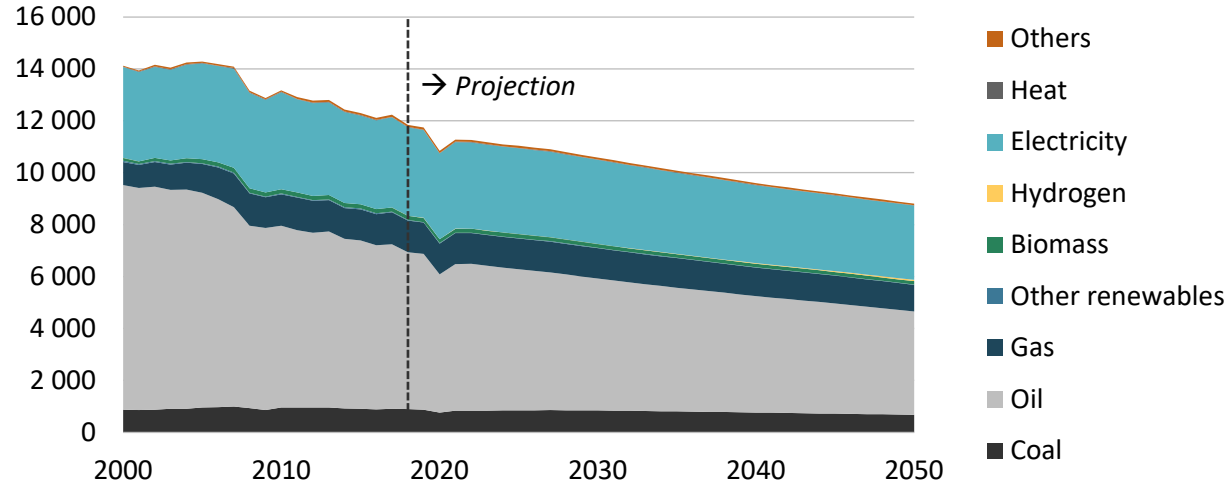


Notes: Historical population data from World Bank WDI. Projections from UN Department of Economic and Social Affairs 2019 Population Prospectus.

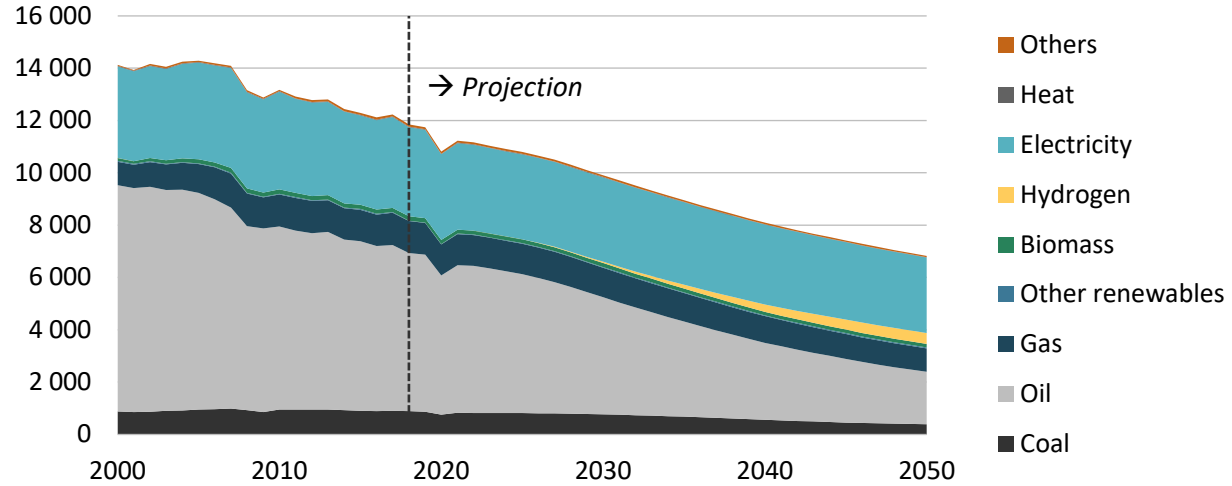
- Japan's GDP growth is assumed to be moderate through the projection period (1.1% average annual growth in constant USD).
- Japan's population peaked in the 2000s. The population is projected to continue to decrease throughout the projection period.

End-use energy demand by fuel in Japan

Energy demand in REF, 2000-2050 (PJ).



Energy demand in CN, 2000-2050 (PJ).

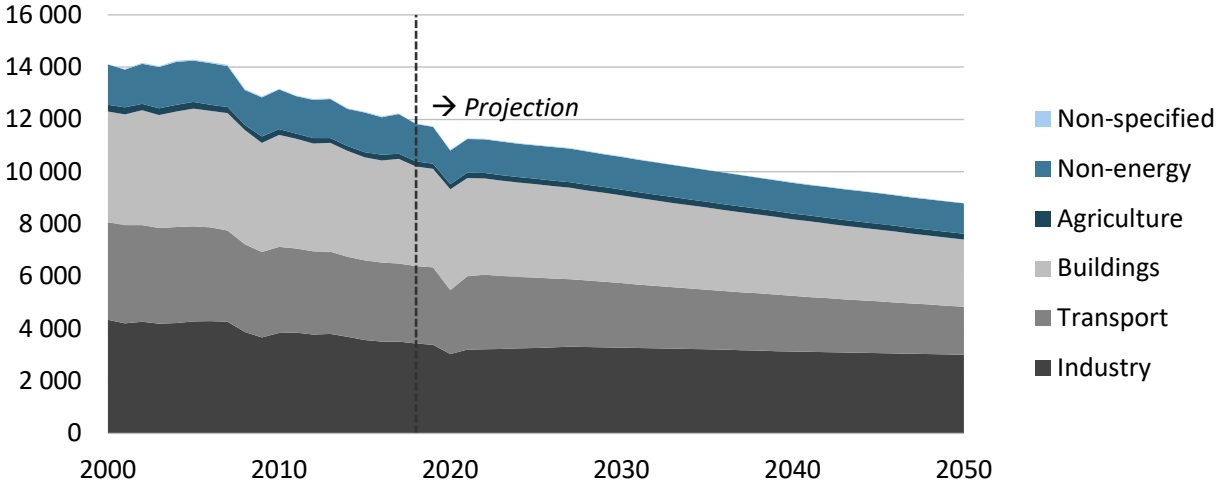


Sources: EGEDA, APERC analysis. Includes non-energy.

