APECエネルギー需給見通し第8版
-2050年までのAPEC地域のエネルギー動向

経済産業研究所 BBLセミナー
2022年9月30日

一般財団法人アジア太平洋エネルギー研究センター
所長　入江一友




Asia Pacific Energy Research Centre

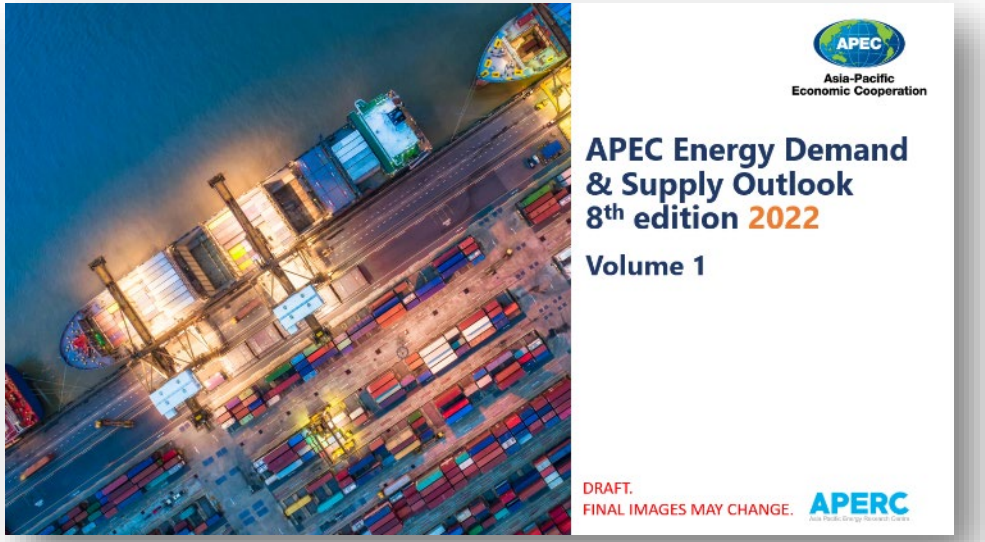
- APERC is the energy research arm of Asia-Pacific Economic Cooperation (APEC)
- Established in 1996 by initiative of the Japanese Government
- Located in Tokyo, Japan
- Four pillars of activities
  - Research Activities
  - Training
  - Data Management
  - Policy Cooperative Activities
- Two flagship publications
  - APEC Energy Demand and Supply Outlook
  - APEC Energy Overview

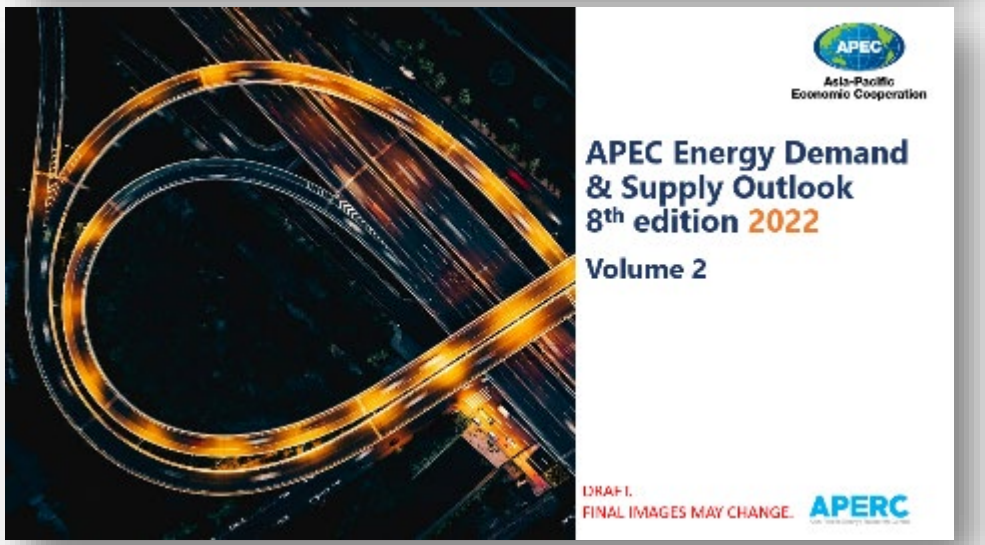
Points of discussion

1. Outline of the APEC Energy Demand and Supply Outlook
2. Scenarios: Reference and Carbon Neutrality
3. Results

Outline of the APEC Energy Demand and Supply Outlook

- Published every three years
- 8th edition: official launch end of September 2022
- Provides coverage on projected energy demand and supply trends
  - APEC-wide trends (Volume 1)
  - Economy-specific trends (Volume 2)
- For the 8th edition:
  - Projections: 2018-2050
  - Emissions focus (Kaya Identity)
  - Two scenarios: Reference and Carbon Neutrality





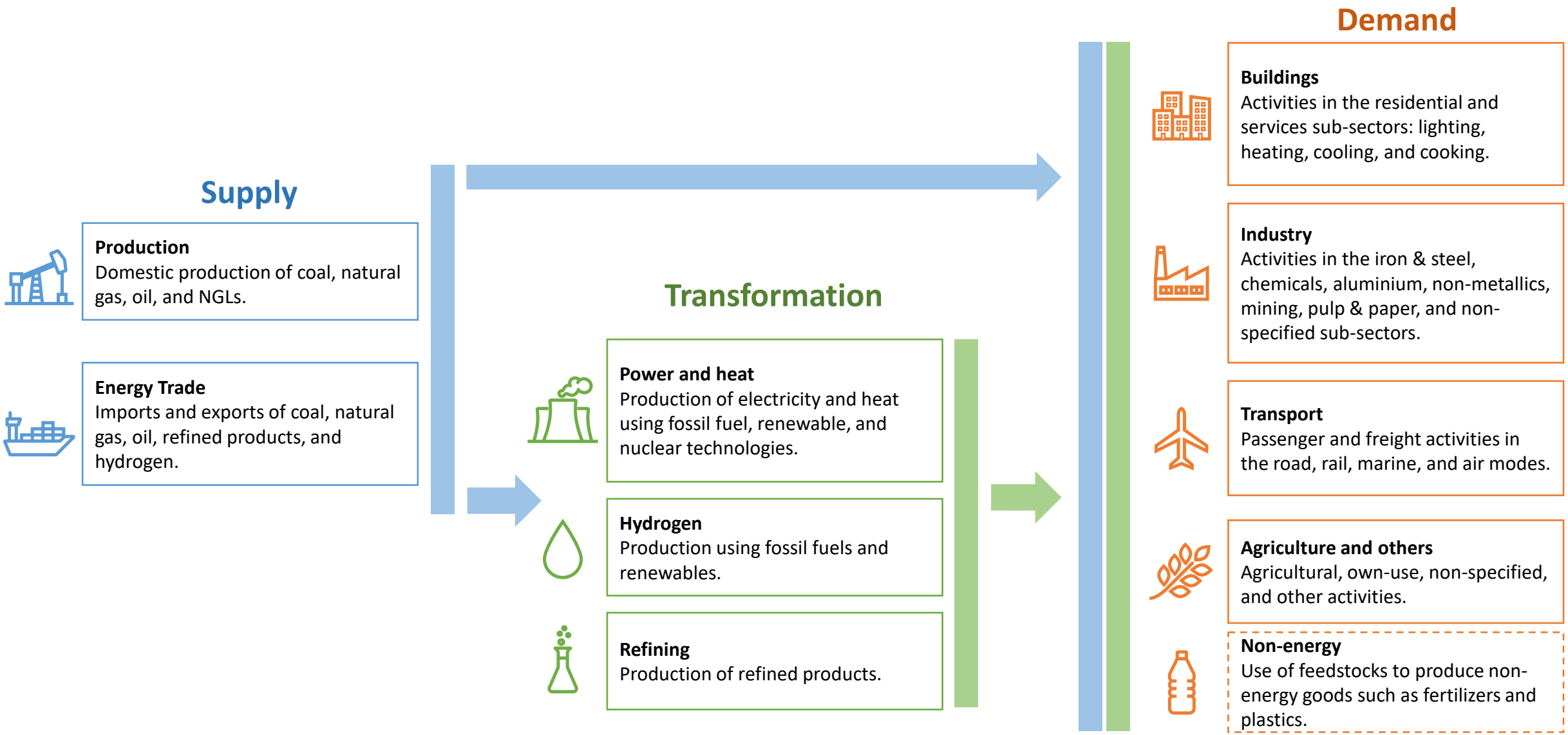
Scenarios: Reference and Carbon Neutrality

	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. Does not include announced carbon neutral plans that remain uncertain.	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 impacts 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.

