

A light gray silhouette of a world map is centered in the background of the slide. The map shows the outlines of all major continents and countries.

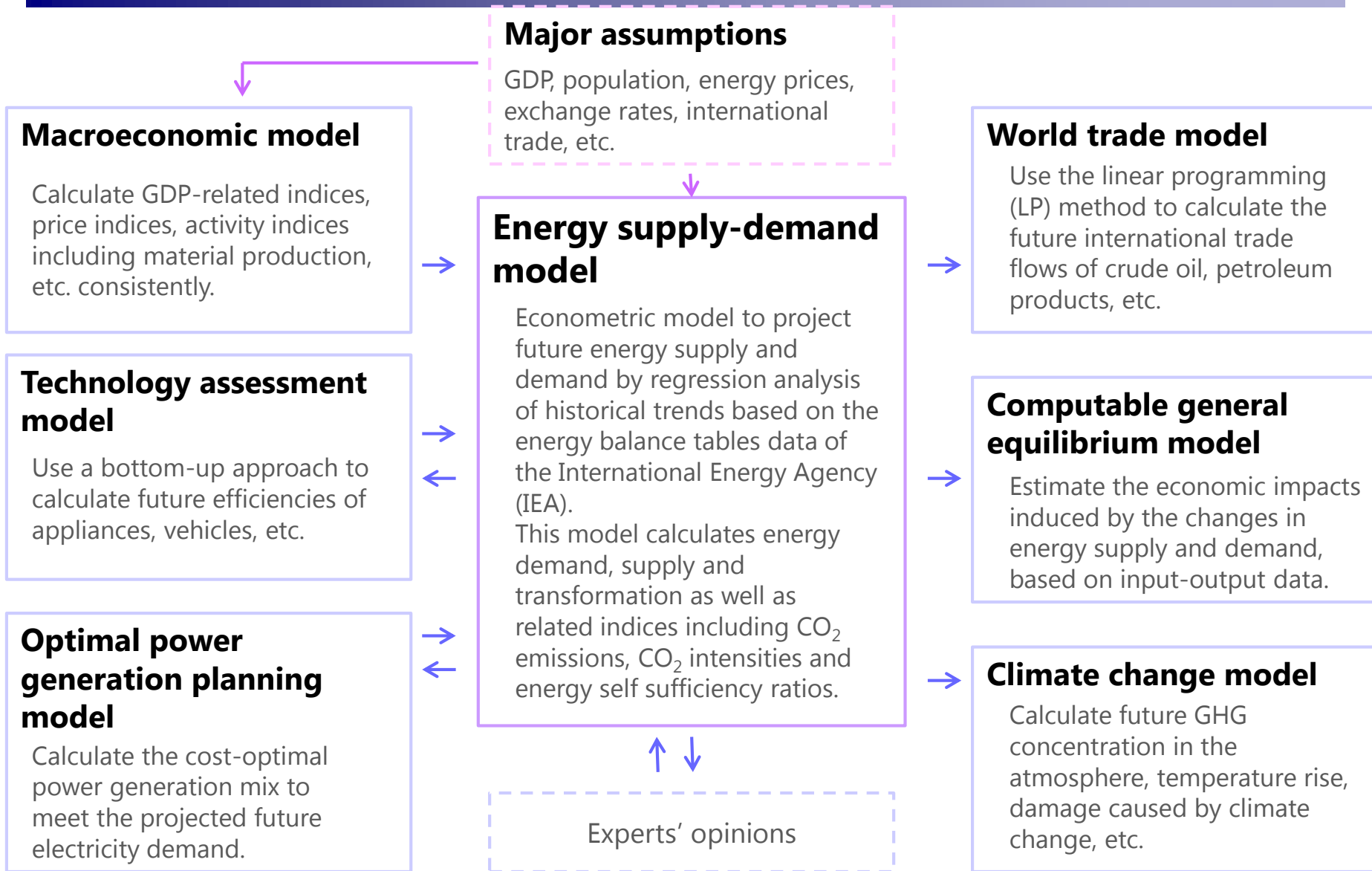
# Energy Outlook for ASEAN+3

Ryo Eto

The Institute of Energy Economics, JAPAN (IEEJ)

- Introduction
- Modeling framework, Major assumptions
- TPES, FEC and Power Generation Mix in Reference Scenario
- Energy saving and CO<sub>2</sub> emissions reduction
- Conclusion

- This energy outlook shows and draws energy demand situations in ASEAN8+3 between 2016 and 2050.
- ASEAN8+3 countries would play more important roles for the world economy and the environmental issues for the period.
- It would be important to tackle both energy security issues with regard to high dependence on fossil fuels and reducing CO<sub>2</sub> with improving our living standards further.



