Carbon Neutrality scenario in the 8th APEC Energy Demand and Supply Outlook

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Outline

- Scenarios
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- Power
- Energy supply
- CO_2 emissions
- Kaya identity

Scenarios

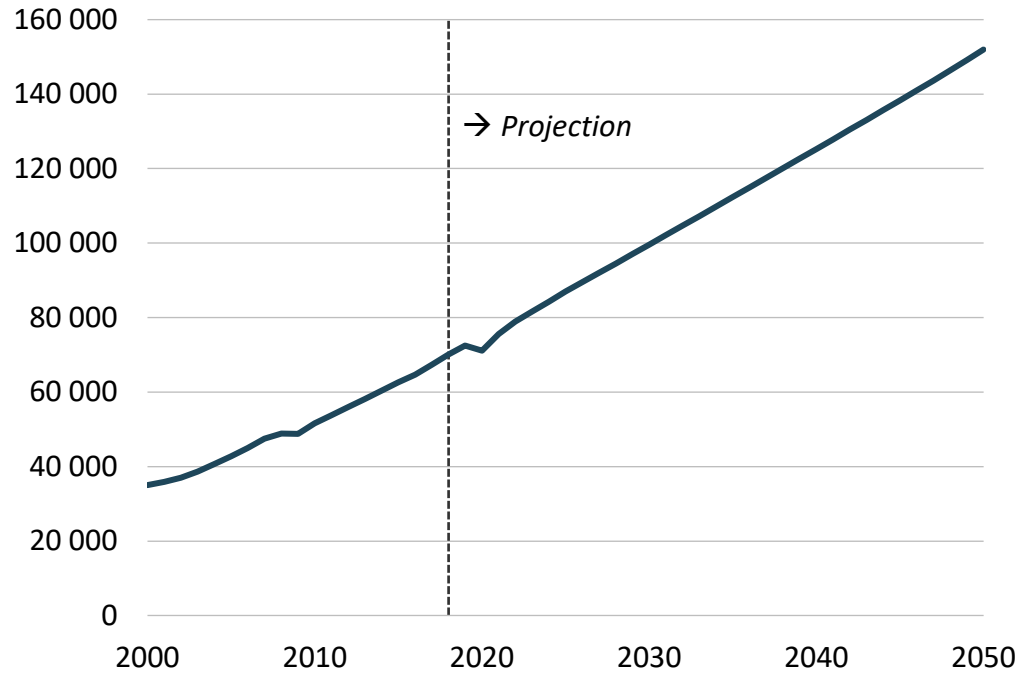
	Reference (REF)	Carbon Neutrality (CN)
Definition	Recent trends and current policies.	Hypothetical decarbonisation pathways for each APEC economy.
Purpose	Provides a baseline for comparison with the Carbon Neutrality scenario.	Additional energy sector transformations that support decarbonisation objectives.
Key assumptions	Current polices and trends continue.	Increased levels of energy efficiency, behavioral changes, fuel switching, and CCS deployment.
Limitations	Assumes that recent trends, including relevant decarbonisation measures continue.	Does not consider non-energy use on CO_2 or removal.

Note: does not represent APERC's recommendation or advocacy for a pathway or set of policies.