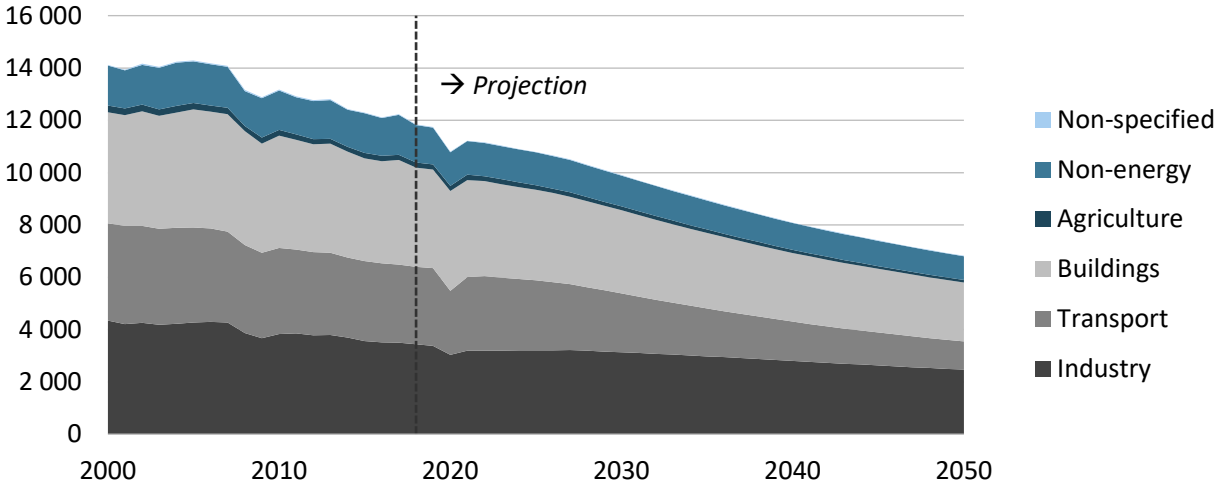
- Energy efficiency and population decline will drive Japan's future energy consumption.
- Electricity, gas, and hydrogen all have higher relative shares in CN, mostly displacing oil.

End-use energy demand by sector in Japan

Energy demand in REF, 2000-2050 (PJ).



Energy demand in CN, 2000-2050 (PJ).

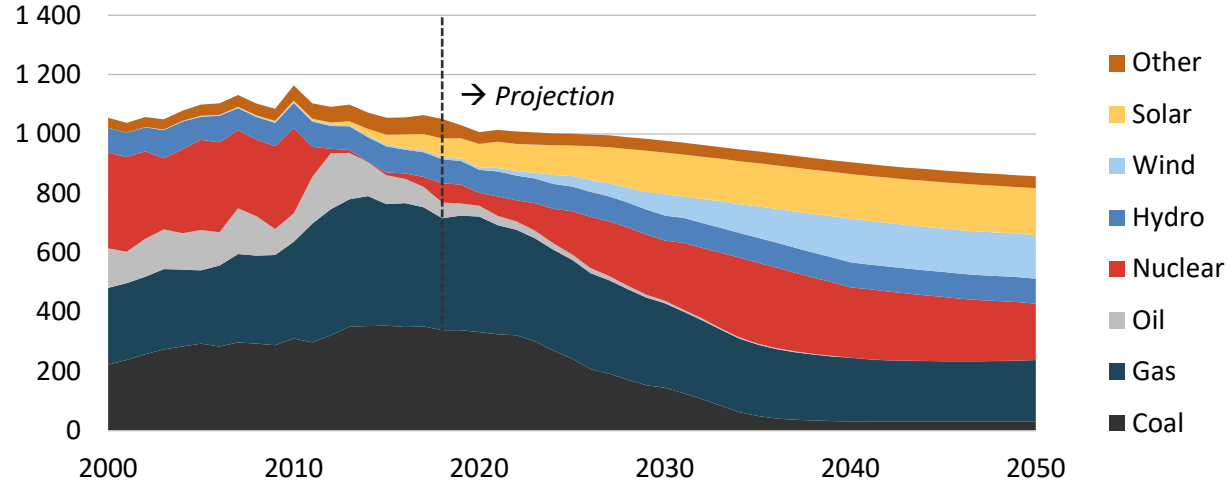


Sources: EGEDA, APERC analysis. Includes non-energy.

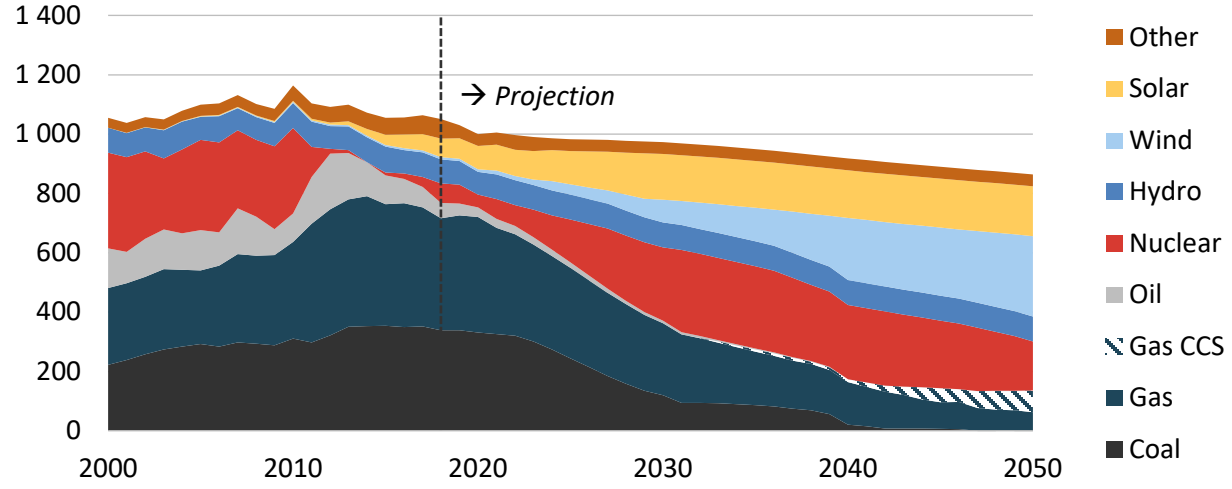
- The industrial sector declines by less than other sectors, due to three factors;
  - Current high levels of efficiency.
  - Output being tied closer to trade rather than domestic consumption.
  - The difficulty of electrifying some of the largest energy consuming segments in the industry sector.

The sources for Japan's electricity generation

Electricity generation in REF, 2000-2050 (TWh).



Electricity generation in CN, 2000-2050 (TWh).

