

# Reference scenario in the 8th APEC Energy Demand and Supply Outlook

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# Outline

- **Reference vs Carbon Neutrality** scenarios
- Macroeconomic backdrop
- Energy demand
- Power
- Energy supply
  - Production
  - Coal and gas
- CO<sub>2</sub> emissions
- Kaya identity
- Decarbonisation technologies

# Scenarios

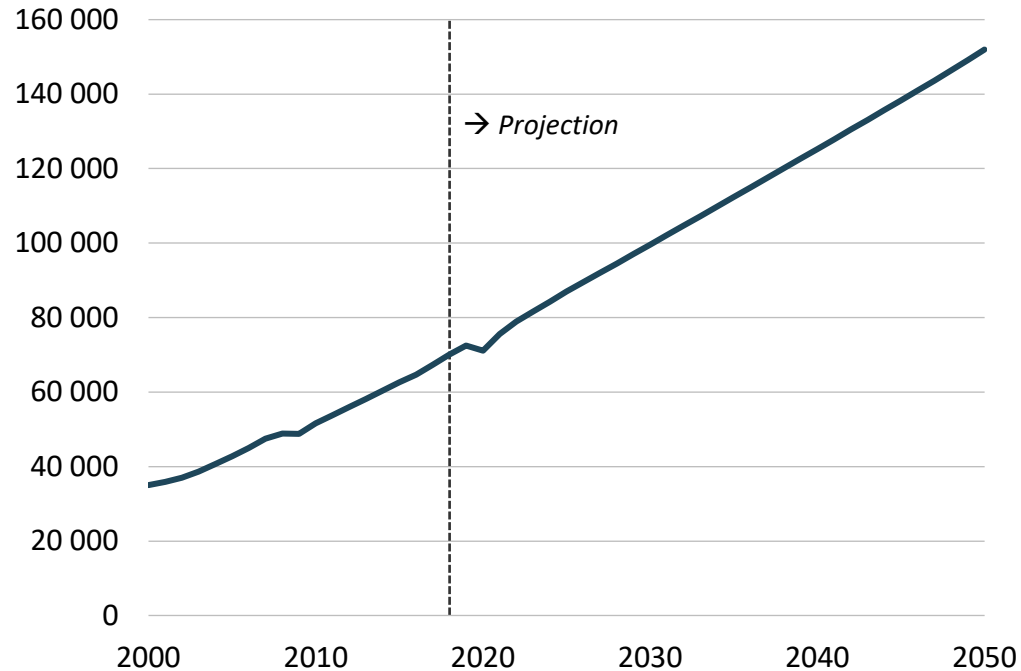
	Reference (REF)	Carbon Neutrality (CN)
<b>Definition</b>	Recent trends and current policies.	Hypothetical decarbonisation pathways for each APEC economy.
<b>Purpose</b>	Provides a baseline for comparison with the Carbon Neutrality scenario.	Additional energy sector transformations that support decarbonisation objectives.
<b>Key assumptions</b>	Current polices and trends continue.	Increased levels of energy efficiency, behavioral changes, fuel switching, and CCS deployment.
<b>Limitations</b>	Assumes that recent trends, including relevant decarbonisation measures continue.	Does not consider non-energy impacts on CO <sub>2</sub> or removal.

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

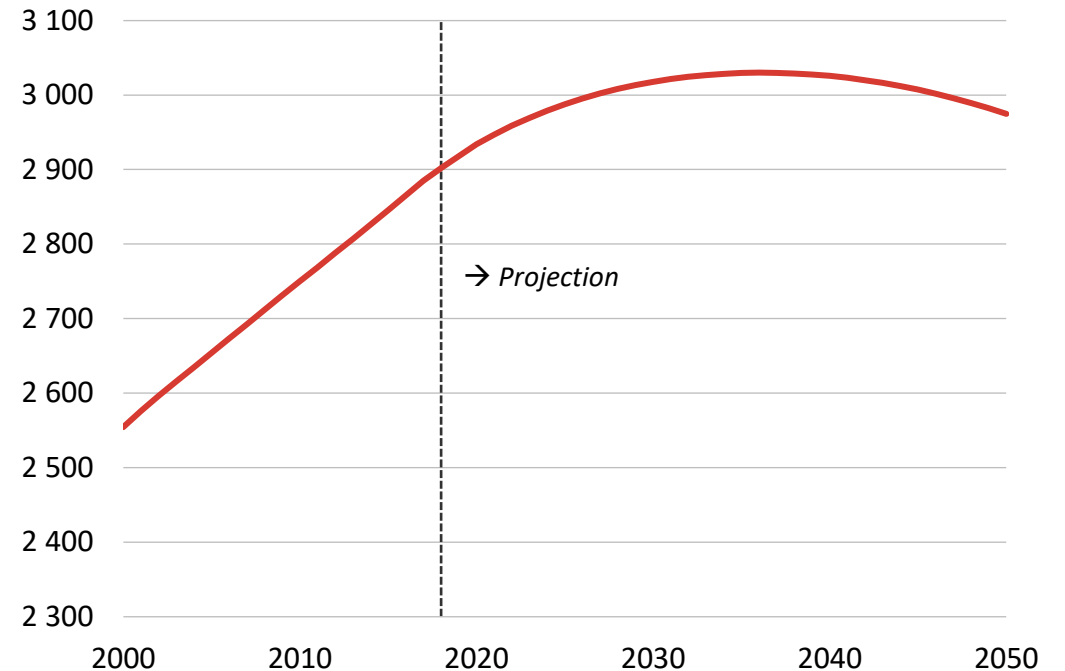
*The analysis was performed prior to March 2022 and does not include current disruptions to international energy markets.*

# Macroeconomic backdrop

APEC GDP in billion 2018 USD PPP, 2000-2050.



APEC population in millions, 2000-2050.

