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# Energy Outlook Focusing on Oil and Gas in EAS17 Region

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# OUTLINE OF PRESENTATION

- I. INTRODUCTION**
- II. RESEARCH FRAMEWORK**
- III. EAS17- OIL & GAS FINAL ENERGY CONSUMPTION**
- IV. EAS17- OIL & GAS PRIMARY ENERGY SUPPLY**
- V. EAS17- OIL & GAS POWER GENERATION**
- VI. SCENARIO OF LARGE GAS DEMAND IN ASEAN+INDIA**
- VII. NECESSARY INVESTMENT COST**
- VIII. EAS17- ENERGY SAVING POTENTIAL**
- IX. CONCLUSIONS & POLICY IMPLICATIONS**

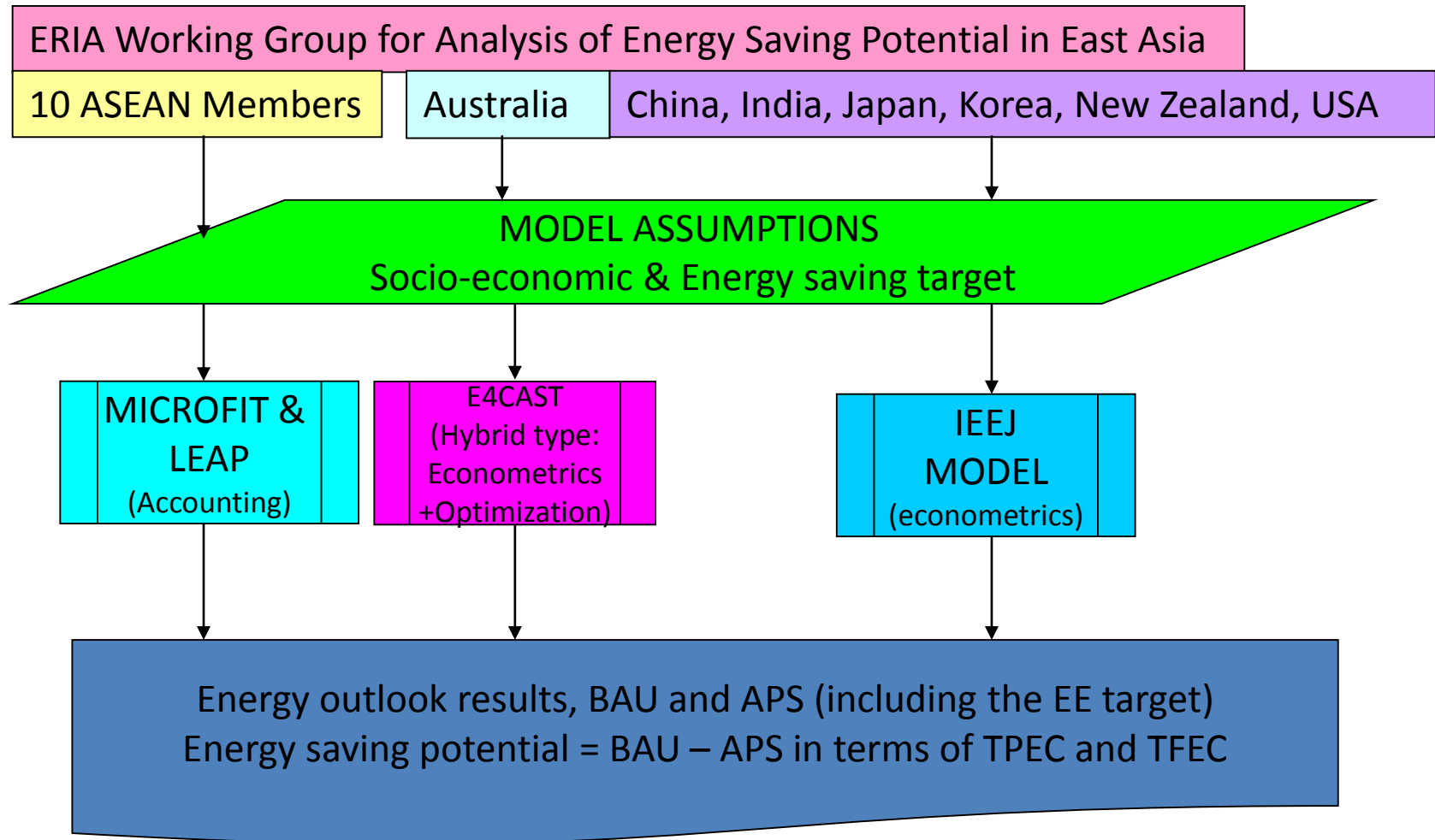
## I- INTRODUCTION

- Sustained population and economic growth in the East Asia Summit (EAS) region (the original EAS plus the United States of America [EAS17]) are the key drivers for the projected increasing energy demand for both primary and final energy consumption to nearly 50% from 2015 to 2040, reflecting an annual growth rate of about 1.6%.
- This increasing energy demand threatens the region's energy security. Hence, energy infrastructure including oil stock, energy cooperation, and energy saving are keys to energy security.

## OBJECTIVE AND RATIONALE OF EOSP

- This study aims to analyse the potential impacts of proposed additional energy-saving goals, action plans, and policies in the EAS17 region on energy consumption, by fuel and sector, and GHG emissions. The study also provides a platform for energy collaboration and capacity building amongst EAS17 countries on energy modelling and policy development.
- The study supports the Cebu Declaration, which highlighted several goals such as improving the efficiency and environmental performance of fossil fuel use...etc

# II- Research Framework

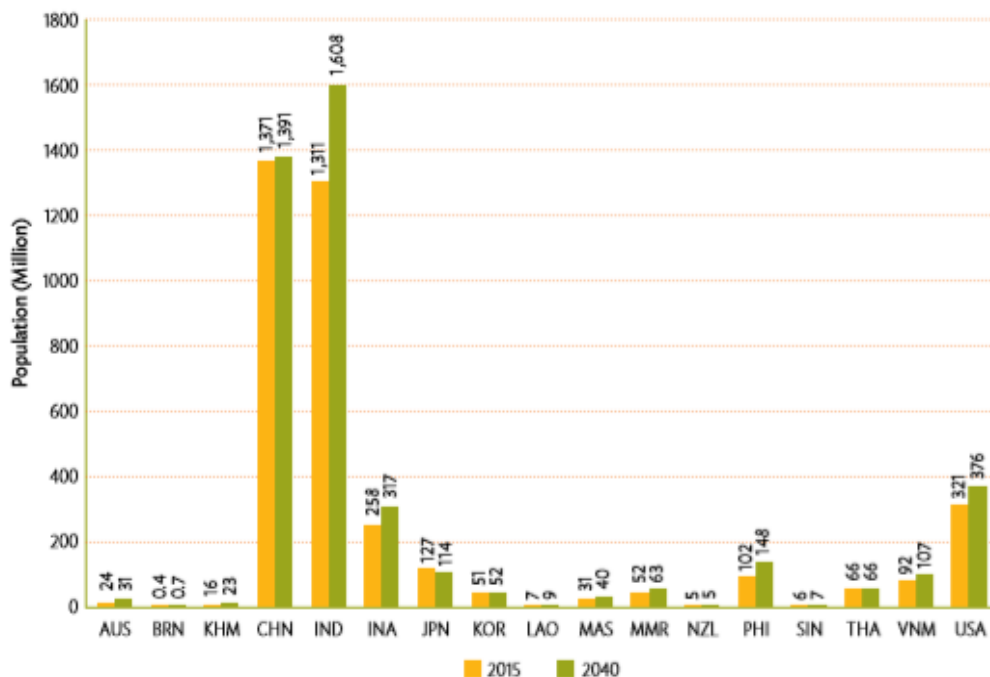


## ✓ METHODOLOGY AND ASSUMPTIONS

- *ASEAN countries*: The energy models of ASEAN countries were developed using the Long-range Energy Alternative Planning System (LEAP) software. Final energy consumption is forecasted using energy demand equations by energy and sector and future macroeconomic assumptions.
- The Working Group members were asked to specify assumptions about the future electricity generation mix in their respective countries by energy source. These assumptions were used to determine the future electricity generation mix.
- Many assumptions were used to make prediction based on each country's situation of data availability.