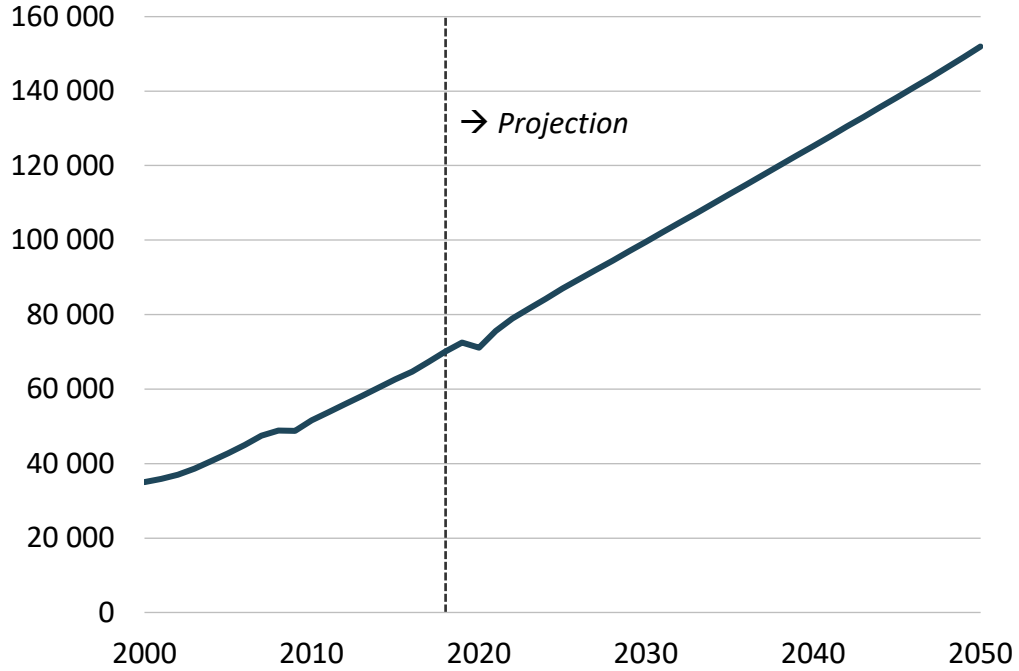
Components of the APEC energy system



APEC-wide results

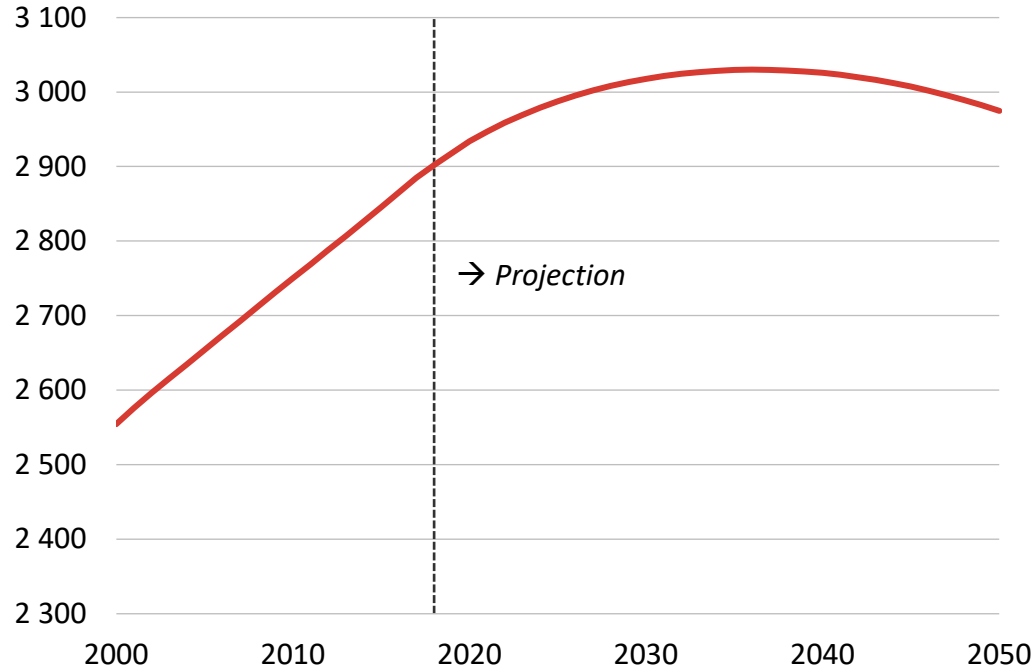
Macroeconomic backdrop

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.

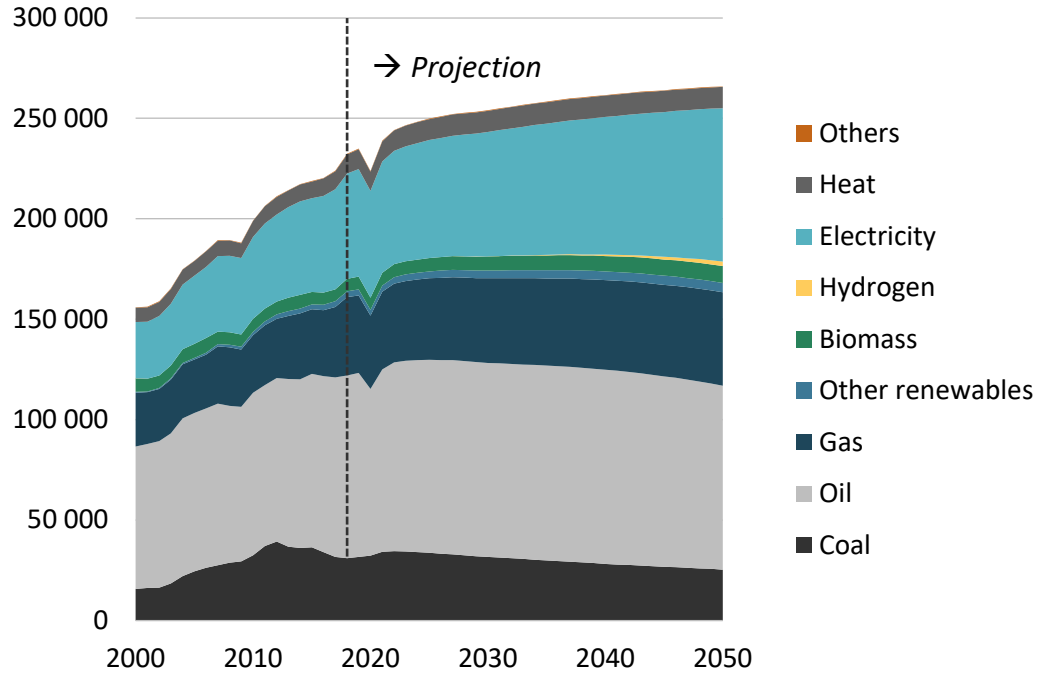


Notes: Historical population data from World Bank WDI. Projections from UN Department of Economic and Social Affairs 2019 Population Prospectus.

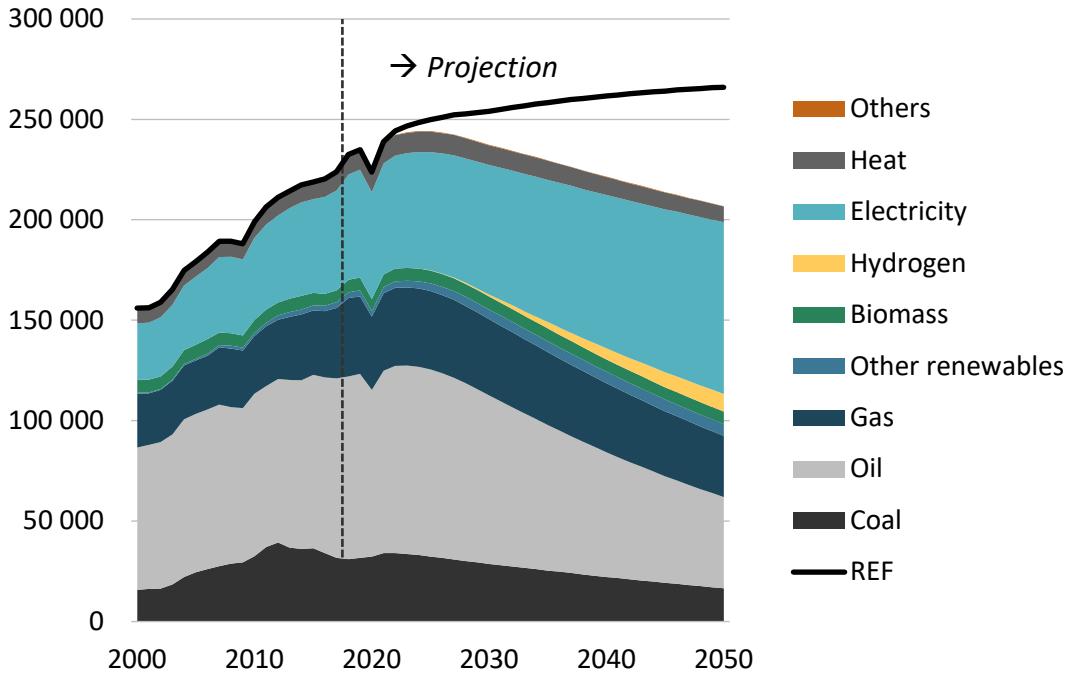
- Macroeconomic trends are expected to drive energy demand through 2050.
- Trends vary by APEC sub-region and economy.

APEC end-use energy demand increases 14% with current trends (2018-2050)