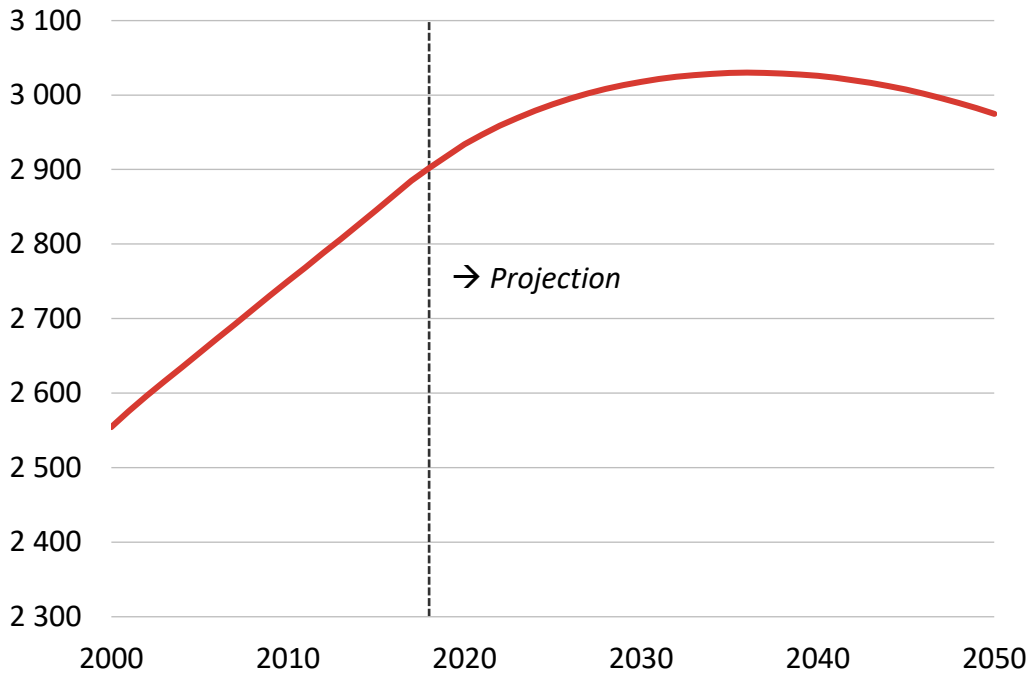
The analysis was performed prior to March 2022 and does not include current disruptions to international energy markets.

Macroeconomic assumptions

GDP in billion 2018 USD PPP, 2000-2050.



Population in millions, 2000-2050.

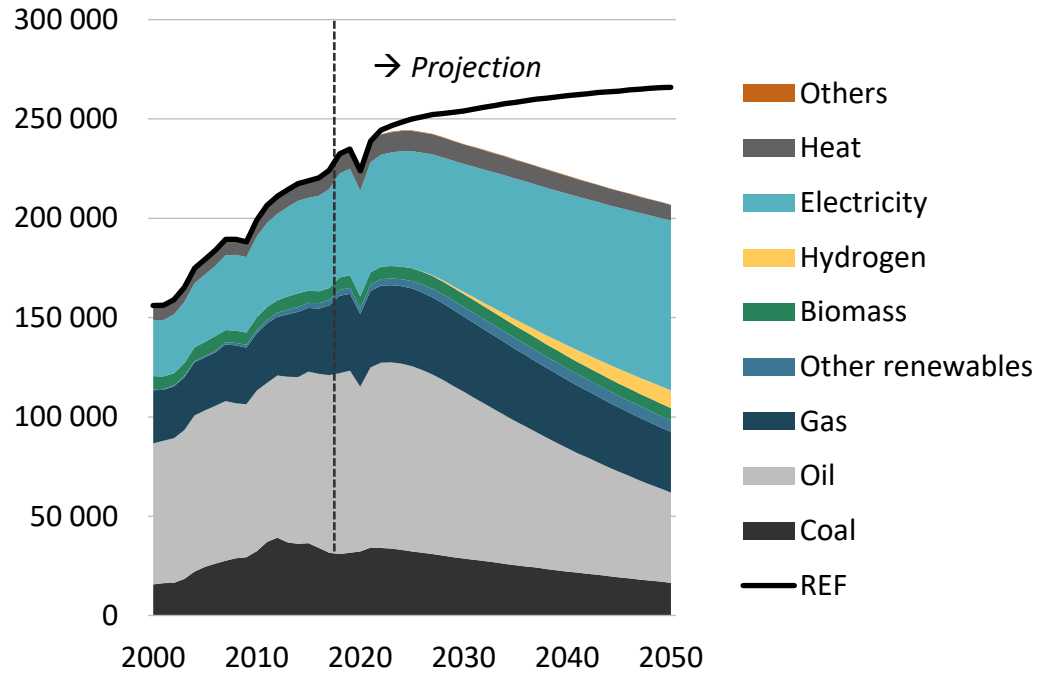


- Macroeconomic trends are expected to drive energy demand through 2050
- Trends vary by APEC sub-region and economy