# ✓ Population Assumptions

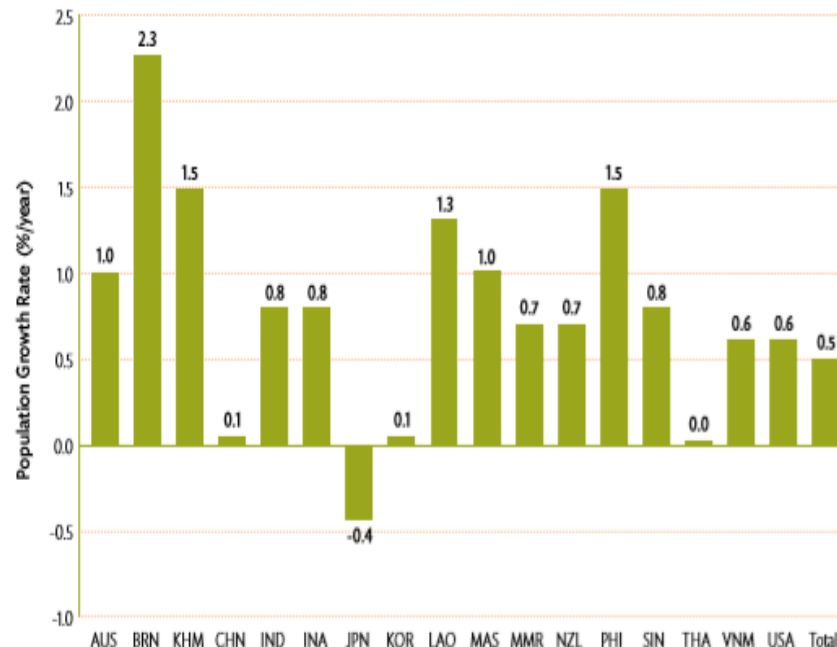
Assumed population in the EAS17 Region, 2015 and 2040



AUS = Australia, BRN = Brunei, EAS = East Asia Summit, KHM = Cambodia, CHN = China, IND = India, INA = Indonesia, JPN = Japan, KOR = Korea, LAO = Lao PDR, MAS = Malaysia, MMR = Myanmar, NZL = New Zealand, PHI = Philippines, SIN = Singapore, THA = Thailand, VNM = Viet Nam, USA = United States of America)

Source: WDI (2018).

Assumed average annual growth in population, 2015 and 2040



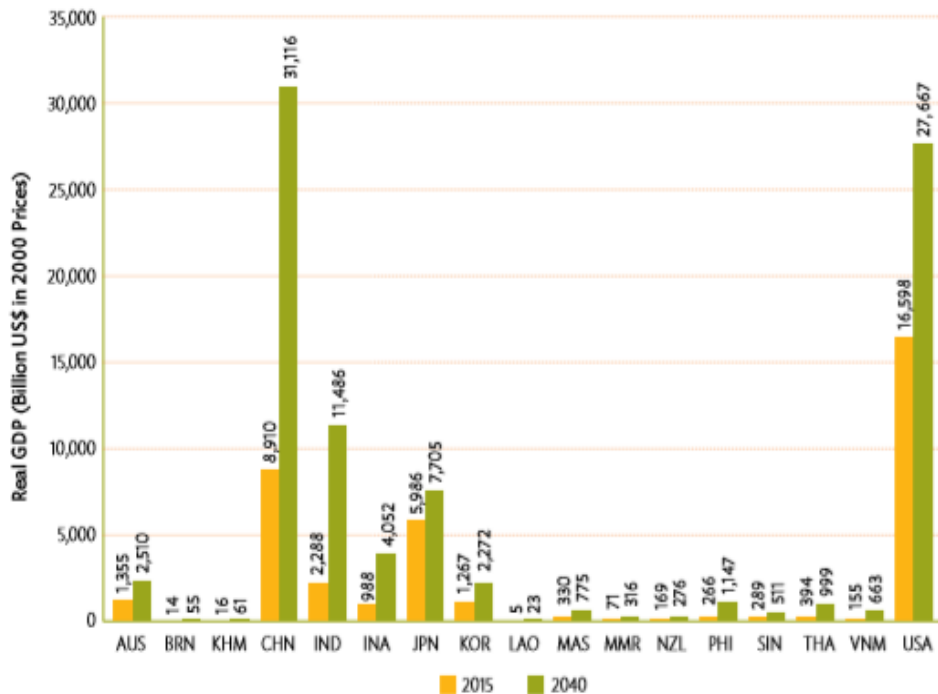
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Source: WDI (2018).

- The population growth is assumed to be fastest in developing countries. Only Japan will experience negative growth by 2040

# ✓ Economic Assumptions

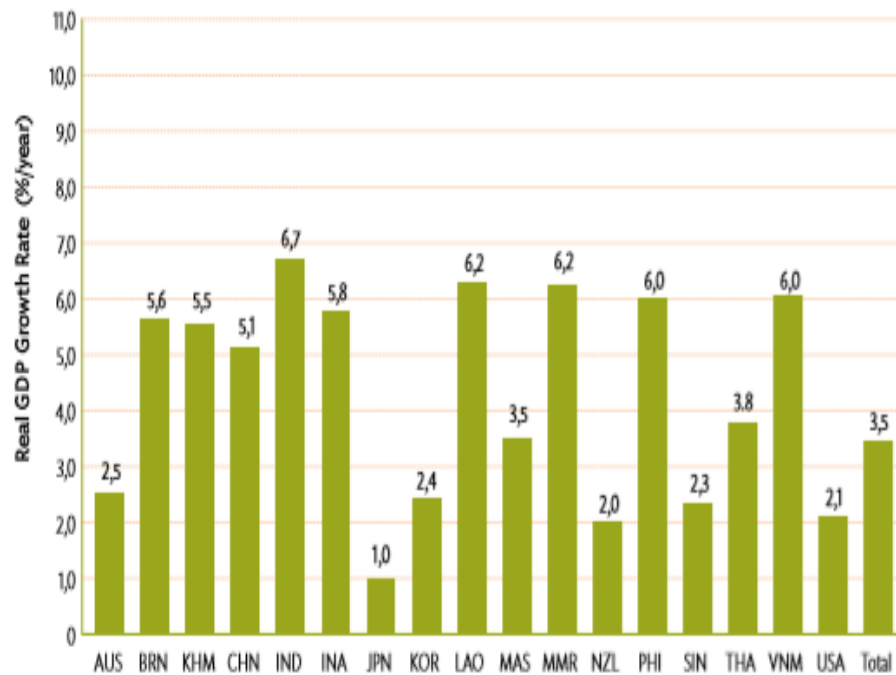
Assumed economic activity in the EAS17 Region, 2015 and 2040



AUS = Australia, BRN = Brunei, KHM = Cambodia, CHN = China, EAS = East Asia Summit, GDP = gross domestic product, IND = India, INA = Indonesia, JPN = Japan, KOR = Korea, LAO = Lao PDR, MAS = Malaysia, MMR = Myanmar, NZL = New Zealand, PHI = Philippines, SIN = Singapore, THA = Thailand, VNM = Viet Nam, USA = United States of America.

Source: WDI (2018).

Assumed average annual growth in GDP, 2015 and 2040



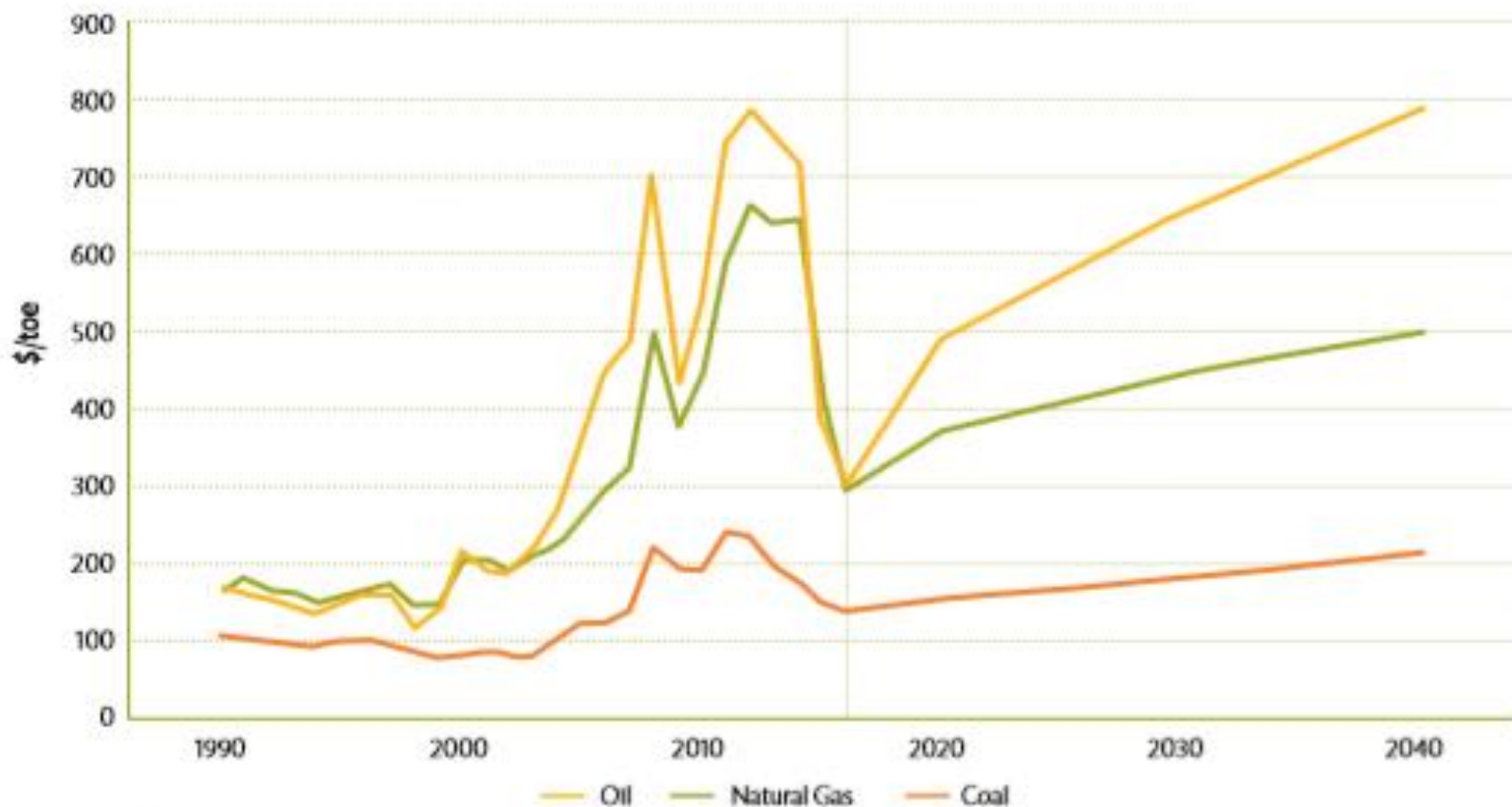
AUS = Australia, BRN = Brunei, KHM = Cambodia, CHN = China, GDP = gross domestic product, IND = India, INA = Indonesia, JPN = Japan, KOR = Korea, LAO = Lao PDR, MAS = Malaysia, MMR = Myanmar, NZL = New Zealand, PHI = Philippines, SIN = Singapore, THA = Thailand, VNM = Viet Nam, USA = United States of America.

