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2. APEC Energy Demand and Supply Outlook 6th Edition

2-3 BAU Electricity

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***Preliminary results
(under review by economies)***

Please do not cite



Outline

Past trends

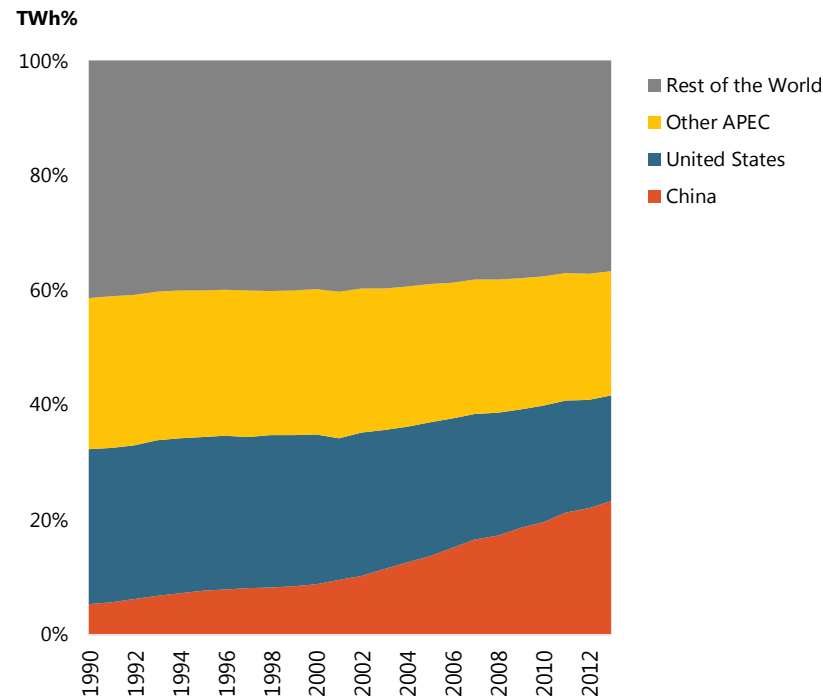
Methodologies and key assumptions for the BAU Scenario

Projections – electricity demand and supply

Key trends and implications

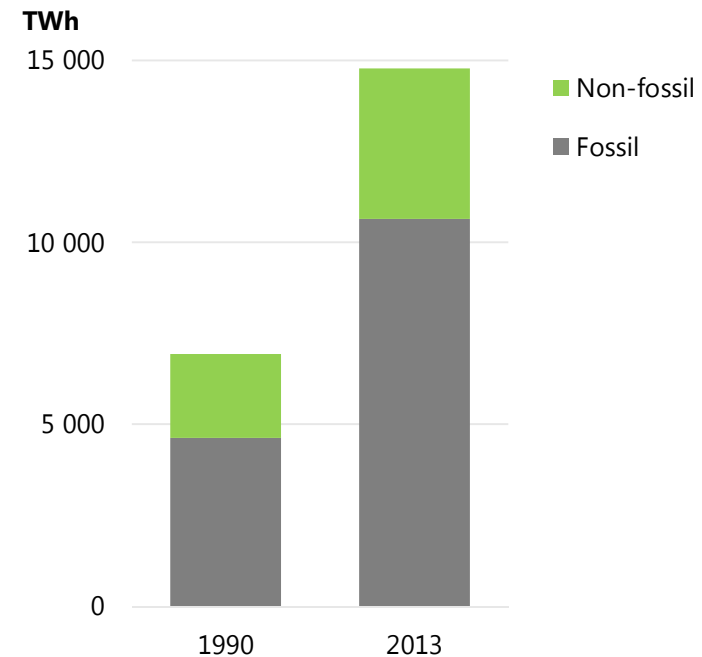
Past trends – *APEC economies have been major electricity market in the world*

APEC share in world generation



Source: EGEDA (2015) and IEA Statistics (2015)