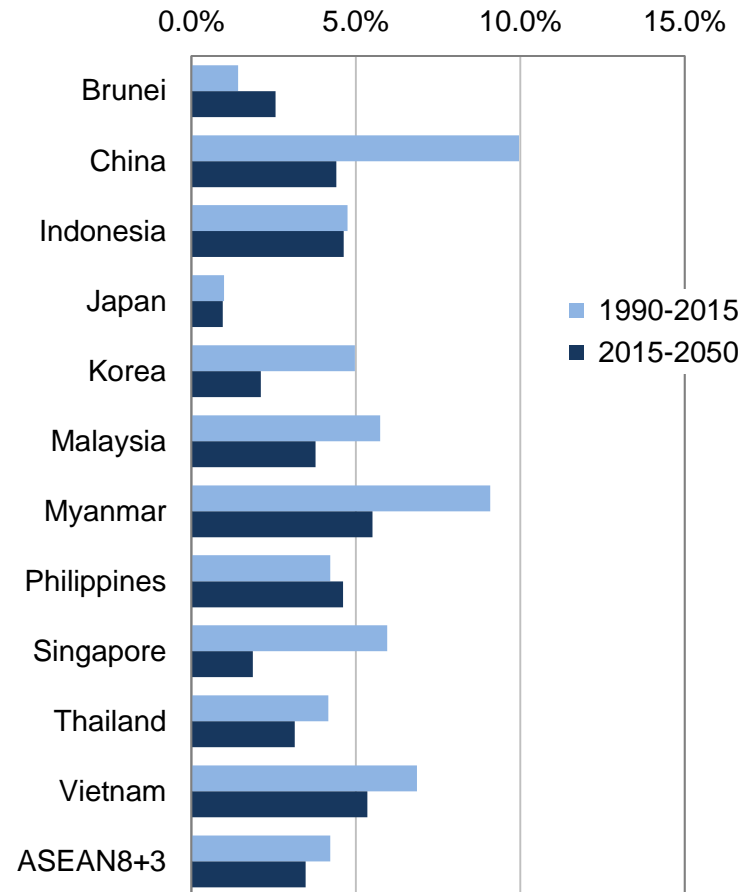
# Assumptions: Population and GDP

- Total population in ASEAN+3 : 2.2 bil. (2015) → 2.3 bil. (2050)
- Total real GDP in ASEAN+3 : 18.7 tril. (2015) → 61.7 tril. (2050) (2010 US\$)