Source: WDI (2018).

- Long-term economic growth rates are assumed to be quite high in the developing countries, with the highest growth rates in India, Myanmar, Lao PDR, Philippines, Viet Nam, and Cambodia



# Real Oil, Natural Gas, and Coal Imported Price Assumptions (Real prices in 2016 US\$)



toe = tons of oil equivalent.

Note: Crude oil price assumptions start from 2016 onwards.

Source: IEEJ's oil price assumptions (2017).

# Production Outlook of Oil 2014-2040

	Oil Production (1,000b/d)					
	2014	2020	2025	2030	2035	2040
Australia	448	600	650	650	600	600
Brunei	138	140	130	130	120	120
China	4,341	4,300	4,250	4,200	4,100	4,000
India	895	740	680	680	700	720
Indonesia	852	830	820	800	780	770
Japan	17	15	15	15	15	15
Korea, Rep. of	20	15	15	15	15	15
Malaysia	666	650	620	600	600	600
Myanmar	20	20	20	20	20	20
Philippines	24	39	35	30	30	30
New Zealand	47	27	10	3	1	1
Thailand	453	480	470	460	450	440
United States	8,900*	10,700	11,380	11,700	11,850	11,900
Viet Nam	365	360	350	330	320	320
<b>Total EAS</b>	<b>17,186</b>	<b>18,916</b>	<b>19,445</b>	<b>19,633</b>	<b>19,601</b>	<b>19,551</b>

\*The number is in year 2016, b/d = barrel/day

Source: IEA (2017).

# Production Outlook of Gas 2014-2040

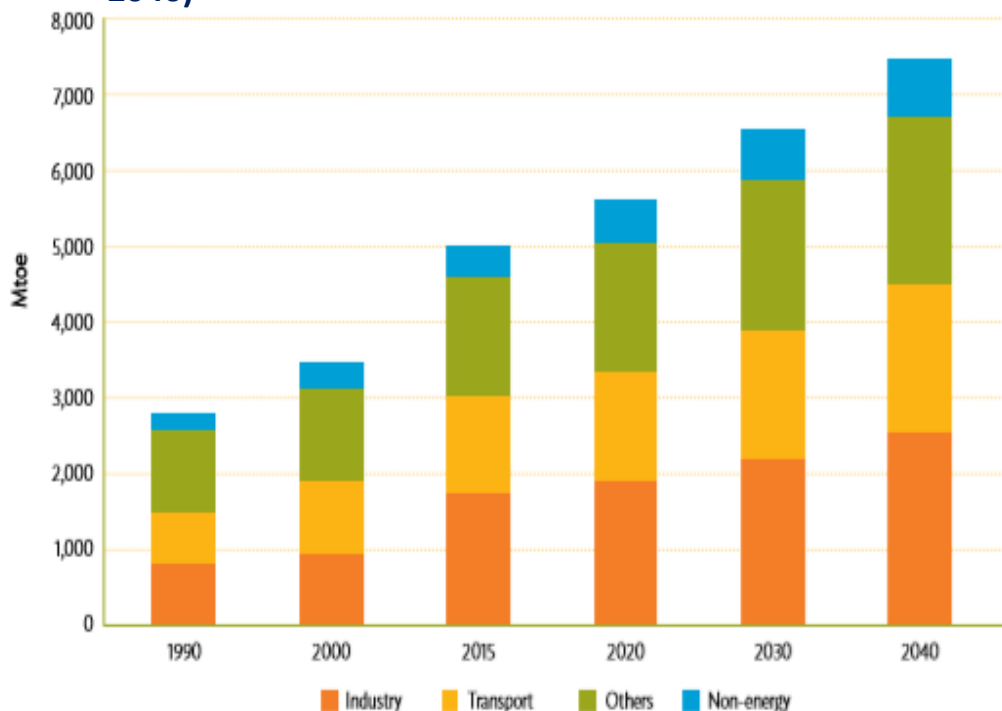
	Gas Production (bcm)					
	2014	2020	2025	2030	2035	2040
Australia	58.8	133.0	144.5	165.5	175.5	174.0
Brunei	11.9	12.5	12.5	12.5	12.5	12.5
China	134.5	172.0	212.0	255.0	299.0	342.0
India	31.7	38.0	45.0	55.0	69.0	89.0
Indonesia	73.4	80.0	82.0	83.0	84.0	85.0
Japan	3.9	3.5	3.0	3.0	3.0	2.5
Korea, Rep. of	0.5	0.5	0.5	0.5	0.5	0.5
Malaysia	66.4	68.0	70.0	67.0	65.0	65.0
Myanmar	16.8	17.5	18.5	18.5	18.5	18.5
Philippines	3.4	3.0	4.0	7.0	7.0	8.0
New Zealand	5.4	4.0	3.0	2.0	1.0	1.0
Thailand	42.1	42.0	41.0	40.0	40.0	40.0
United States	27,000*	32,700	35,800	37,900	38,800	40,200
Viet Nam	11.1	11.0	15.0	18.0	22.0	25.0
<b>Total EAS</b>	<b>27,460</b>	<b>33,285</b>	<b>36,451</b>	<b>38,627</b>	<b>39,597</b>	<b>41,063</b>

\*The number is in year 2016, bcm = billion cubic metre.

Source: IEA (2017).

### III- EAS17-FINAL ENERGY CONSUMPTION (BAU)

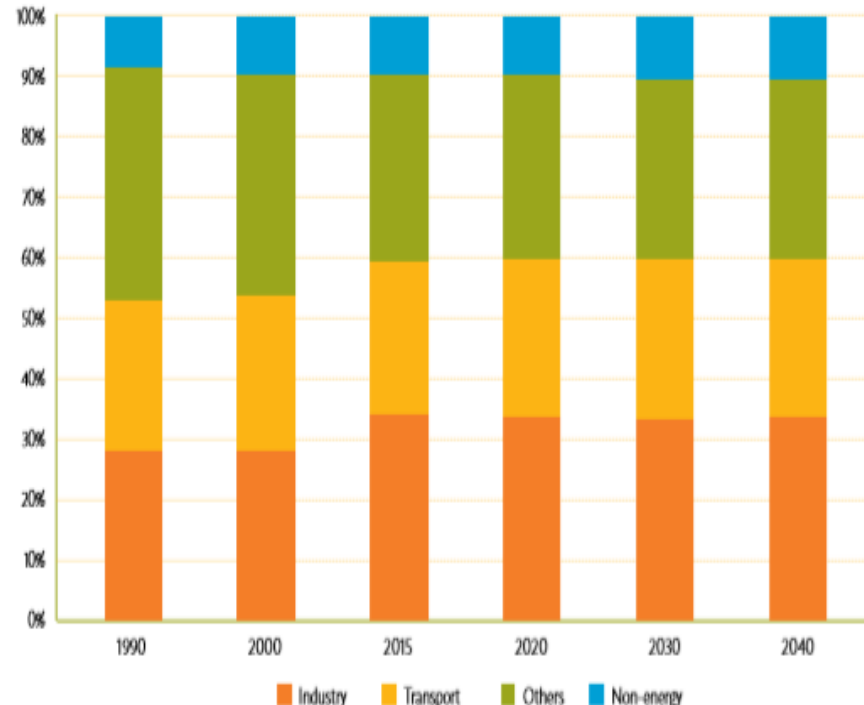
Final energy consumption by sector, BAU (1990-2040)



BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Authors' calculation.