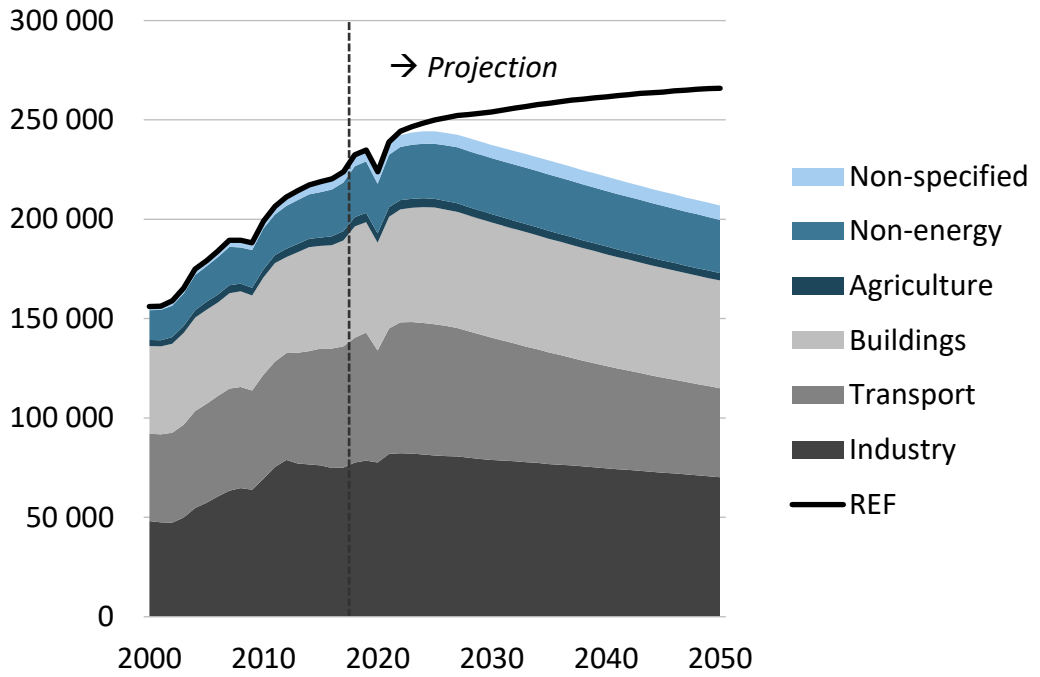
Notes: Historical GDP data from World Bank WDI. GDP projections from OECD and internal analysis.
COVID-19 impact on GDP is incorporated in the 2020-2025 timeframe based on IMF projections (May 2021).

Energy efficiency measures and fuel switching lead to -11% reduction (2018-2050)

