APEC Energy Demand and Supply Outlook

6th Edition

Session 2-2

<revised>

Exploring an Alternative Electricity Mix

On behalf of Alternative Electricity Mix Group

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This presentation is revised after the conference as errata (pp.17-18) shows. However, it is still only for review purpose. Citation is not allowed.

Scenario Overview

- The scenario strives to increase the use of **cleaner coal, natural gas and nuclear in the electricity generation** of APEC member economies.

- It also illustrates the hypothetical effects and policy implications from drastic changes in the power mix.

Key Messages

- **Coal remains the dominant source** for electricity generation in APEC under all scenarios.
- **Five Economies** concentrate **over 80% of APEC's electricity generation.**
- Future emissions reduction depends on action in these Economies: **China, USA, Russia, Japan and Canada.**

Trade-offs

Dimension	Fuel		
	Coal	Natural gas	Nuclear
Carbon dioxide emissions	High, with the exception of advanced technologies and CCS	The lowest among fossil fuels	Nil emissions
Energy security (supply)	Abundant, distributed extensively worldwide	Supply concentrated in a few economies, although market is increasingly global. In some economies, unconventional gas resources could reduce their dependence on external supplies in the long term	Supply concentrated in a few economies, most of them stable
Costs			
Fuel	Relatively cheap and stable	Except for certain gas-producing economies, it is relatively expensive and uncertain due to its strong linkage to (unpredictable) oil prices. Supply requires dedicated infrastructure (LNG terminals and transmission pipelines)	Inexpensive considering the amount of electricity generated
Capital	Low capital investment unless other more sophisticated technologies are deployed	Higher capital investments compared to coal, but lower compared to nuclear (Increasingly affordable)	High capital investment
Construction and operation of electricity generation			
Construction timeframes	Medium to long if other technologies are deployed	Short	Long
Flexibility	Mainly base load	Intermediate and peaking loads	Mostly base load
Other issues	Local pollution impacts	Safety concerns over transportation and storage (especially for LNG)	Stirs acute political and social controversy from potential catastrophic accidents

Legend ***Positive*** ***Neutral*** ***Negative***

Cleaner Coal Scenario

- Assumes that **all new additions of coal-based electricity generation plants after 2020 are at least Super Critical (SC) or Ultra Super Critical (USC).**
- **After 2030, all new power plants are constructed with Carbon Capture and Storage (CCS) technology.**

Economies	Type of new coal plants after 2020	Type of new coal plants after 2030
Major coal-using economies **(Australia, China, Japan, Korea, Chinese Taipei, Russia and United States)**	Advanced Ultra Super Critical (A-USC) or Integrated Gasification Combined Cycle (IGCC) Effiiciency: 45-50%	A-USC or IGCC with CCS
Other coal-using economies **(Chile, Hong Kong, Indonesia, Malaysia, Philippines, Thailand and Viet Nam)**	SC or USC Effiiciency: 38-46%	USC with CCS