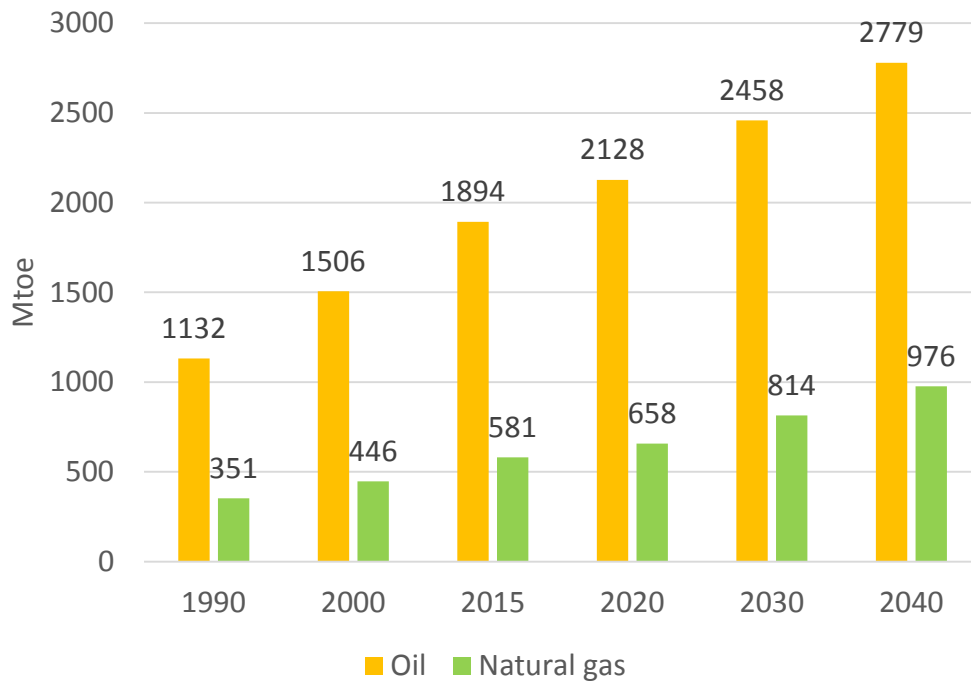
Final energy consumption share by sector (1990-2040)



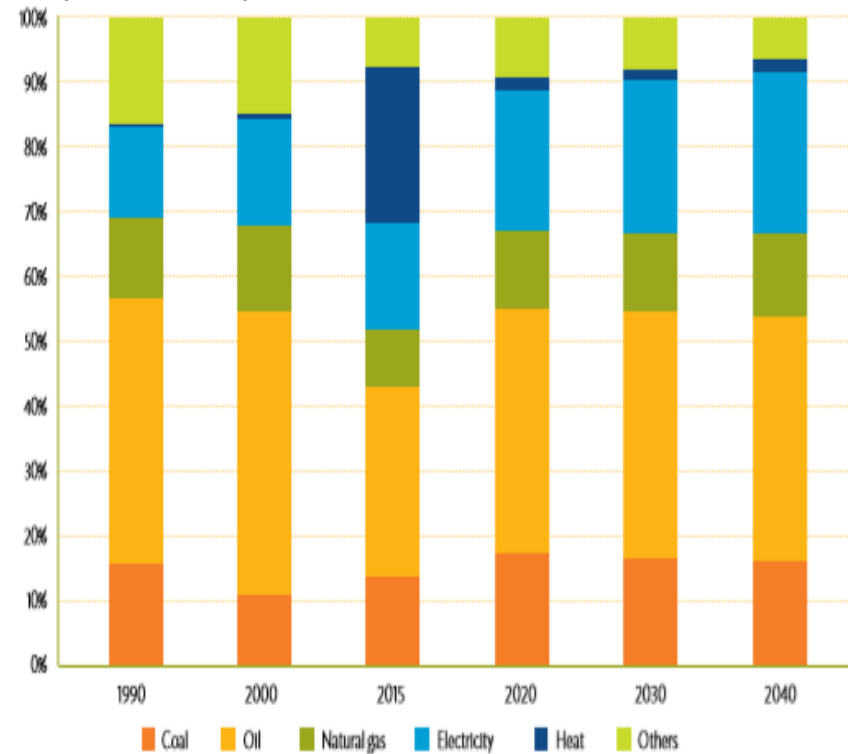
Source: Authors' calculation.

Final energy consumption is projected to increase from 5,020 Mtoe in 2015 to 7,410 Mtoe in 2040.

## EAS17- Oil and Gas in Final Energy Consumption



## Final energy consumption share by fuel type (1990- 2040)

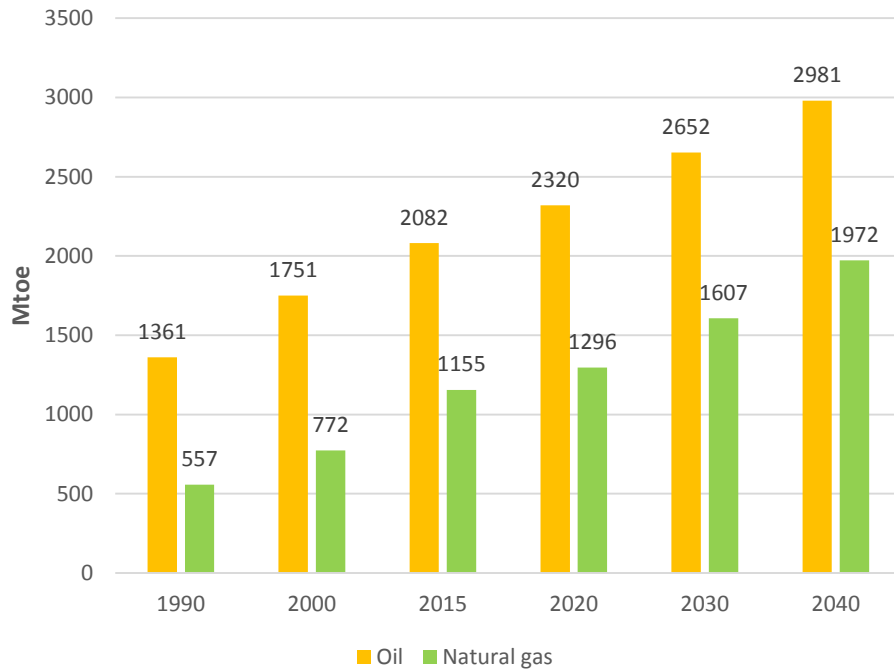


Source: Authors' calculation.

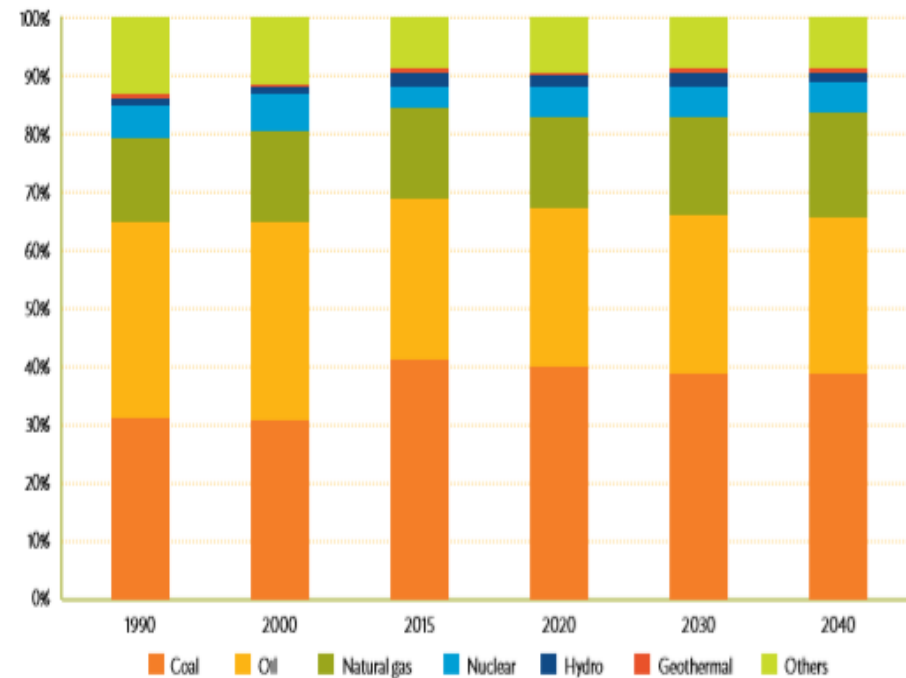
Oil will remain the largest share at 37.5% of TFE, it is projected to grow at a lower rate of 1.5% per year (2015–2040), reaching 2,779 Mtoe in 2040. Gas consumption is expected to grow at 2.1% per year (2015-2040) and it will reach 13.2% share in 2040 from 11.6% share in 2015.