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



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

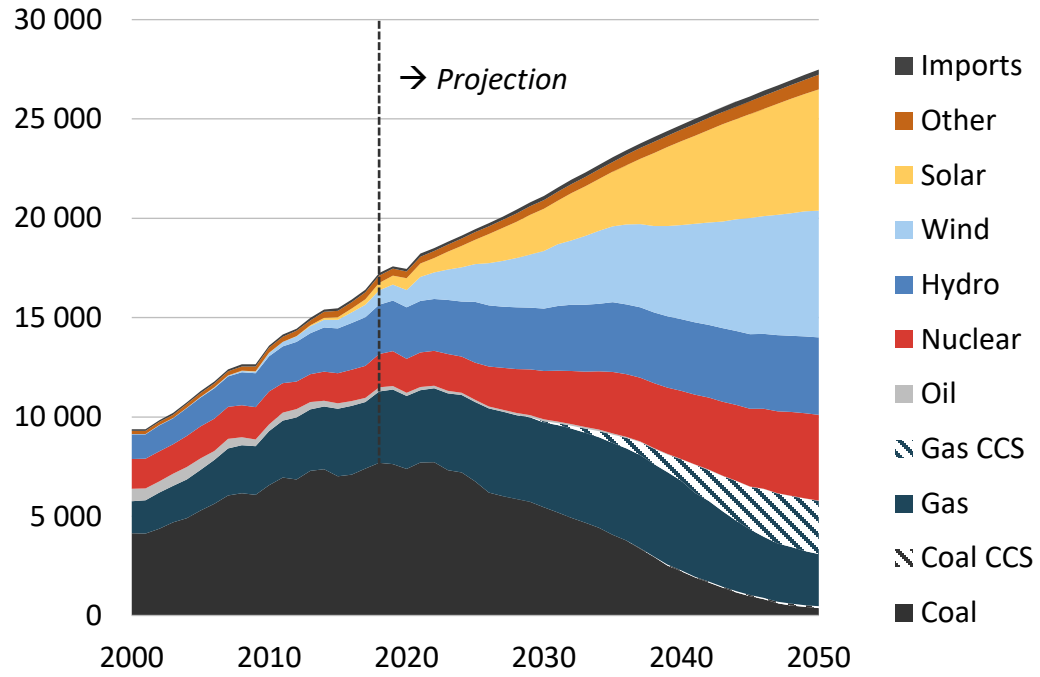


Sources: EGEDA, APERC analysis

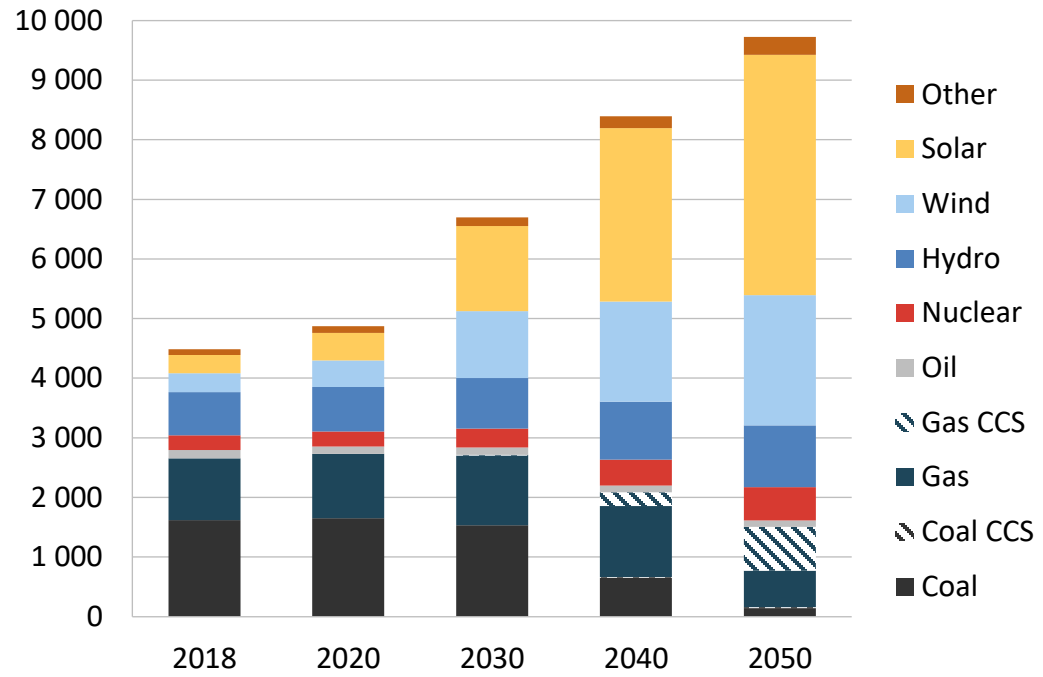
- Additional energy efficiency measures and electrification lead to -11% lower demand in CN (2018-2050).
- Despite fuel switching, substantial fossil fuels demand remains in CN.
- Electrification of transport drives a large proportion of energy demand reductions in CN.

Electricity generation grows in both scenarios

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



Generation capacity in CN, 2000-2050 (GW).