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



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

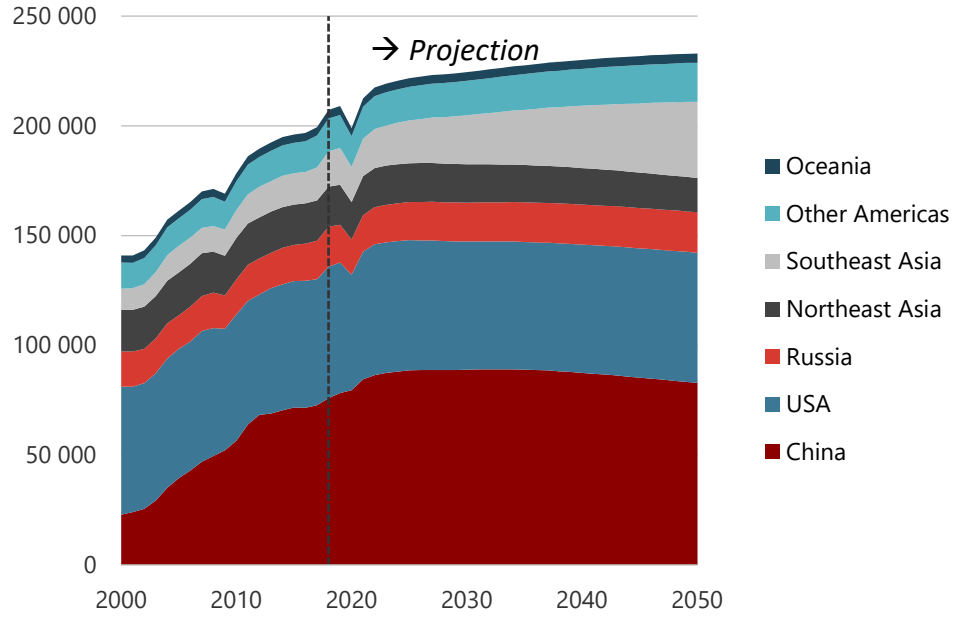


Sources: EGEDA, APERC analysis

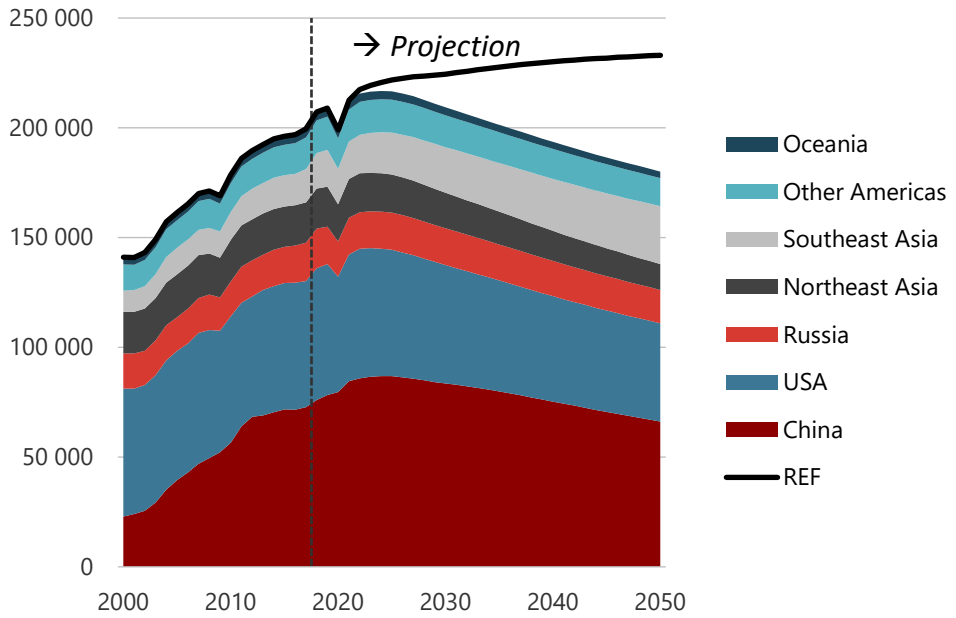
- In CN, additional energy efficiency, electrification, and fuel switching leads to an 11% drop in demand (2018-2050).
- Substantial fossil fuels demand remains in both REF and CN.

Largest energy demand remains in China and the United States

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



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



Sources: EGEDA, APERC analysis

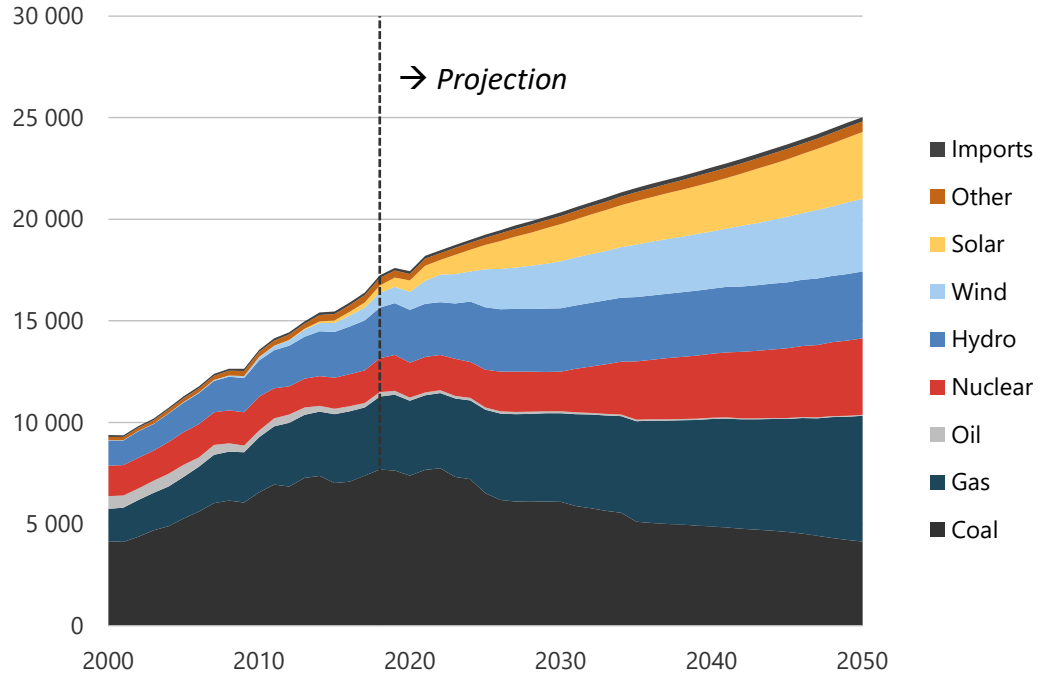
- Energy demand increases substantially in southeast Asia driven by macroeconomic trends.

Regional Groupings

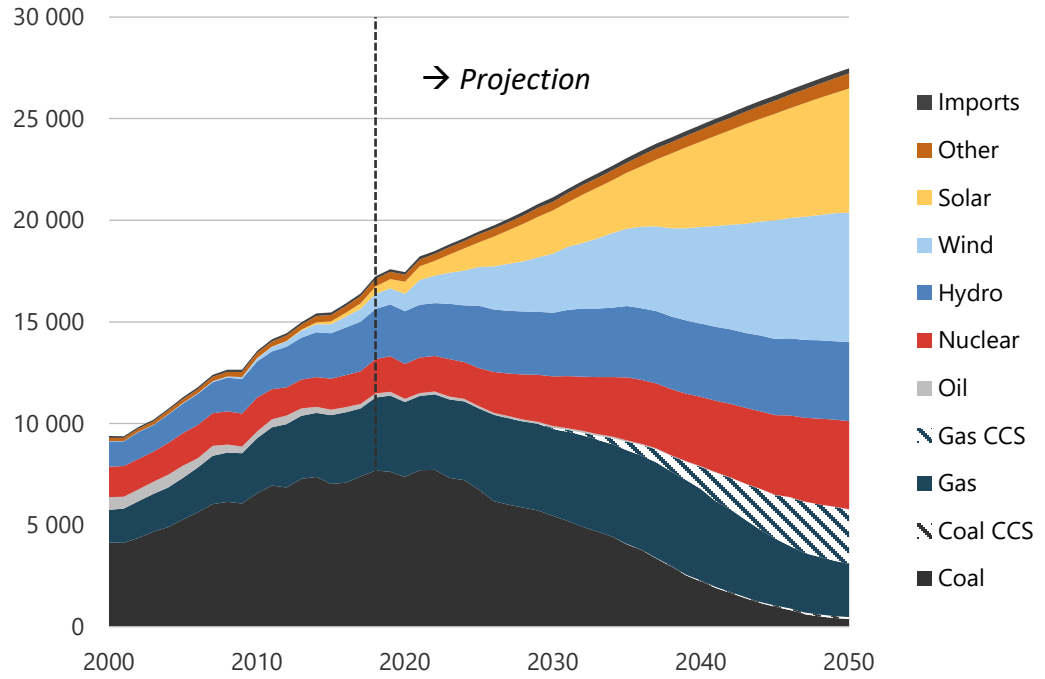
China	
Northeast Asia	Hong Kong, China; Japan; Korea; Chinese Taipei.
Oceania	Australia; New Zealand; Papua New Guinea.
Other Americas	Canada; Chile; Mexico; Peru.
Russia	
Southeast Asia	Brunei Darussalam; Indonesia; Malaysia; the Philippines; Singapore; Thailand; Viet Nam.
United States	