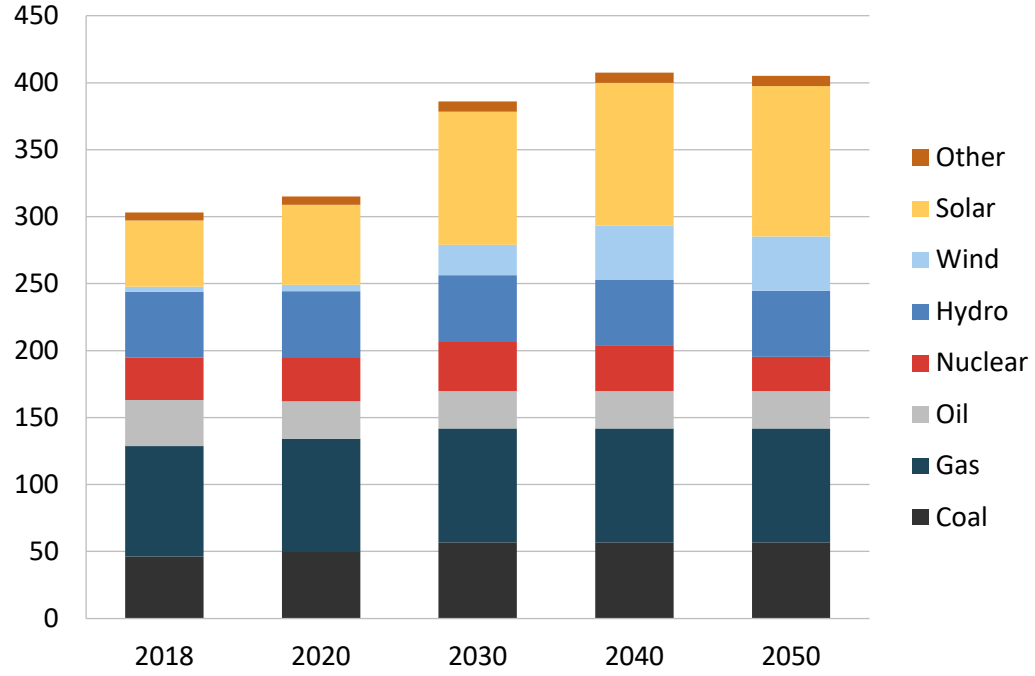


Sources: EGEDA, APERC analysis.

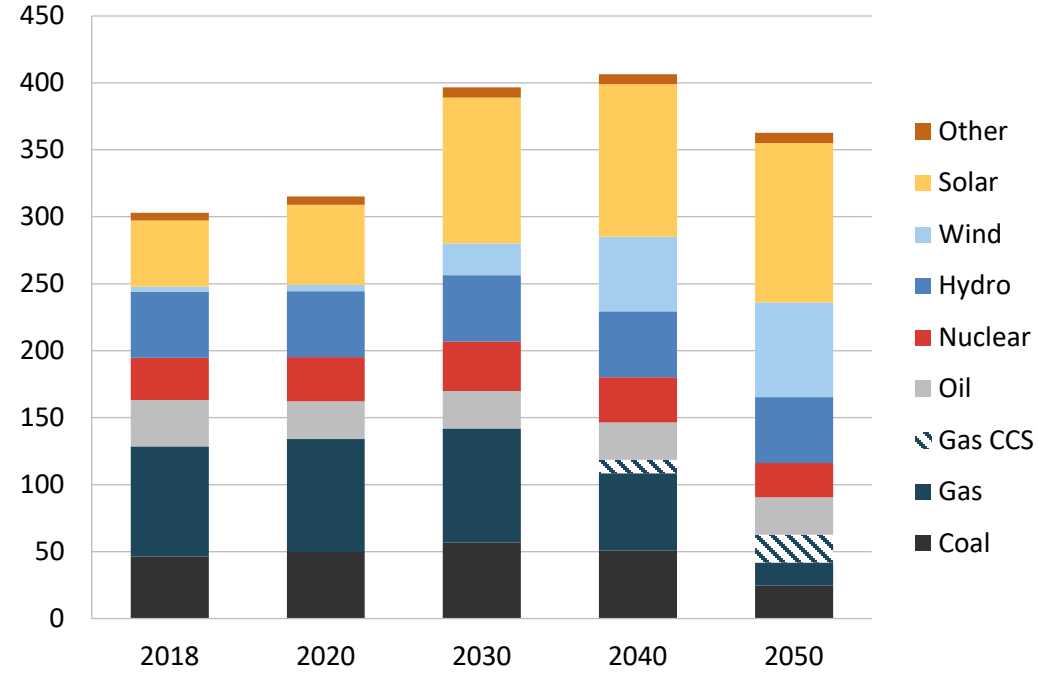
- Greater electrification of end-uses is offset by declining need for energy in CN.
  → REF and CN electricity consumption is similar.
- Wind becomes more prominent in CN, mostly displacing gas.
- There have recently been announcements regarding nuclear and these accord with assumptions we made about Japan's nuclear restart.

Generation capacity

Capacity in REF, 2018-2050 (GW).



Capacity in CN, 2018-2050 (GW).



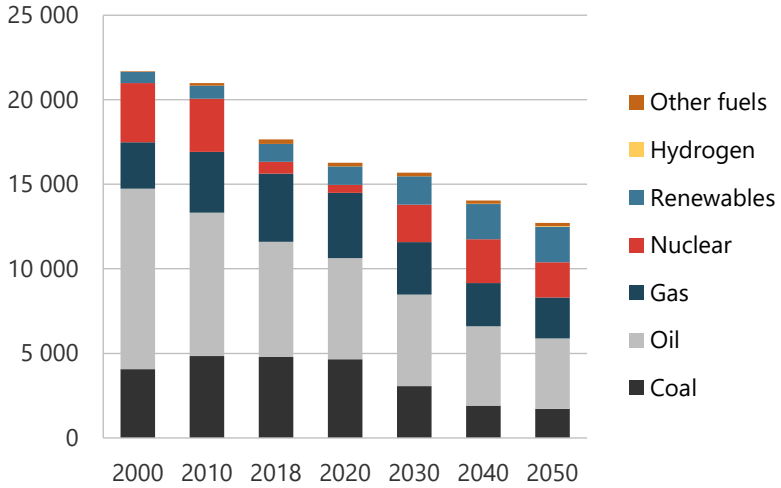
Sources: EGEDA, APERC analysis

- In REF, generation capacity will increase by a third to over 400 GW in 2050.
- In CN, the fall in capacity is mostly due to the closure of coal and gas power plants.
- CCS plays an important role for reducing unabated natural gas plants.

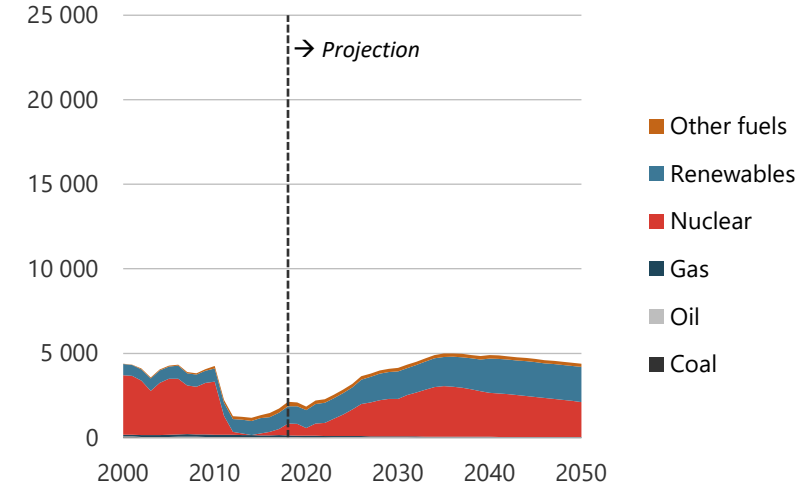
Japan's energy supply: where does this energy come from?

