

LONG-TERM ELECTRICITY DEMAND AND SUPPLY OUTLOOK IN THE APEC REGION

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Overview

The Asia Pacific Energy Research Centre (APERC) is compiling APEC Energy Demand and Supply Outlook 6th Edition to provide the implications of policy actions and regional cooperation within the framework of the Asia Pacific Economic Cooperation (APEC) (APERC, 2016, forthcoming). This paper provides the preliminary results of the Business as Usual (BAU) scenario, which takes into consideration only existing policies as of 2015.

APEC economies are the major electricity markets in the world, together accounting for about 60% of global generation over the last two decades. APEC consists of developed economies (like Australia, Japan, Russia and U.S) and developing economies (like China and Southeast Asian economies), and the region is expected to grow in the foreseeable future driven mainly by the emerging economies. However, its power generation mix has not been environmentally sustainable as fossil fuel-fired generation dominates over the decades. Thus, in 2014, APEC energy ministers have agreed a goal of ‘doubling the share of renewables in the APEC energy mix, including in power generation, from 2010 levels by 2030’ to accelerate the integration of low-carbon generation technologies. Based upon this background, APERC projects electricity demand and supply towards 2040 considering the latest policy updates in order to provide implications for further policy discussions and actions.

Methods

APERC projects sectoral electricity demand using an econometrics model and electricity supply with an optimisation model. The demand models, decomposed into industry sub-model, transport sub-model and residential, commercial and other sector sub-model, project electricity demand by economy from today to 2040 using macroeconomic indicators, sectoral information and econometrics techniques.

The electricity supply model calculates capacity and generation based on the demand projected by the demand sub-models. This is a linear programming model (bottom-up type), which minimises each economy’s overall system cost over the outlook period under technical and political constraints. Note that, in APERC’s analysis, nuclear and renewables capacity are subject to government policies and any recent developments. Therefore, the model determines the fossil fuel-fired capacity, and dispatches power generation and storage technologies, considering representative yearly or daily load duration curves. Cost information relies on each economy’s assessment (for example, BREE (2012) for Australia, METI (2015) for Japan) as well as IEA analysis (IEA WEIO, 2014). Assumptions for retirement are as follows: 40-60 years for nuclear, 40-60 years for fossil fuel-fired plants and 25 years for solar and wind. The BAU scenario assumes 40 years and 60 years lifetime for nuclear in Japan and United States, respectively.

The following generation technologies are considered in the BAU: nuclear, coal subcritical, coal super/ultra super critical, advanced coal technologies, gas turbine, combined-cycle gas turbine, oil-fired, hydro (large and small scale), wind (onshore and offshore), solar (photovoltaics and concentrating solar power), geothermal, and biomass/others. The model also takes into account pumped hydro storage and battery as storage technologies.

Results

1. Electricity demand: China and Southeast Asian economies drive the growth.

Electricity demand in the APEC region rises by 70% from 2012, at a 1.8% compound average annual growth rate (CAGR), over the outlook period. In absolute terms, it expands from 12 680TWh to 21 060TWh. Growth is mainly driven by China and Southeast Asian economies, each of which more than doubles its electricity demand, at CAGRs of 2.9% for China and 3.3% for Southeast Asia. Despite a slowdown in China’s economic growth, it remains a key driver of APEC electricity demand.

2. Generation: renewables expand, but fossil fuels still dominate.

Fossil fuels have been and are projected to be dominant sources in the APEC generation mix (Fig. 1). Although their share decline by eight percentage points to 64% by 2040, fossil fuels increase in absolute terms, coal generation by 2 370TWh (+32% from 2013) and gas by 2 950TWh (almost doubling). Gas generation increases across APEC, while the coal generation increase is mainly in China and Southeast Asia. These incremental fossil fuel generation results in higher CO₂ emissions, which poses environmental challenges as explained below.