Fossil vs non-fossil in APEC

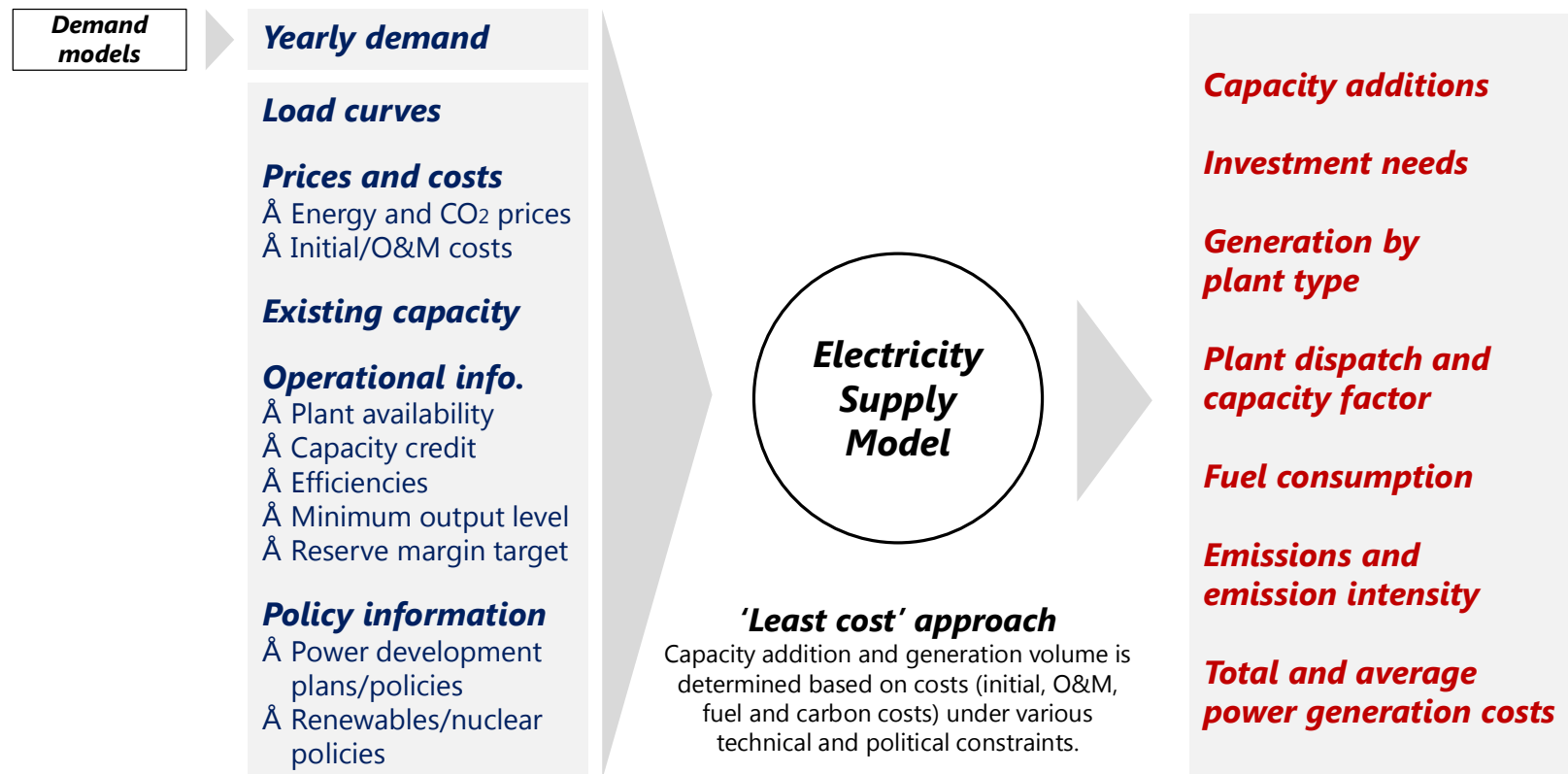


Source: EGEDA (2015) and IEA Statistics (2015)

APEC accounts for over 60% of global electricity market. China's rising presence from 2000, led fossil fuel consumption to more than double

Methodology – APERC uses a long term electricity supply model based on cost-optimisation

Electricity supply model structure



**Sectoral demand models project electricity demand based mainly on econometrics.
Electricity supply model employs bottom-up optimisation techniques**

Key assumptions – *BAU analysis includes existing policies/plans as a set of constraints in the model*

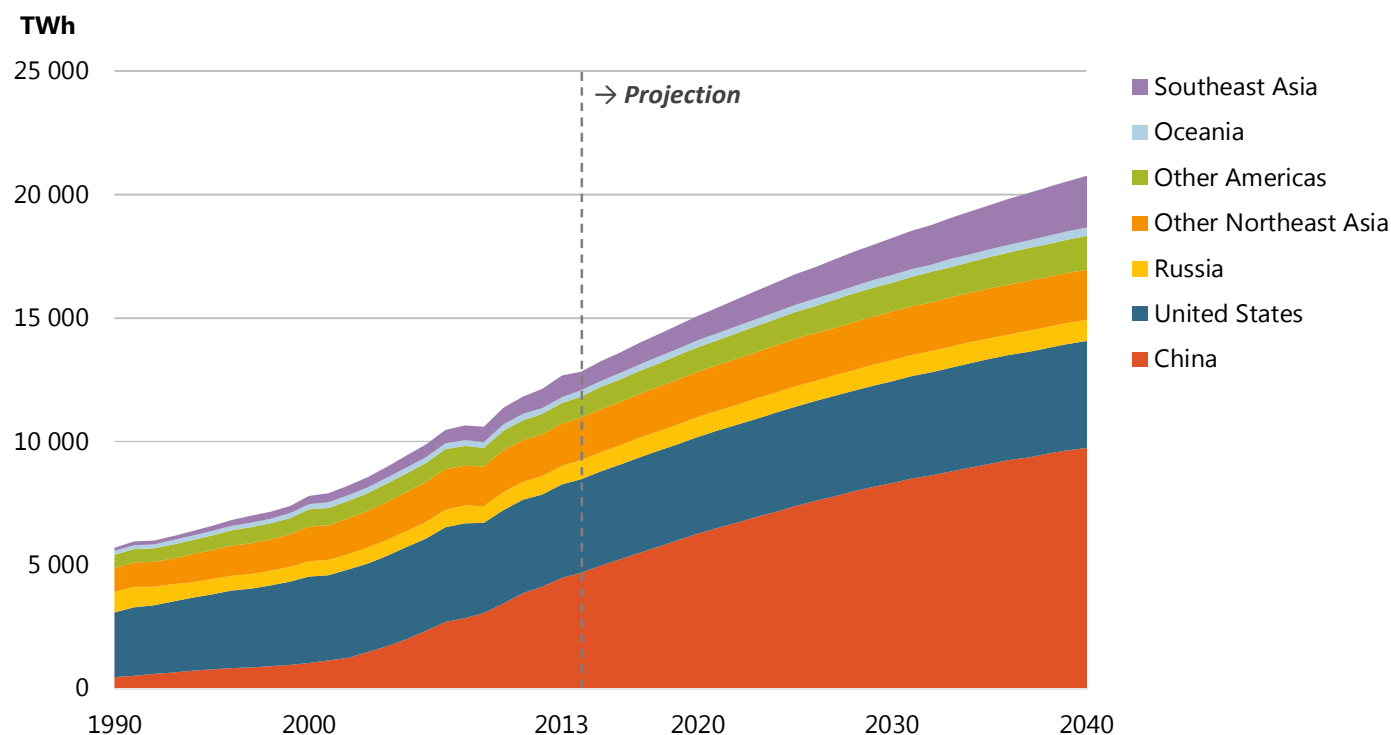
Major assumptions in selected economies

Region	Key assumptions and references
China	Fossil fuel: Gas accelerates, but coal still dominates new fossil fuel capacity additions (the trend in <i>The 12th five-year plan</i> and <i>Action Plan on Energy Strategies for 2014-2020</i>). Nuclear: Reach 58 GW by 2020, then yearly additions of 4 reactors on average.
United States	Fossil fuel/renewables: The <i>Clean Power Plan</i> considered. Retirements of existing coal-fired, and acceleration of gas-fired. Nuclear: 60 years lifetime for existing reactors.
Japan	Fossil fuel: <i>Power producers' plan</i> considered. Gas-fired plants dominate new fossil plant projects as of mid-2015. Nuclear: Basically 40 years lifetime. Addition of three reactors under construction. Renewables: Feed-in tariff, but gradually reduce purchase prices.
Southeast Asian economies	Fossil fuel: The latest <i>Power Development Plan (PDP)</i> and <i>utilities' power plant projects</i> are considered (i.e., <i>PLN's plan</i> for Indonesia, <i>PDP2015</i> for Thailand, etc.).