# IV- EAS17-PRIMARY ENERGY SUPPLY (BAU)

## EAS17- Oil and Gas in Primary Energy Supply



## Share of primary energy mix by source (1990-2040)

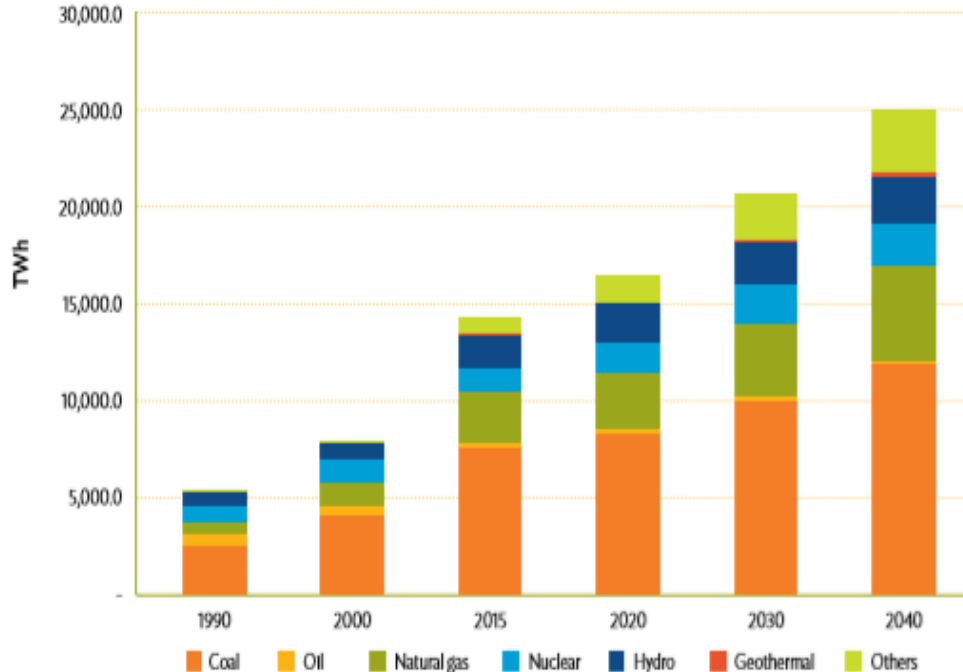


Source: Authors' calculation.

Oil remains the 2<sup>nd</sup> largest energy after coal, and its share is projected to be 27.2% in 2040, a slice reduction from its share 27.8% in 2015. Gas supply is expected grow 2.2% per year (2015-2040), reaching 18% share in 2040, a growth from 15% share in 2015.

## V. EAS17- POWER GENERATION (BAU)

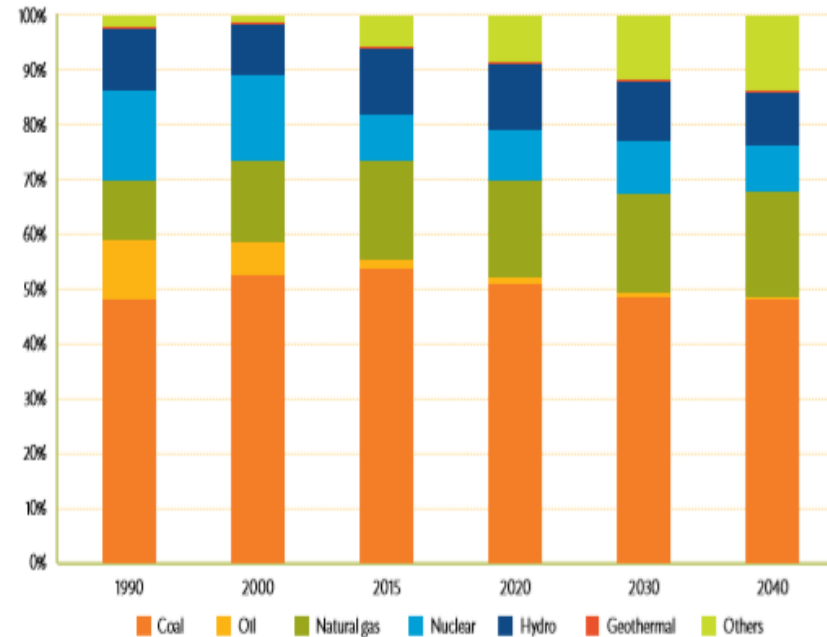
Power generation in EAS17 (1990- 2040)



EAS = East Asia Summit, TWh = terawatt-hour.

Source: Authors' calculation.

Share of power generation mix in EAS17 (1990-2040)



EAS = East Asia Summit.

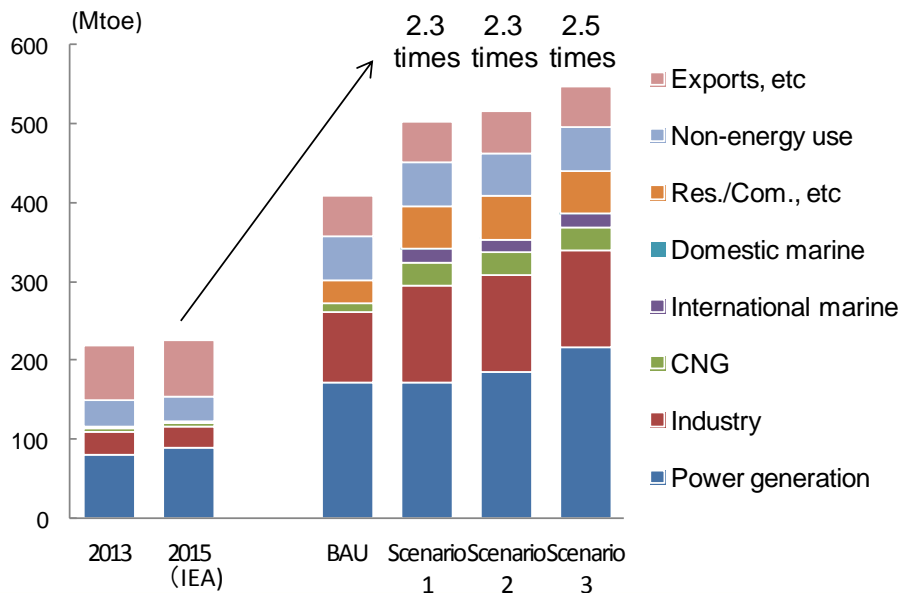
Source: Authors' calculation.

The share of coal-fired generation is projected to continue to be the largest and will be about 48% in 2040, a drop from the 53.8% share in 2015. **The share of natural gas is projected to increase from 17.8% in 2015 to 19.4% in 2040**

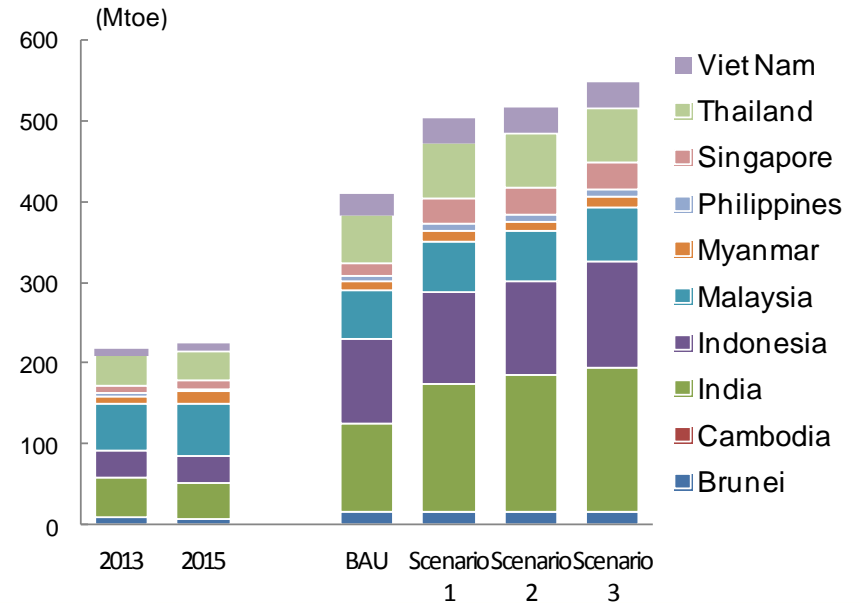
# VI. Scenarios: Large Gas Demand Potential in ASEAN + India

- ◆ 3 Scenarios as to the share of natural gas in the additional thermal power plants (15%, 30%, 60%)
- ◆ Natural gas demand for ASEAN + India may expand to;
  - ✓ 2.3 to 2.5 times larger than 2015 (Approx. +293 to +339Bcm @ 40 MJ/ m<sup>3</sup>)
  - ✓ 1.2 to 1.3 times larger than BAU scenario
- ◆ By sector, the power generation sector has the largest potential, followed by the industrial sector.
- ◆ By country, India has the largest potential, followed by Indonesia.
- ◆ In order to realize the natural gas demand potential, various policy supports will be required.

