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3-3. Electricity Demand and Supply

Gigih Udi Atmo, Ph.D.
Researcher, APERC

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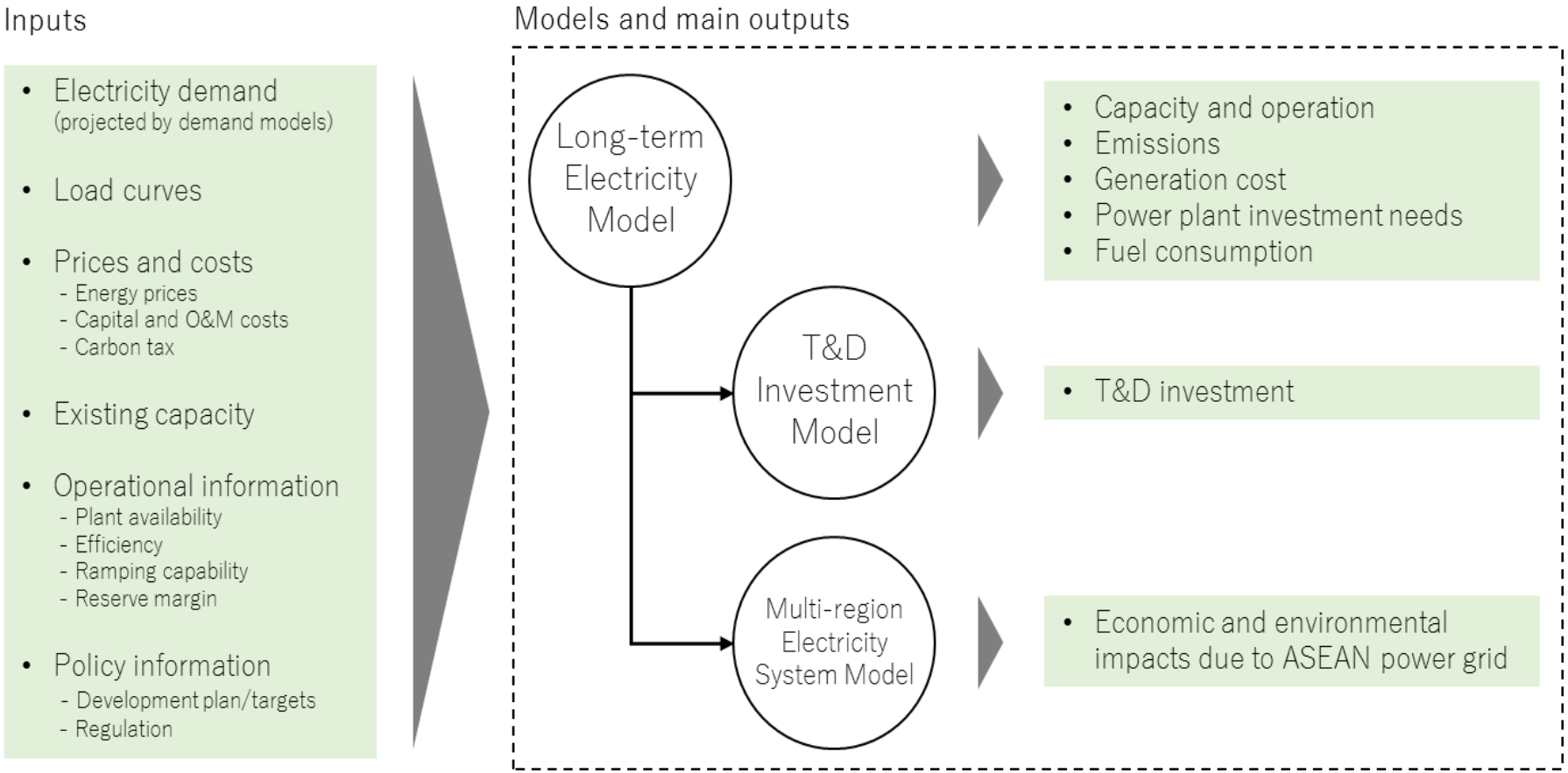
Outline

