

The Role of Renewables in Electric Power Systems in Achieving Carbon Neutrality in APEC

IAEE Conference 2022, Tokyo, Japan

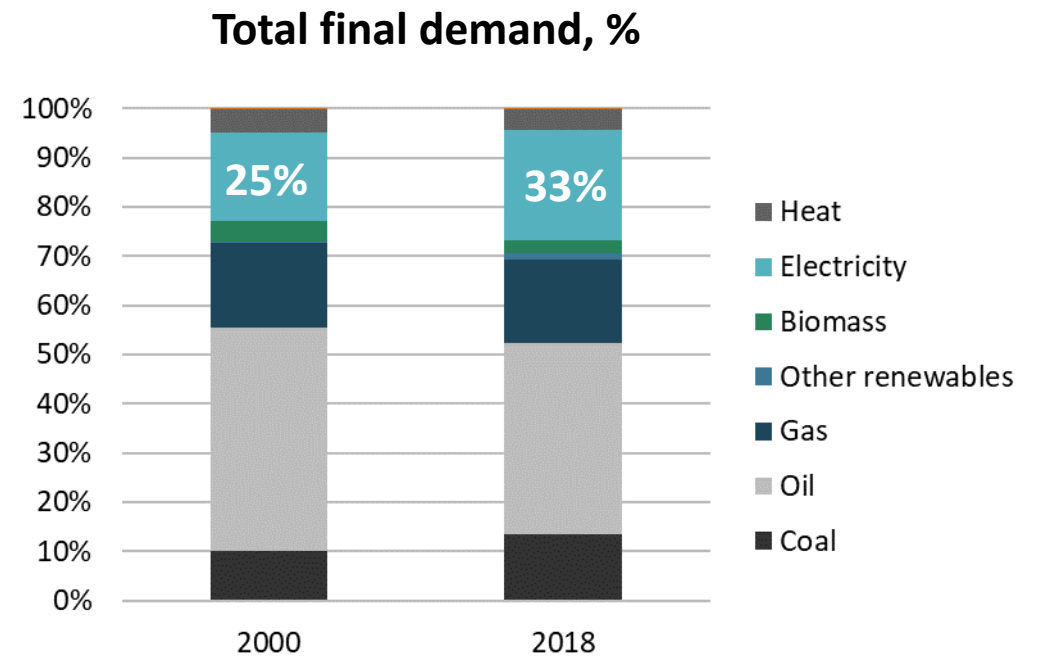
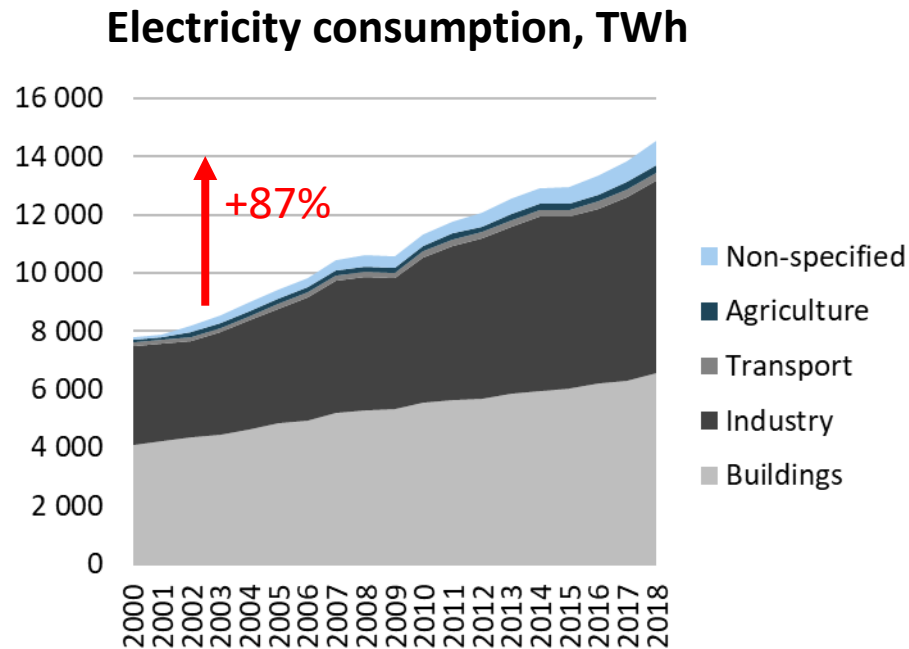
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Electricity consumption in APEC in 2000-2018