Existing decarbonising policies promote low-carbon technologies, in particular, renewable energy. Renewables show the largest growth in generation, rising 2.5 times over the projection period. Nevertheless, APEC economies do not achieve doubling the share of renewables in the power mix by 2030 (nor 2040) (Fig. 1). The economies need to further enhance policies promoting renewable energy. Nuclear share of APEC generation, around 10% today, remains at a similar level by 2040. China, Korea and Russia are expected to expand nuclear power; however, the additions are partly offset by retirements of aging reactors in several economies, including Canada, Japan, Mexico, Chinese Taipei and United States. The current lifetime regulation of nuclear may result in modest nuclear growth in APEC.

3. CO₂ Emissions from Power Generation: BAU is not environmentally sustainable.

Deployment of lower emission sources, such as nuclear, renewables as well as gas, contributes to improving APEC average emissions intensity from 0.56kg -CO₂/kWh today to 0.44kg-CO₂/kWh by 2040. However, the BAU generation would not be environmentally sustainable as increased fossil fuel consumption results in larger CO₂ emissions in APEC from 8Gt-CO₂ to 11Gt-CO₂. The surge of the emissions mainly comes from China and Southeast Asia economies by 1.6Gt-CO₂ and 1Gt-CO₂, respectively, where fossil fuel generation increases to meet their expanding demand (Fig. 2).

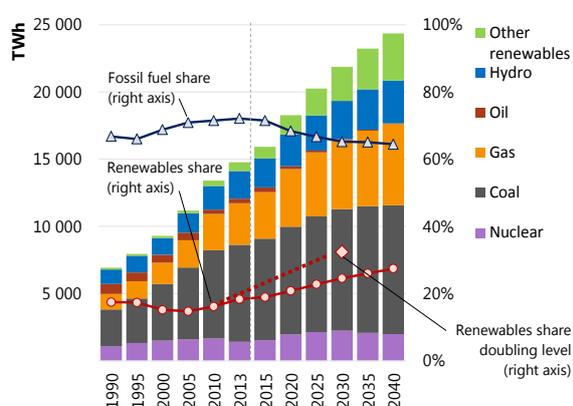


Fig. 1: Power generation, APEC region

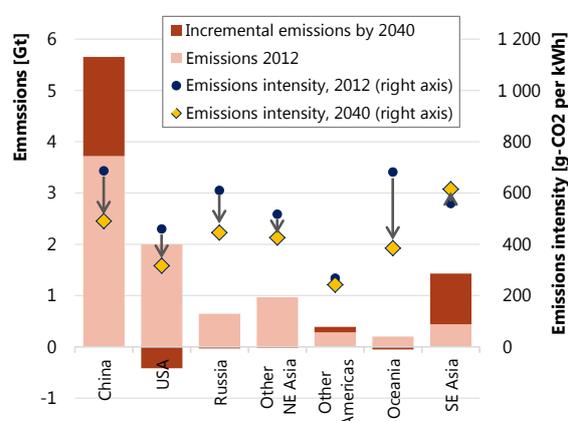


Fig. 2: Direct CO₂ emissions from electricity sector, by region

Note: Regional groupings in Fig. 2 are as follows: Other Northeast Asia (Other NE Asia) includes Hong Kong, Japan, Korea and Chinese Taipei; Other Americas includes Canada, Chile, Mexico and Peru; Oceania includes Australia, New Zealand and Papua New Guinea; and Southeast Asia (SE Asia) includes Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam. The BAU results, presented in this abstract, assume the clean power plan in United States, but this assumption may be revised after the review by experts and economies.

Conclusions

Existing policy is not enough to realise an environmentally sustainable society. APEC economies need to strengthen energy policies to aimed at decarbonising the electricity sector by accelerating the development and deployment of low-carbon technologies, energy efficient technologies, energy saving measures and so on. Given that the surge of the emissions is in the emerging economies, APEC economies should continue to pursue cooperative projects to support the decarbonisation across APEC.

References

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