The BAU scenario assumes that the trend of these existing policies/plans continues

Electricity demand – *China and Southeast Asian economies drive growth*

Electricity demand by region

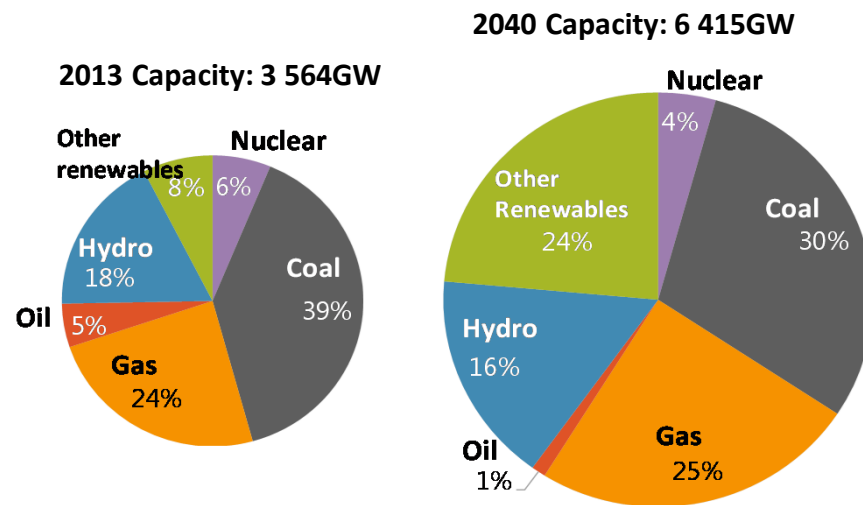


***Electricity demand in APEC grows by 70% over the outlook period.
China and Southeast Asian economies more than double their demand***

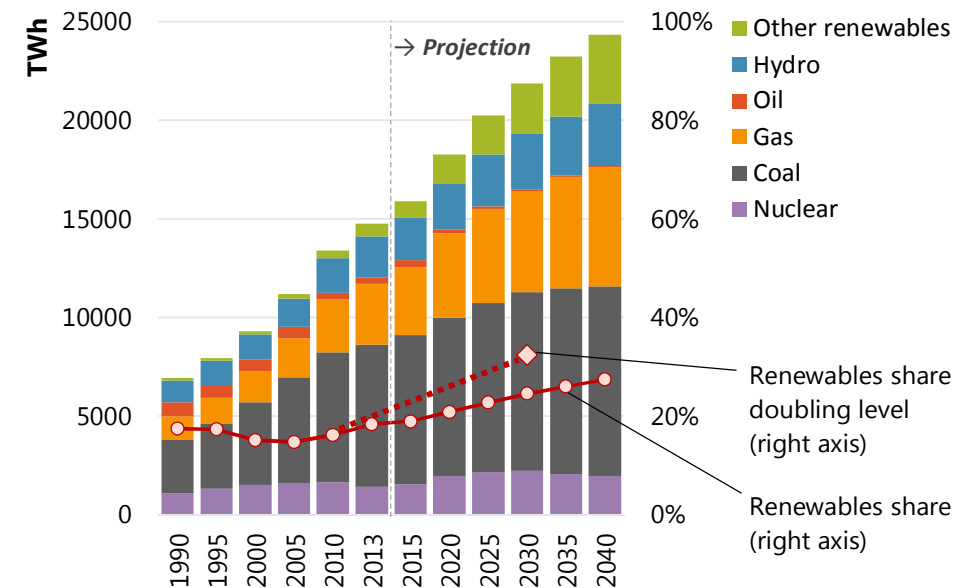
Note: **Oceania** (Australia, New Zealand and PNG), **Other Americas** (Canada, Chile, Mexico and Peru), **Other Northeast Asia** (Hong Kong, Japan, Korea and Chinese Taipei), **Southeast Asia** (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam)