- Japan's domestic energy production is much lower than its supply (what is consumed domestically).
- Fossil fuels are two-thirds of energy supply in REF, but less than half in CN.
- In CN, industry consumption of coal is displaced by alternative fuels such as gas, hydrogen and electricity.

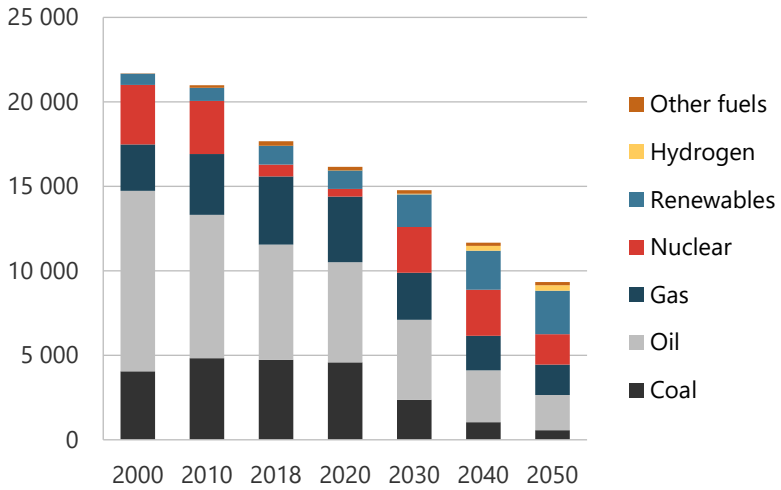
Total energy supply in REF, 2000-2050 (PJ).



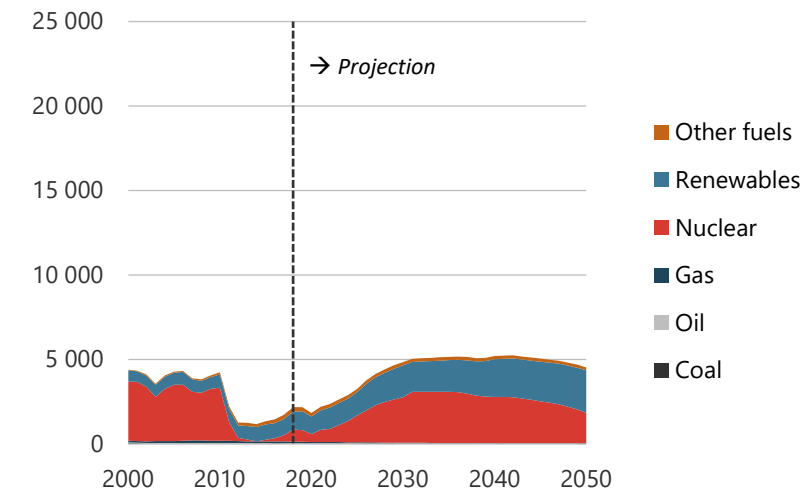
Energy production in REF, 2000-2050 (PJ).



Total energy supply in CN, 2000-2050 (PJ).



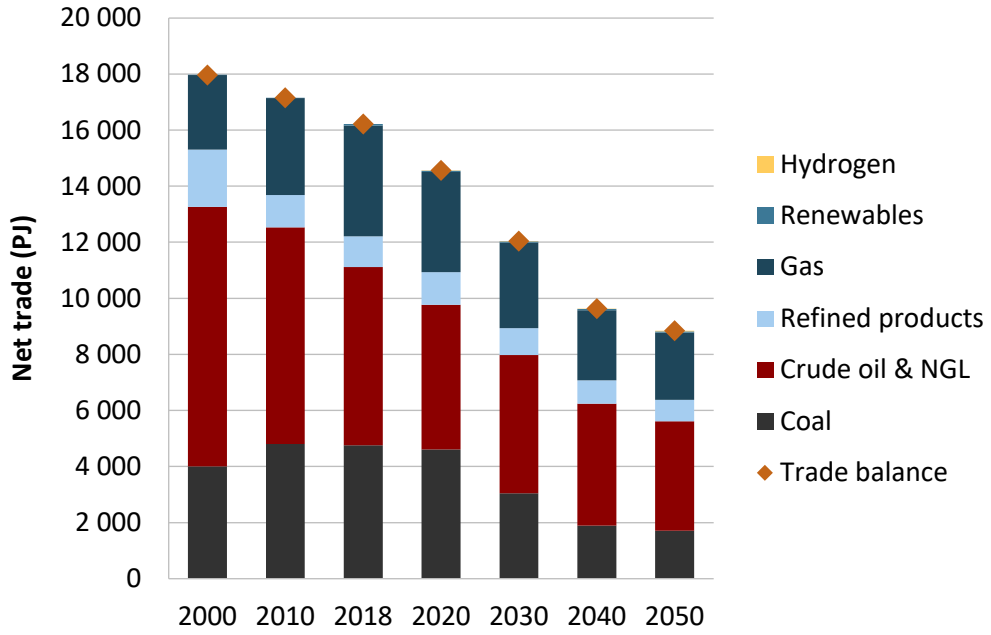
Energy production in CN, 2000-2050 (PJ).



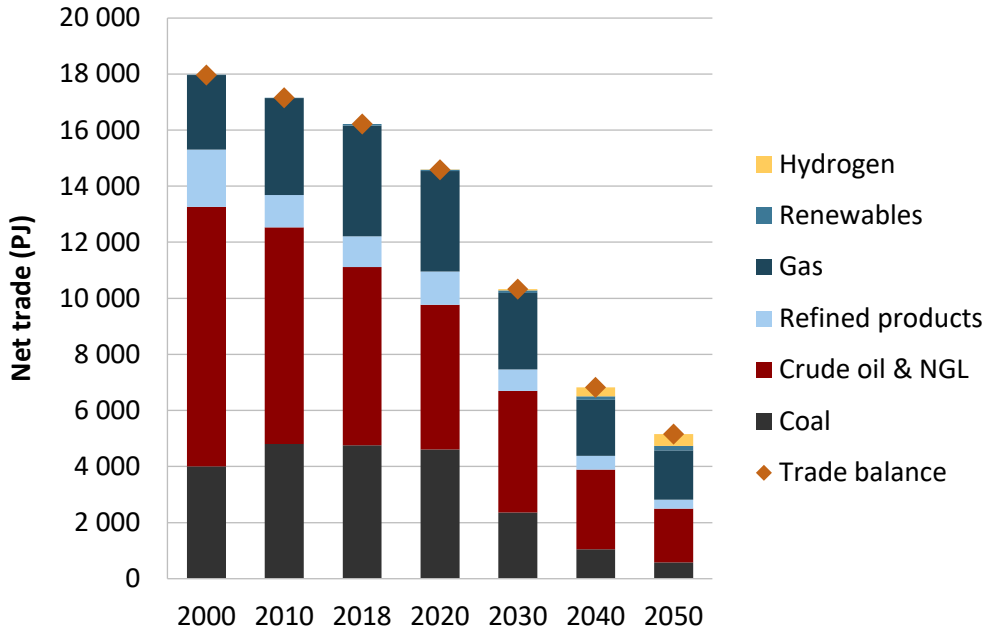
Sources: EGEDA, APERC analysis.