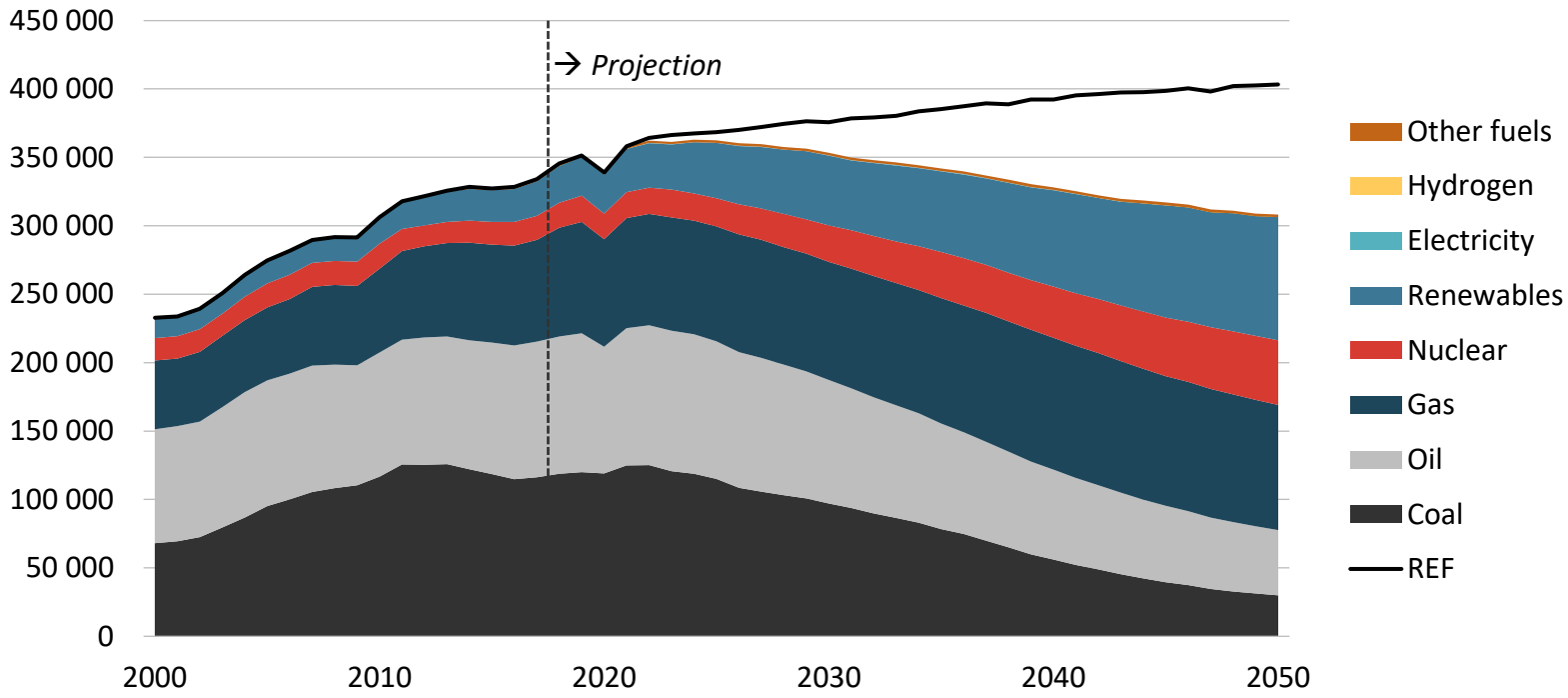


Sources: EGEDA, APERC analysis

- Growth in electricity generation to meet increased buildings and transport demand.
- Wind and solar provide the most incremental generation in both scenarios.
- Wind and solar capacity additions outpace all other technologies