1. **Methodologies and key assumptions for the BAU Scenario**
2. **Projections – electricity demand and supply**
3. **Key trends and implications**

Methodology – long term cost-optimization

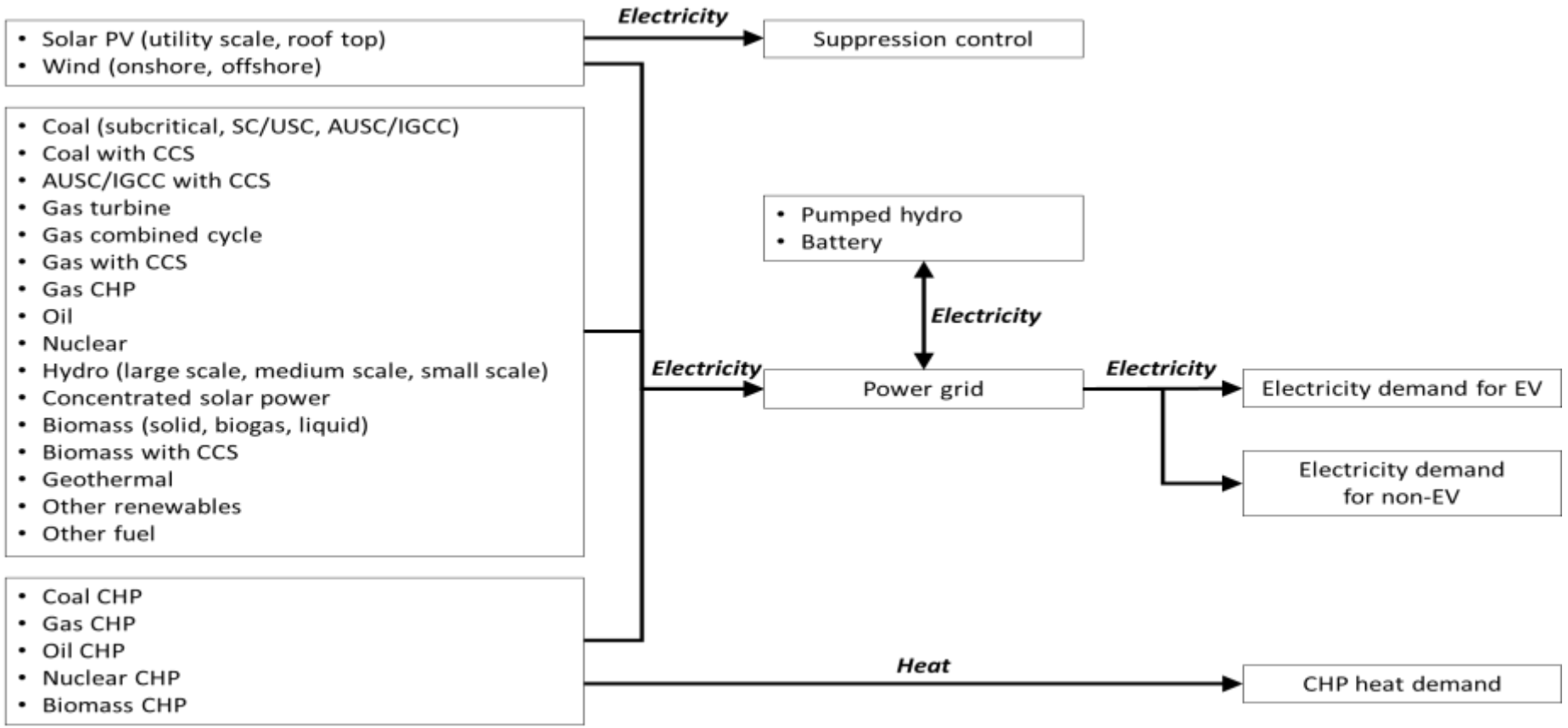
Electricity supply model structure



Long-term electricity model calculates the capacity and operation of power plants to meet the electricity and heat demand to 2050.