Japan's energy trade

Net energy trade in REF, 2000-2050 (PJ).



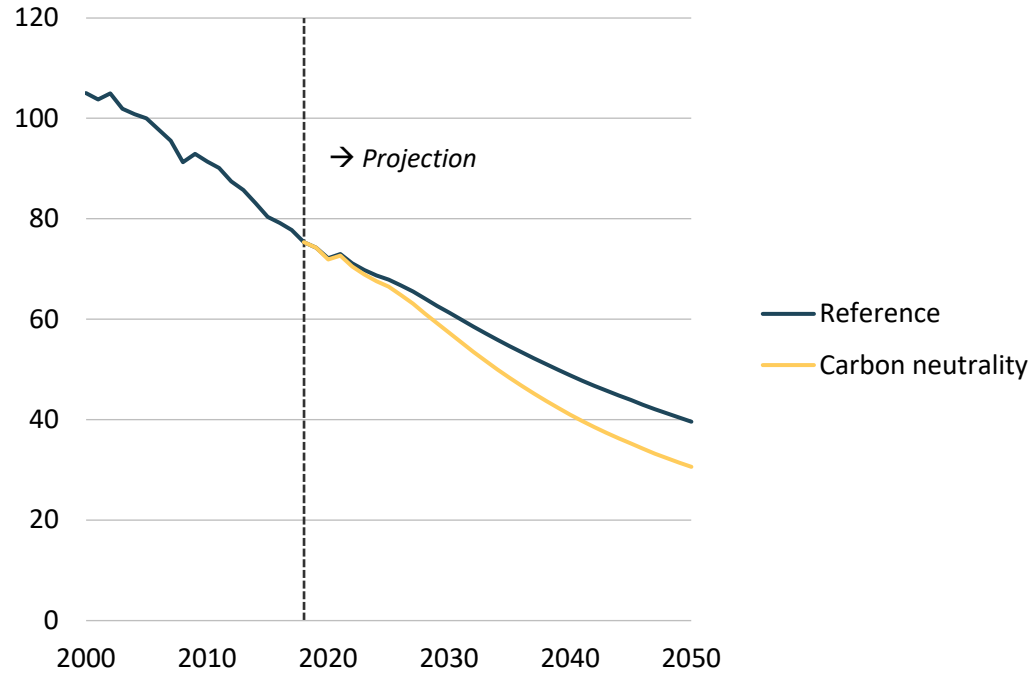
Net energy trade in CN, 2000-2050 (PJ).



- Japan remains reliant on energy imports from the rest of the world.
- But that reliance is falling and is much lower in CN (5,000 PJ versus 9,000 PJ).
- There is a notable shift away from oil, partially displaced by an increase in hydrogen imports in CN.

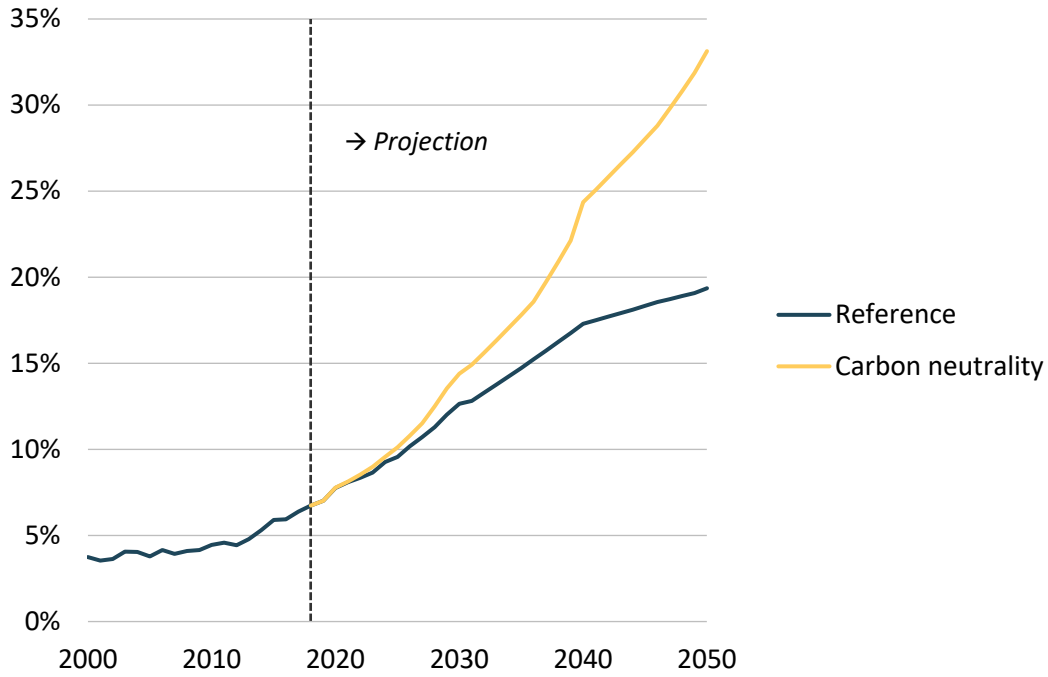
Energy intensity and modern renewables share

Final energy intensity in REF and CN (2005=100).



Sources: EGEDA, APERC analysis. Excludes non-energy.

Modern renewables share in REF and CN, 2000-2050.