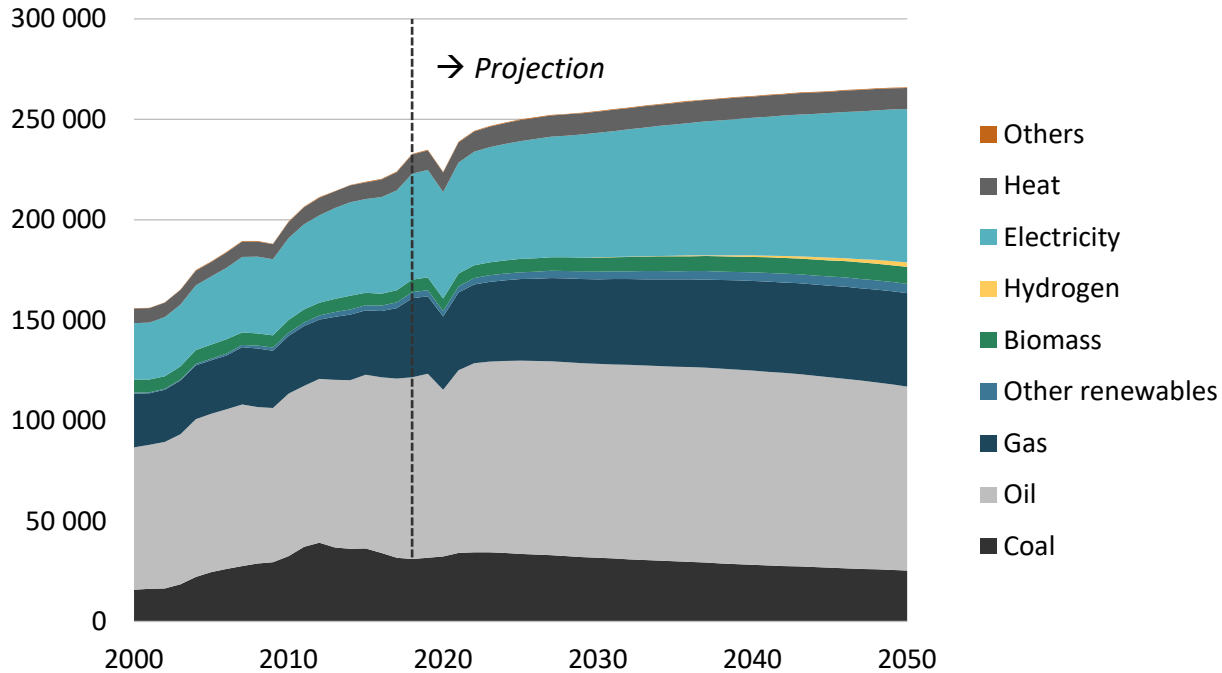


- APEC GDP is projected to more than double out to 2050.
- APEC population is anticipated to peak in the 2030s and then decline to less than 3 billion people in 2050.

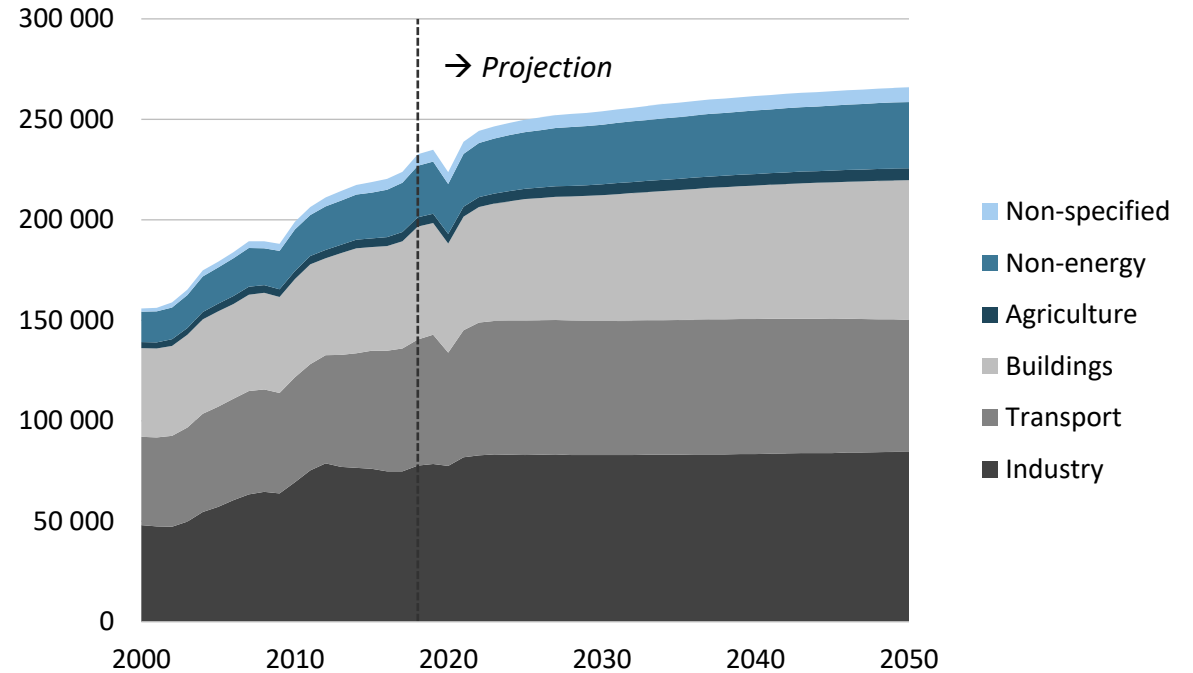
Notes: Historical GDP data from World Bank WDI. GDP projections from OECD and internal analysis. COVID-19 impact on GDP is incorporated in the 2020-2025 timeframe based on IMF projections (May 2021).