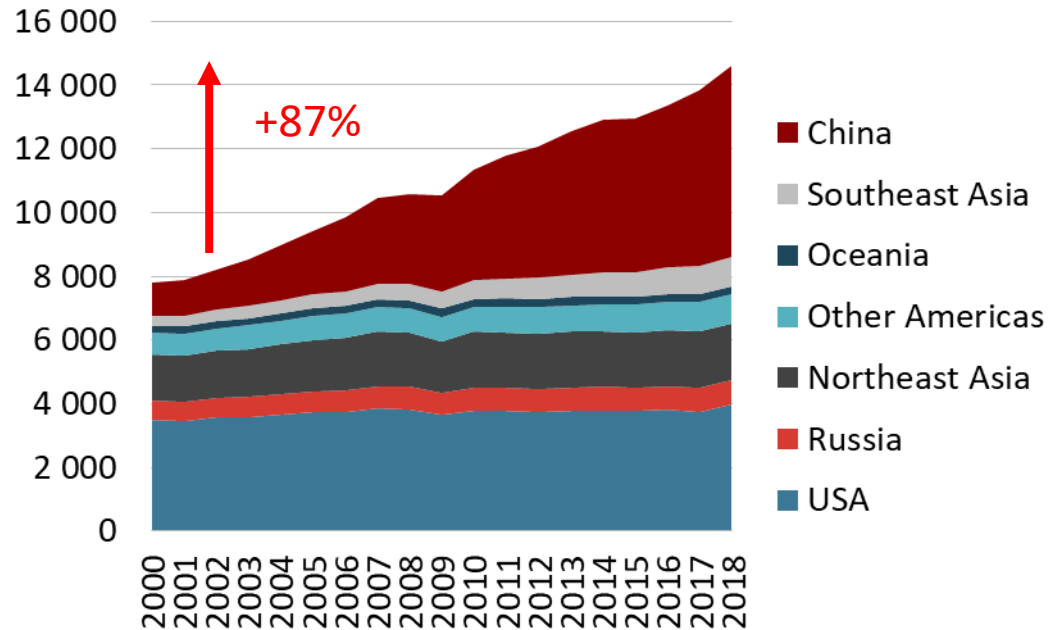


- Electricity consumption increased by **87%**.
- Industry and buildings accounted for more than 80% of the increase.
- Share of electricity increased from 25% to 33%.

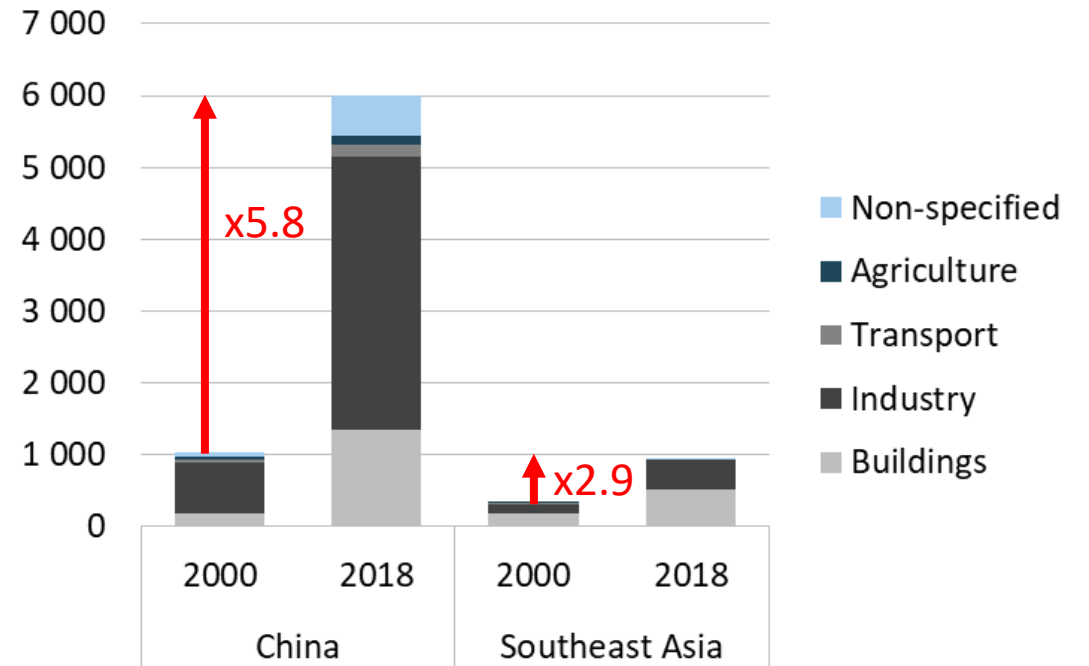
Note: Non-specified refers primarily to consumption that was not categorized when reported.

Electricity consumption in APEC in 2000-2018: regional breakdown

Electricity consumption, TWh



Electricity consumption in China and Southeast Asia, TWh

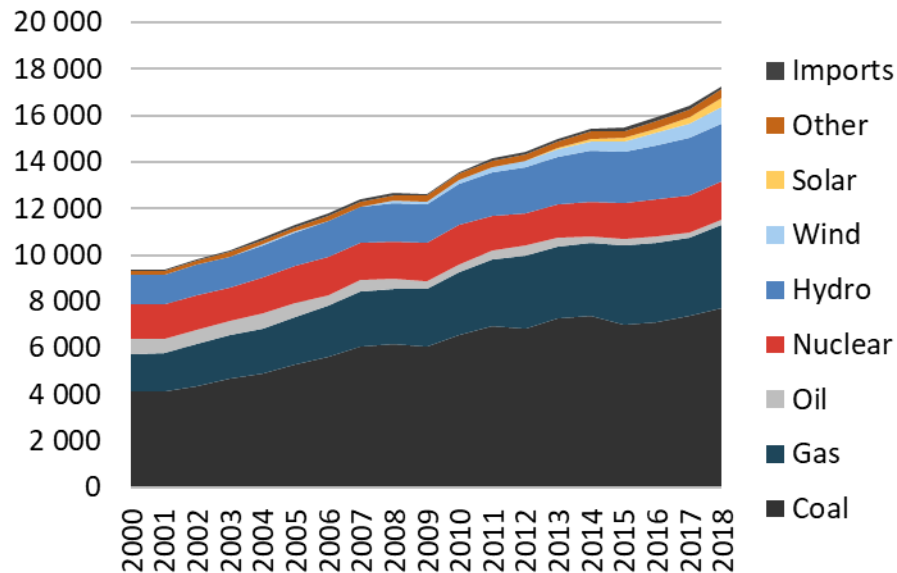


Electricity consumption in:

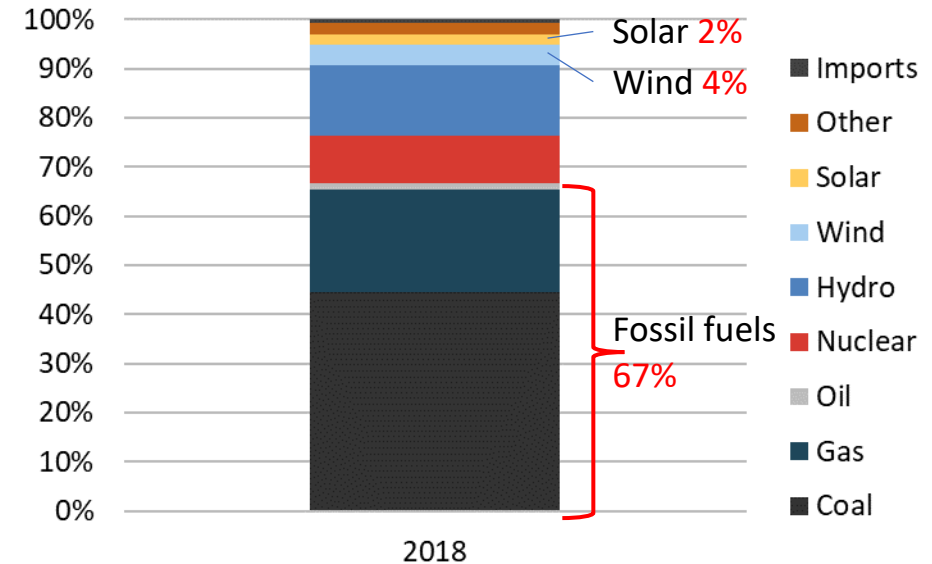
- APEC almost doubled (+87%)
- China increased six-fold
- Southeast Asian economies increased three-fold
- Rest of APEC increased by 20%

Electricity generation in APEC in 2000-2018

Electricity generation by fuel, TWh



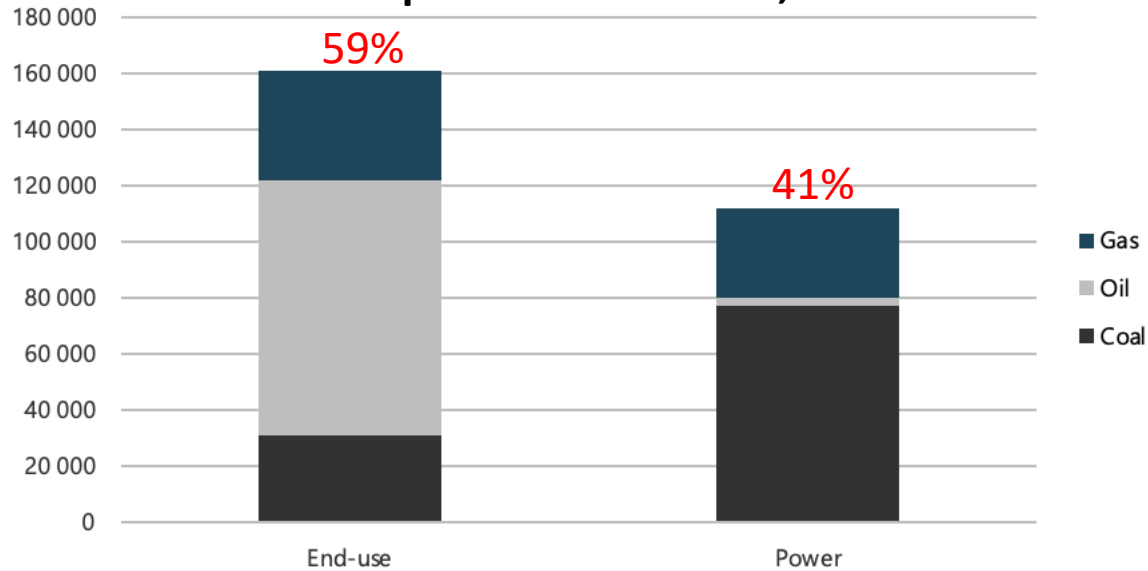
Electricity generation in 2018, %



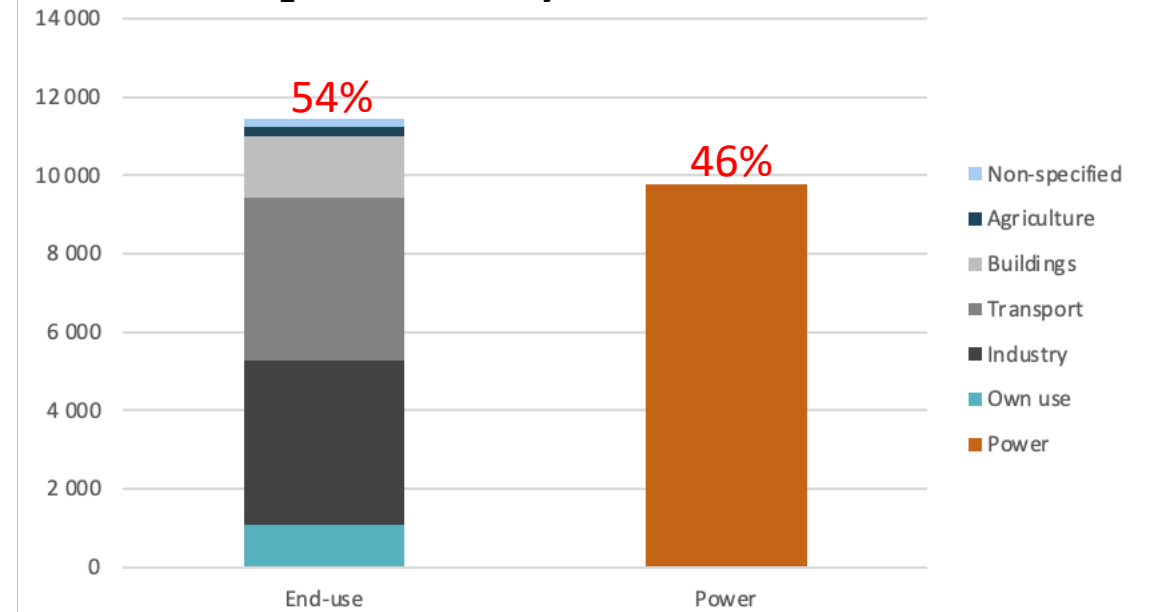
- 67% of the electricity in 2018 was generated by thermal power plants.
- Around 25% generated by nuclear and large hydro.
- Only 6% was generated by wind and solar combined.
- Share of renewables in electricity generation (including large hydro) was 21%.