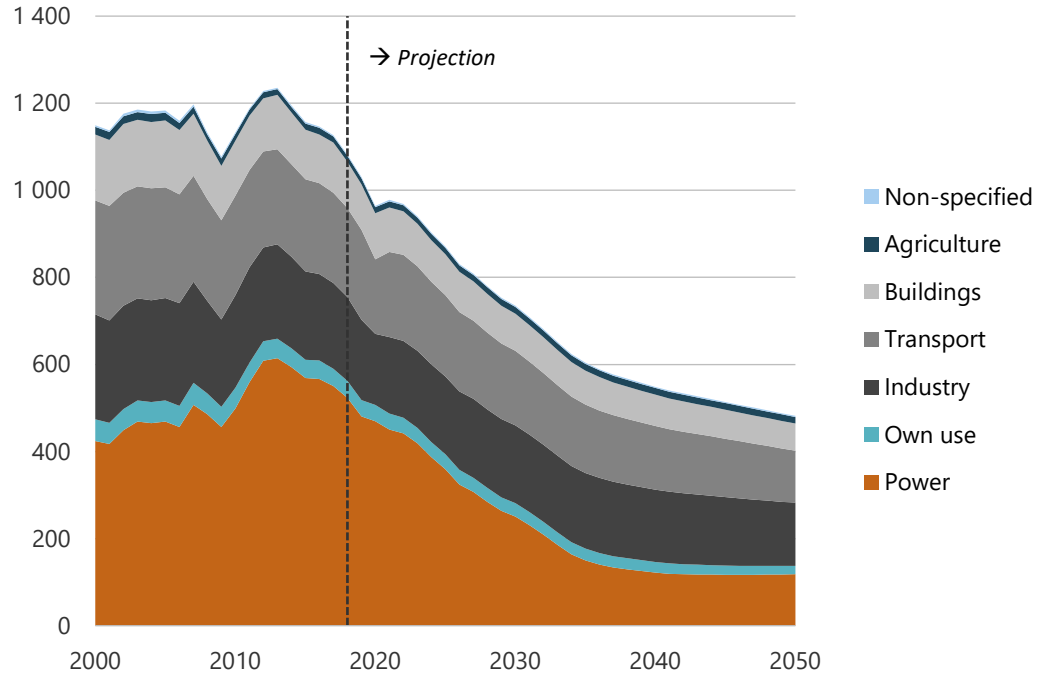


Sources: EGEDA, APERC analysis. Includes direct consumption of renewables in end-use demand sectors (excluding non-energy and biomass in some sectors) and the share of electricity produced by renewable sources.

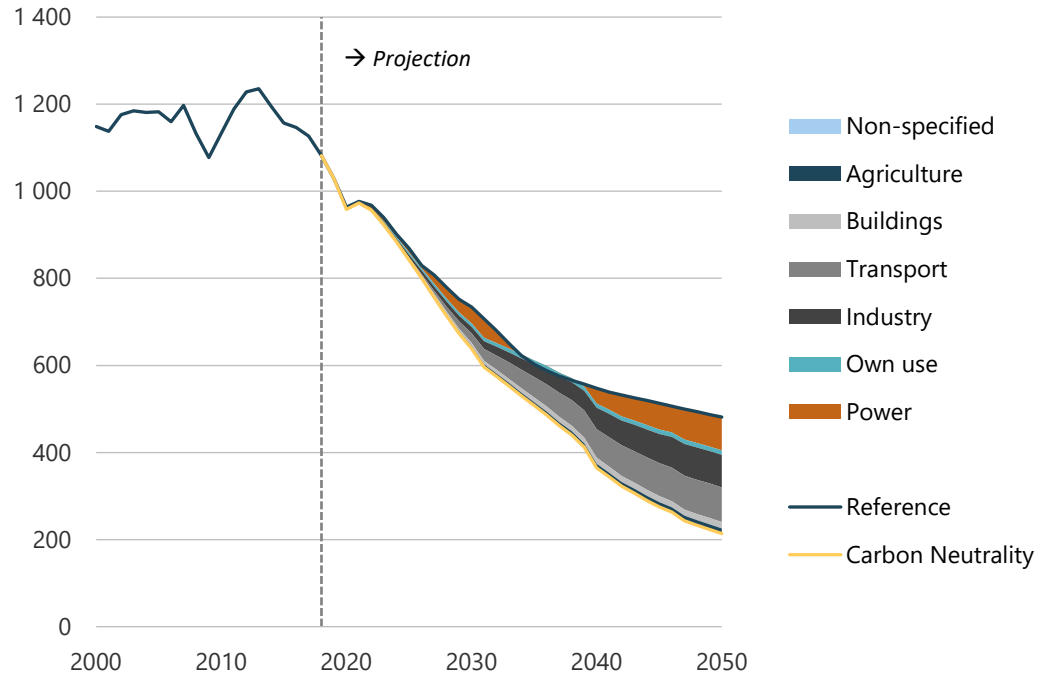
- From 2018 to 2050, energy intensity will improve by almost half in REF, and by almost three-fifths in CN.
- The share of modern renewables in Japan's final energy demand was just under 7% in 2018. This share will increase significantly in both scenarios.

Gross CO_2 emissions

Gross CO_2 emissions in REF, 2000-2050 (million tonnes).



Change in gross CO_2 emissions, 2000-2050 (million tonnes).



Sources: UNFCCC, EGEDA, APERC analysis. Excludes non-energy, land-use, and methane emissions.

- The power sector decarbonises significantly.
- The transport sector emissions decline by 80% which is the largest sectoral reduction relative to REF.
- From 2013 to 2030, CO_2 emissions are projected to decline by 41% in REF, and by 48% in CN.

Kaya identity decomposes CO_2 emissions into four components

- Defined as:

$$CO_2\ emissions = Population * \frac{GDP}{Population} * \frac{Energy\ supply}{GDP} * \frac{CO_2\ emissions}{Energy\ supply}$$

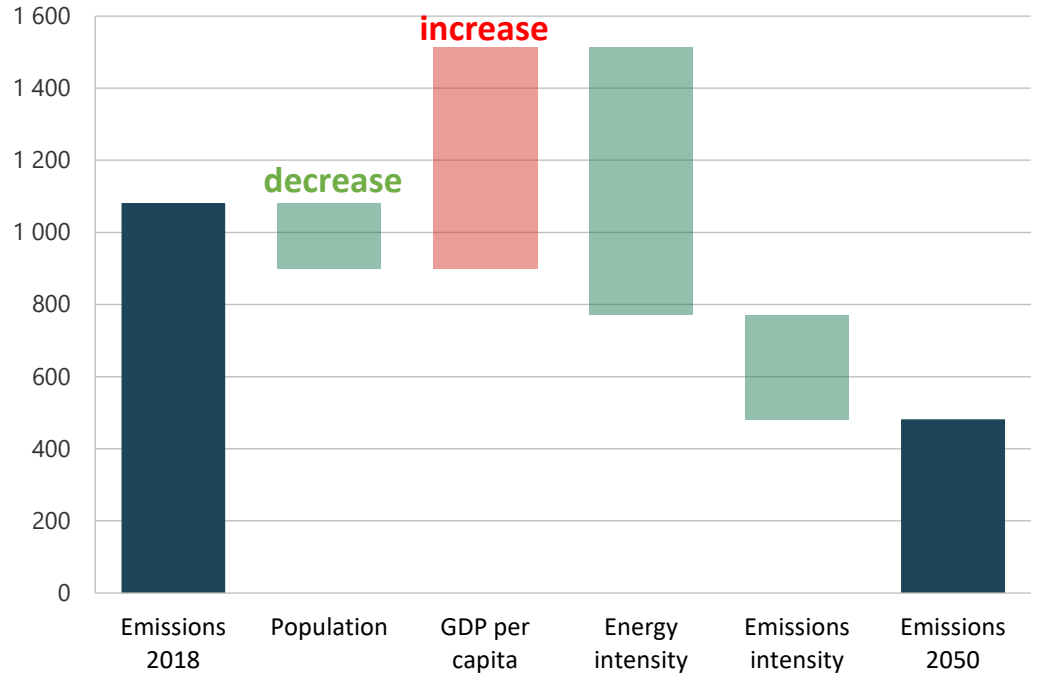
GDP per capita | Energy supply intensity | Emissions intensity