# Energy demand increases 14% in the Reference scenario

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



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

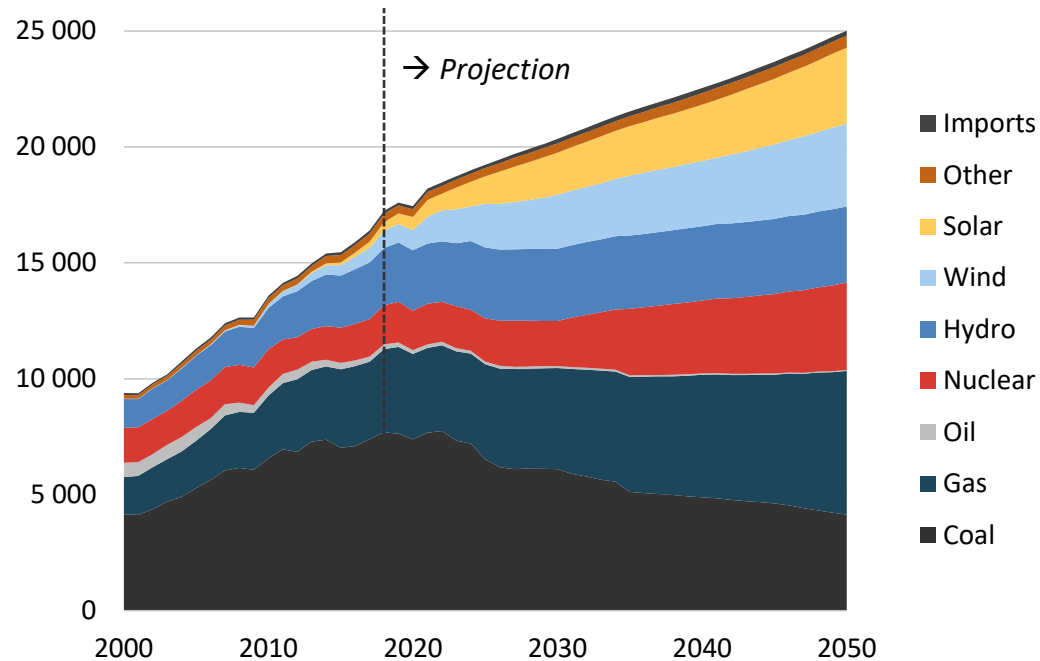


Sources: EGEDA, APERC analysis

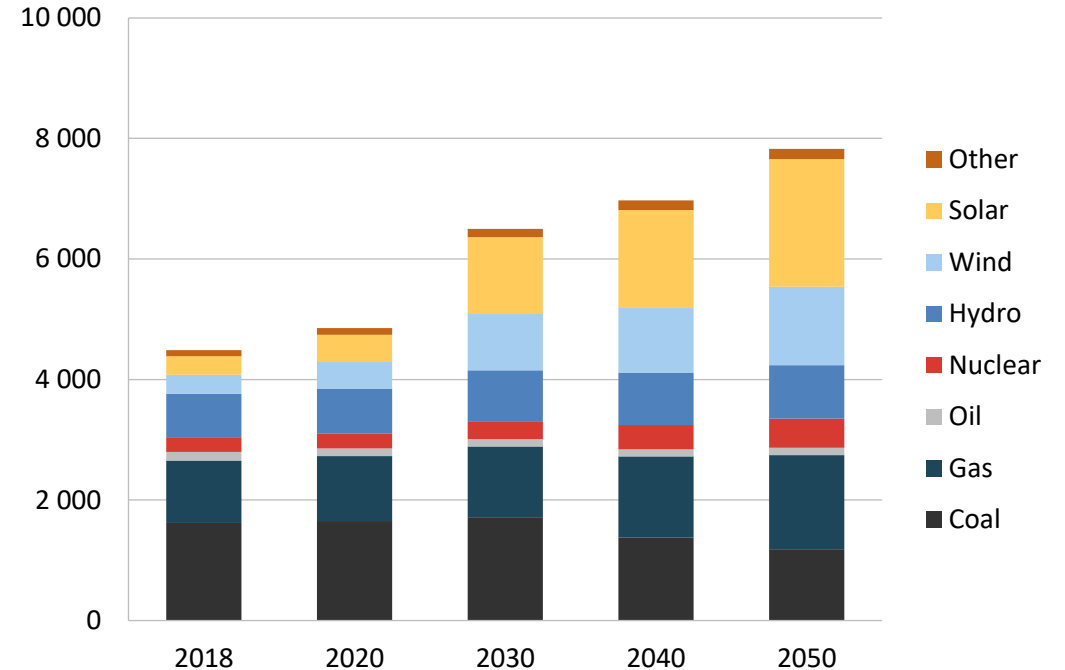
- **Decoupling:** While GDP more than doubles, energy intensity improvements mean that energy demand only increases by 14%.
- Electricity increases from a 18% share in 2000 → 23% share in 2018 → 29% share in 2050.
- Energy and sectoral mix is slow moving in this scenario.