Electricity generation grows in both scenarios

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



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

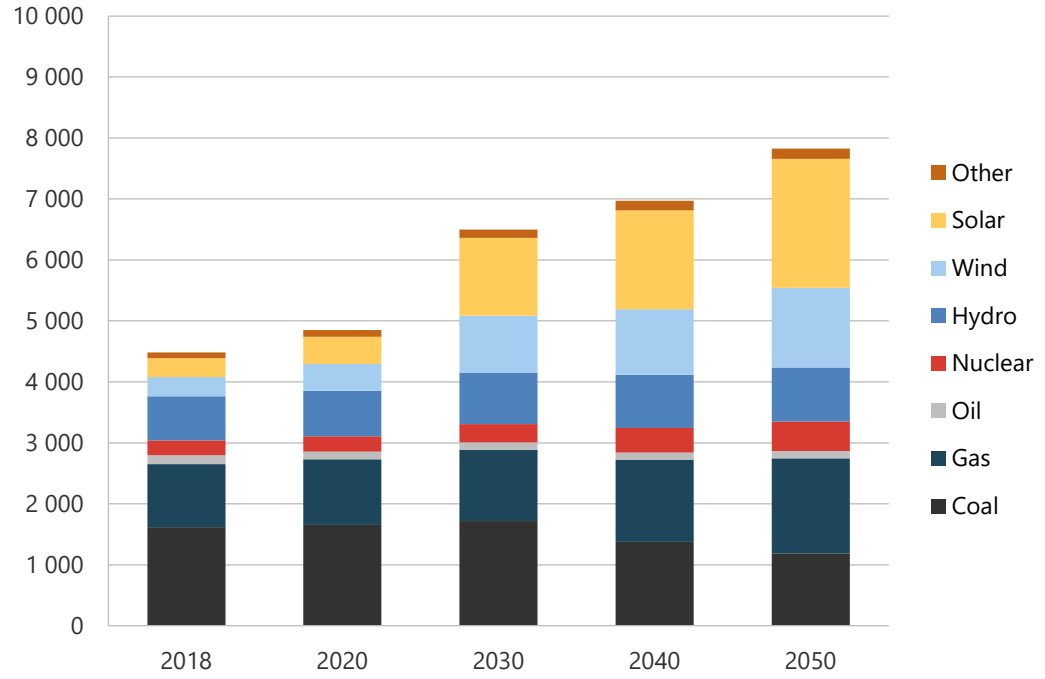


Sources: EGEDA, APERC analysis

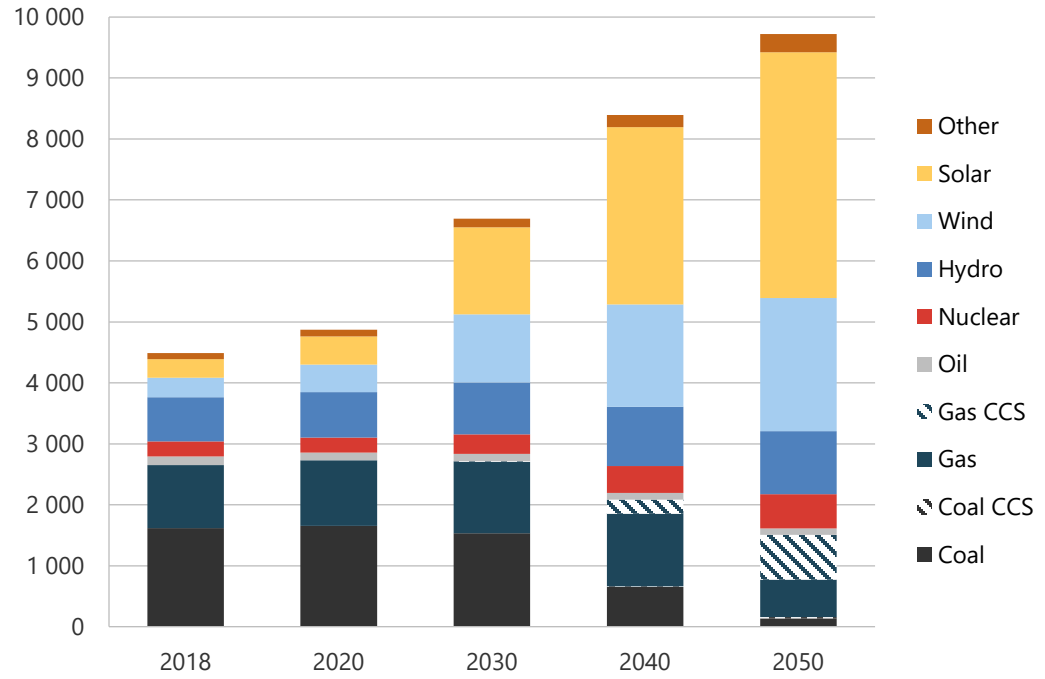
- Growth in electricity generation to meet increased demand primarily in the buildings and transport sectors.
- Wind and solar provide the most incremental generation in both scenarios.
- Natural gas substitution for coal continues and provides balancing and ancillary services to the grid.

Wind and solar capacity additions outpace all other technologies

Capacity in REF, 2018-2050 (GW).



Capacity in CN, 2018-2050 (GW).

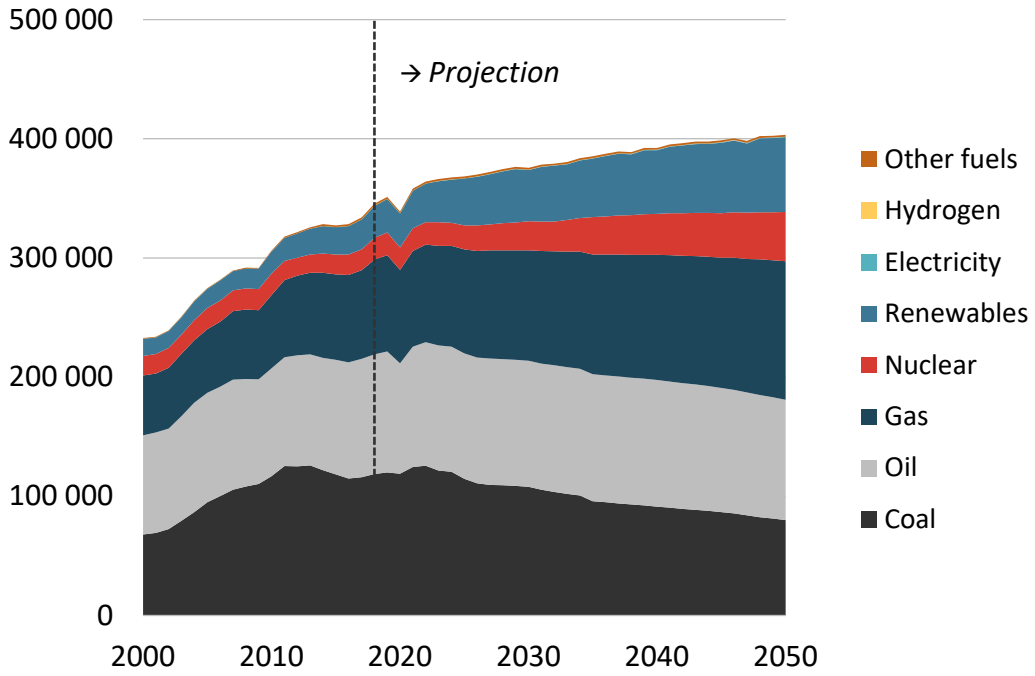


Sources: EGEDA, APERC analysis

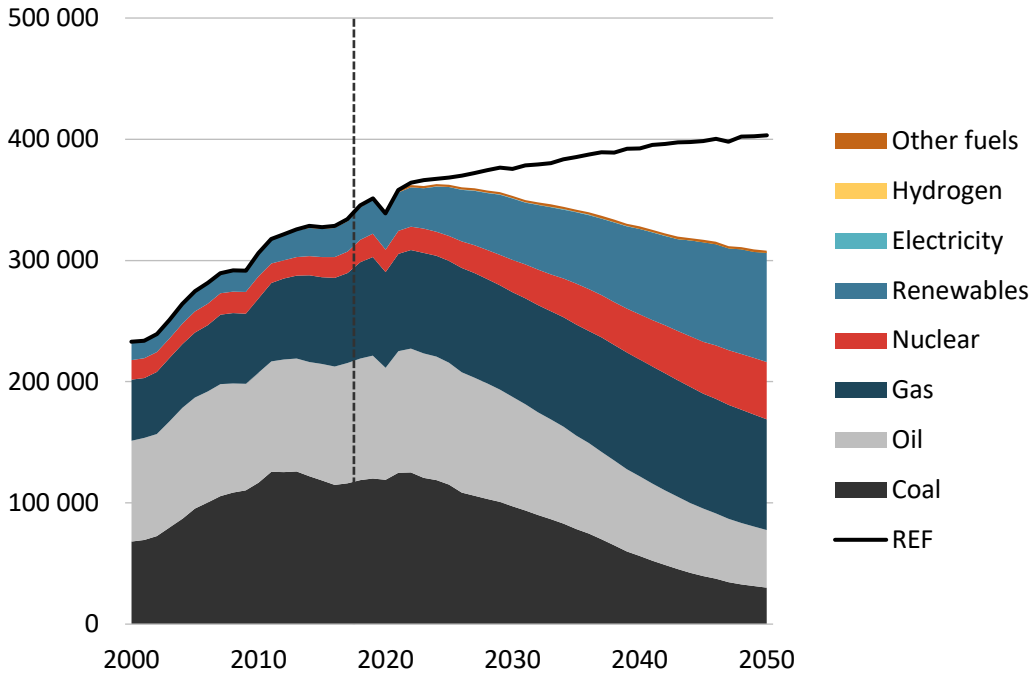
- Average capacity factor declines from 44% in 2018 to 36% (REF) and 32% (CN).
- CCS plays an important role for reducing unabated natural gas plants (and coal in select economies).
- Increased wind and solar introduces grid reliability challenges.