Model enhancements since the 6th edition

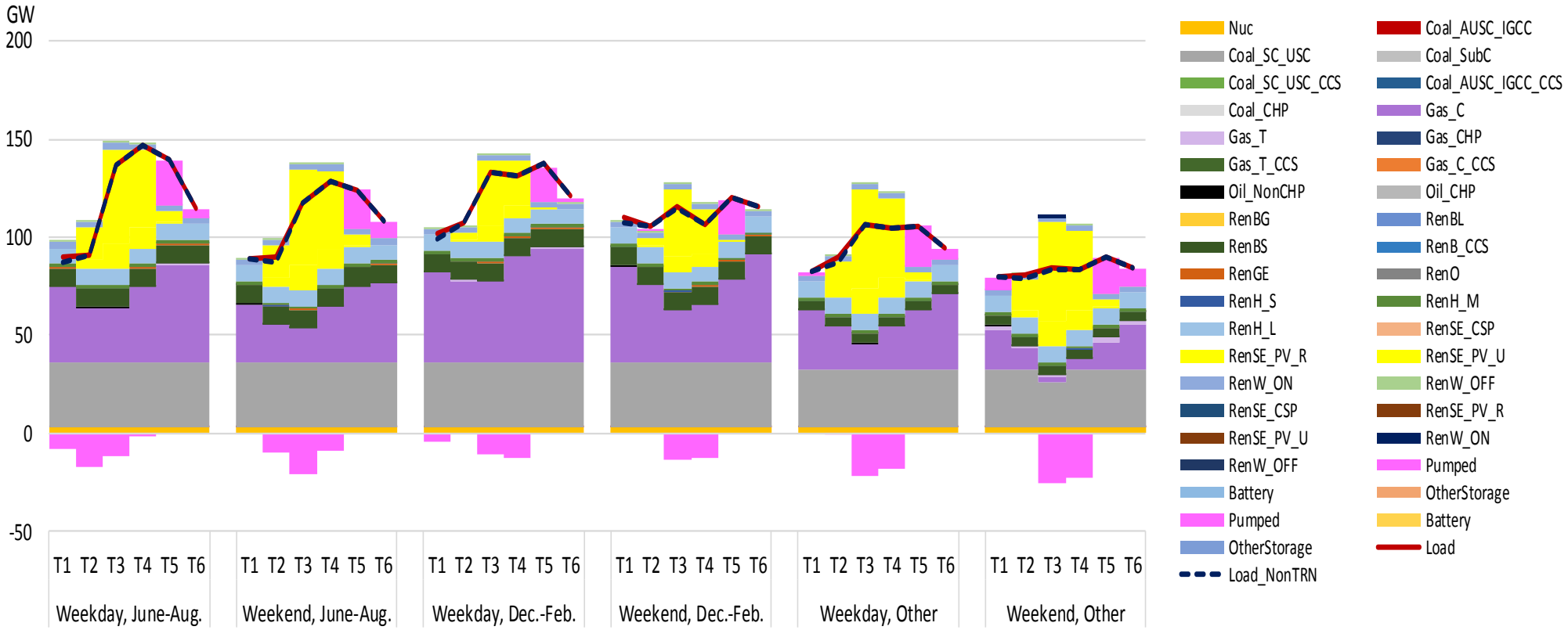
Categories for electricity supply technologies



The electricity supply model takes into account 33 types of technologies: 31 types for power generation and 2 types for storage. More renewable technologies including biomass with CCS were introduced in the 7th edition.

Enhanced temporal resolution of daily load curve

Daily load curve model in the long-term electricity model



The model now divides the year into 72 temporal slices to incorporate seasonal and diurnal generation behaviour of variable renewable energy, an improvement from the single load curve model in the 6th edition.