# Fossil fuel generation falls from two-thirds to just over two-fifths in 2050

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



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

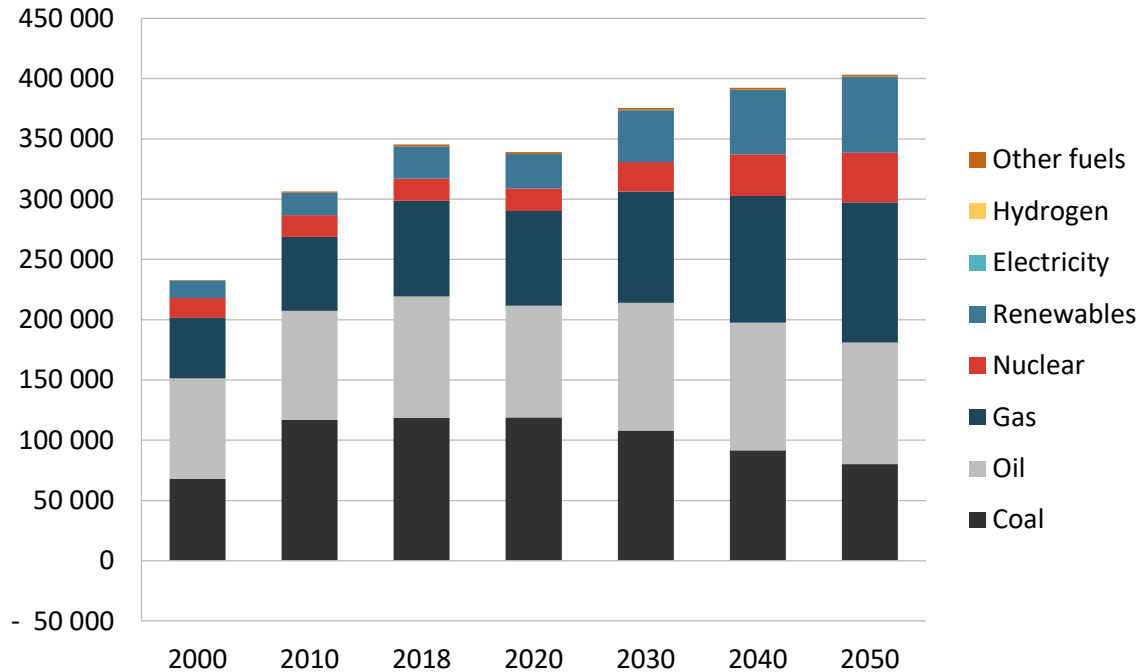


Sources: EGEDA, APERC analysis

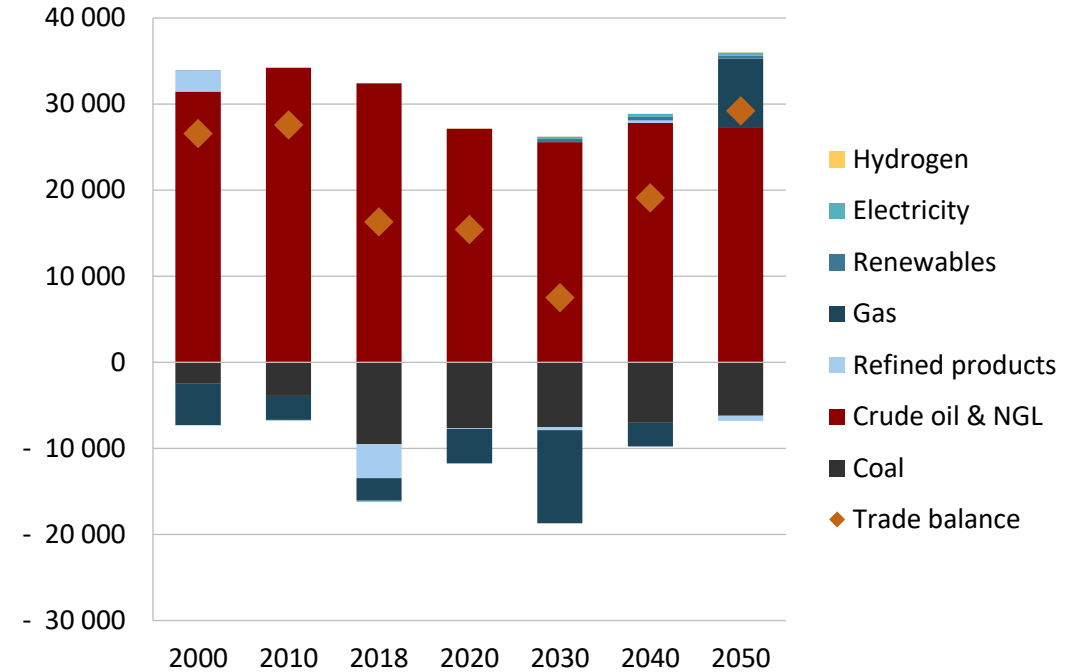
- Gas offsets a large portion of the fall in coal; fossil fuel generation maintains a high plateau.
- Solar and wind capacity grows significantly (RHS)  
→ Variable characteristics limit share of generation (LHS).
- Nuclear generation more than doubles (share increases from 10% to 15%).