High Natural Gas Scenario

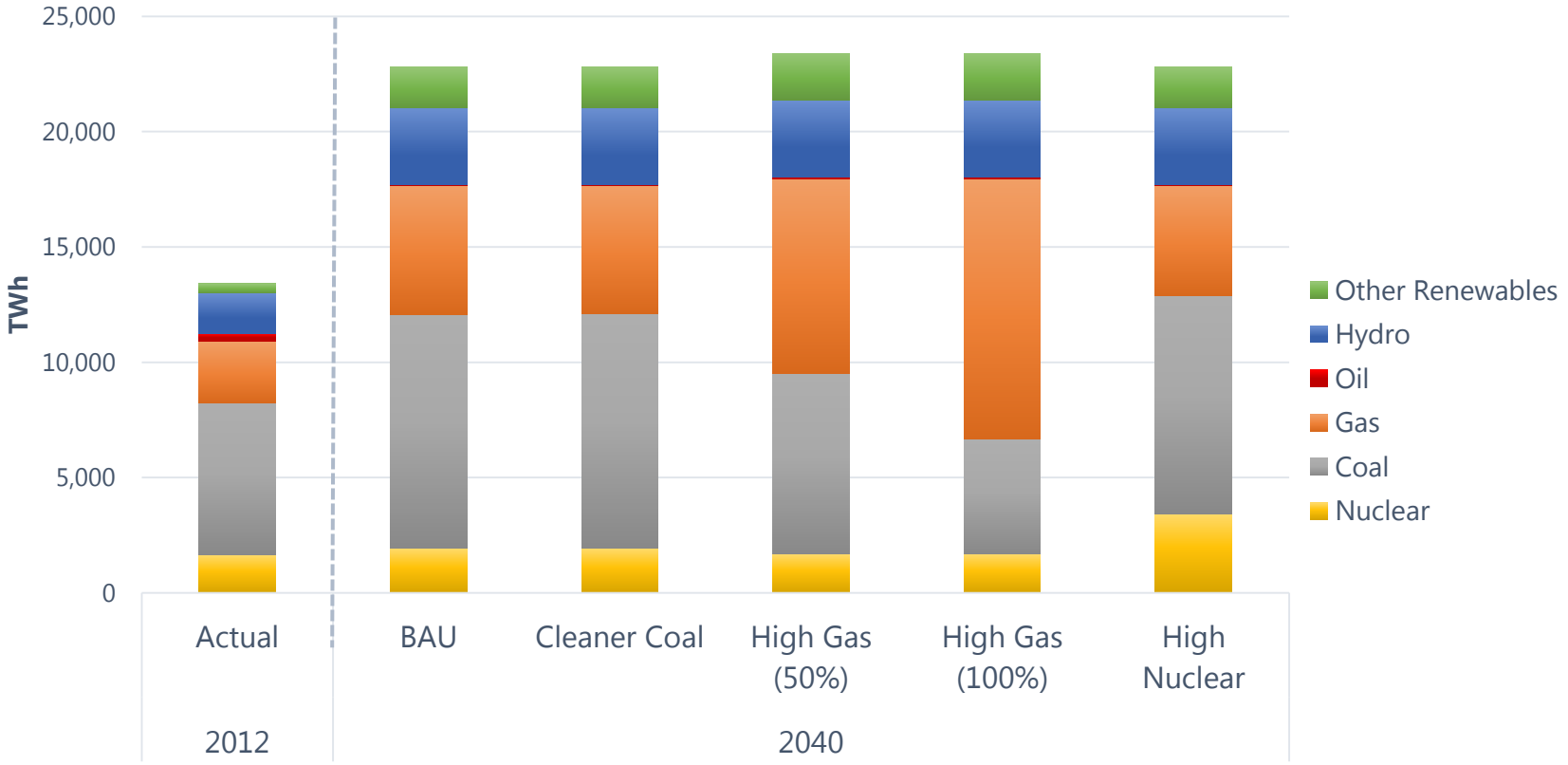
- **Assumes a given level of the new additions of coal-based electricity generation* capacity to be replaced by natural gas up to 2040.**
  - *Only in PNG, natural gas would replace oil-based generation.
- **Replacement is assumed at two levels:**
  - Half (i.e. 50%, High Gas 50%)
  - All (i.e. 100%, High Gas 100%)
- **Six economies not included as their gas use is already high:**
  - Brunei, Canada, Mexico, New Zealand, Peru and Singapore.

High Nuclear Scenario

- **Considers the potential nuclear expansion in the region, by focusing on economies with existing nuclear generation, and on those with a clear plan to develop it.**
  - Generation projections are calculated by using the capacity projections and the capacity factors of the covered economies.

Preliminary results: Overall Electricity Mix Scenarios

APEC's electricity generation, 2012 and 2040: Main results by Scenarios



*Data exclude imports

Source: APERC Analysis

Preliminary Results: Cleaner Coal

- **Coal's share is expected to amount to 44%** of APEC's total generation output by 2040.
- The share of coal including CCS technologies could represent 17% of APEC's total coal generation.
- In terms of capacity, this is equivalent to 290 GW out of 2,200 GW.
- By 2040, **CO_2 emissions are expected to decline 2.8% without CCS and 11.5% with CCS.**