Fossil fuels remain a large share of APEC Energy supply

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



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



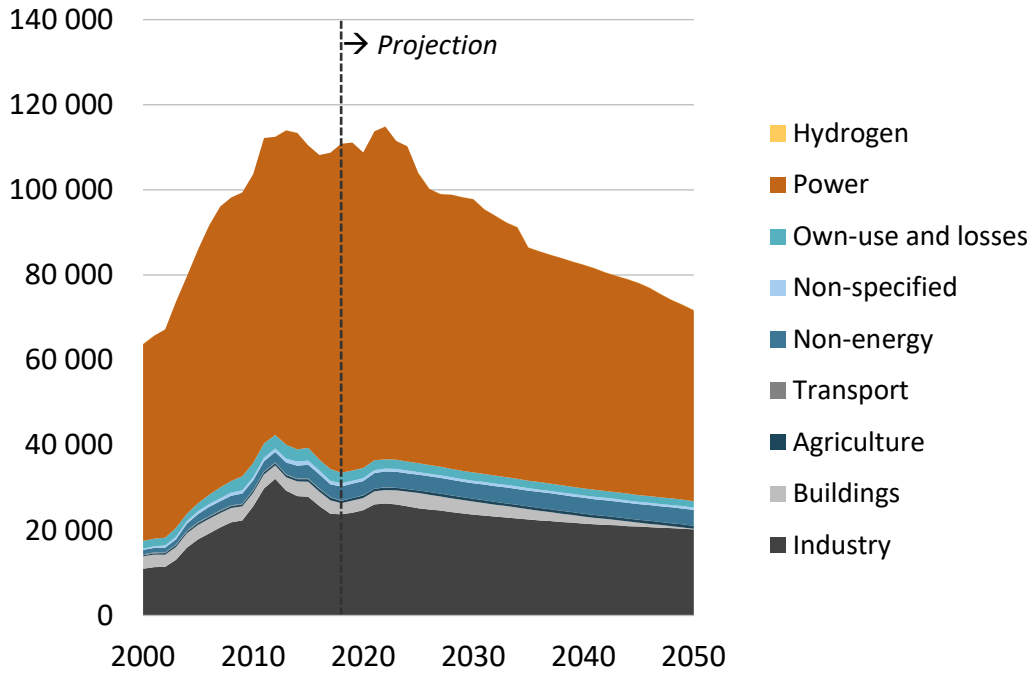
Sources: EGEDA, APERC analysis

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

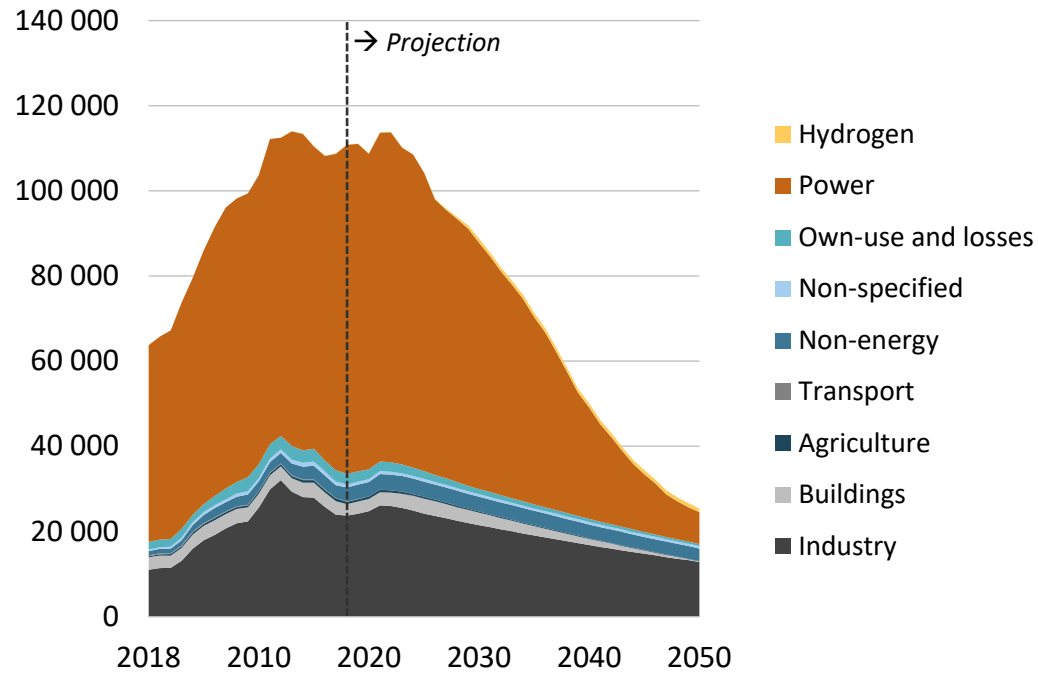
Note: energy supply = production + net imports + bunkers

Coal consumption declines in both scenarios

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



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

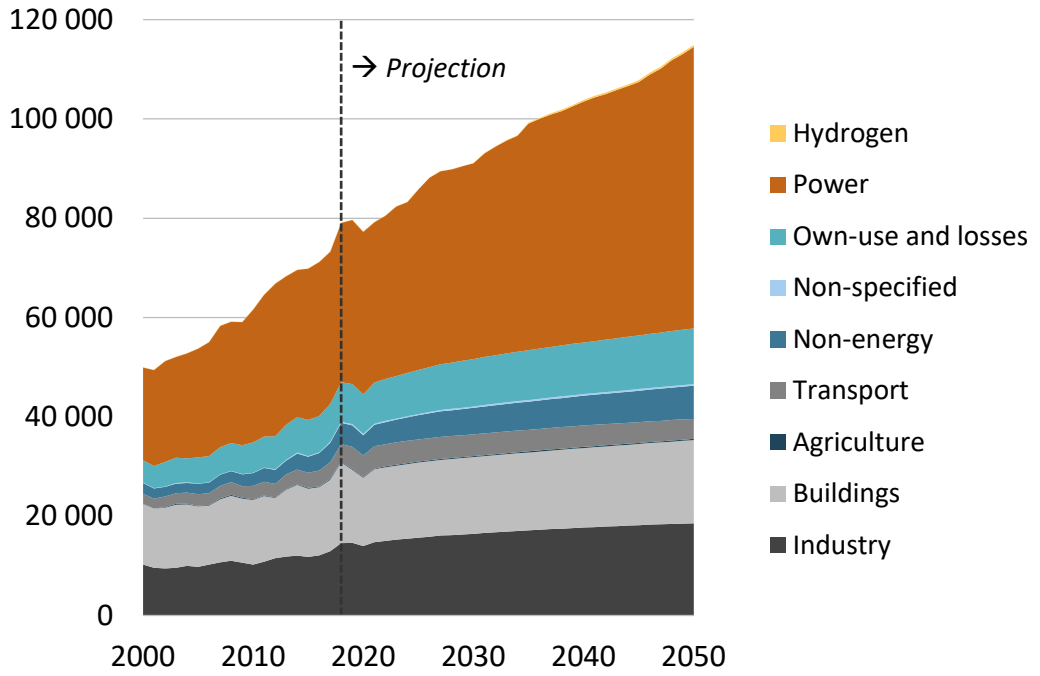


Sources: EGEDA, APERC analysis

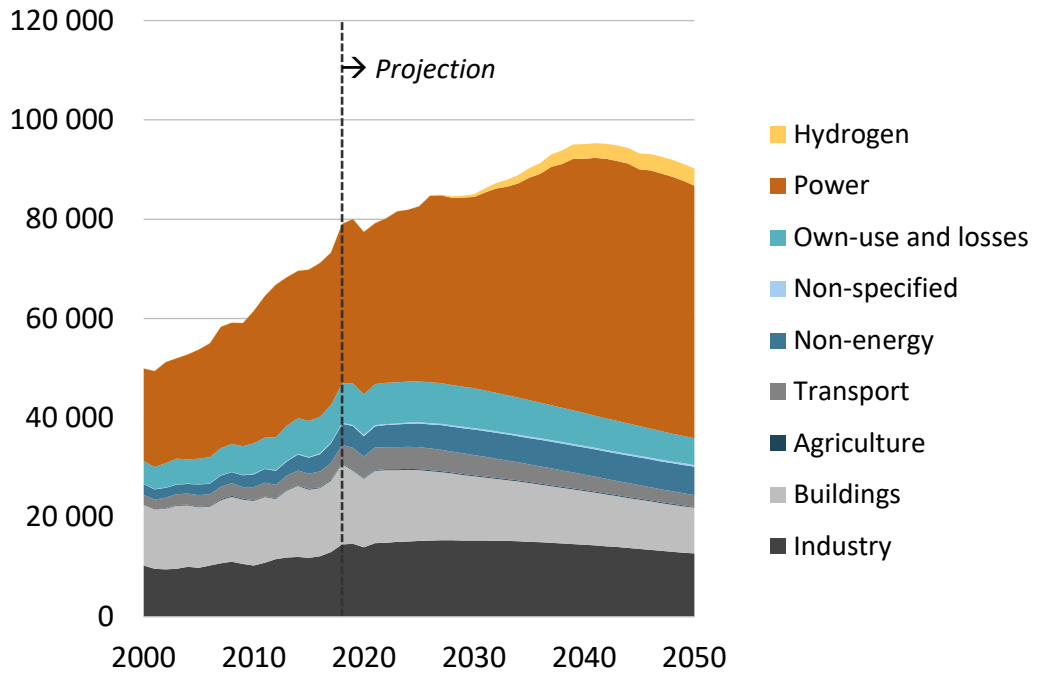
- Coal phase-down and phase-out policies increase substantially in CN primarily in the power sector.
- Metallurgical coal is difficult to replace for industrial processes.

Natural gas consumption increases in both scenarios (2018-2050)