# Fossil fuels supply remains foundational

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



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

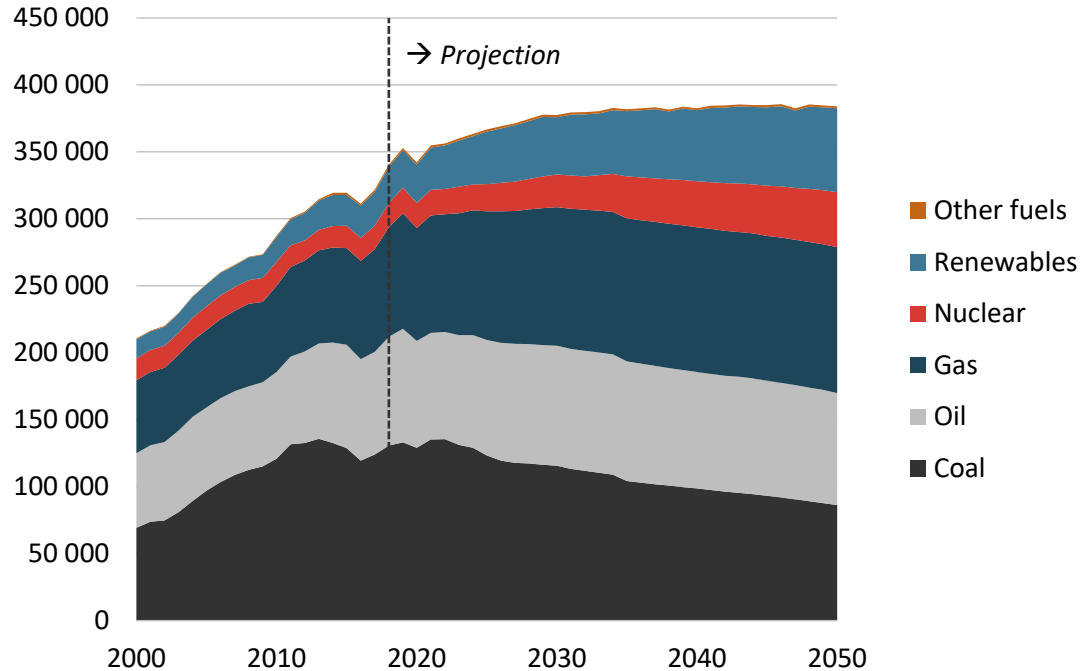


Sources: EGEDA, APERC analysis

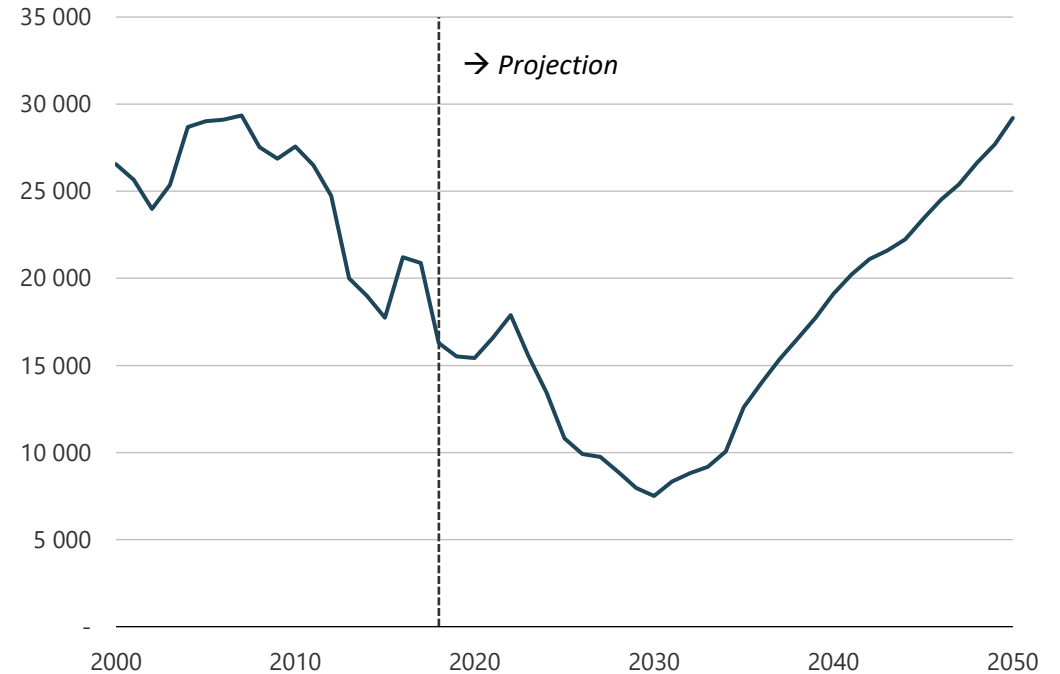
- Fossil fuels plateau with their share of supply falling from 85% to 75%.
- There is a large movement from coal to gas, with APEC eventually requiring imports to satisfy supply near the end of the projection.
- Renewables supply increases by 130% (relative share of renewables supply doubles).

# Coal (2020s) and then oil (2030s) production peaks

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



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



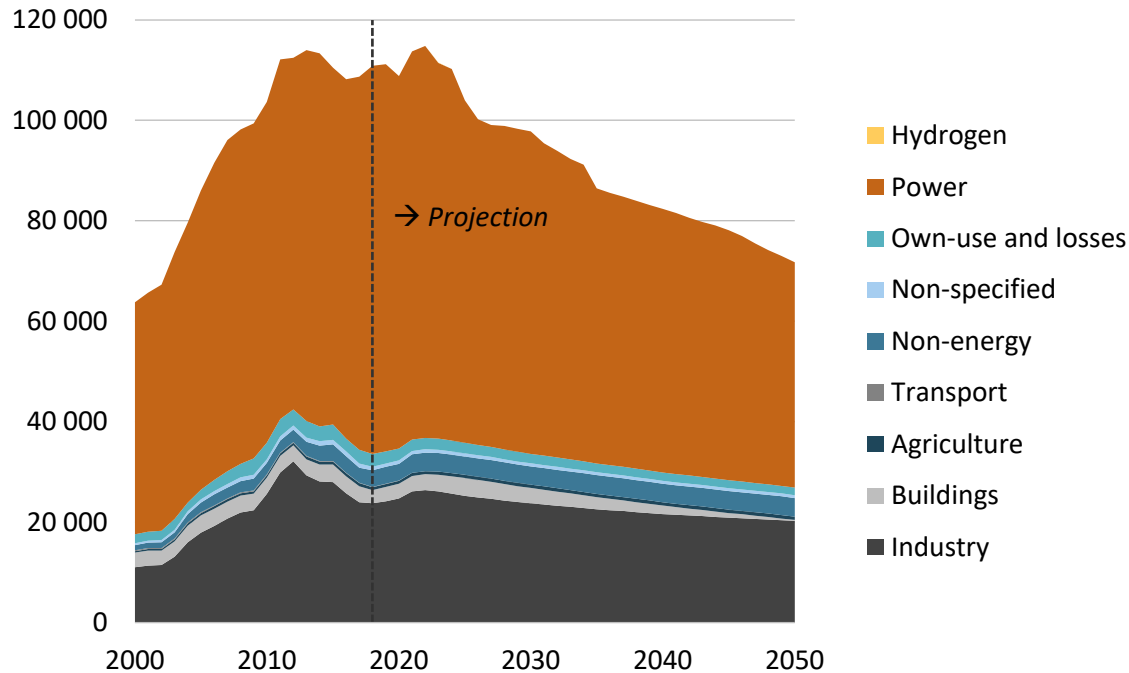
Sources: EGEDA, APERC analysis

- APEC is a large energy producer, though production is insufficient to meet supply requirements.
- Declining import dependence continues through 2020s.
- The rise of southeast Asian economies and declining coal and oil production leads to increasing import dependence from the 2030s.