Preliminary Results: High Natural Gas

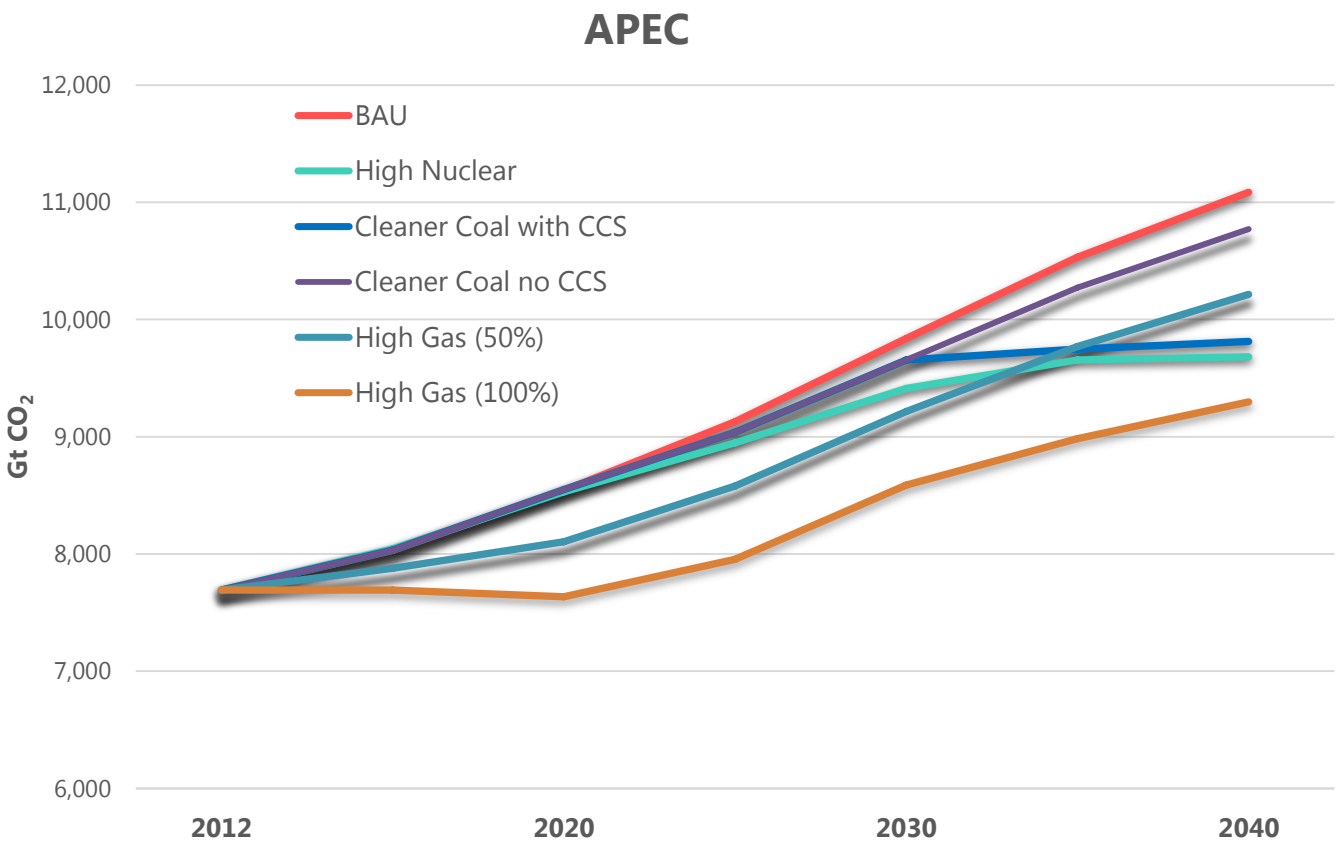
- In the **High Gas 50% Scenario**:
  - Natural gas-based generation will grow **more than 2 times, or at an annual average rate of 3.7%**
  - **CO_2 emissions would decrease 11%** in comparison to BAU
- In the **High Gas 100% Scenario:**
  - Natural gas-based generation will grow **around 2.8 times, or an annual average rate of 4.6%**
  - **CO_2 emissions would decrease 26%** in comparison to BAU. **This is the largest possible decline across the alternative power mix scenarios.**

Preliminary Results: High Nuclear

- APEC's nuclear capacity and generation would increase, respectively, **by about 1.4 times, and by about 1.9 times** by 2040.
- As a result, nuclear generation would replace 10% of coal and 23% of gas used for power generation.
- Nuclear generation would decrease coal use by 247 Mtoe and gas use by 227 Mtoe.
- **The jump in nuclear generation would result in a reduction of CO_2 emission by 13%** compared to the BAU scenario.
- **China would be the major contributor both in terms of capacity and generation increases**, followed by the US, Russia and Korea.

CO_2 Emissions by Scenarios

CO_2 emissions from electricity generation, 2012 and 2040: Results by Scenario



Source: APERC analysis

Limitations

- **The mix analyzed in this scenario only considers three fuels** (cleaner coal, natural gas and nuclear).
- **The expansion of renewable energy is not considered**. Renewables however, represent the other main alternative.
- **Several APEC economies were not included in each one of these scenarios** on the basis of the respective assumed criteria.

Policy Implications

- Each economy's generation portfolio will depend on **environmental, economic and energy security criteria**.
- **Changes will require strong policy support** to underpin several institutional, economic and technical factors.
- **Without CCS technologies, it is impossible to achieve substantial emissions reduction** with continued coal use.
- Even though coal is the cheapest fuel, **net benefits might be offset from the efficiency gains in the use of gas-fueled technologies** with higher efficiencies and lower emissions.
- If used with high safety standards, **nuclear could be a reliable source of zero carbon energy**.