Key assumptions (1) for BAU - existing policies

Key assumptions in selected economies (1)

Region	Key assumptions and references
China	**Fossil fuel**: Coal-fired plants peak in the 2020s driven by strong policy initiatives to mitigate air pollution and CO_2 emission concerns. **Nuclear**: Nuclear capacity target of 58GW by 2020 is included, which is equivalent to installation about 5.8GW/year in 2016-2020. Nuclear construction is more moderate after 2020, averaging approximately 3-4GW/year of additional capacity by 2050. **Renewables**: Lower-carbon technologies (such as hydro, wind, solar and natural gas) increase their presence to meet electricity demand and to replace supplies from coal power plants that reach retirement.
United States	**Fossil fuel**: Retirements of inefficient existing coal-fired power plants with declining economic competitiveness (approximately 80GW by 2025). Low gas price remains, resulting in the growing share of gas-fired generation. **Nuclear**: The BAU includes two new nuclear reactors (Vogtle 3-4) and retirements of seven reactors from 2018-2025 (Oyster Creek, Pilgrim, Three Mile Island, Indian Point 1-2, and Diablo Canyon 1-2). **Renewables**: Improved economics of solar panels pushes up the pace of their installation in the long-term. Cost reductions for renewables accelerate their deployment of renewables driven by cost reductions are included.

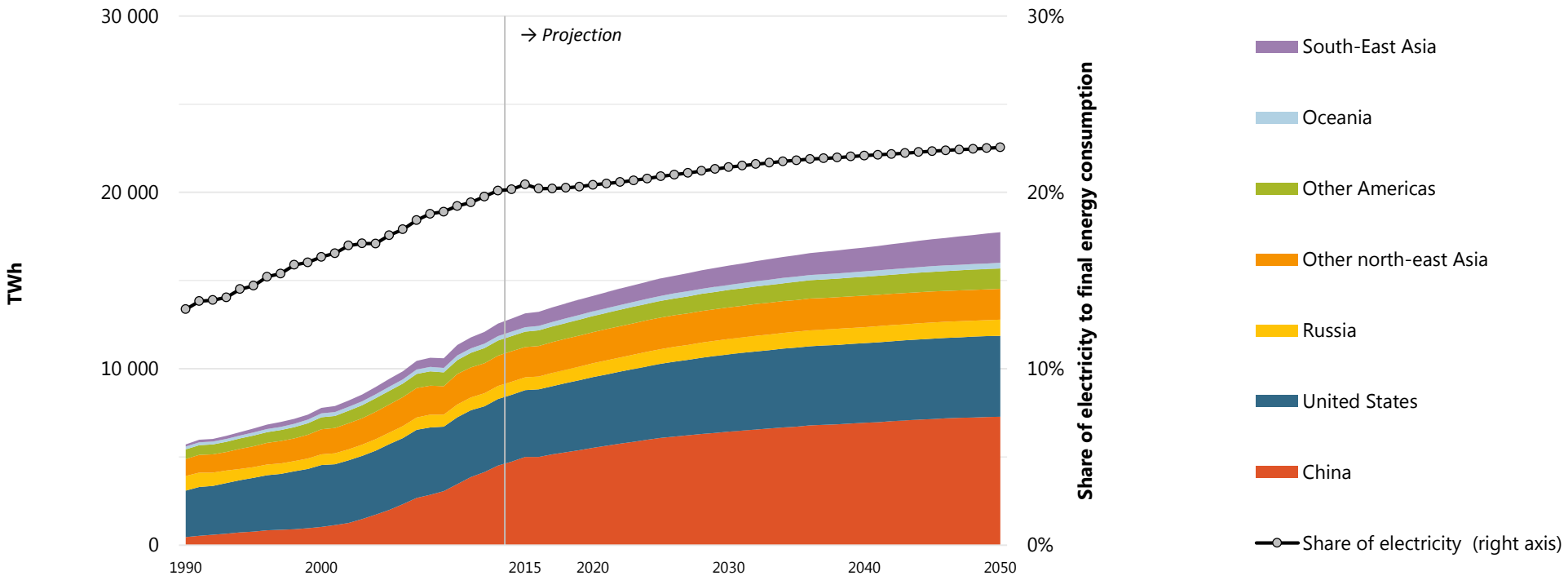
Key assumptions (2) for BAU - existing policies

Key assumptions in selected economies (2)