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



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

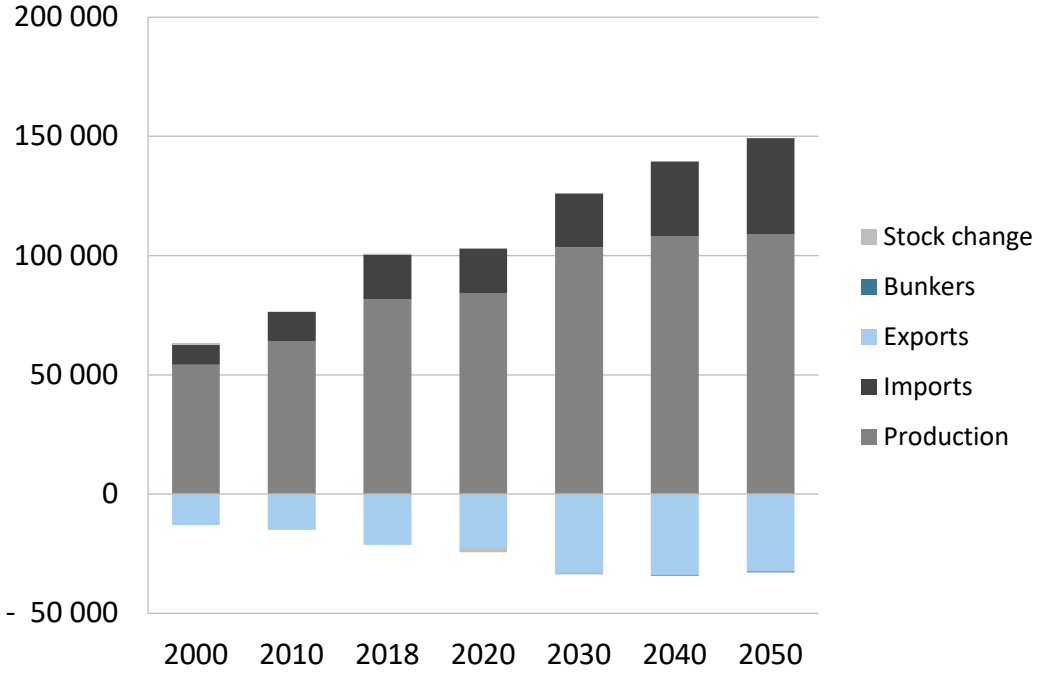


Sources: EGEDA, APERC analysis

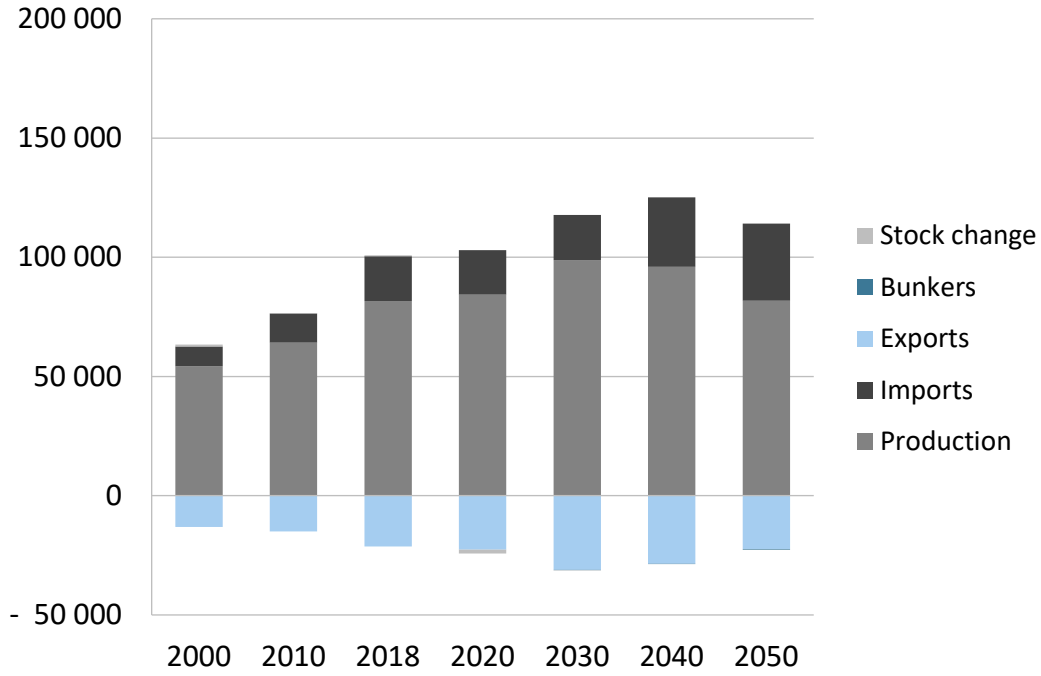
- Power sector remains largest consumer of natural gas.
- Introduction of CCS technology in gas-fired plants and industry prolongs natural gas consumption.

APEC becomes a net natural gas importer in both scenarios in 2040s

Natural gas production, imports, and exports in REF, 2000-2050 (PJ).



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

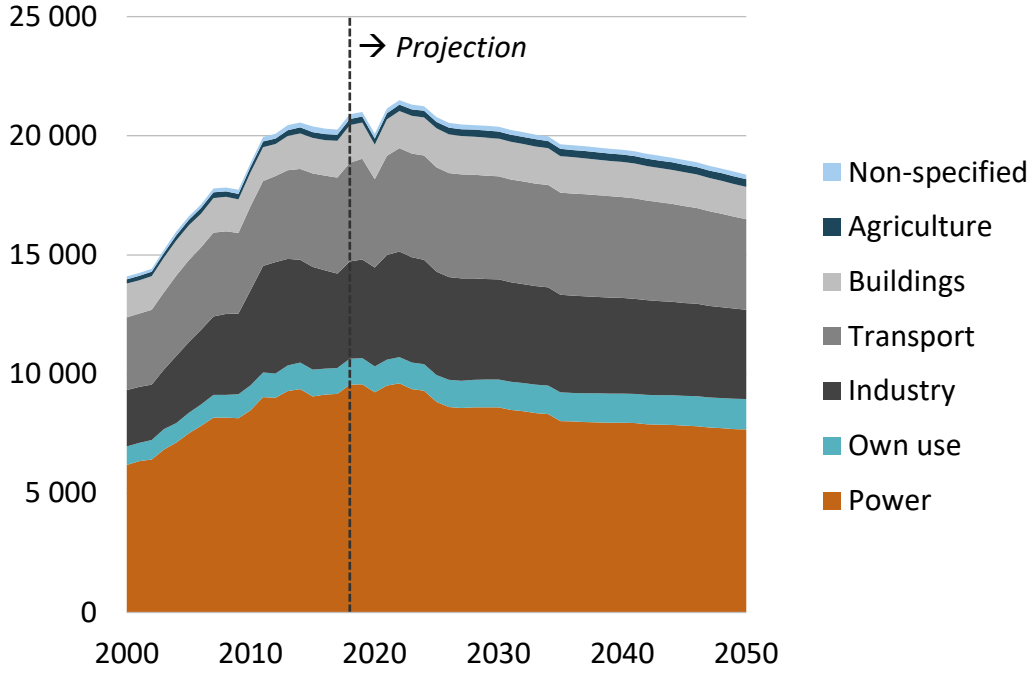


Sources: EGEDA, APERC analysis

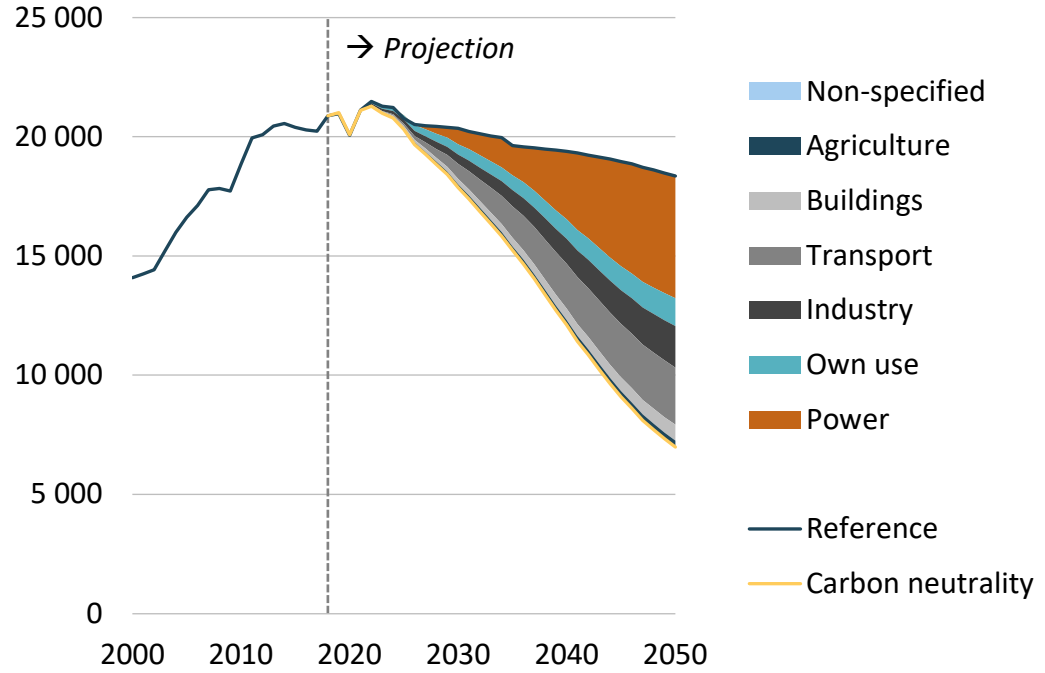
- USA, China, Russia, and Canada account for essentially all the production growth in REF.
- APEC natural gas trade volumes are 25% lower in CN than REF by 2050.

Gross CO_2 emissions by sector

Gross 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.
- In CN, emissions decline 67%. 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:

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

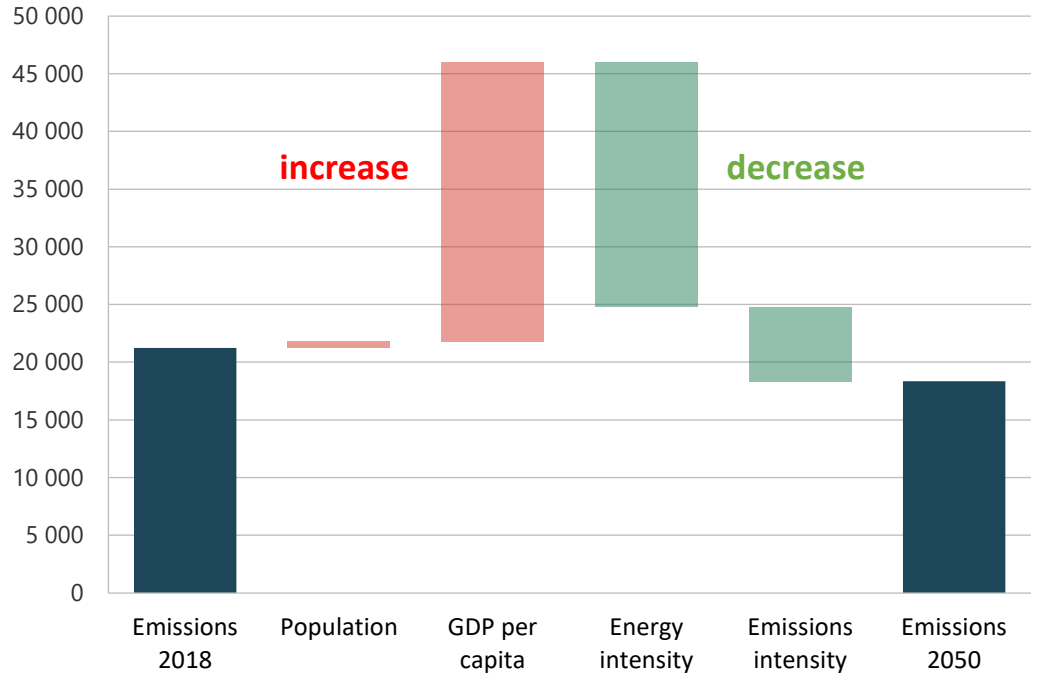
GDP per capita | Energy supply intensity | Emissions intensity