Fossil fuels remain a large share of APEC energy supply

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



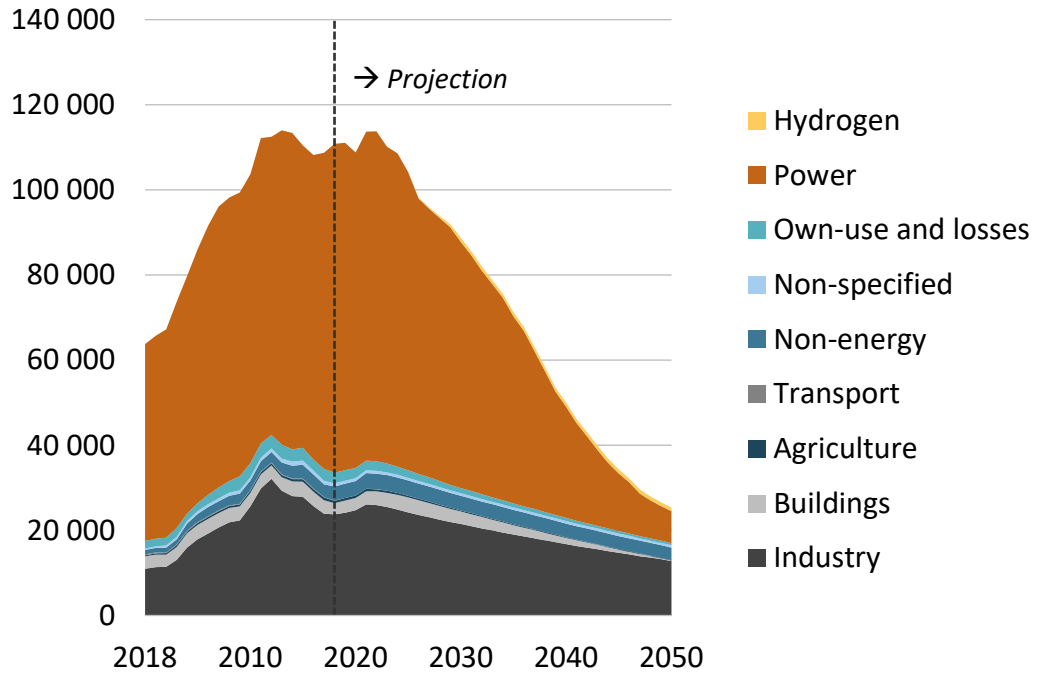
Sources: EGEDA, APERC analysis

- Natural gas supply increases in both scenarios as coal declines.
- Oil supply is level in REF and declines in CN as APEC and global oil use declines.

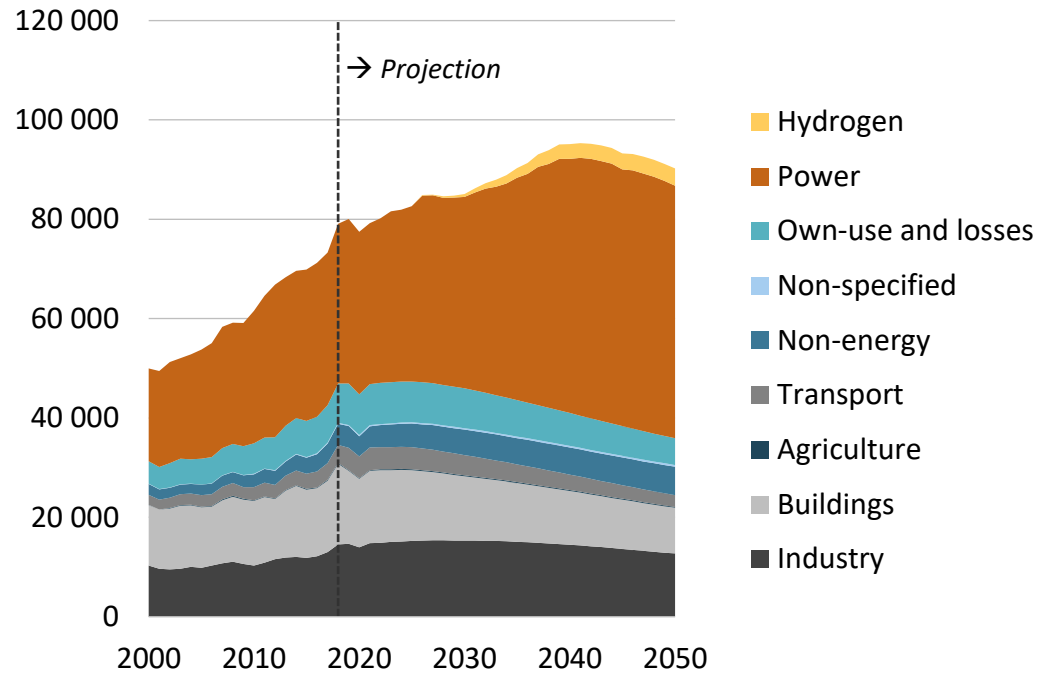
Note: energy supply = production + net imports + bunkers