Fuel consumption and CO₂ emissions in 2018

Consumption of fossil fuels, PJ



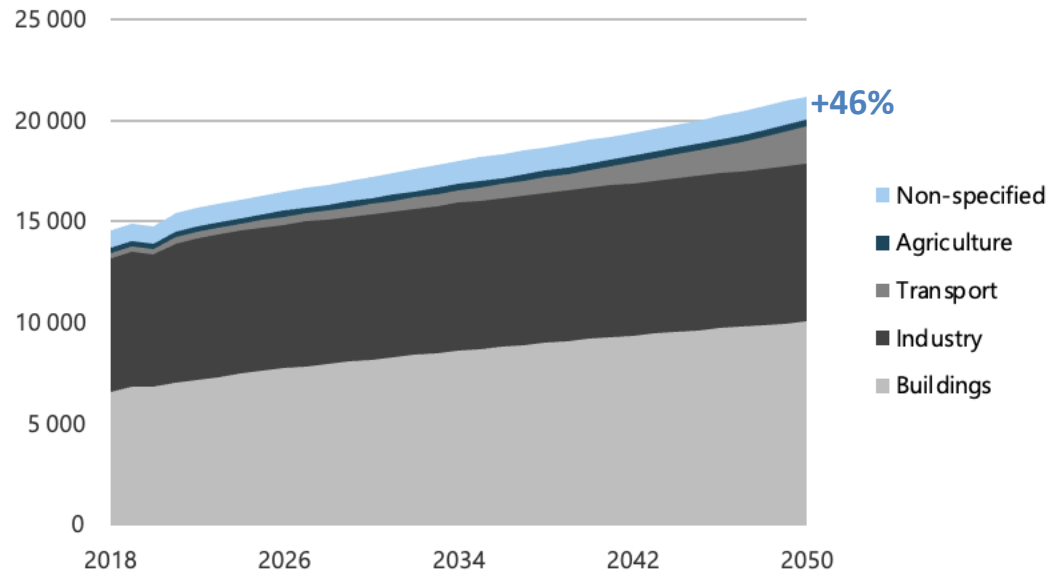
CO₂ emissions by sector, Gt



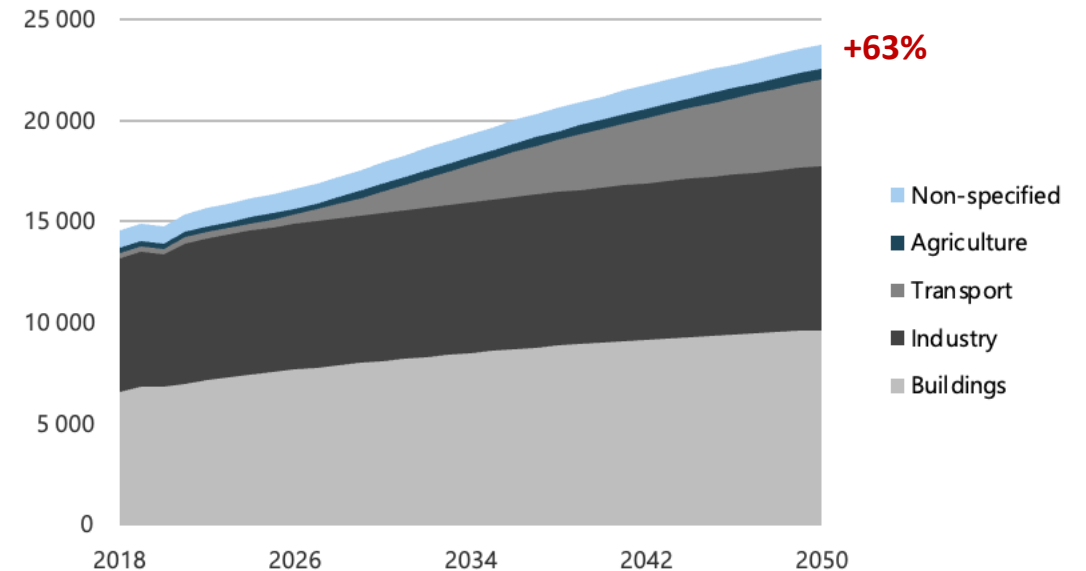
- Power sector share of fossil fuels: **41%**.
- Power sector share of total CO₂ emissions: **46%**.
- Difference in shares caused primarily by coal use.

How much electricity will APEC need on the way to carbon neutrality (CN)?

Electricity consumption in REF by sector, TWh



Electricity consumption in CN by sector, TWh



- APEC will need a lot more electricity: +46% in REF and +63% in CN
- End-use sector contributions to growth through 2050:

Reference:

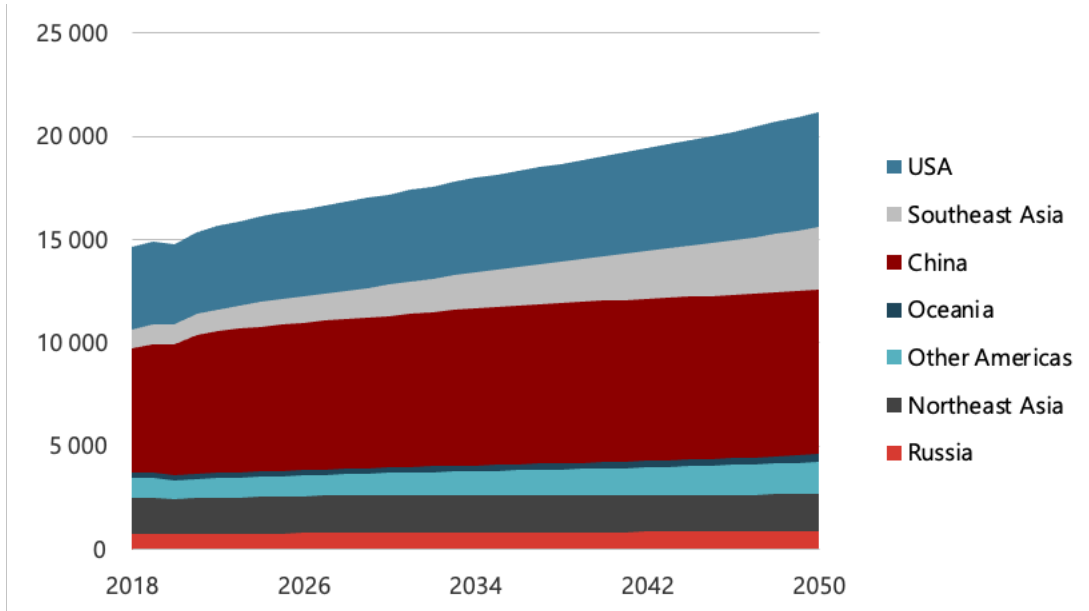
- Buildings 52%
- Transport 23%
- Industry 18%
- Other 7%

Carbon neutrality:

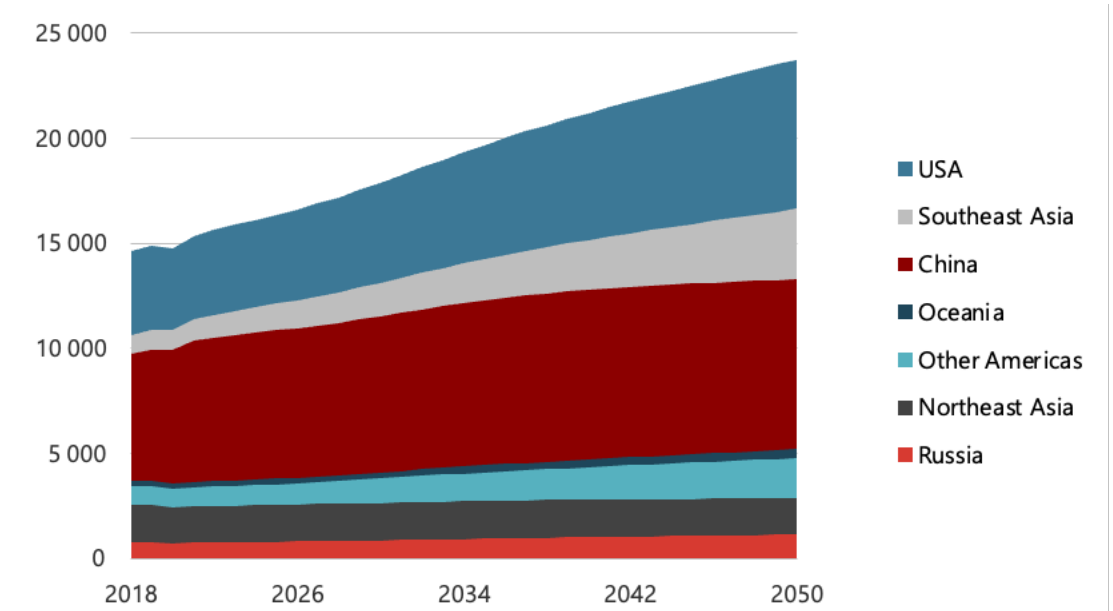
- Transport 44%
- Buildings 33%
- Industry 17%
- Other 6%