- Energy supply intensity includes supply transformation, and final demand
- Energy supply intensity is different than final energy intensity (which is used most often for the APEC goal)

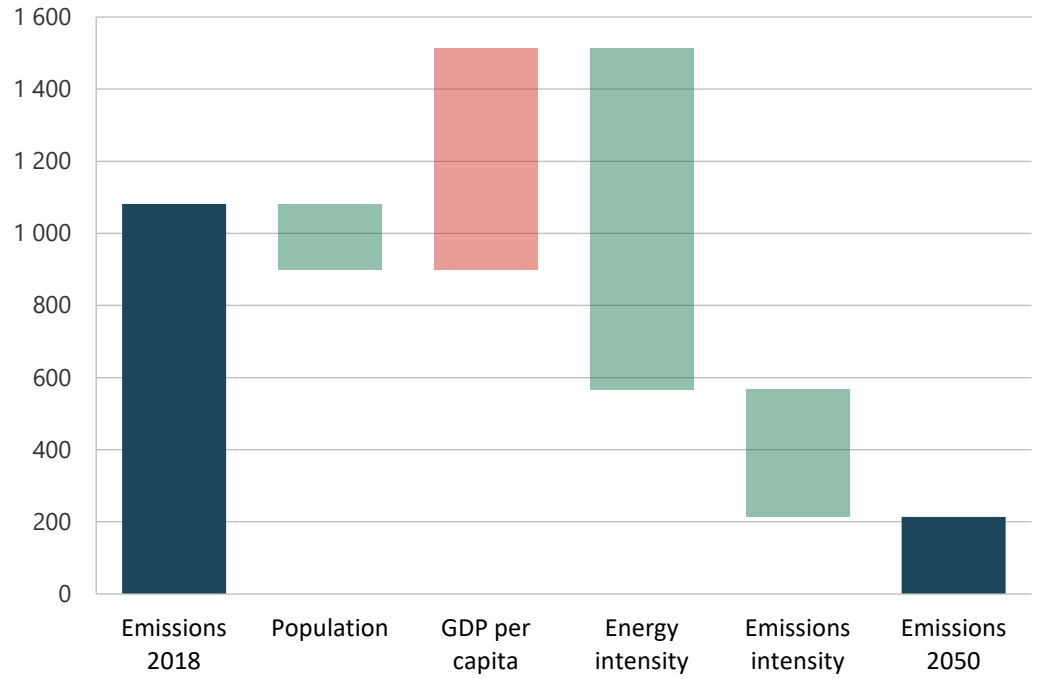
- Emissions intensity covers all CO_2 emissions in energy supply
- Modern renewables contribute to emissions intensity

Gross CO_2 emissions

CO_2 emissions components in REF, 2018 and 2050 (million tonnes).



CO_2 emissions components in CN, 2018 and 2050 (million tonnes).

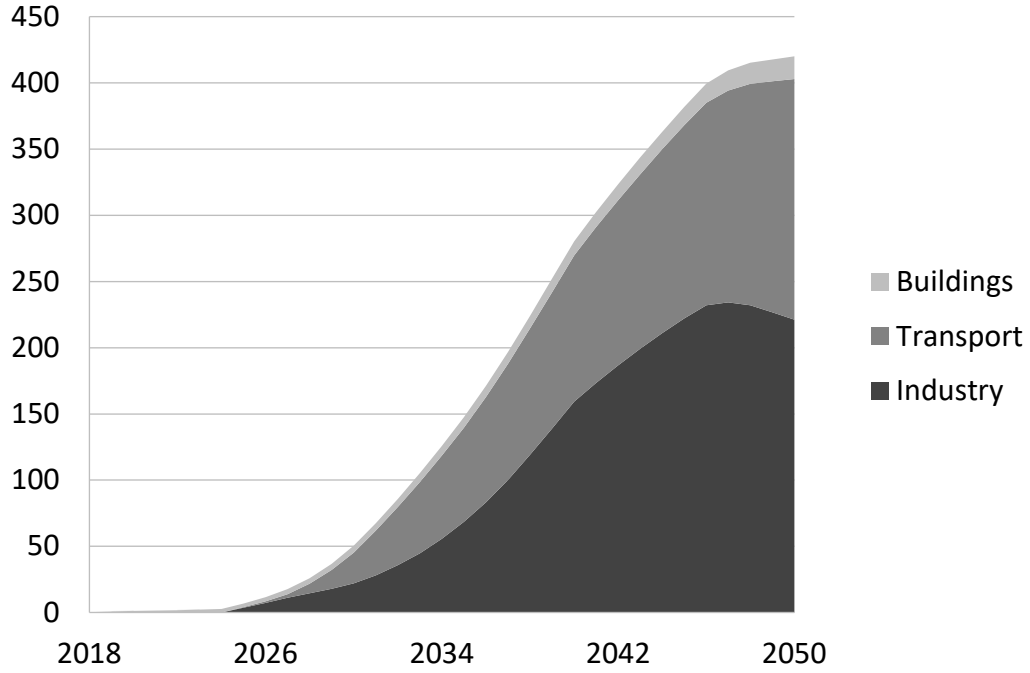


Sources: UNFCCC, EGEDA, APERC analysis.

- Holding all else equal, emissions increase associated with increases in GDP per capita. Without any energy intensity or emissions intensity improvements, Japan's CO_2 emissions would increase by 40% by 2050.
- Improvements in both energy intensity and emissions intensity lead to significant CO_2 emissions reductions in both scenarios.