Natural gas demand potential by sector (2030)



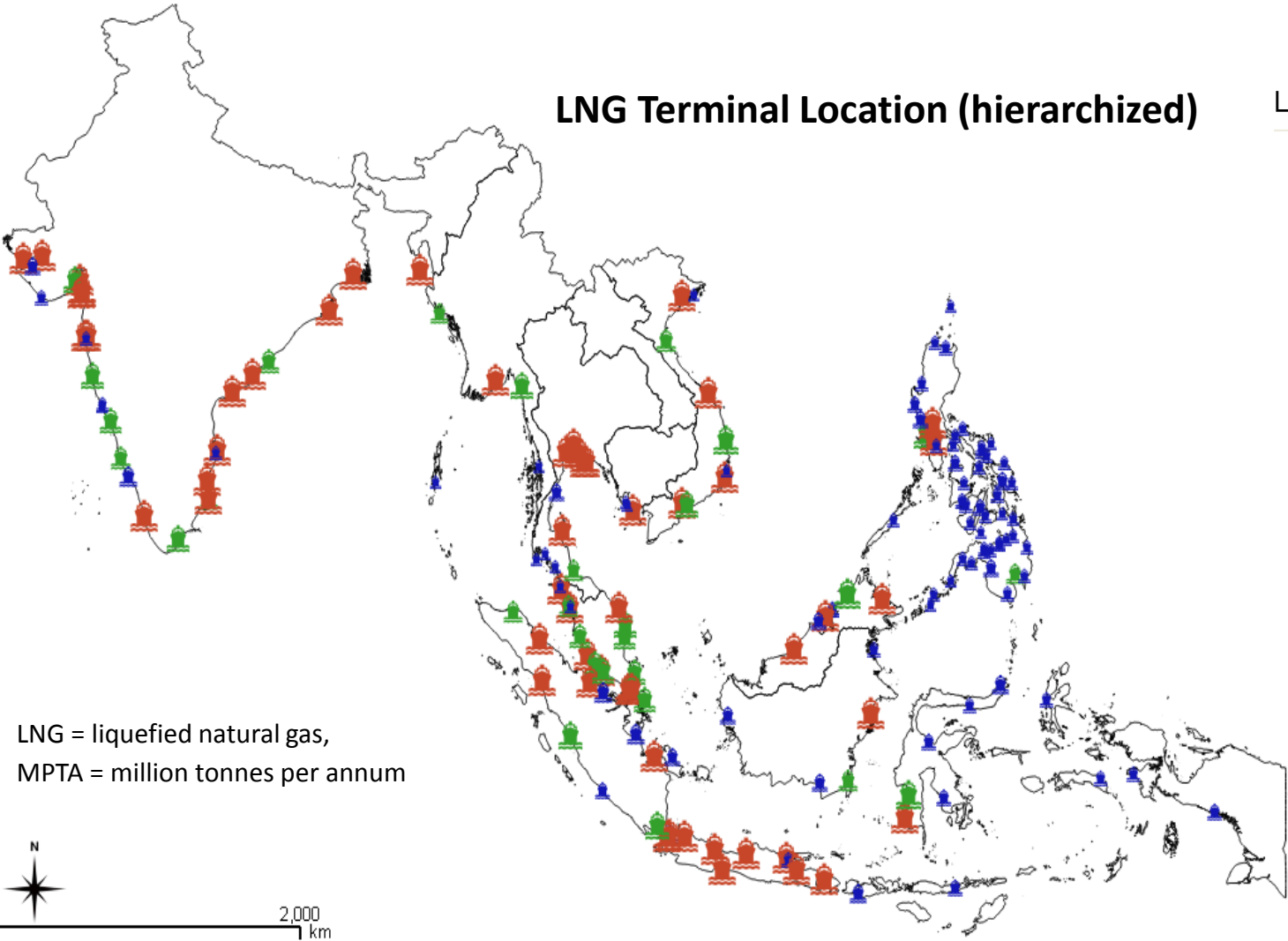
Natural gas demand potential by country (2030)





# Port infrastructure to meet "Gas" demand Potential in ASEAN + India

### LNG Terminal Location (hierarchized)



### Legend

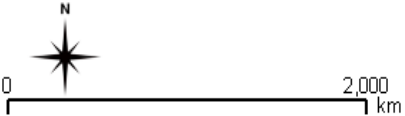
Port category by demand size

- 0-0.2 MTPA
- 0.2-1.0 MTPA
- 1.0 MTPA

Scale of demand size at ports

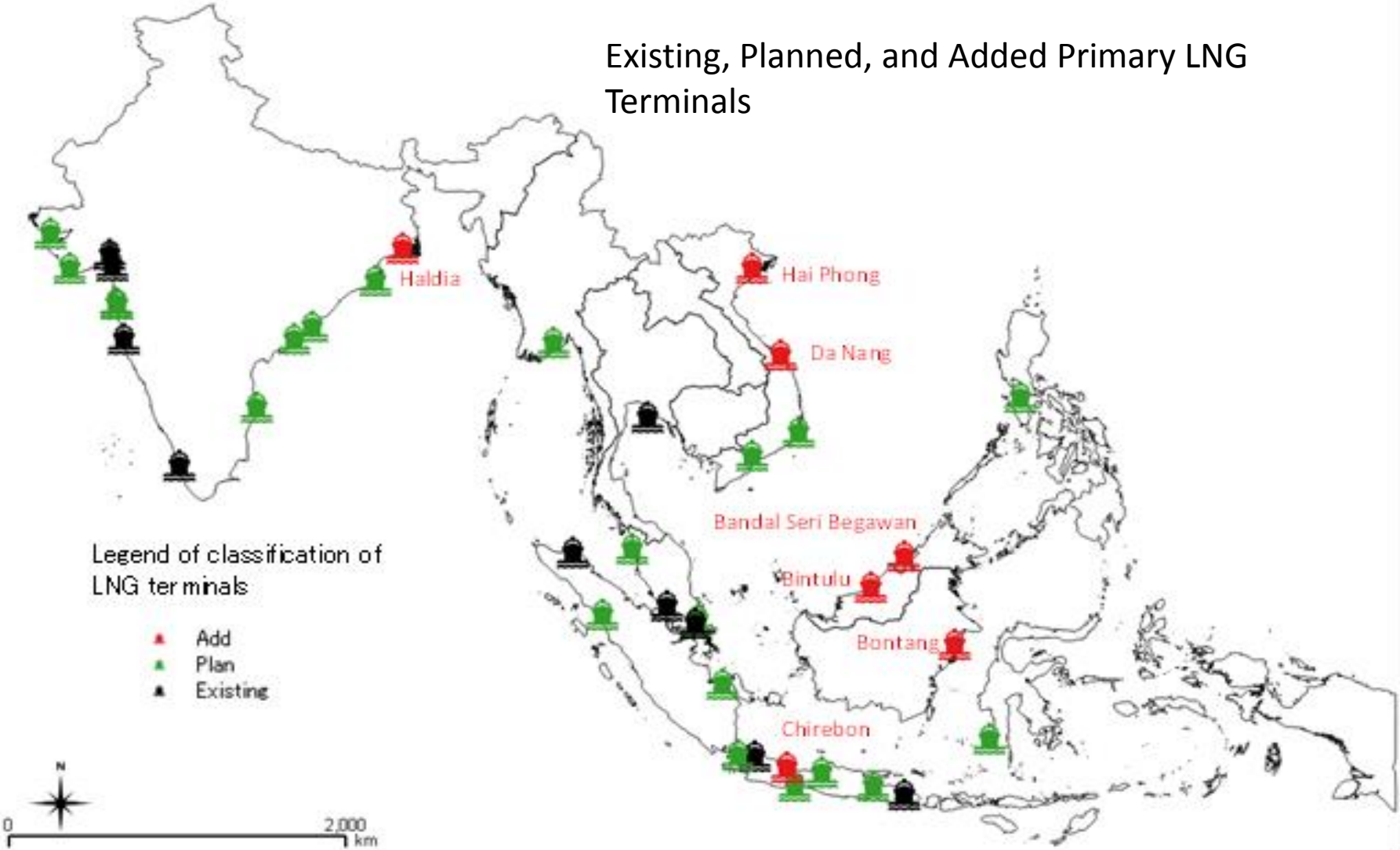
- 0.2
- 0.4
- 0.6
- 0.8
- 1

LNG = liquefied natural gas,  
MPTA = million tonnes per annum



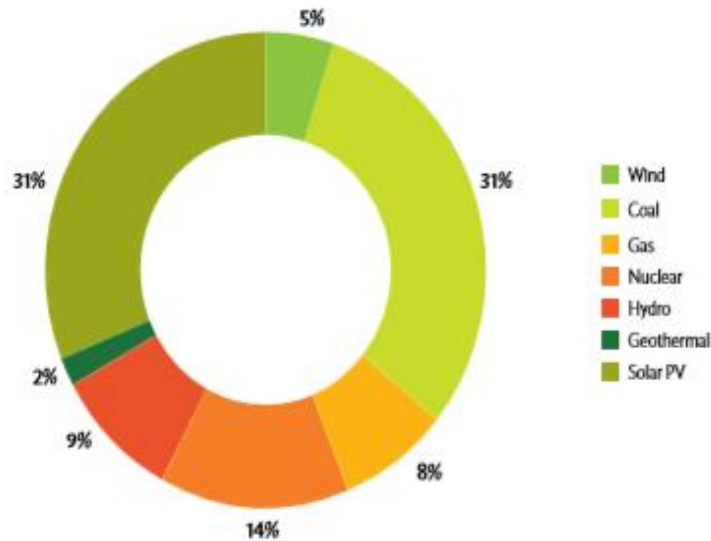
# Port infrastructure to meet “Gas” demand Potential in ASEAN + India

Existing, Planned, and Added Primary LNG Terminals



## VII- NECESSARY INVESTMENT COST

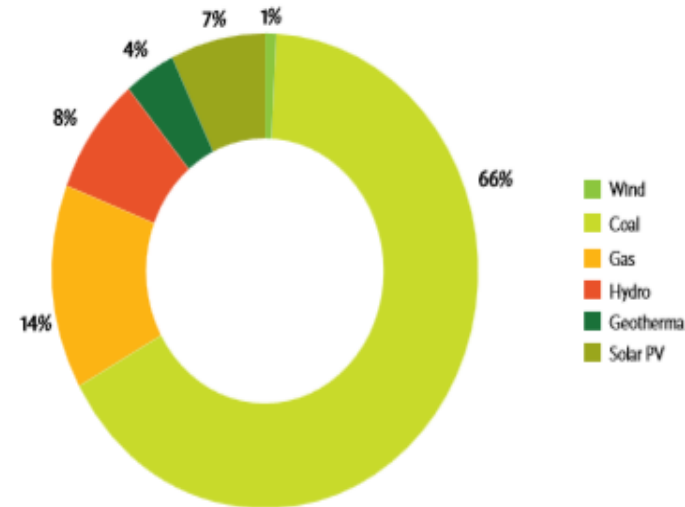
Investment share by power source (EAS17-BAU)



BAU = Business-As-Usual, EAS = East Asia Summit, PV = photovoltaic.