Electricity supply – *Renewables expand, but fossil fuels still dominate*

APEC installed capacity



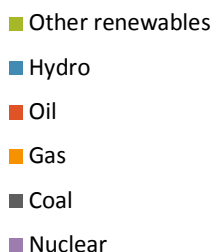
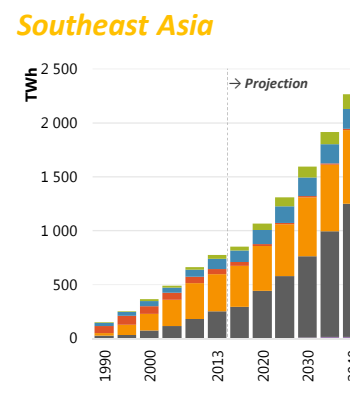
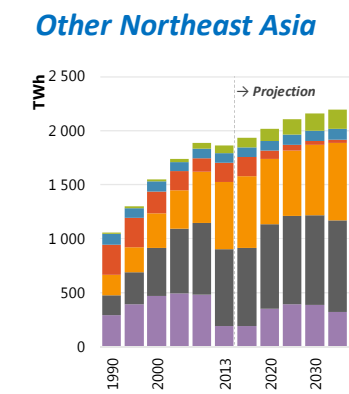
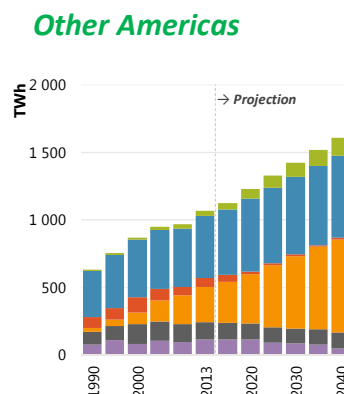
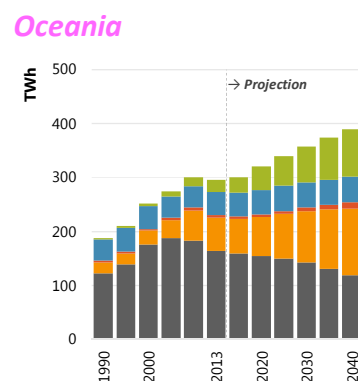
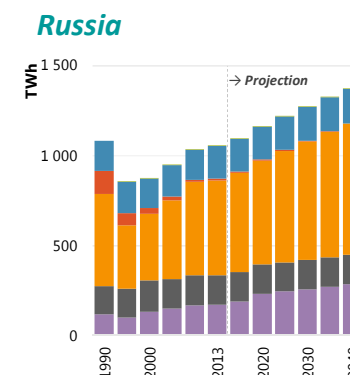
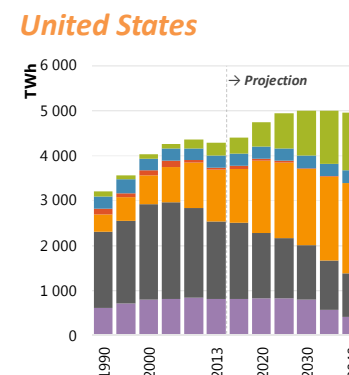
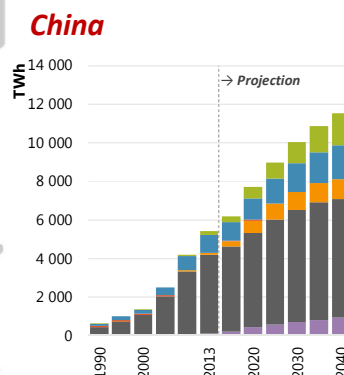
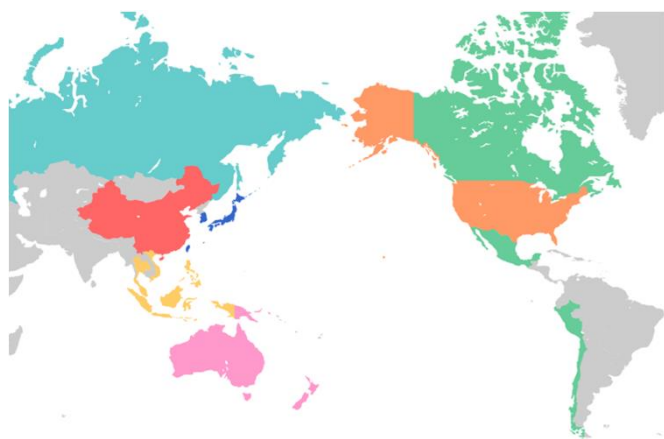
APEC electricity generation



RE capacity expand to 40% by 2040, but fossil fuels dominate generation due to relatively lower RE capacity factors. Doubling not achieved by 2030 nor 2040 in BAU

Note: **Other renewables** include solar PV, CSP, onshore wind, offshore wind, biomass, geothermal and marine.

Electricity supply – regional generation mix reflects local resource availability and policy direction