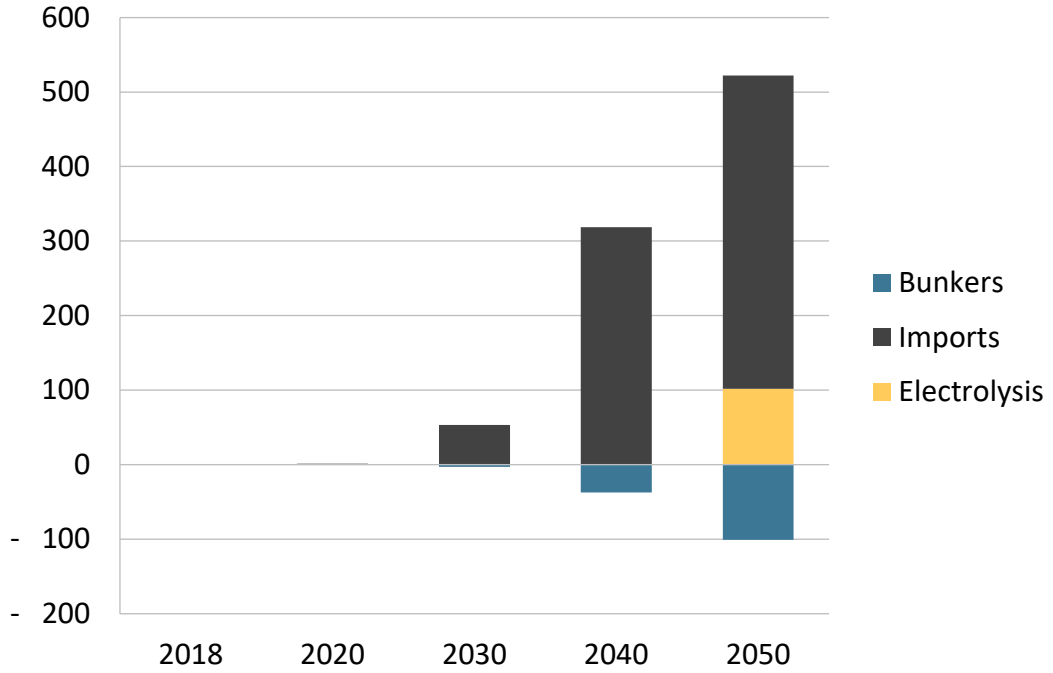
Uncertain Futures: Hydrogen in the Carbon Neutrality scenario

Hydrogen consumption by sector in CN, 2000-2050 (PJ).



Notes: hydrogen as an industrial feedstock is not considered.

Hydrogen production, imports, and exports in CN, 2000-2050 (PJ).

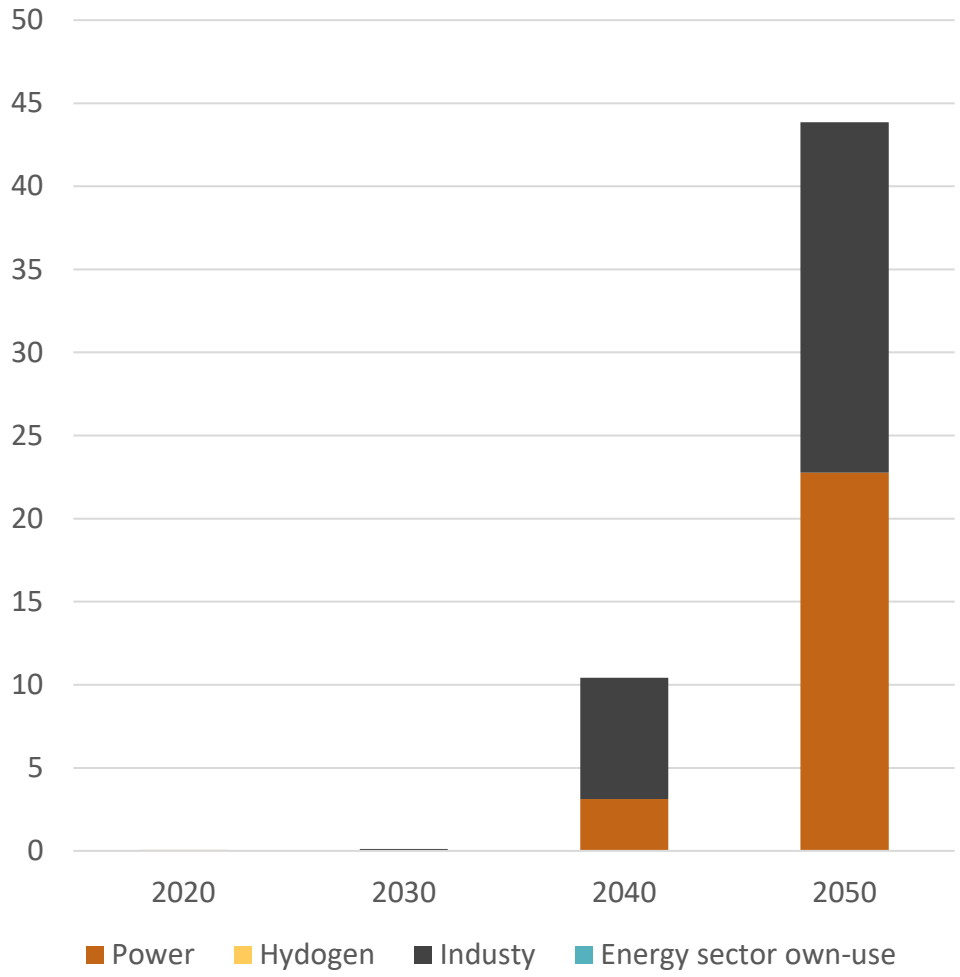


Notes: hydrogen as an industrial feedstock is not considered. Exports are produced from steam methane reformation with CCS (blue) or electrolyser processes (green).

- CN relies on cost assumptions well below current levels.
- Industry is where the most potential for hydrogen lies in Japan.
- Like almost all energy, Japan will be reliant on hydrogen imports, though electrolysis could meet some of its demand.

Uncertain Futures: CCS technologies in Japan

Captured CO2 emissions in CN (million tonnes).



Sources: EGEDA, APERC analysis

- CN assumes CCS costs well below current levels.
- Industry and power sector are assumed to adopt CCS technologies from the 2030s in Japan.
- Almost 45 million tonnes of captured emissions in 2050 is significant in the context of 200 million total tonnes of CO_2 emissions in Japan in 2050 in CN.

Summary of Japan Outlook

- Energy demand and supply decreases in both scenarios with greater reductions in CN than in REF: -23% and -27% respectively.
- In CN, there will be a more drastic decline in energy demand. Increased wind and solar generation and more end use electrification in the building and transport sectors will lead to the share of fossil fuels declining to less than half.
- Wind and solar electricity generation is expected to increase in both scenarios. Much higher levels of offshore wind contribute to significant additional decarbonisation in CN. However, challenges remain to ensure grid reliability and affordability.
- Japan remains a net importer in energy trade to 2050. However, import dependency in its primary energy supply will decrease due to increase in renewables and nuclear.
- From 2018 to 2050, CO_2 emissions decline more than 50% in REF and greater reductions (80%) are possible in CN.

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Thank you.

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