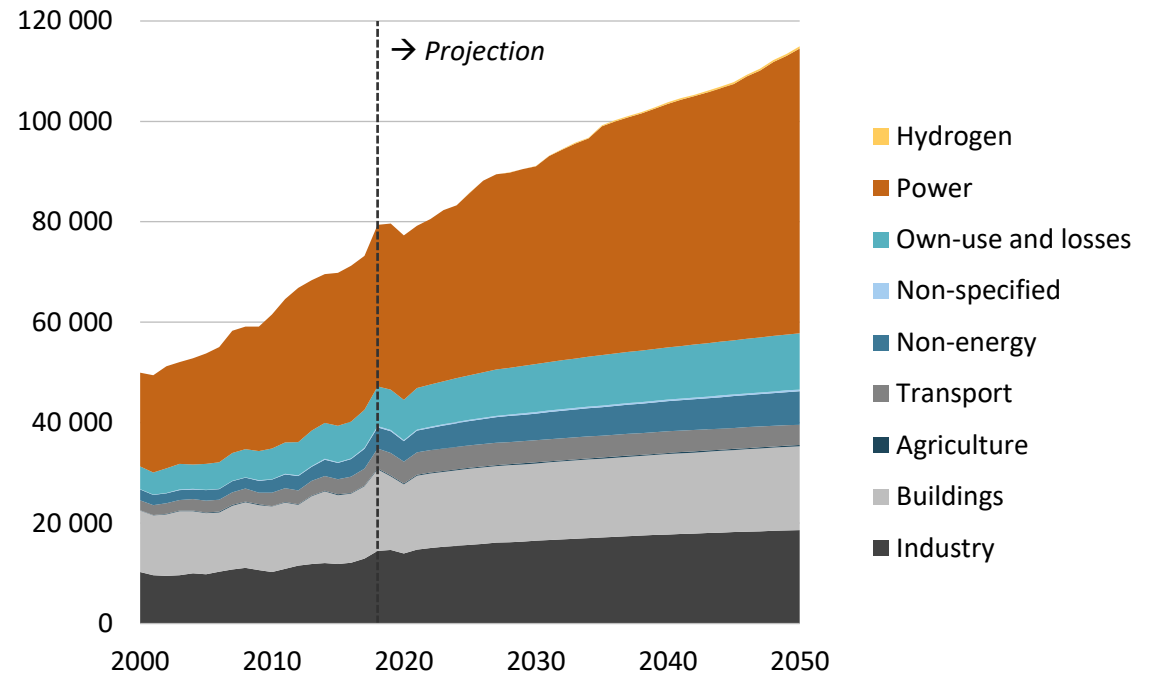


# Natural gas supplants coal in the Reference scenario

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



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

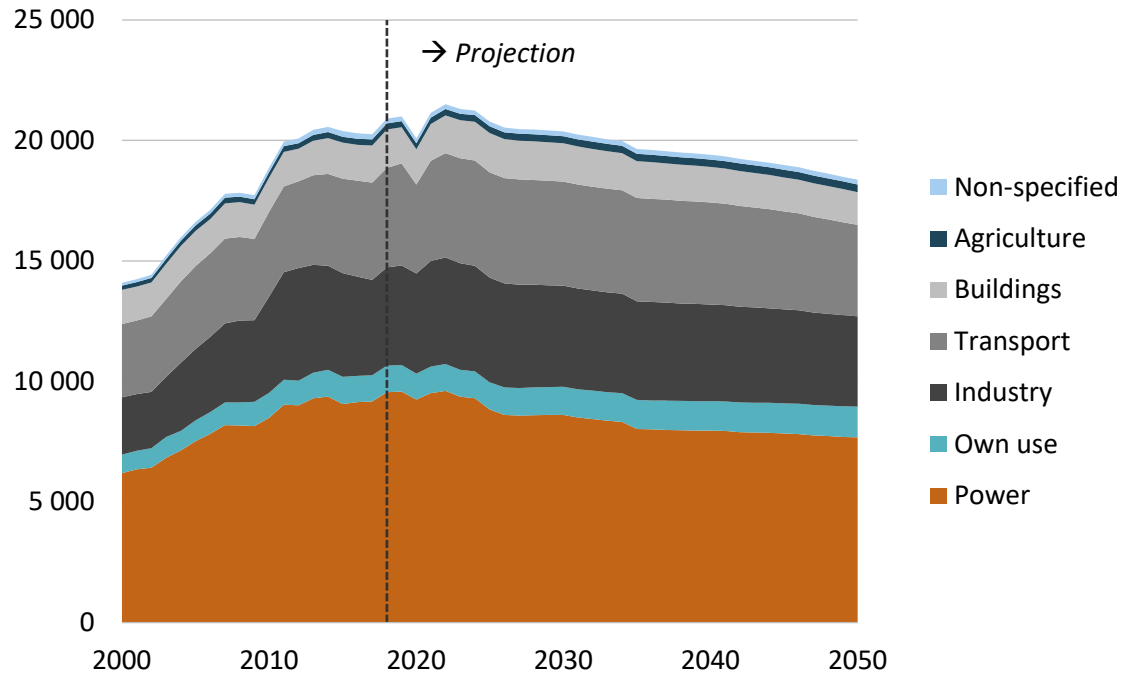


Sources: EGEDA, APERC analysis

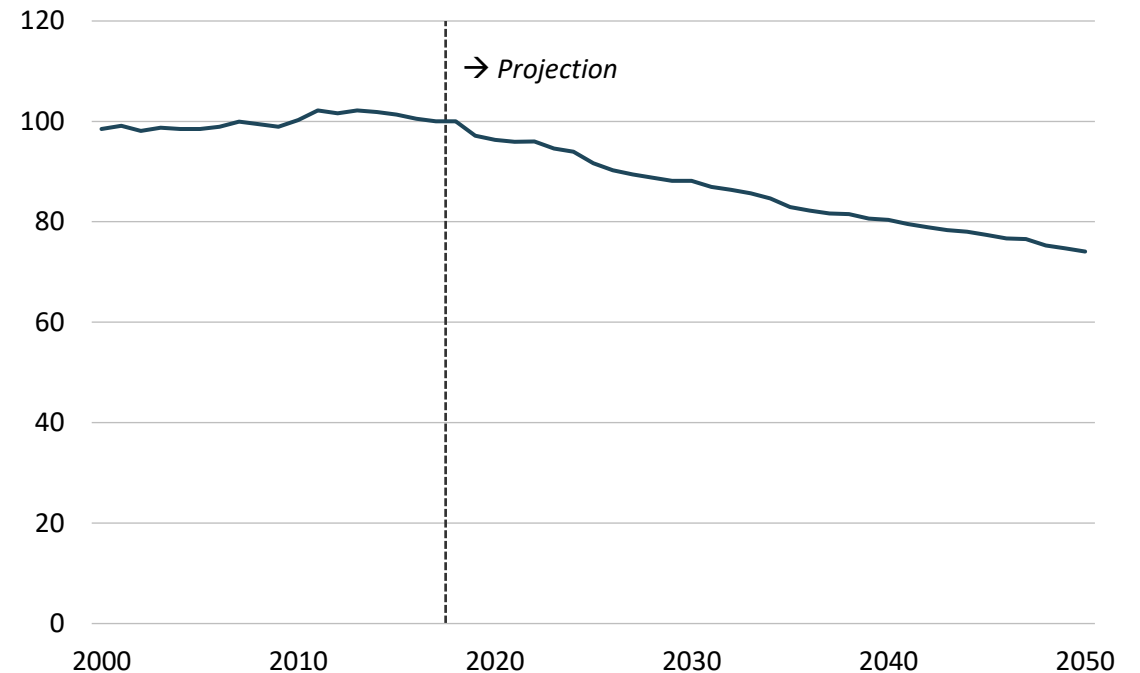
- Coal-fired power generation falls by more than 40% out to 2050.
- Gas consumption by gas-fired power plants increases 80% out to 2050.
- The decline in industry coal consumption is lower than in other sectors, partly due to robust demand for metallurgical coal to produce coke for steel making.