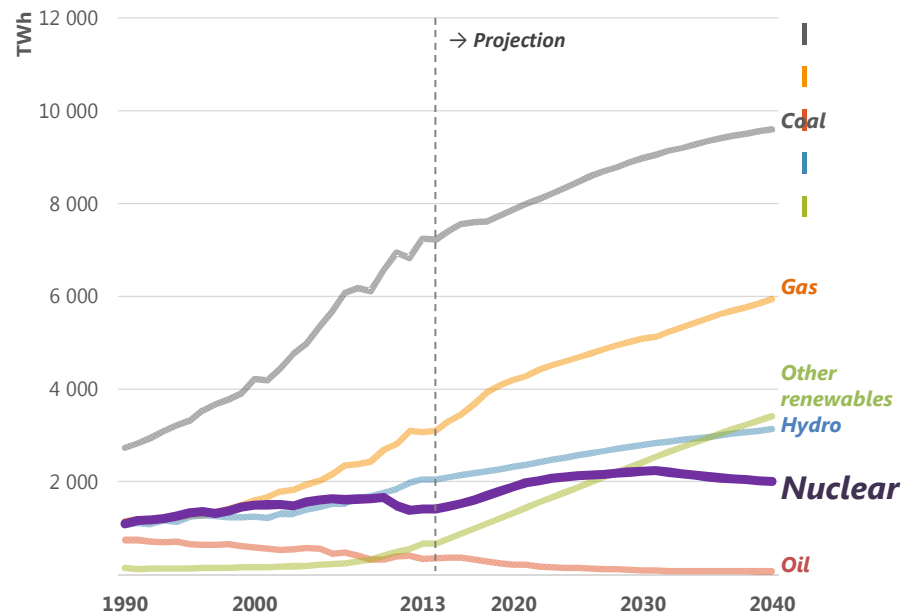


Note1: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

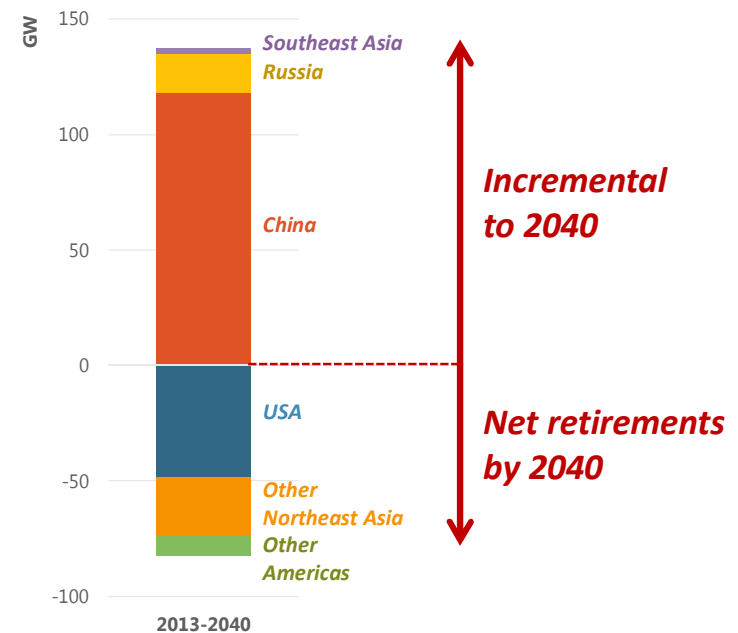
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Electricity supply – Current reactor lifetime regulation and retirement plans may result in modest nuclear growth

APEC generation by fuel type



Nuclear capacity changes by 2040

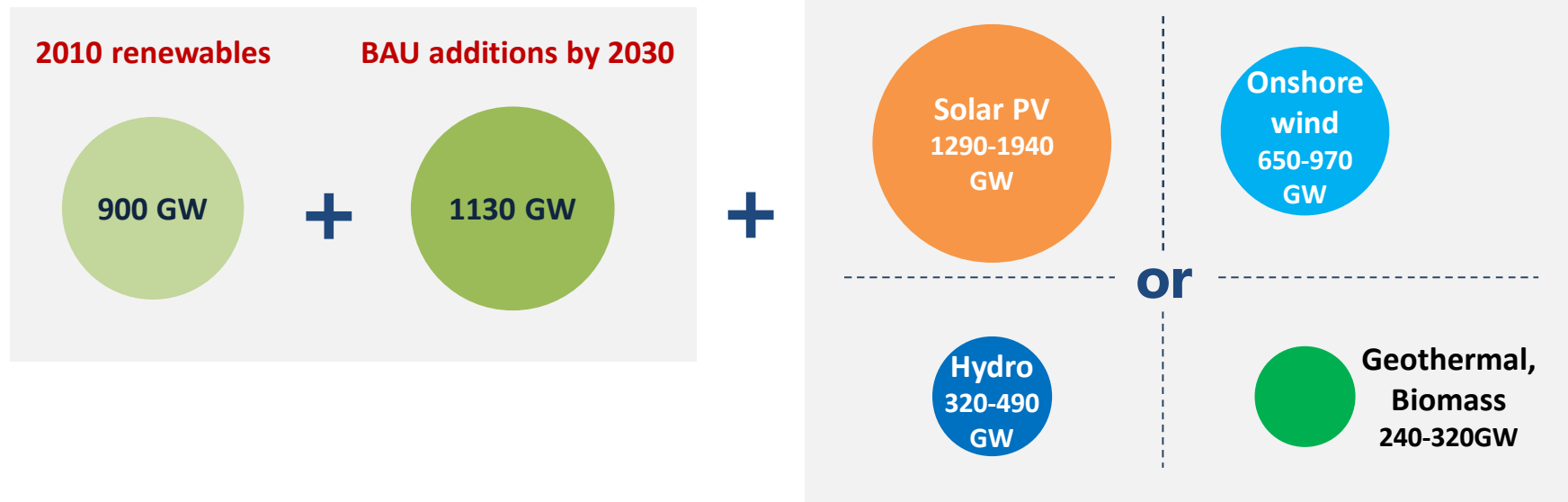


Nuclear expands mainly in China, Korea and Russia; however, these additions are offset by retirements of existing reactors, resulting in the peak around 2030

Note: **Other renewables** include solar PV, CSP, onshore wind, offshore wind, biomass, geothermal and marine.

Doubling renewables in electricity sector – *a long way to go in electricity sector?*