Source: Authors' calculation.

Investment share by power source (ASEAN-BAU)

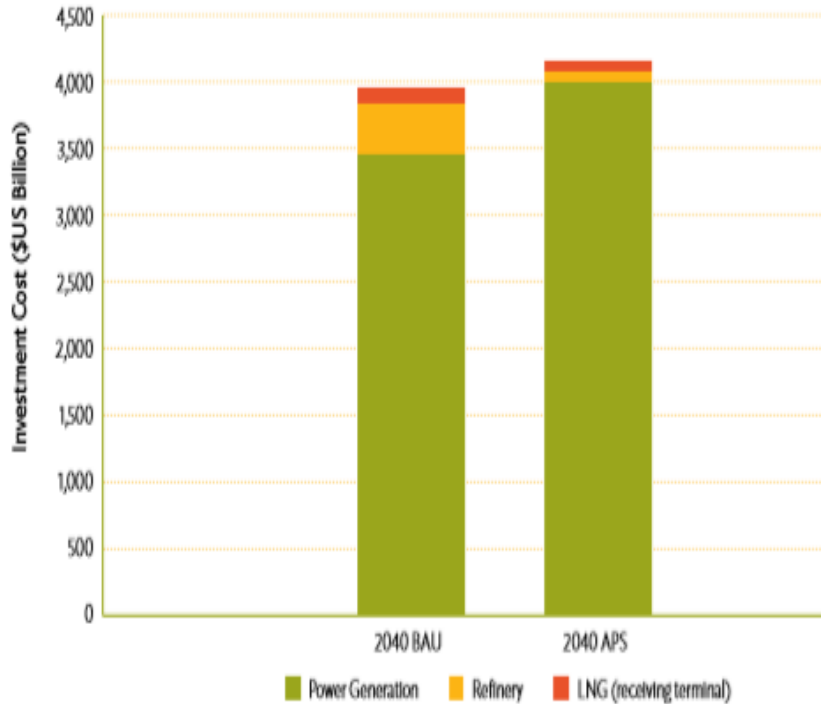


ASEAN = Association of Southeast Asian Nations, BAU = Business-As-Usual, PV = photovoltaic.

Source: Authors' calculation.

- EAS17 countries will need investment to meet electricity demand, US\$3.5 trillion for the BAU scenario and US\$4 trillion for the APS.
- ASEAN would account for about US\$432 billion for the BAU scenario, and about US\$440 billion in the APS.

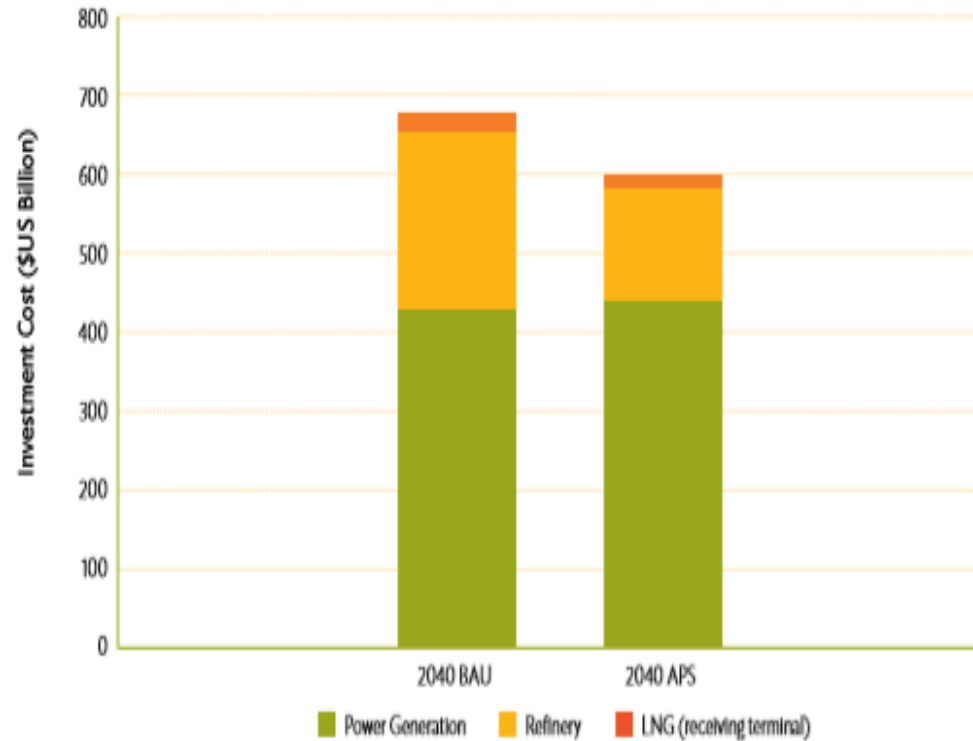
## Energy infrastructure investment (EAS17,BAU-APS)



APS = Alternative Policy Scenario, BAU = Business-As-Usual, EAS = East Asia Summit, LNG = liquefied natural gas.

Source: Authors' calculation.

## Energy infrastructure investment (ASEAN, BAU-APS)



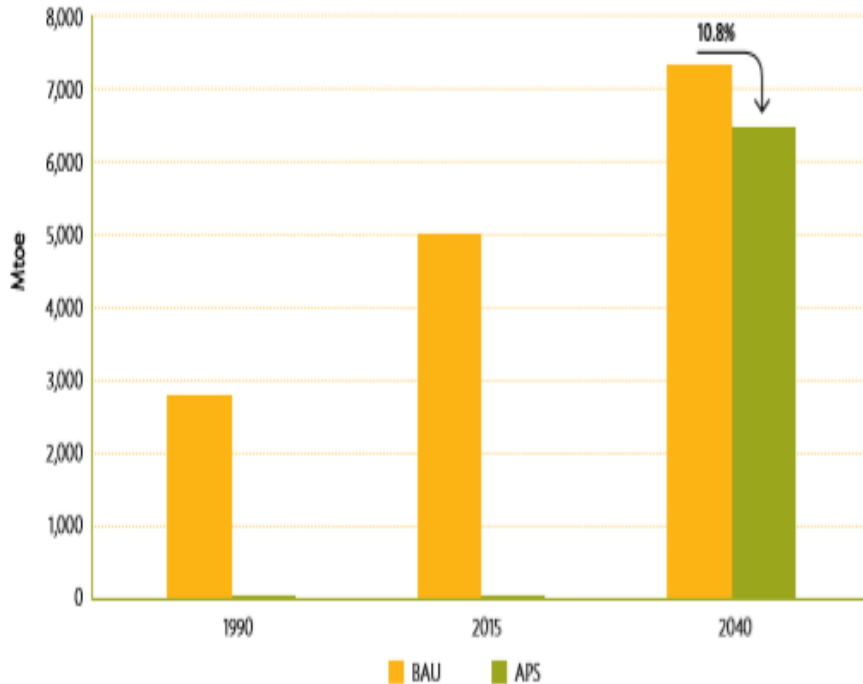
APS = Alternative Policy Scenario, ASEAN = Association of Southeast Asian Nations, BAU = Business-As-Usual, LNG = liquefied natural gas.

Source: Authors' calculation.

The investment for refineries and LNG receiving terminals in EAS17 will be estimated at US\$367 billion and US\$132 billion, respectively, in the BAU scenario. The investments for refineries and LNG-receiving terminals in ASEAN are estimated at US\$226 billion and US\$28 billion, respectively, in the BAU scenario.

# VIII- EAS17-ENERGY SAVING POTENTIAL (BAU VS APS)

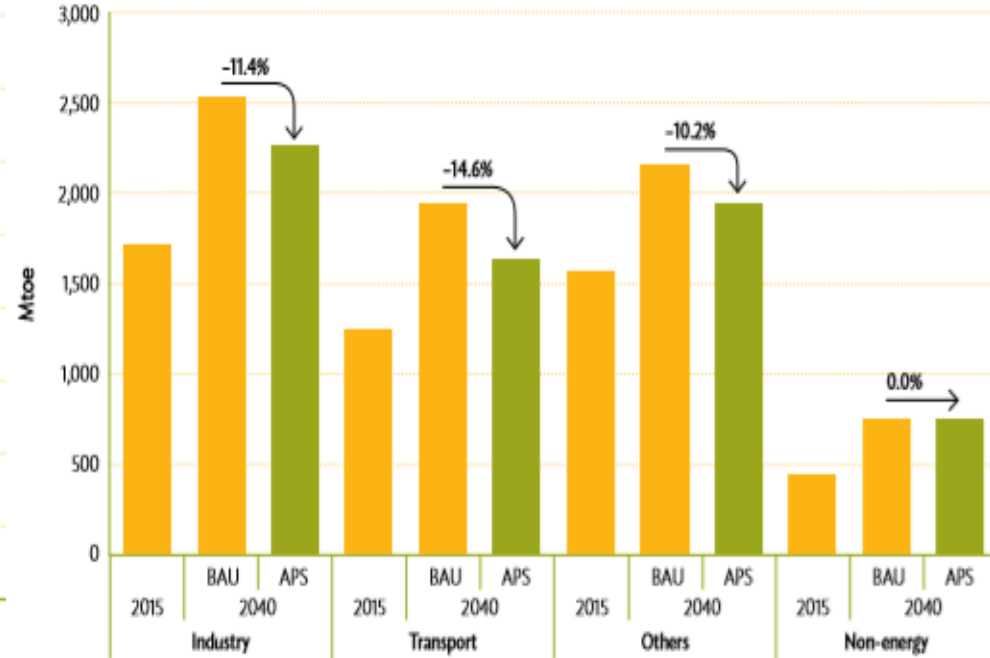
Total final energy consumption, BAU and APS



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Authors' calculation.