Region	Key assumptions and references
Australia	Approximately half (45%) of existing coal-fired plants gradually retire due to ageing from 2021 to 2050. Rooftop solar PV reaches the level projected in a report for Australian Energy Market Operator.
Japan	Nuclear reactors retire after 40 years of operation, except for these reactors that had their license extensions approved by March 2018. Exogenous additions of solar PV and wind are based on power producers' plan. Carbon tax of 289 JPY/tCO_2 (3.7 USD/tCO_2) applies over the Outlook period.
Others	**Brunei and Singapore**: Both continue to rely on gas generation, mainly installing high efficiency gas combined-cycle plants. Brunei installs a 10 MW waste-to-energy plant by 2020. **Indonesia, the Philippines and Thailand**: Each economy increases its reliance on coal-fired generation because of low fuel costs and local coal resource availability. In Thailand, two planned nuclear reactors are commissioned after 2035. Indonesia continuously develops geothermal over the projection period. Thailand increases electricity imports from neighboring economies. **Malaysia and Vietnam**: both continue to develop coal and gas for fuel diversification reasons as well as to manage generation costs. Nuclear development is not included. Renewable promotion policies, such as FiT in Malaysia, continue.

APEC electricity demand continues to rise

APEC electricity demand by regional grouping, 1990-2050

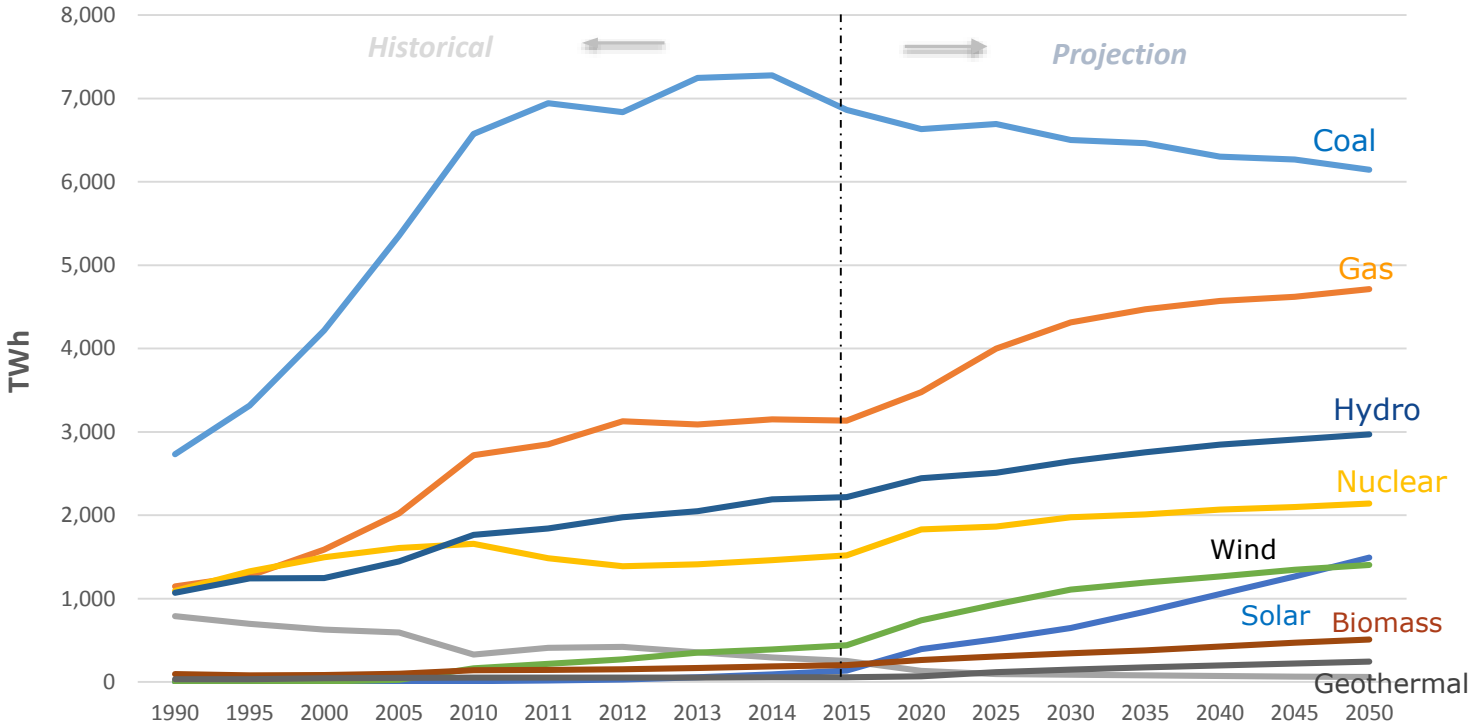


APEC electricity demand more than doubled from 1990 to 2015, and continues to increase by 35% over the projection period; Growth is mainly driven by South-East Asia and China