Additional renewables capacity needed for doubling by 2030

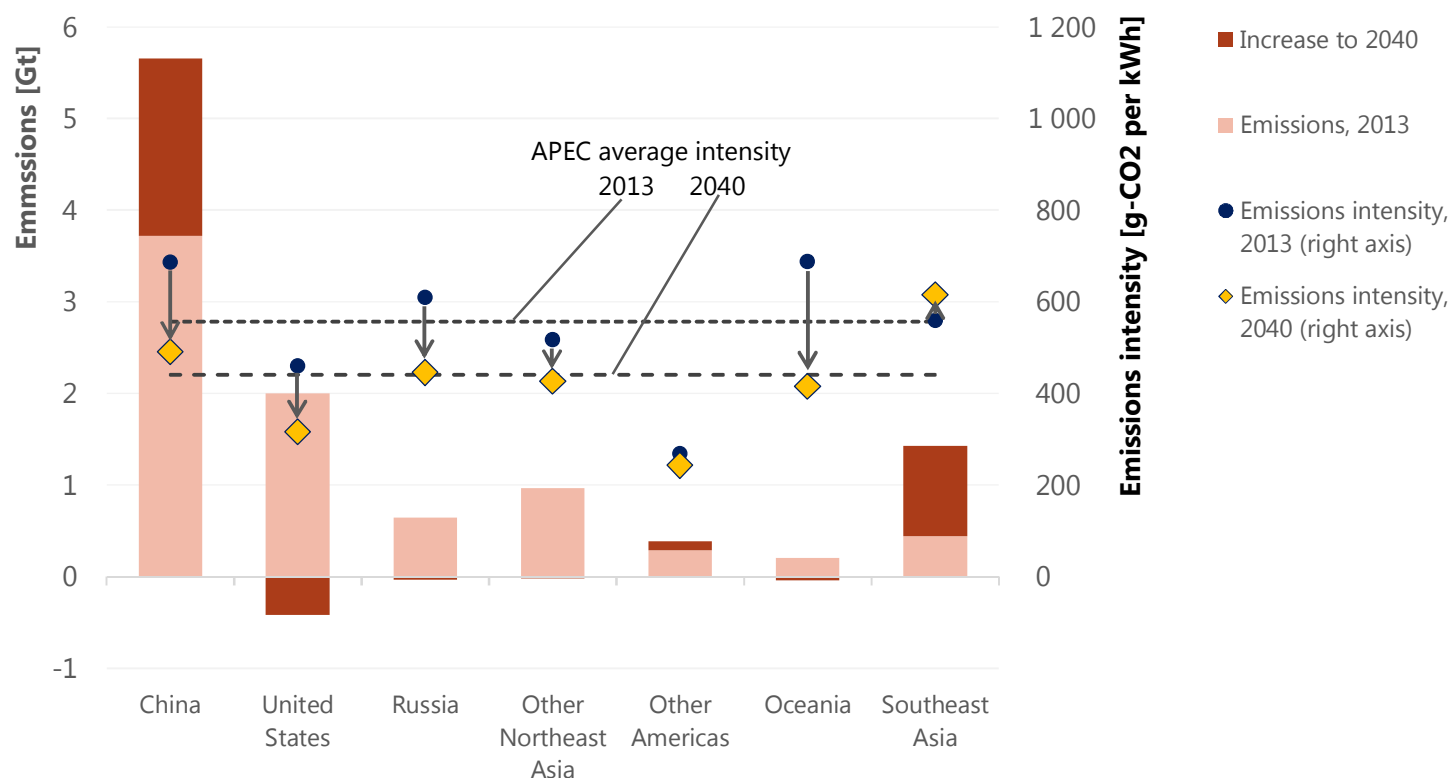


Substantial amounts of renewables needed to meet the doubling level in electricity sector, i.e., +240 ~ 1 940 GW, depending on capacity factor of additional RE

Note: Assumptions for capacity factor are as follows: 10%~15% for solar PV, 20%~30% for onshore wind, 40%~60% for hydro and 60%~80% for geothermal and biomass. This estimation does not take into account losses through storage or through curtailments to stabilise the grid. If such losses are considered, even more installed capacity would be needed to achieve doubling.

CO₂ emissions – *BAU is not environmentally sustainable.* *Low-carbon measures are important especially in China/SE Asia*

Annual emissions and emissions intensity

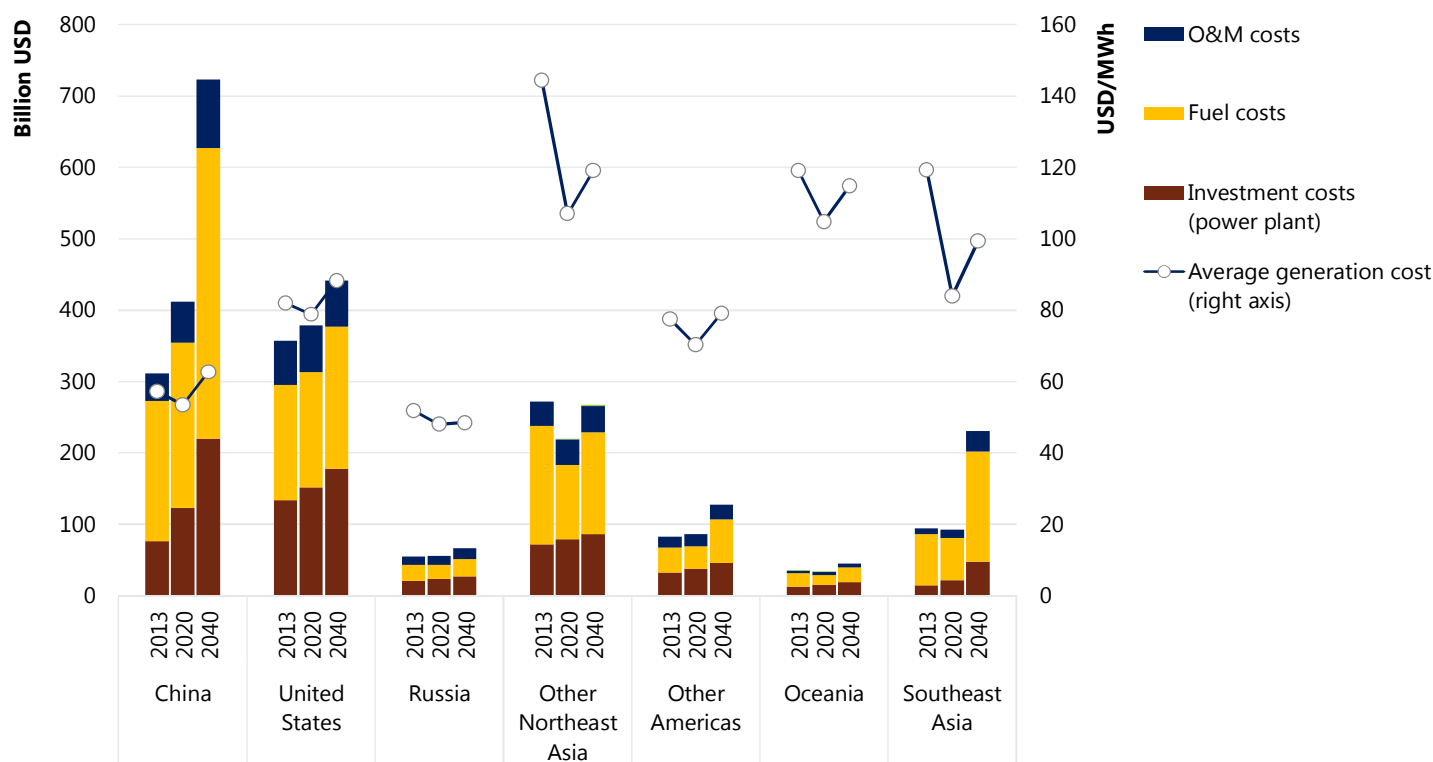


***Emissions intensity falls by 21% on average in APEC,
however, in absolute terms, annual APEC emissions increase by 2.5 GtCO₂ by 2040***