Regional breakdown of electricity consumption

Electricity consumption in REF by region, TWh

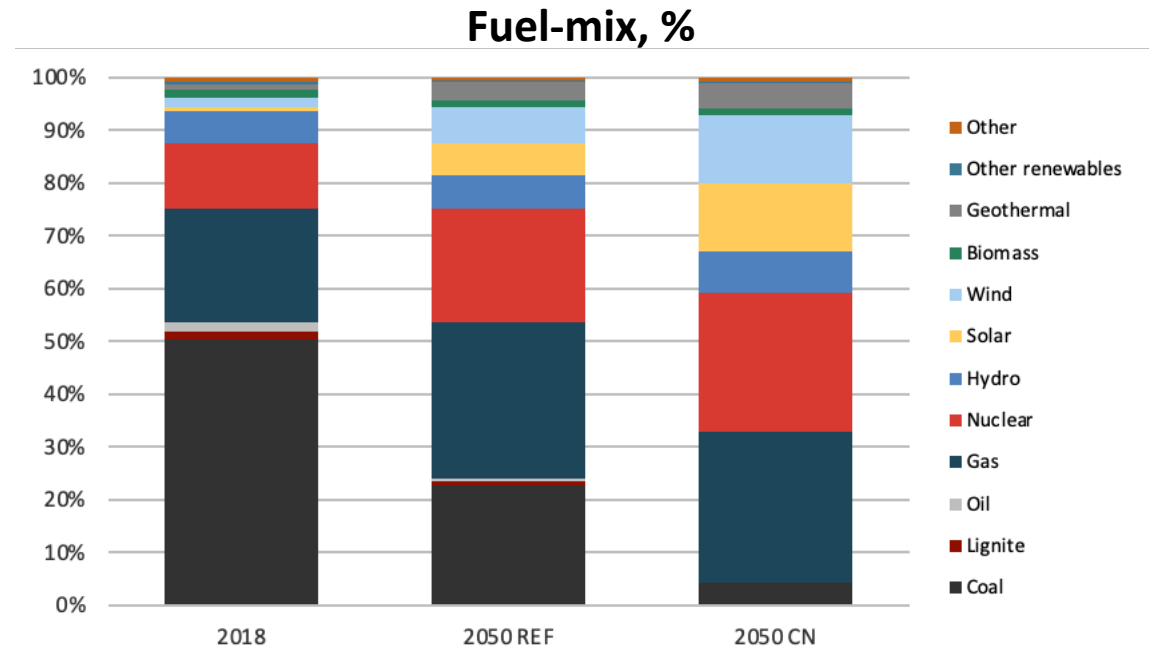
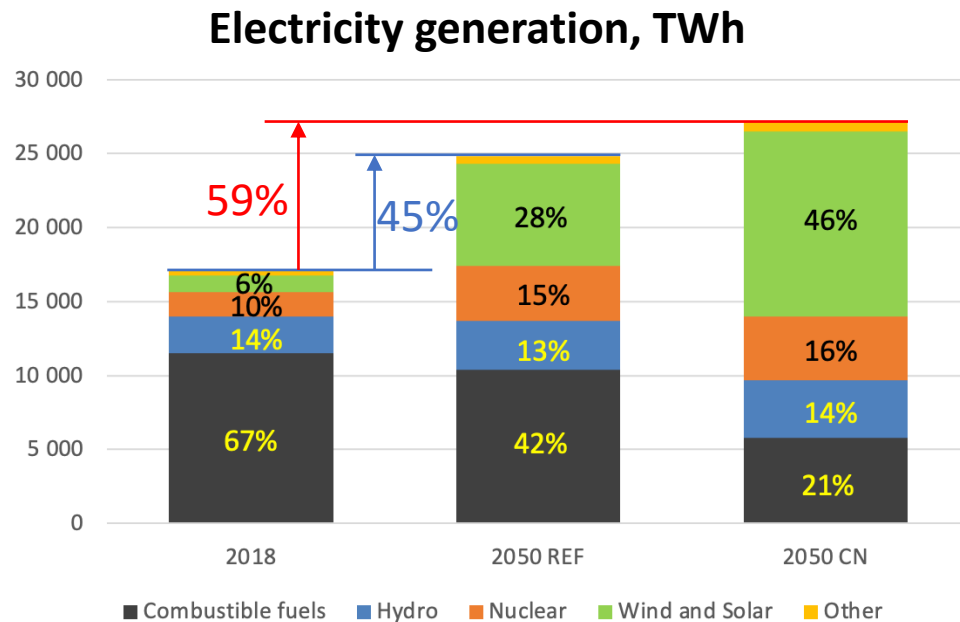


Electricity consumption in CN by region, TWh



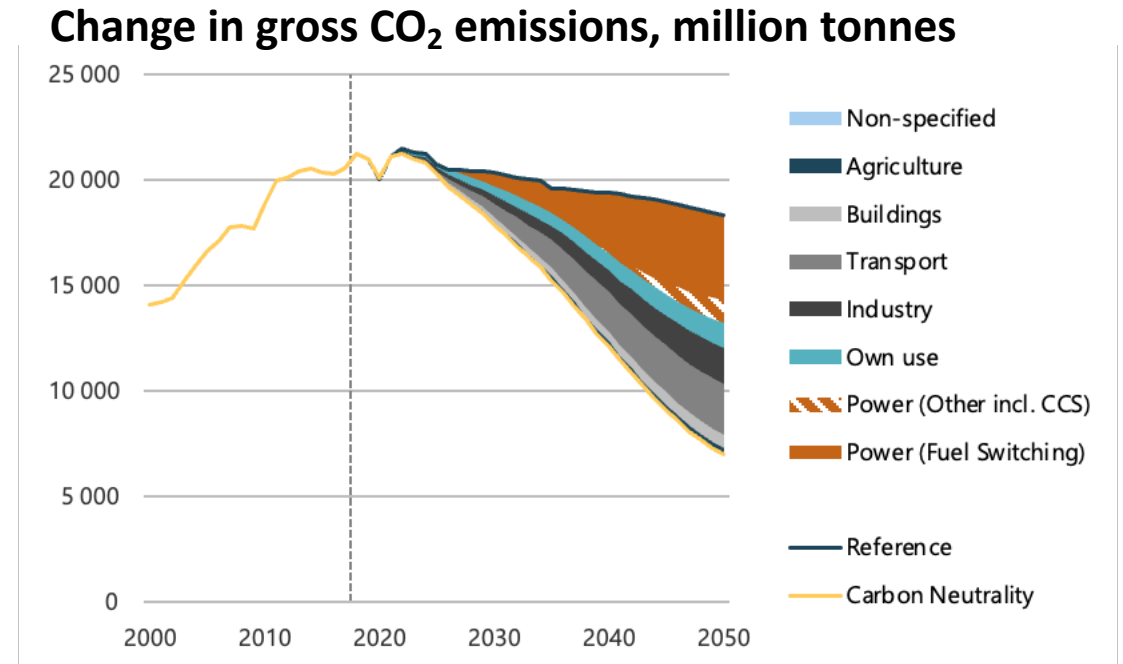
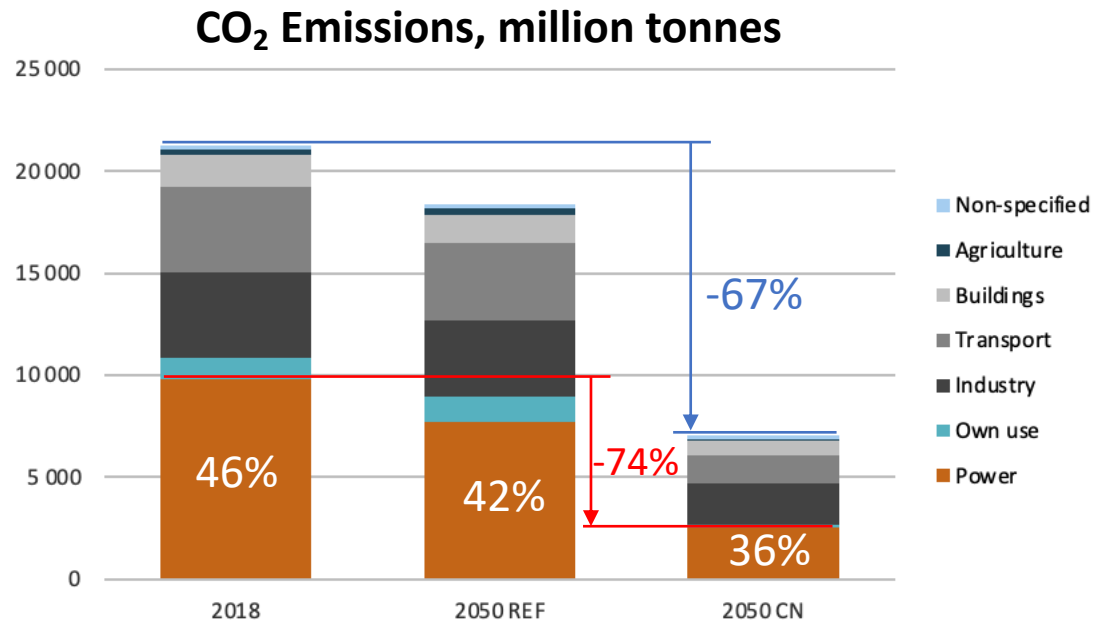
- The increase in electricity consumption will be distributed unevenly among regions.
- 84% of the increase in consumption will be concentrated in 3 regions: USA, China and Southeast Asia.
- Electricity consumption in Southeast Asia will increase by more than 2.5 times. SEA will become the 3rd largest consumer region in APEC.
- Electricity consumption in Northeast Asia not expected to increase.