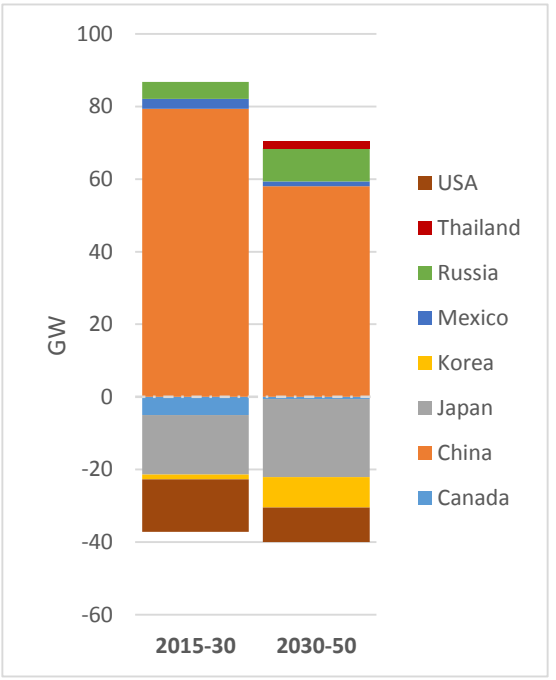
Note: **Oceania** (Australia, New Zealand and PNG), **Other Americas** (Canada, Chile, Mexico and Peru), **Other Northeast Asia** (Hong Kong, Japan, Korea and Chinese Taipei), **Southeast Asia** (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam)

APEC electricity generation shifts away from coal

APEC electricity generation by fuel type, 1990-2050



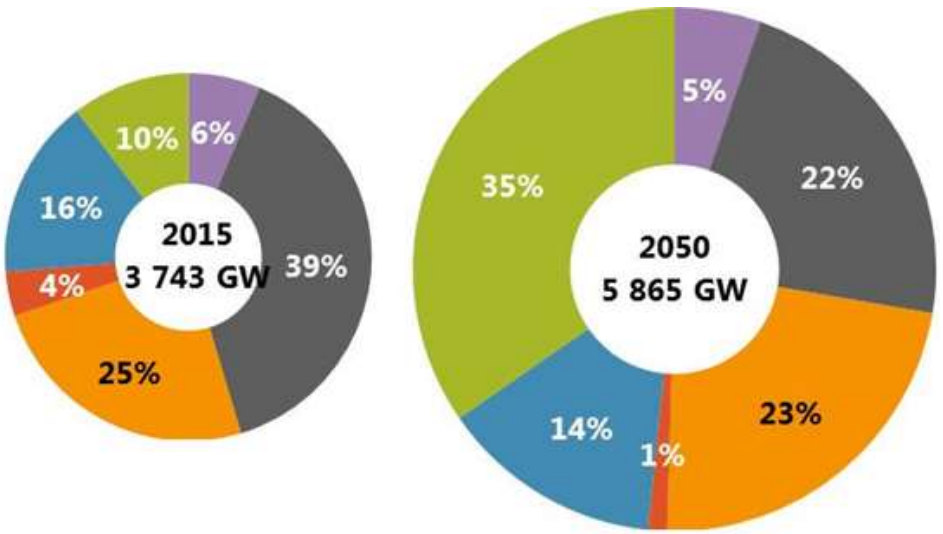
Nuclear capacity changes (2015 -2050)