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Generation costs – average cost drops across APEC in the short term mainly due to oil deflation, but the effect largely differs by regions

Total cost and average power generation cost



Average cost largely drops in Other Northeast Asian and Southeast Asian economies, by 26~30% by 2020. The 2040 average cost is also lower than 2013 in these regions

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APEC Electricity Outlook – Key trends and implications

- Å **China and Southeast Asian economies drive the growth of APEC electricity demand.**
- Å ***BAU* scenario is not environmentally sustainable; further policy actions toward more efficient and low-carbon electricity systems are necessary.**
- Å **Current reactor lifetime regulation may result in modest nuclear growth.**
- Å **Economies need to enhance renewable promotion policies in order to double renewables in power mix.**
- Å **Given the significance of fuel price on average costs, fuel-importing economies need to continue exploring the possibilities of managing the long-term fuel price surge.**

Thank you for your kind attention

<http://aperc.ieej.or.jp>

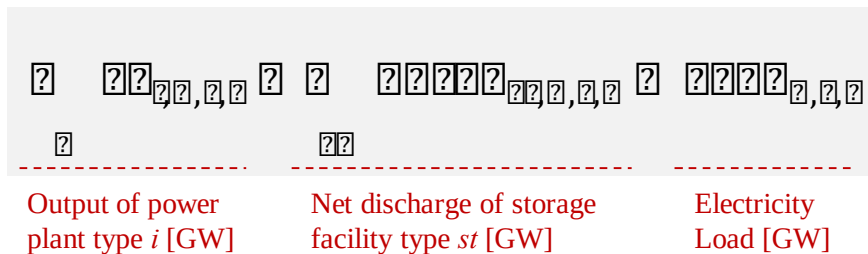
Methodology – *Power generation and storage technologies in BAU scenario*

	Type	Definition
Nuclear	Nuclear	Nuclear
Fossil fuel fired	Coal_SubC	Coal (Sub-Critical)
	Coal_SupC/USC	Coal (Super Critical, Ultra Super Critical)
	Gas_Turbine	Gas steam turbine, Gas turbine
	Gas_CCGT	Gas combined cycle
	Oil	Oil steam turbine, Diesel engines
Renewables	Hydro	Hydro (large and small-scale)
	Wind	Wind onshore and offshore
	Solar	Solar PV, Solar thermal
	Geothermal	Geothermal
	Biomass and others	Biomass, biogas, renewable waste and marine
Storage	Pumped Hydro	Pumped hydro storage
	Battery	Battery

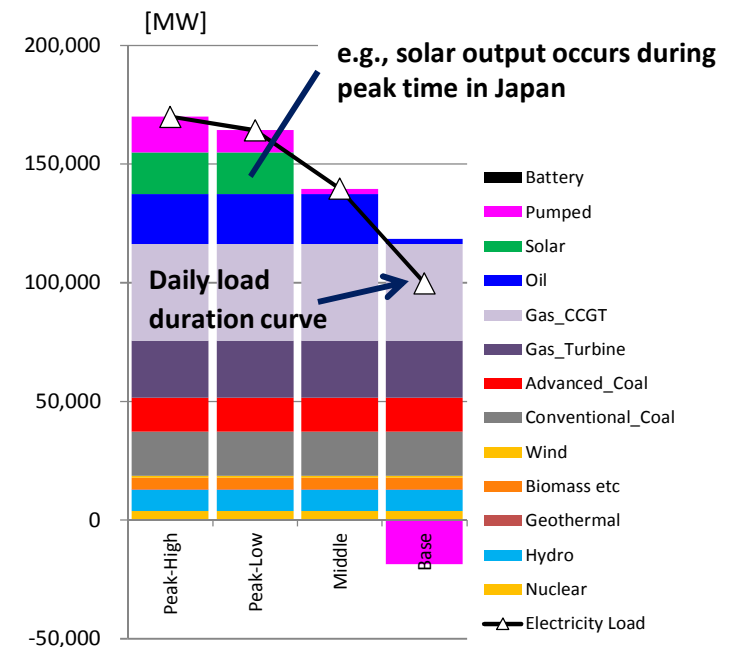
Methodology – APERC's supply model dispatches power plants and storages facilities.

Electricity demand-supply balance

- Electricity demand and supply are balanced using load duration curves.
- Peak, middle, and base load in each season is modelled.
- Type of season can be changed from economy to economy.
- We can approximately describe VREs output profiles and back-up capacities (e.g., fossil fuel-fired should be prepared for the VREs' intermittency).



Dispatch in Japan (Summer, 2040)