Electricity generation and fuel-mix in the power sector



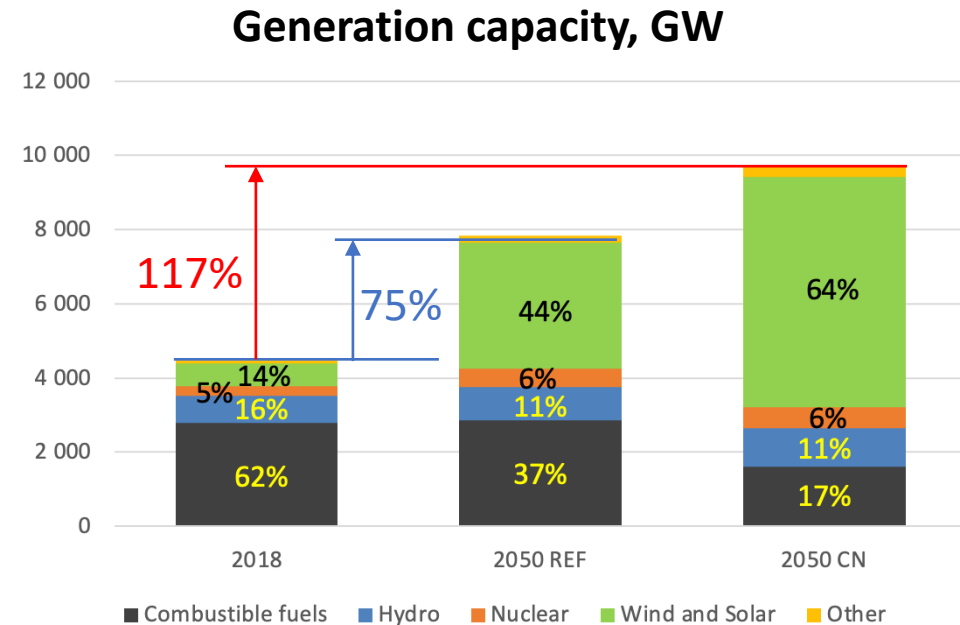
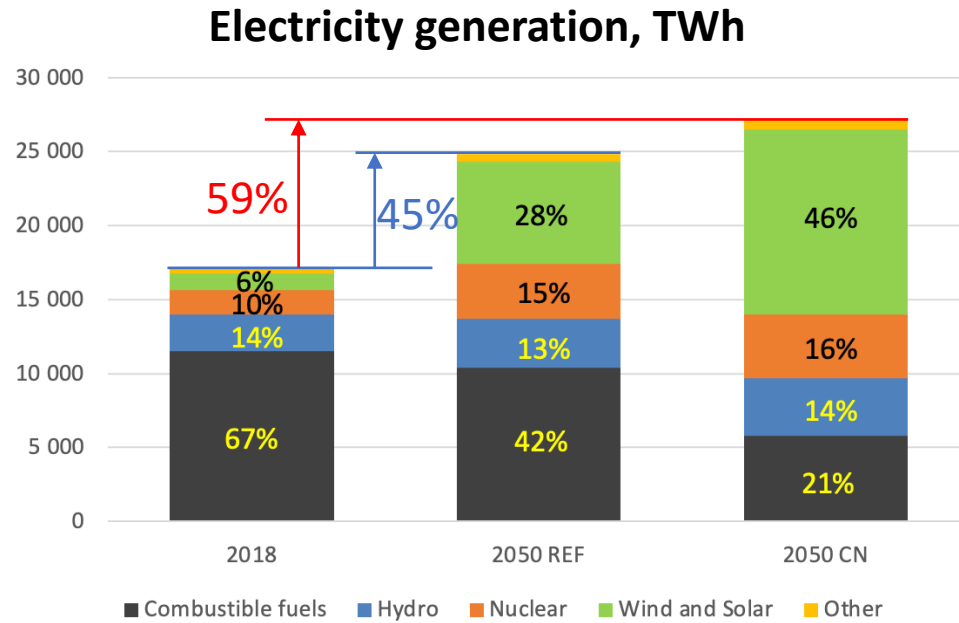
- Wind and solar generation increases more than 7-fold in REF and 10-fold in CN.
- Wind and solar shares increase from 6% to 28% (REF) and 47% (CN).
- Fossil fuels share decreases from 67% in 2018 to 42% (REF) and 21% (CN).
- Fossil fuels replaced by wind, solar, nuclear, hydro, and geothermal.