Coal consumption declines in both scenarios

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



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

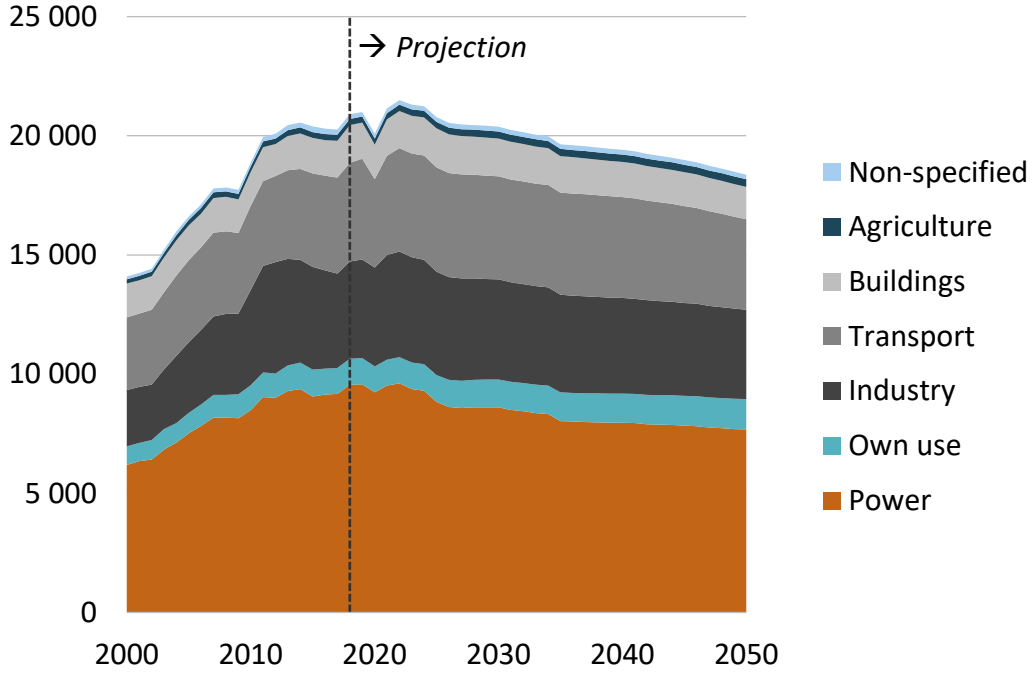


Sources: EGEDA, APERC analysis

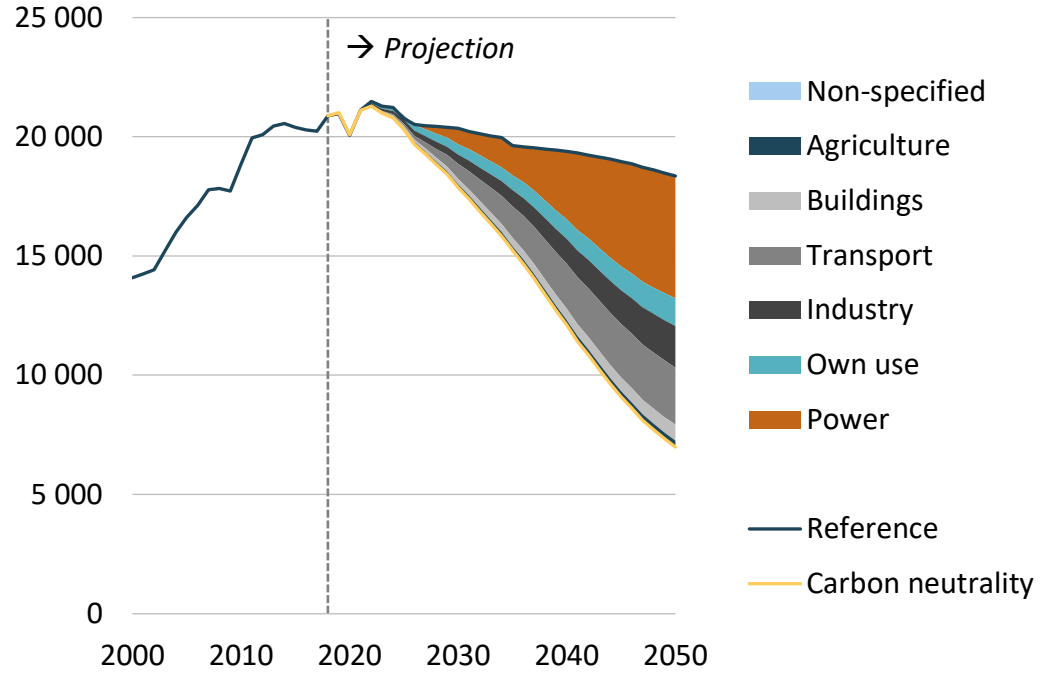
- Coal phase-down and phase-out policies increase substantially in CN primarily in the power sector.
- Natural gas is substitute for coal.
- Introduction of CCS technology in gas-fired plants and industry prolongs natural gas consumption.