# APEC CO<sub>2</sub> emissions are 14% lower by 2050

CO<sub>2</sub> emissions in REF, 2000-2050 (million tonnes).



Emissions intensity in REF, 2000-2050 (2018 = 100).



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

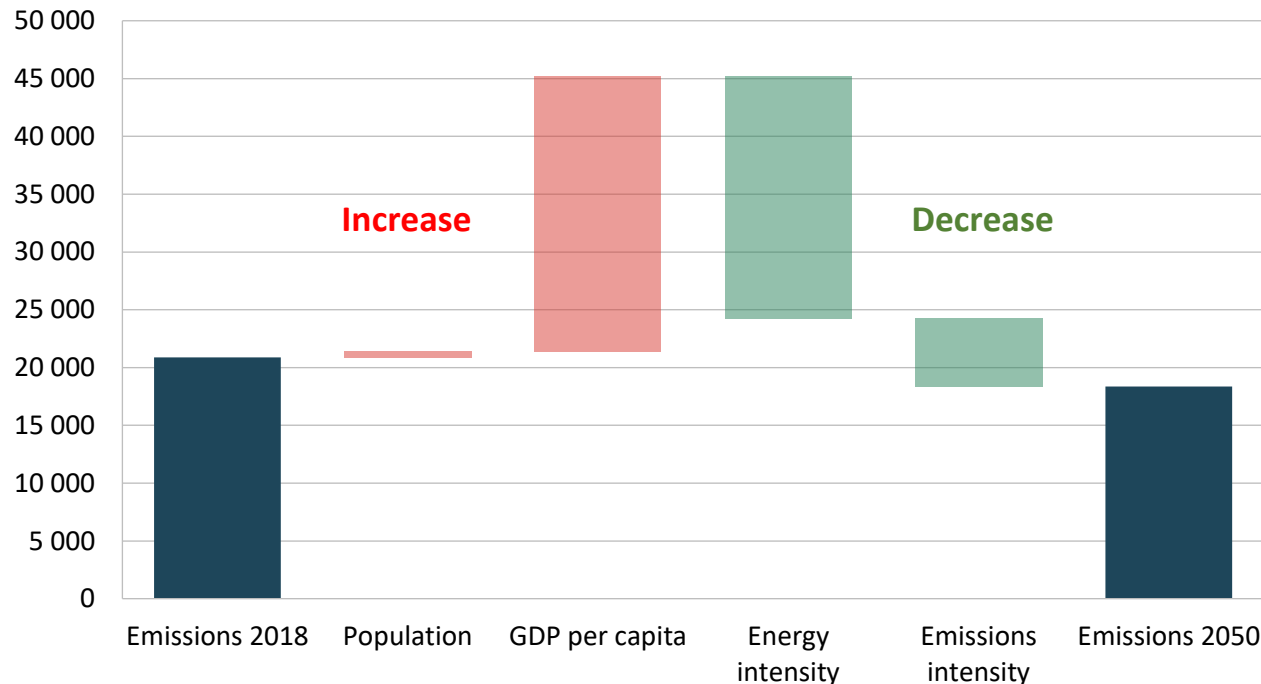
- The decline in emissions out to 2050 is achieved through:
  - Energy efficiency: influential in all sectors.
  - Emissions intensity: more than 25% improvement (mostly coal to gas and renewables).