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

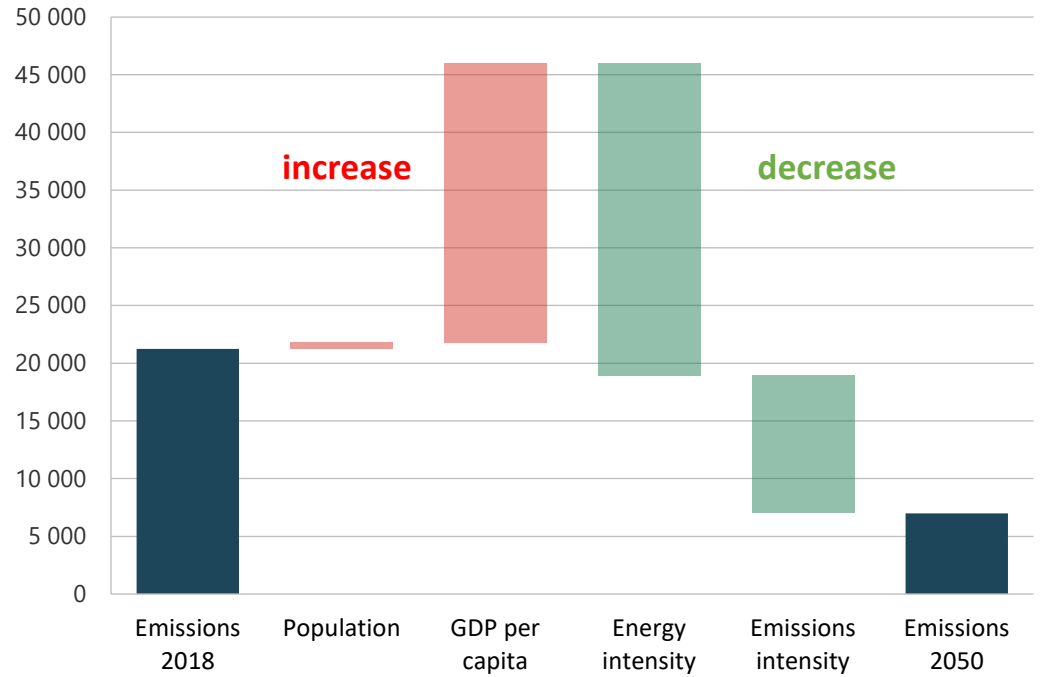
- Emissions intensity covers all CO_2 emissions in energy supply.
- Modern renewables contribute to emissions intensity.

Components of CO2 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. 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 (REF).
- Energy and emissions intensity reductions provide roughly equal incremental emissions improvements in CN relative to REF.

APEC goals

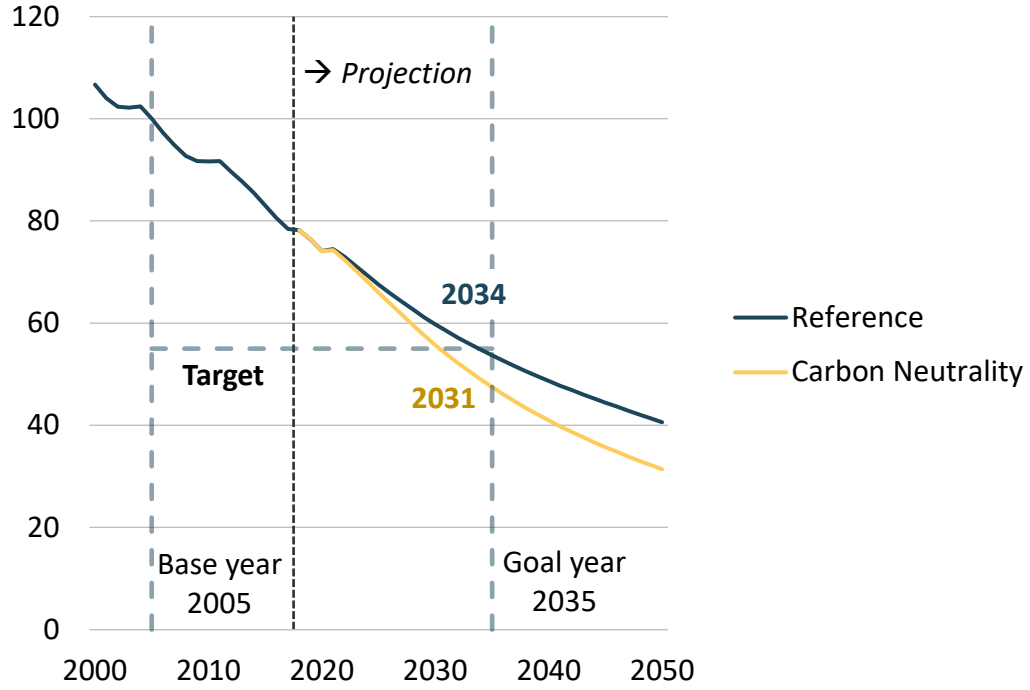
APEC currently has two energy goals:

1. **Reducing APEC's aggregate energy intensity by 45% by 2035 relative to 2005**
   - The target is expressed in final energy demand (excluding non-energy) relative to GDP.

2. **Doubling the share of modern renewable energy by 2030 relative to 2010 levels**
   - Modern renewables:
     - demand of renewables in end-use sectors (excluding non-energy and traditional biomass)
     - proportion of electricity and heat demand that is attributable to renewable sources.
   - The modern renewables share is considered in terms of demand, supply, and electricity generation.

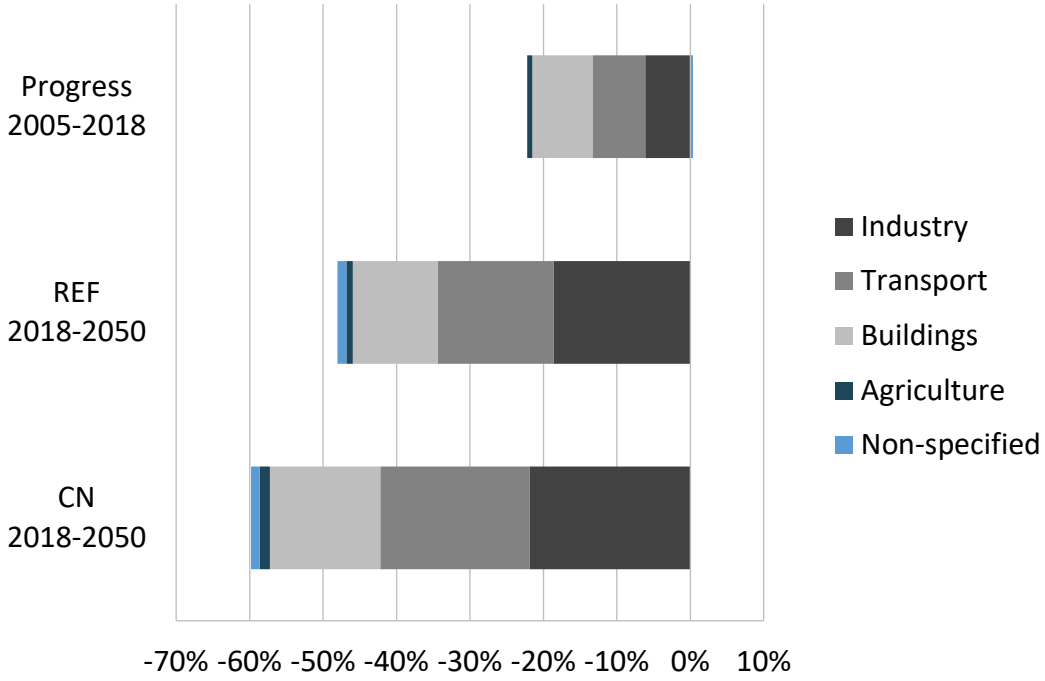
APEC Goal: Final energy intensity

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



Note: Final energy intensity = final energy demand (excluding non-energy) divided by GDP.

Contribution to change in final energy intensity.