CO_2 emissions by sector

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



Emissions changes from REF to CN, 2000-2050 (million tonnes).



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

- In REF, emissions decline 14% mostly due to a reduction in coal-fired electricity generation.
- Key drivers include a phase-out of coal in the power sector, widespread electrification, CCS deployment, and hydrogen advancements.
- Industry remains difficult to decarbonise.

Kaya identity decomposes CO_2 emissions into four components

- Defined as:

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

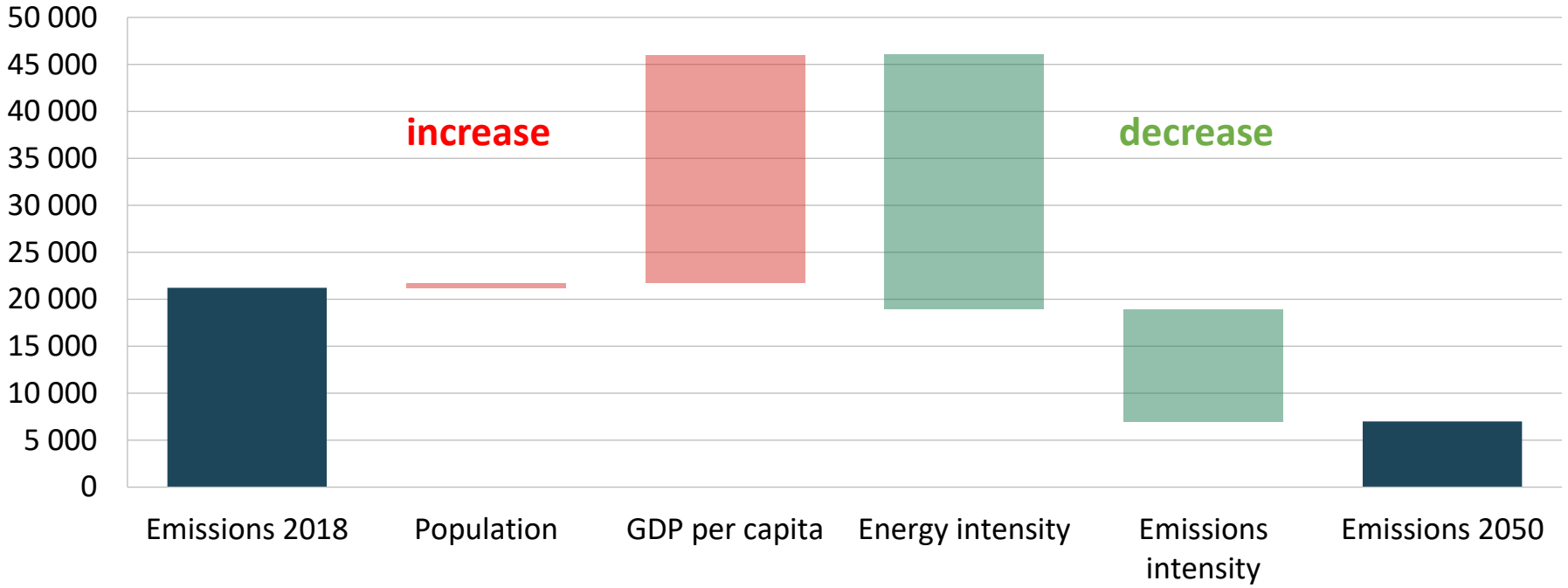
GDP per capita | Energy supply intensity | Emissions intensity

- Energy supply intensity includes supply transformation and final demand
- Energy supply intensity is different than final energy intensity

- Emissions intensity covers all CO_2 emissions in energy supply (including non-energy)

Components of CO_2 emissions

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



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

- Macroeconomic trends increase CO_2 emissions (mostly economic activity).
- Improvements in energy and emissions intensity fully offset emissions increases from macro.
- Emissions intensity provides most incremental improvement in CN.

Conclusions

- Energy efficiency and electrification lead to substantial demand reductions in CN.
- Fossil fuel demand is substantial in CN; however, consumption is much lower.
- Wind and solar electricity generation is expected to increase in both scenarios; however, challenges remain with balancing reliability, affordability, and sustainability.
- CN envisions large CO_2 emissions reductions (66%).
- Improving emissions intensity is important to reducing CO_2 emissions.

Thank you.

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