# Kaya identity decomposes CO<sub>2</sub> emissions into four components

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

GDP per capita
Energy supply intensity
Emissions intensity

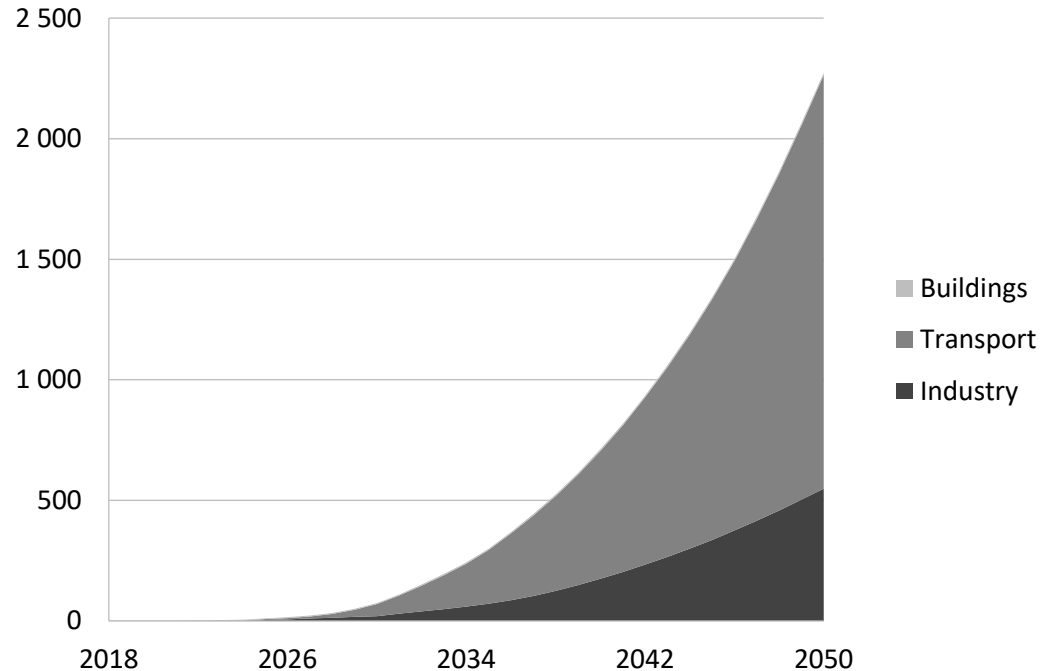
CO<sub>2</sub> emissions components in REF, change from 2018 to 2050 (million tonnes).



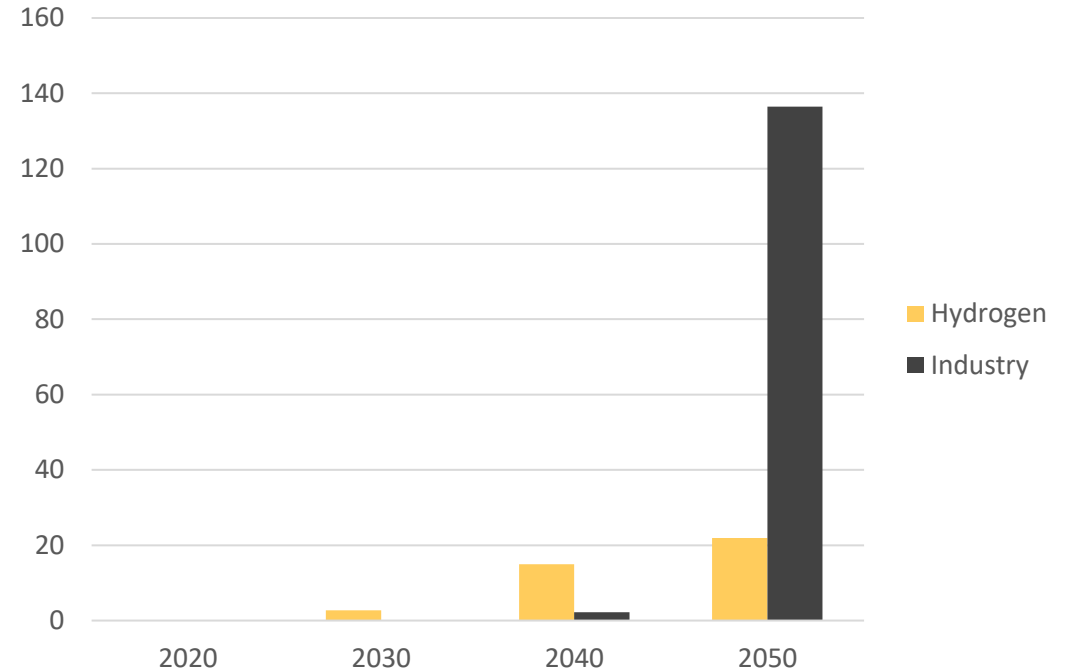
- Increasing living standards would lead to a more than doubling in emissions were it not for **energy intensity** and **emissions intensity** improvements.
- Instead, emissions fall by 14%.

# Decarbonisation technologies contribute small emissions reductions

APEC hydrogen consumption in REF, 2000-2050 (PJ).



CO<sub>2</sub> captured by CCS facilities in REF, by sector (million tonnes).



- Development of end-use applications that incorporate hydrogen increase from the late 2020s  
→ Hydrogen: 1% of end-use energy demand by 2050.
- Hydrogen production incorporates CCS in the 2020s; industry from the late 2030s.
- These technologies play a small role in the modelled emissions reductions for APEC.

# Conclusions from the Reference scenario

- **Decoupling (economic growth and energy demand)**

Energy demand continues to decouple from economic growth, leading to a modest increase in energy consumption out to 2050 in the Reference scenario.

- **Fossil fuels supply remains foundational**

Current demand and supply of fossil fuels persist, though there is a marked movement from coal to gas.

- **Wind and solar**

Account for 27% of generation and 44% of capacity by 2050. Balancing reliability, affordability, and sustainability will be a challenge even without aggressive decarbonisation.

- **Emissions peak and then end up lower than current levels**

While energy consumption increases, CO<sub>2</sub> emissions decline due to energy intensity improvements and lower emissions intensity of the energy being consumed.

**Thank you.**

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