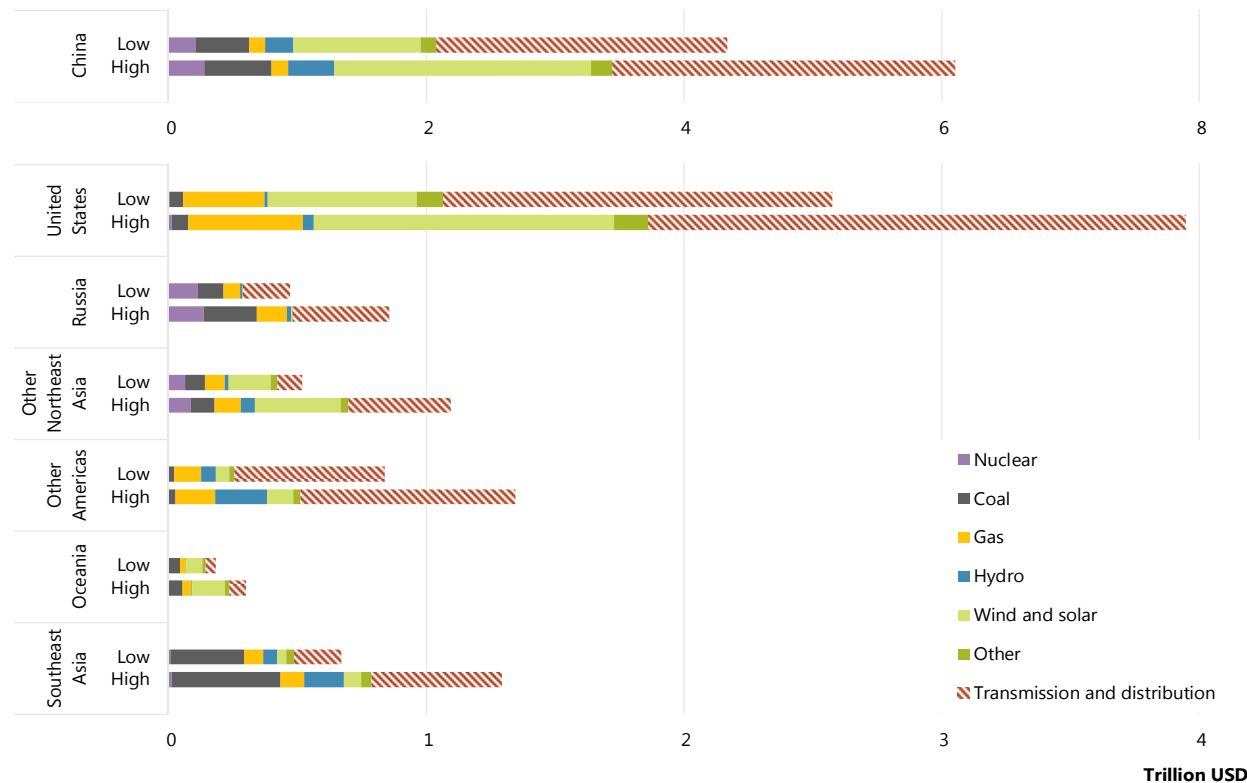


*Japan case: 3 season $\times$ 4 time segment
(Summer, Winter, Intermediate)

Operation of power plants and storages is determined considering load duration curve.

Electricity infrastructure investments – *The APEC region's electricity sector provides a huge investment opportunity*

Electricity infrastructure investments

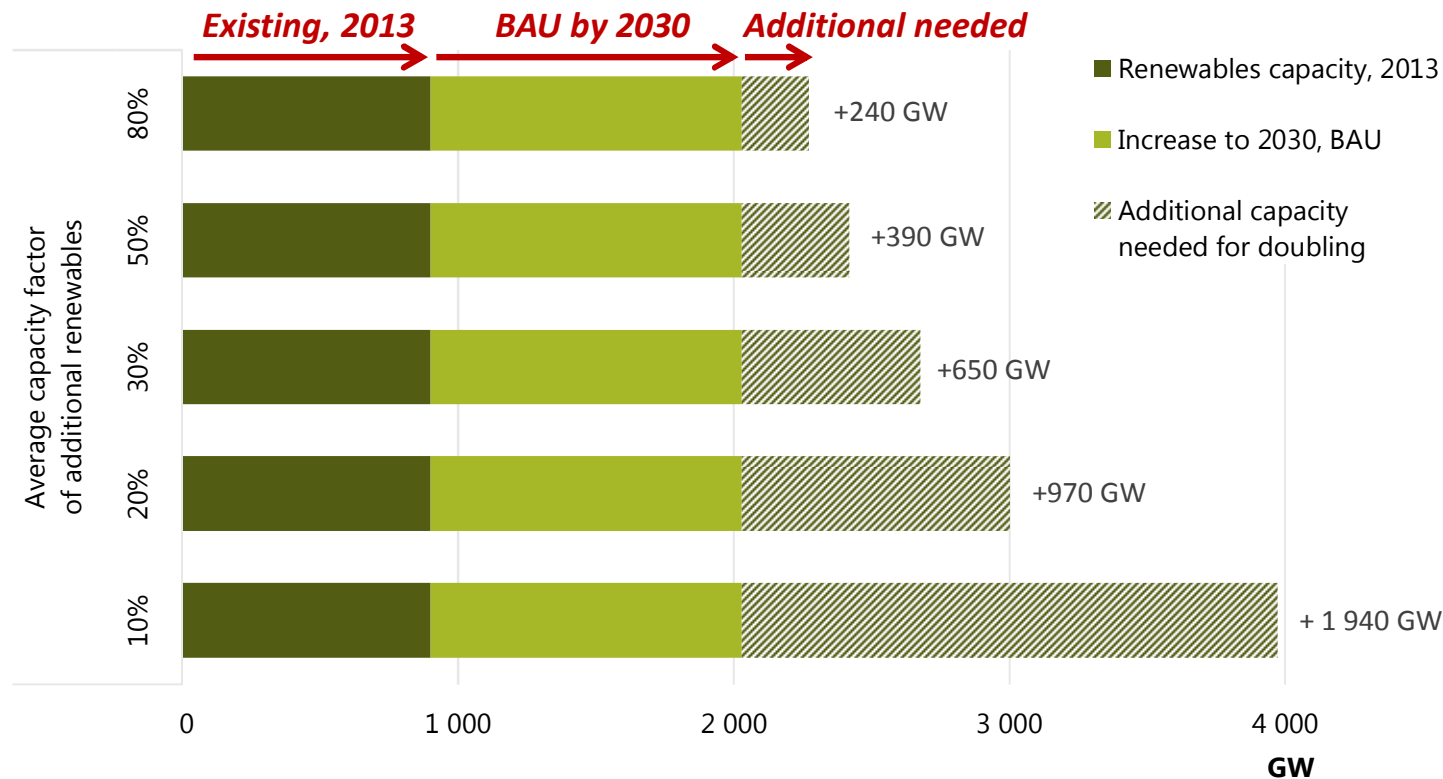


Total investments range USD 9.6 - 15 trillion. Investments required not only in emerging economies to meet rising demand, but also in mature economies to deploy RE and replace old plants

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