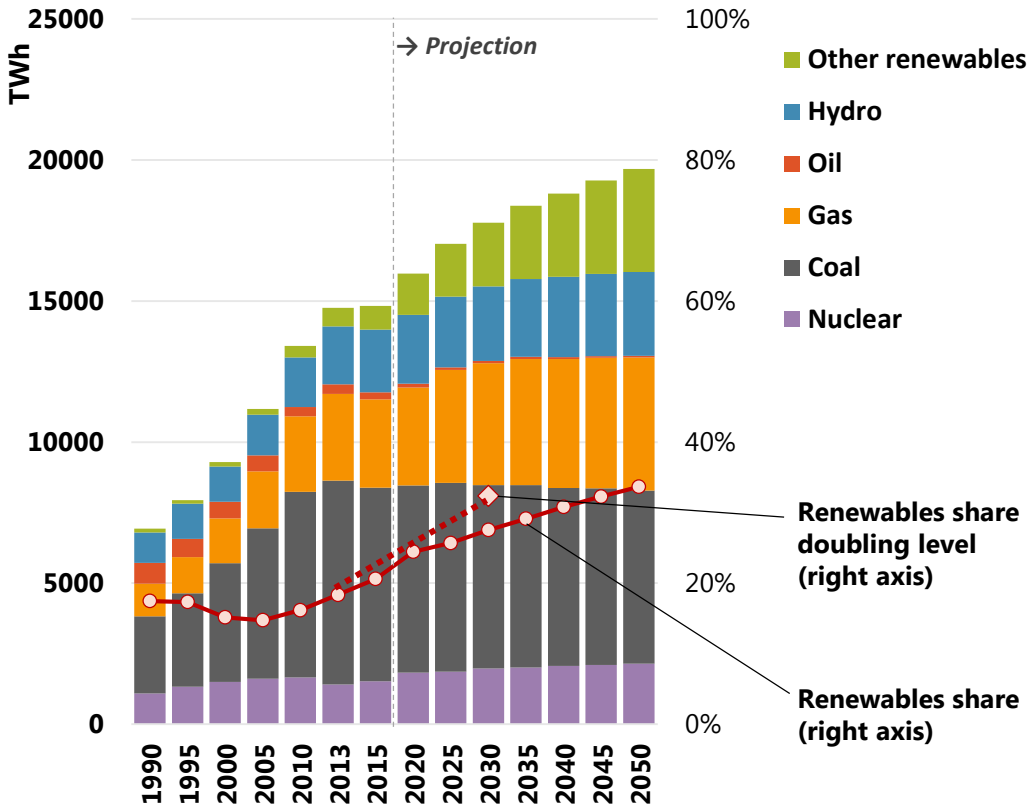
- ***APEC increasingly uses renewables, gas and nuclear.***
- ***Nuclear expands in China, Russia and Mexico while other economies retire existing nuclear power plants; In 2035, Thailand becomes the first APEC economy in Southeast Asia to use nuclear power.***