Final energy consumption by sector, BAU vs APS

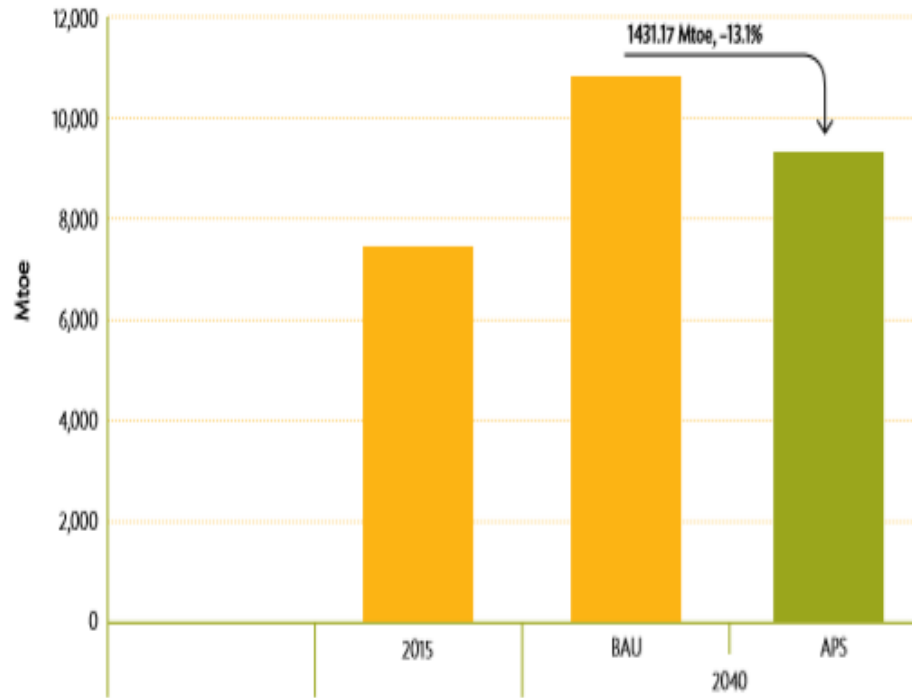


APS = Alternative Policy Scenario, BAU = Business-As-Usual.

Source: Authors' calculation.

The final energy consumption is projected to be 795 Mtoe or 10.8% lower than in the BAU scenario in 2040. The reduction is largest in the transportation sector (14.6%), followed by the industry sector (11.4%).

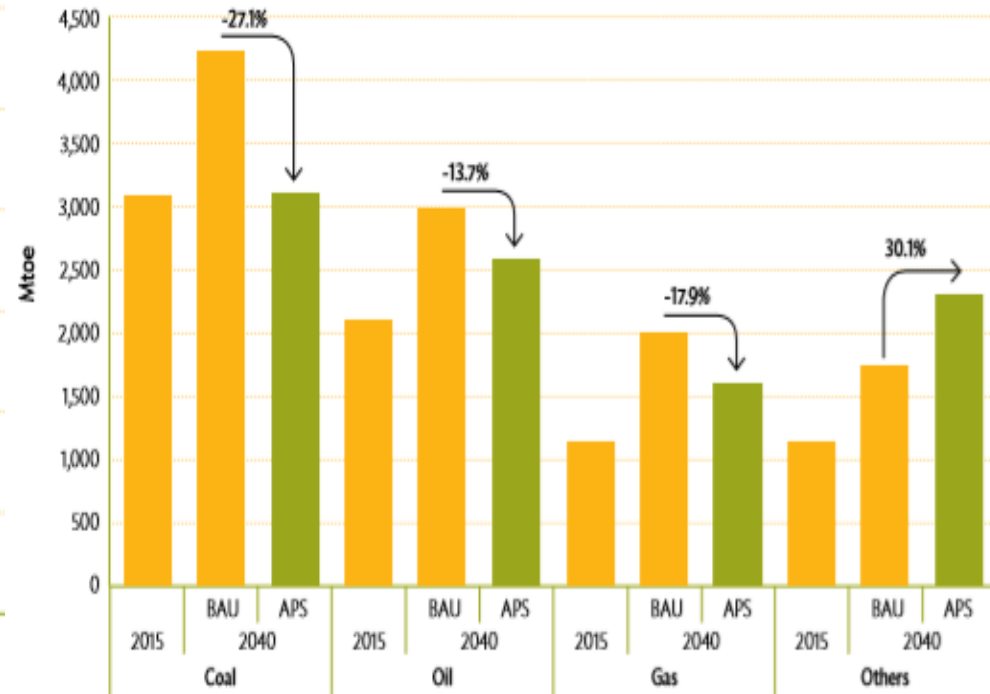
## Total primary energy supply-BAU and APS



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Authors' calculation.

## Primary energy supply by source-BAU and APS



APS = Alternative Policy Scenario, BAU = Business-As-Usual, Mtoe = million tons of oil equivalent.

Source: Authors' calculation.

The total savings potential in the TPES is expected to be 1,431 Mtoe, representing a 13.1% reduction from the BAU scenario to the APS. The largest reduction will be in coal demand, by 1,154 Mtoe or 27.1% from the BAU scenario's 4,254 Mtoe to 3,100 Mtoe in the APS. Oil and gas consumption is expected to reduce in APS due to power generation efficiency and high efficient vehicle.



## IX- CONCLUSIONS AND POLICY IMPLICATION

- Sustained population and economic growth in the EAS region will lead to significant increases in energy demand. Total final energy consumption in 2040 will increase by almost 50%, reflecting actual annual growth rate of 1.6% per year between 2015 and 2040.
- Oil remains the 2<sup>nd</sup> largest energy in Primary energy supply after coal, and its share is projected to be 27.2% in 2040, a slice reduction from its share 27.8% in 2015. Gas supply is expected grow 2.2% per year (2015-2040), reaching 18% share in 2040, a growth from 15% share in 2015.
- In the final energy consumption, Oil is the largest share at 37.7% of TFEC and it is expected to have the same share in 2040. Oil is projected to grow at a lower rate of 1.5% per year (2015–2040), reaching 2,779 Mtoe in 2040. Gas consumption is expected to grow at 2.1% per year (2015-2040) and it will reach 13.2% share in 2040 from 11.6% share in 2015.
- The share of coal-fired generation is projected to continue to be the largest and will be about 48% in 2040, a drop from the 53.8% share in 2015. **The share of natural gas is projected to increase from 17.8% in 2015 to 19.4% in 2040**

- Based on the key find the necessary investment cost of combined power generation, refineries, and LNG-receiving terminals in EAS17 is estimated to be US\$4.0 trillion in the BAU scenario by 2040, and US\$4.2 trillion in the APS.
- Investments in refineries and LNG-receiving terminals in EAS17 are estimated to cost US\$67 billion and US\$131 billion, respectively, in the BAU scenario. Investments in the APS are reduced to US\$60 billion for refineries and US\$75 billion for LNG receiving terminals.
- In the APS, although electricity demand is lower due to the implementation of efficiency measures, the estimated investment cost of power generation will be larger (US\$4.0 trillion in the APS from US\$3.5 trillion in the BAU scenario) mainly because of the increased share of renewables imposed under the APS in addition to the EEC measures.
- The largest share of total investment will be for additional capacity of NRE plants, such as hydro, geothermal, solar PV, wind, and biomass.



- **Energy efficiency action plans in final consumption sectors:**
  - The industry sector will be a major source of energy savings because it will still be the largest energy consuming sector by 2040, followed by transport especially road and residential/ commercial sectors.
- **Renewable energy policies:**
  - Low-carbon fuels need to be increased. This could be attained by increasing the share of NRE and nuclear energy in the energy mix of each country.
- **Technology development policy:**
  - The development of carbon capture and storage (CCS) technology will be very important in controlling the release of GHGs into the atmosphere. Continued research and development will be important to ensure the future economic viability of deploying CCS technology.
  - Hydrogen could be extracted from fossil fuels, such as oil and natural gas, and through electrolysis using renewable energy.
- **Energy supply security policy:** Measures to secure the supply of energy will be very important for the region. Furthermore, resilient domestic infrastructure are key to energy security.