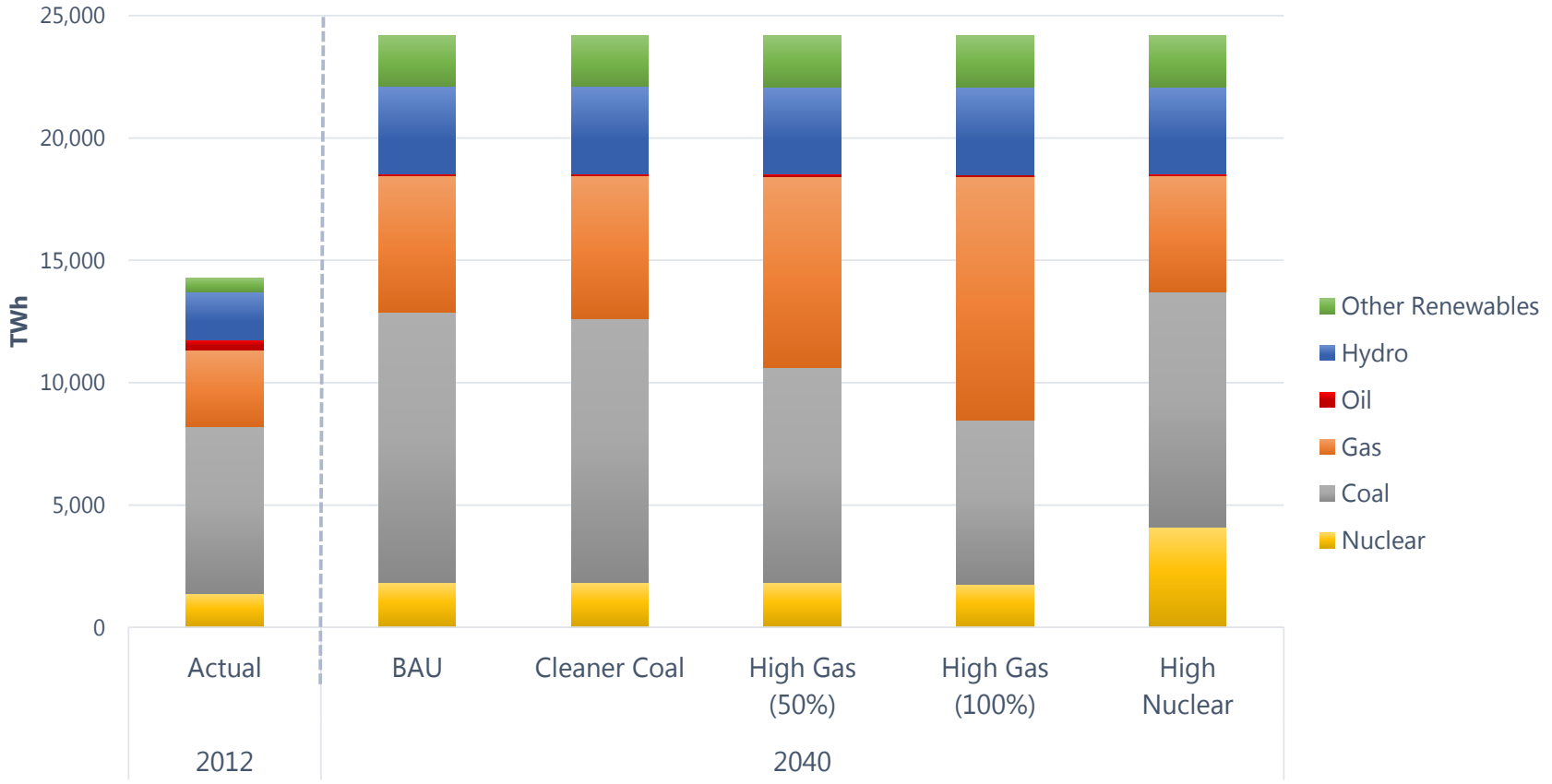
Next Steps

- Each scenario will be fine-tuned on their assumptions and results **based on expert's feedback gained at the Annual Conference**.
- **APERC looks forward to having your participation as reviewers for the preliminary Chapter** by the end of this year.
- We will also appreciate your feedback and discussion for **APERC's Energy Supply and Demand Outlook**.

Errata

Page	Line	Erratum	Correction
9		APEC's electricity generation figure	Please see page 18.
11	3	3.7%	3.3%
11	6	2.8 times	3 times
11	7	4.6%	4.2%
11	8	26%	16%
12	2	by about 1.4 times, and by about 1.9 times	by about 2.4 times, and by about 3.0 times
12	4	10% of coal and 23% of gas used for power generation.	11% of coal and 18% of gas used for power generation.
12	6	coal use by 247 Mtoe and gas use by 227 Mtoe.	coal use by 258 Mtoe and gas use by 208 Mtoe.

Errata – corrected figure of overall APEC's generation mix in page 9



Thank you
for your attention