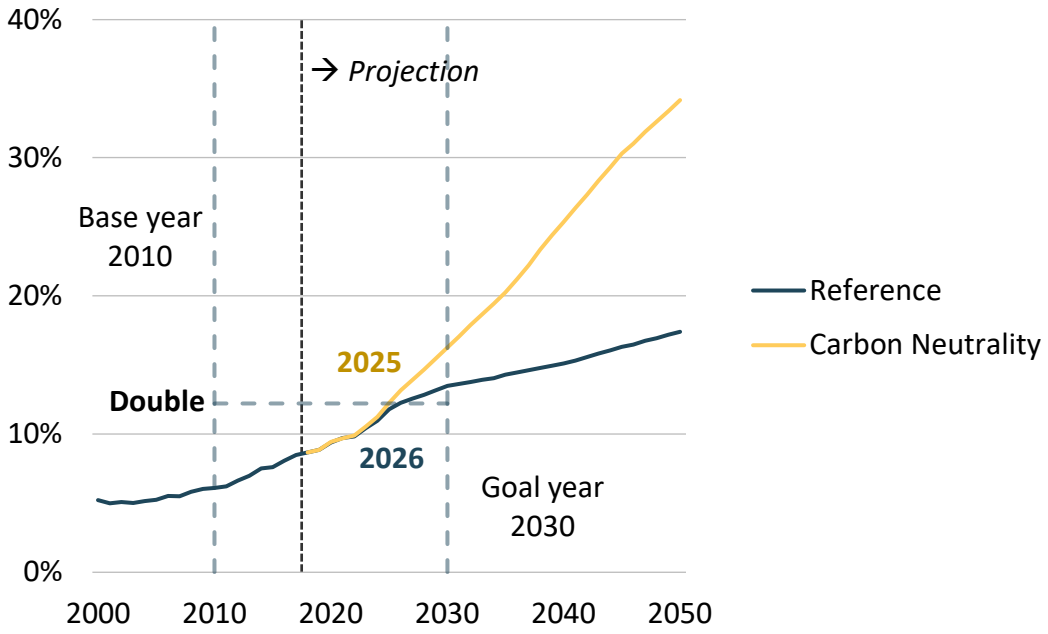


Sources: EGEDA, APERC analysis

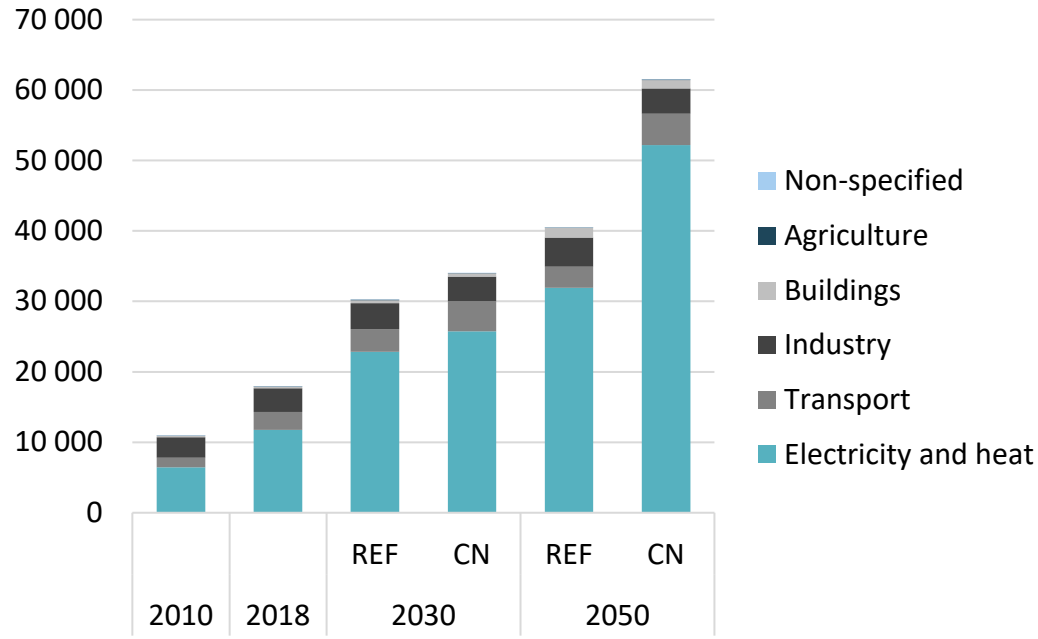
- In 2035, final energy intensity improves by 46.3% (REF) and 52.5% (CN).
- The goal is achieved before the target year 2035 in both scenarios: 2034 (REF) and 2031 (CN).
- Final energy intensity is estimated to improve 60% below 2005 levels (REF) and 70% (CN) by 2050.

APEC Goal: doubling modern renewable energy share

Modern renewable energy share in REF and CN, 2000-2050.



Modern renewable energy demand by sector in REF and CN, 2010-2050 (PJ).

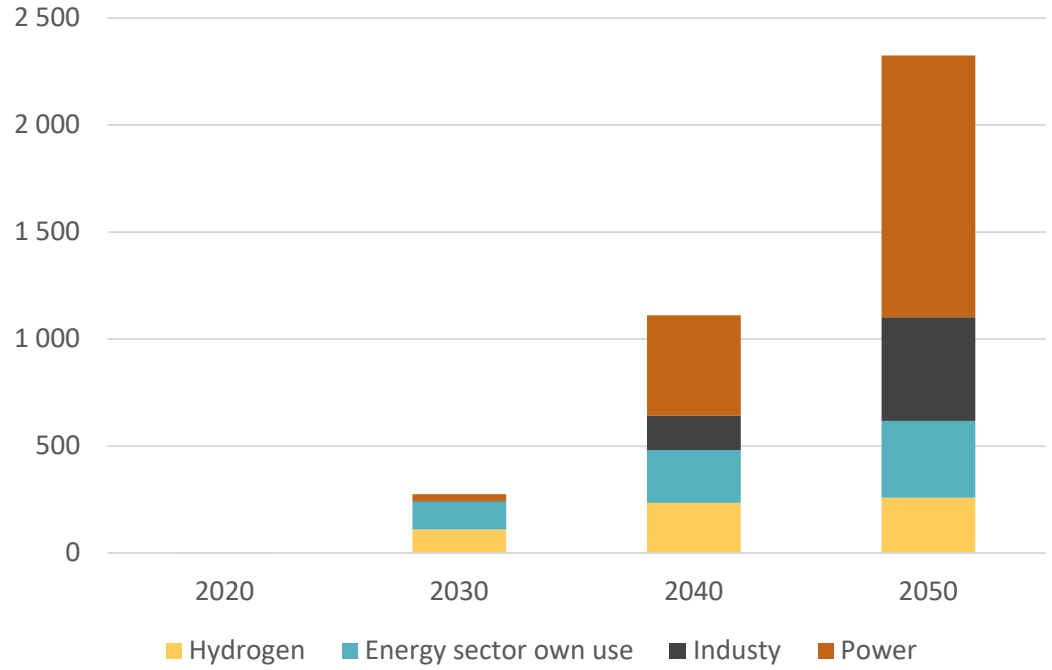


Sources: EGEDA, APERC analysis. Notes: Modern renewables: the demand of renewables in end-use sectors (excluding non-energy and traditional biomass) and includes the proportion of electricity and heat demand that is attributable to renewable sources.

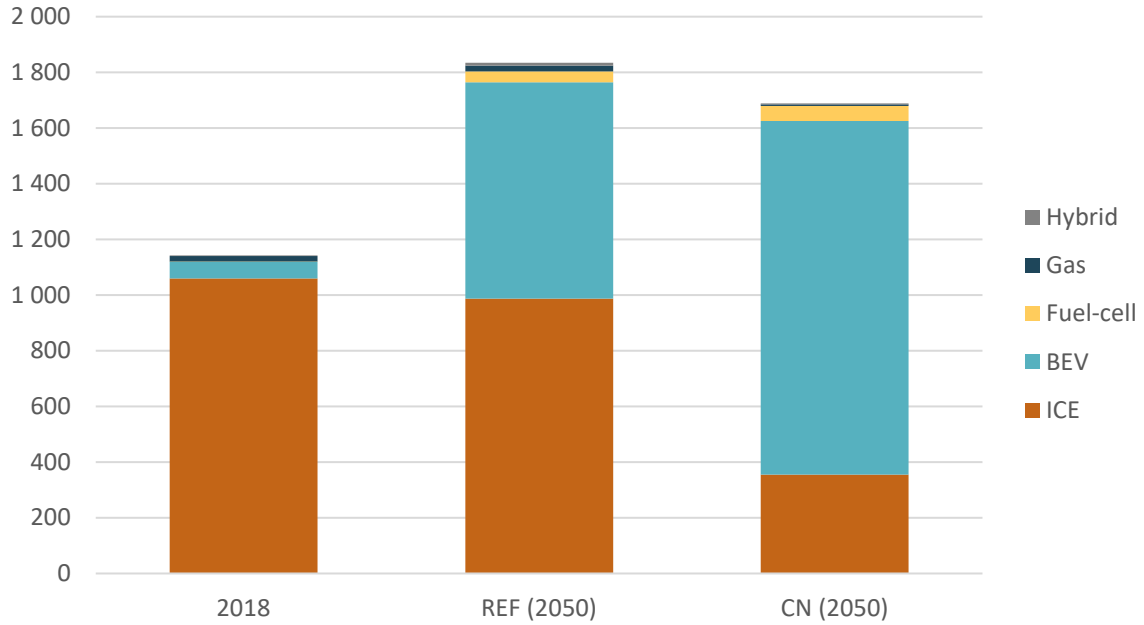
- In 2030, the share of modern renewables is 13.5% (REF) and 16.3% (CN). Cf. 6.1% in 2010
- The goal can be achieved before the target year 2030 in both scenarios: 2026 (REF) and 2025 (CN).
- Growth in modern renewable energy consumption in REF outpaces overall energy consumption.
- In CN, a decrease in overall energy consumption + an increase in renewable electricity drive the long-term uptrend.

Uncertain futures: CCS technologies and electric vehicles in APEC

APEC captured CO2 emissions in CN in APEC (million tonnes)



Road vehicles stock (freight and passenger) in APEC in REF and CN in 2050 (millions)



Sources: EGEDA, APERC analysis

- Gas-fired power with CCS accounts for over 90% of CCS in power sector.
  → Viet Nam and Indonesia incorporate CCS with coal-fired power.
- Industry CCS for steel, chemicals, and cement begins to accelerate in the 2030s.
- Electric vehicles become very prominent in both scenarios.

Summary of APEC wide Outlook

- Energy demand and supply increase in REF.
- Energy efficiency, electrification, and fuel switching lead to substantial demand reductions (CN).
- Fossil fuel demand is substantial in CN; however, it is much lower than REF.
- Wind and solar electricity generation is expected to increase in both scenarios; however, challenges remain with balancing reliability, affordability, and sustainability.
- CO_2 emissions decline in REF (14%); large reductions (67%) are possible in CN.
- APEC is on track to meet the final energy intensity and modern renewables share doubling goals ahead of the target dates.
- Improving emissions intensity is important to reducing CO_2 emissions.

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Thank you.

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