CO₂ emissions



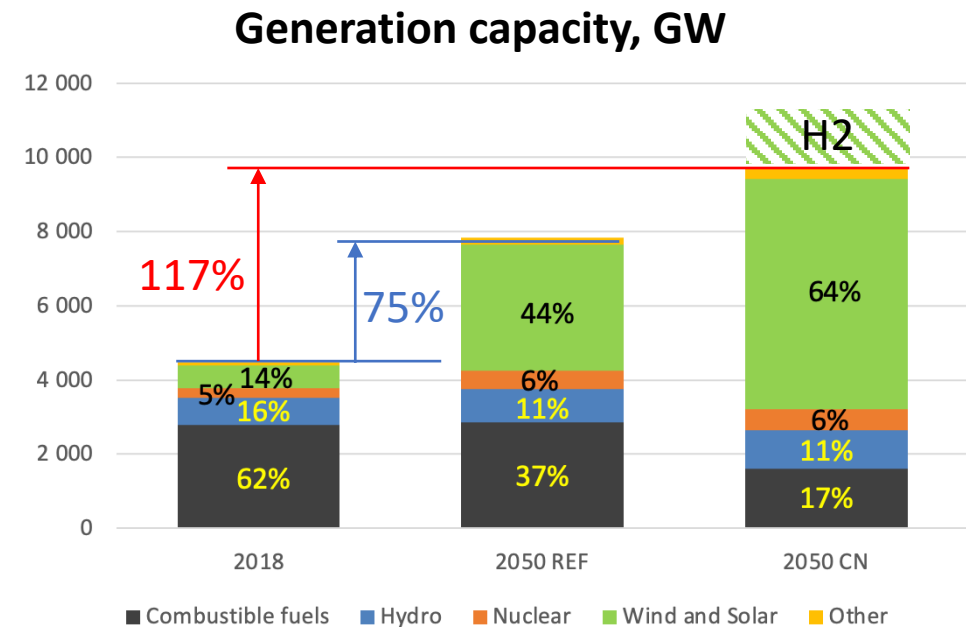
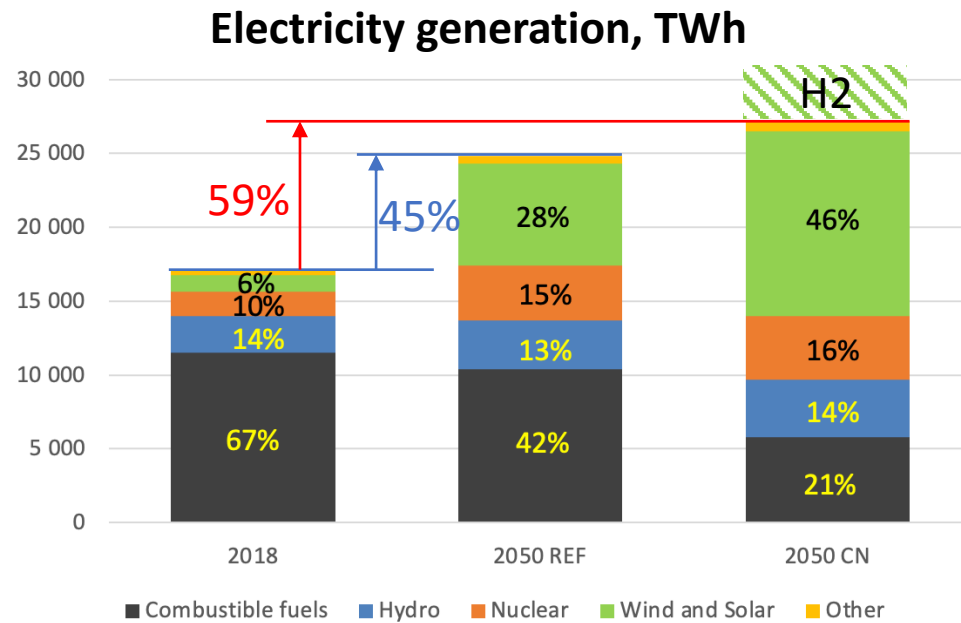
- In CN, CO₂ emissions from the power sector fall by 74%.
- Power sector share of CO₂ emissions falls from 46% in 2018 to 42% (REF) and 36% (CN).
- Reduced coal-firing accounts for 80% of reduced emissions.

How much generation capacity will APEC need?



- In CN, a 10-fold increase in wind and solar generating capacity is required.
- The share of renewables generating capacity increases from 14% to 44% (REF) and 64% (CN).
- The average capacity factor declines from 42% in 2018 to 36% in REF and 32% in CN.

How much additional capacity we need to produce green H2?



- Demand for electricity for green hydrogen production in APEC in CN is 2800 TWh in 2050
- 2800 TWh – 10% of total electricity generation in 2050
- To supply this amount of green electricity, 1000-1500 GW of additional renewables capacity must be built by 2050
- 1000-1500 GW – 20-30% from the new additional renewable capacity

Conclusions

Summary

- APEC will need much more electricity by 2050: +46% in REF and +63% in CN
- In CN, the transport sector accounts for largest increase in electricity consumption
- 10-fold increase in wind and solar generation capacity is required by 2050 (more than 5000 GW)
- 80% of CO2 emissions eliminated by reduced use of coal

Challenges

- High uncertainty in forecasting demand for electricity
- The real cost of wind and solar power, considering integration into existing power grids (dispatchable and variable power are different products) and scalability issues
- Providing peak load with renewables
- Displacing fossil fuels vs displacing fossil-fuel fired generation capacity by renewables
- From dependence on fossil fuels to dependence on critical minerals
- Grid reliability issues (storage, BEVs as a storage, reserve margin)
- Demand side management

Thank you.

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