APEC installed capacity and electricity generation

APEC installed capacity



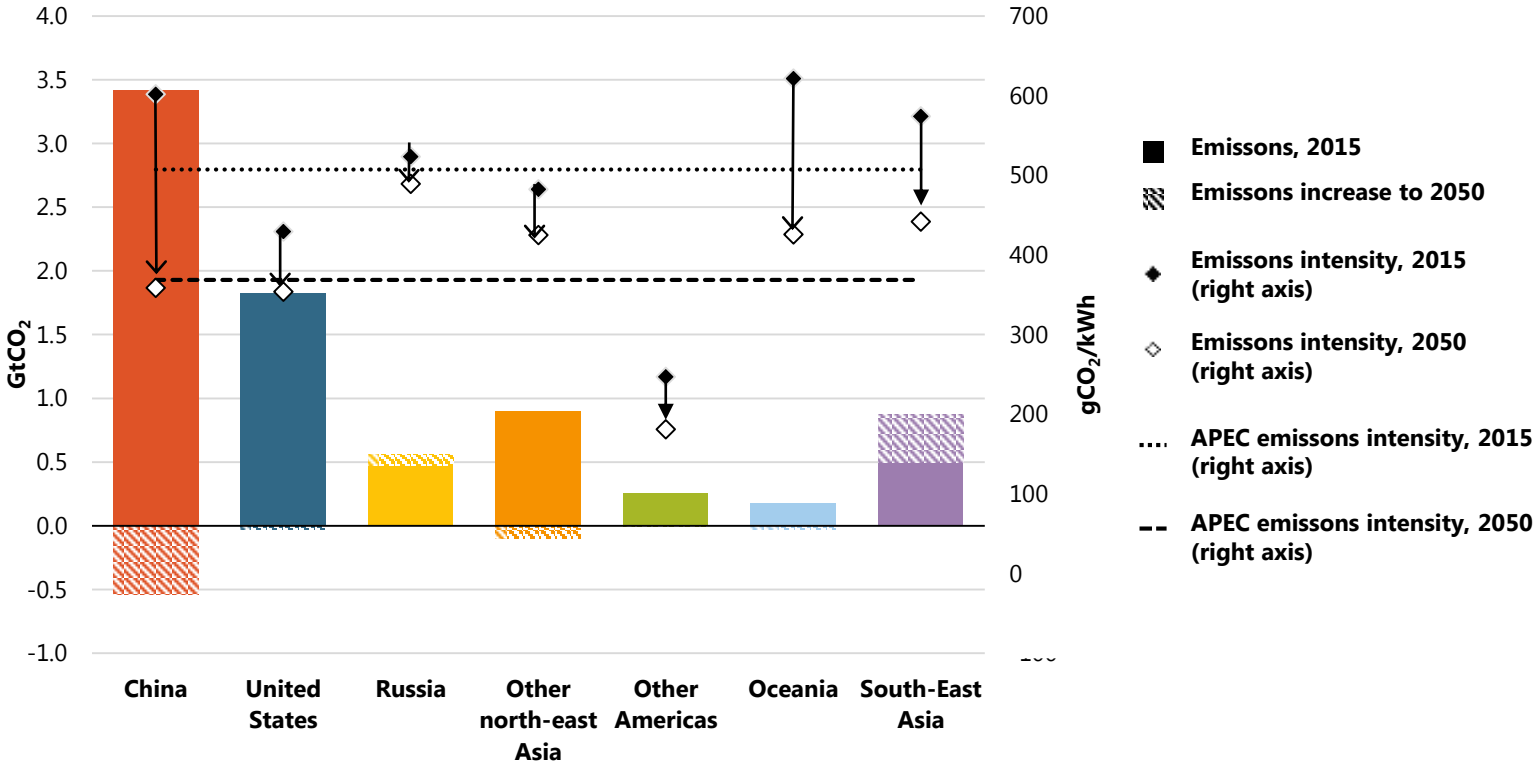
APEC electricity generation



Renewables capacity share expands to 49% while fossil fuel capacity represents 46% by 2050. But, fossil fuels continue to dominate electricity generation. Doubling generation from renewables is achieved by 2045.

APEC CO_2 emissions from electricity in the BAU

Annual emissions and emissions intensity, between 2015 and 2050



Emissions per kilowatt-hour fall by 27% on average in APEC. Total annual APEC emissions from electricity generation decrease by 0.25 $GtCO_2$ by 2050.

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APEC electricity outlook - key trends and implications

- ***Electricity demand in APEC economies continue to increase and growth is mainly driven by South-East Asia and China.***
- ***Nuclear development in APEC economies is diverse, with nuclear expansion in China, Russia, Mexico and Thailand while other economies retire existing nuclear plants.***
- ***Variable renewable energy (solar and wind) in APEC represents 67% of installed RE capacity by 2050, increasing the need for grid flexibility (e.g. through storage technologies and smart power grids).***
- ***Enhanced renewables promotion policies are needed to achieve renewables doubling in power mix by 2030.***

Thank you for your kind attention

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Acknowledgment:

Electricity Supply is prepared by electricity modeling team (Takashi Otsuki and Gigih U. Atmo)
Electricity demand is prepared by energy demand modelers (Alexey, Cho, Diego, Martin, Ruengsak and Yoshika) with integration support from Kirsten and Tom. Melissa reviews electricity demand and supply.

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