**AAGR of Population**

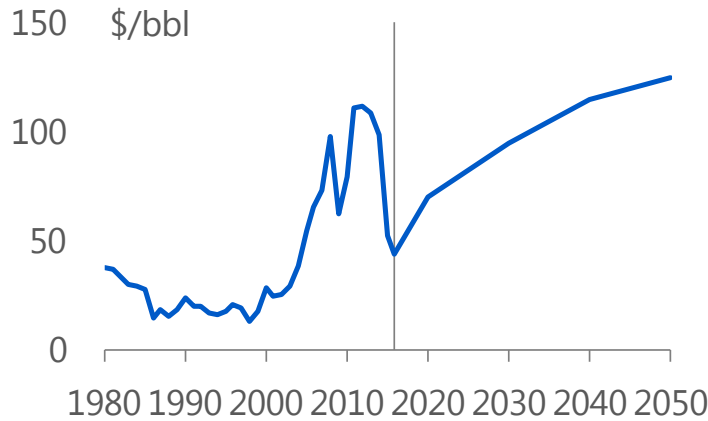


**AAGR of Real GDP**

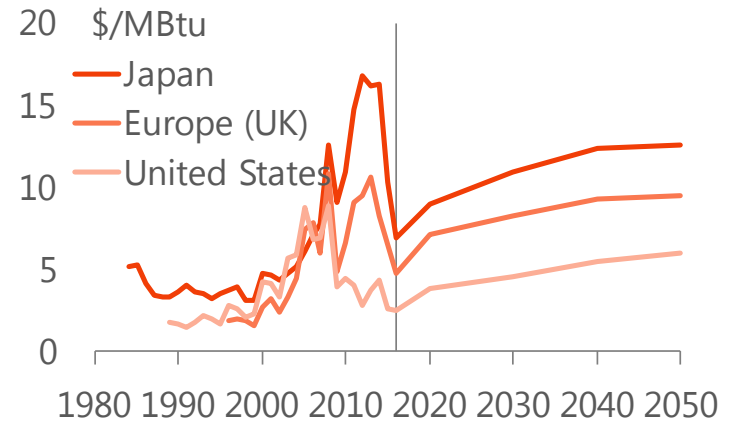


# Assumptions: Primary Energy prices

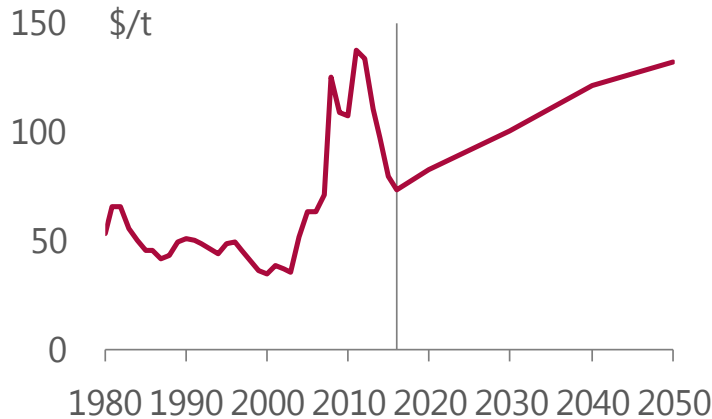
## Crude oil



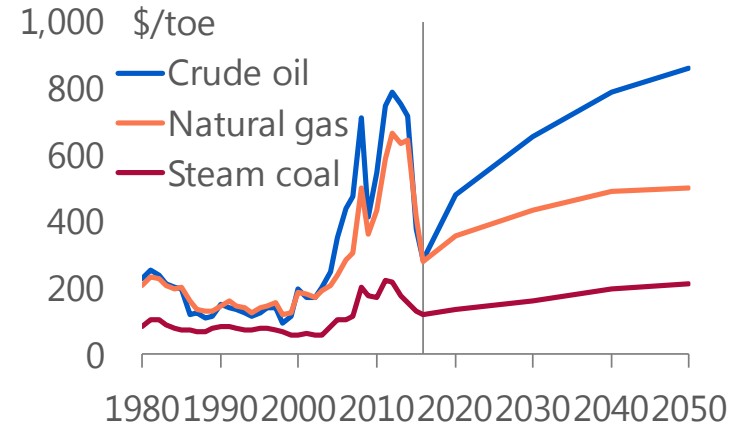
## Natural gas



## Steam coal



## CIF import prices for Japan



\* Historical prices are nominal price. Assumed future prices are real price in  $\text{\$2016}$ .

- In the Reference Scenario, crude oil prices rise gradually again to \$100/bbl by 2030 due to robust demand growth in non-OECD countries, emerging geopolitical risks and financial factors, oil supply constraints reflecting rising depletion rates for oil fields, etc. LNG prices will rise accordingly, with the existing price disparity shrinking due to expanding interregional trades.

## <Energy Model Analysis>

### #Reference Scenario

Reflects past trends with current energy and environment policies. Does not reflect any aggressive policies for low-carbon measures.

### #Advanced Technologies Scenario

Assumes the introduction of powerful policies to enhance energy security and address climate change issues.

It promotes utmost penetration of low-carbon technologies.

## Examples for Technology

		Reference	Advanced Technologies
Energy efficiency	Vehicle technology (ZEV* <sup>1</sup> sales share)	9% in 2030 20% in 2050	21% 43%
	Coal-fired power generation (CCT* <sup>2</sup> share in newly installed capacity)	30% in 2030 90% in 2050	70% 100%
Carbon free technology	Installed capacity Solar PV Wind Nuclear	(2015 to 2050) 0.2 to 1.5 TW 0.4 to 1.9 TW 0.4 to 0.6 TW	(2050) 2.5 TW 3.0 TW 1.0 TW
	Thermal power generation with CCS (Only countries and regions with CO <sub>2</sub> storage potential excluding aquifers)	none	Newly installed after 2030

\*1 ZEV: battery electric vehicles, plug-in hybrid electric vehicles and fuel cell battery vehicles

\*2 CCT: ultra super critical, advanced-USC and integrated coal gasification combined cycle

In Advanced Technologies Scenario, each country further enhances policies on energy security and address climate change. Technology developments and international technology transfers are promoted to further expand the penetration of innovative technologies.

## Introducing and enhancing environmental regulations and national targets

Environment tax, emissions trading, RPS, subsidy, FIT, efficiency standards, automobile fuel efficiency standard, low carbon fuel standard, energy efficiency labeling, national targets, etc.

## Promoting technology development and international technology cooperation

R&D investment expansion, international cooperation on energy efficient technology (steelmaking, cement and other areas), support for establishing energy efficiency standards, etc.

## Demand side technologies

### ■ Industry

Under sectoral and other approaches, best available technologies on industrial processes (for steelmaking, cement, paper-pulp and oil refining) will be deployed globally

### ■ Transport

Clean energy vehicles (highly fuel efficient vehicles, hybrid vehicles, plug-in hybrid vehicles, electric vehicles, fuel cell vehicles) will diffuse further.

### ■ Buildings

Efficient electric appliances (refrigerators, TVs, etc.), highly efficient water-heating systems (heat pumps, etc.), efficient air conditioning systems and efficient lighting will diffuse further, with heat insulation enhanced.

## Supply side technologies

### ■ Renewable energies

Wind power generation, photovoltaic power generation, CSP (concentrated solar power) generation, biomass-fired power generation and biofuel will penetrate further.

### ■ Nuclear

Nuclear power plant construction will be accelerated with capacity factor improved.

### ■ Highly efficient fossil fuel-fired power generation technologies

Coal-fired power plants (SC, USC, A-USC, IGCC) and natural gas-fired more advanced combined cycle (MACC) plants will penetrate further.

### ■ Technologies for next-generation transmission and distribution networks

Lower loss type of transformation and voltage regulator will penetrate further

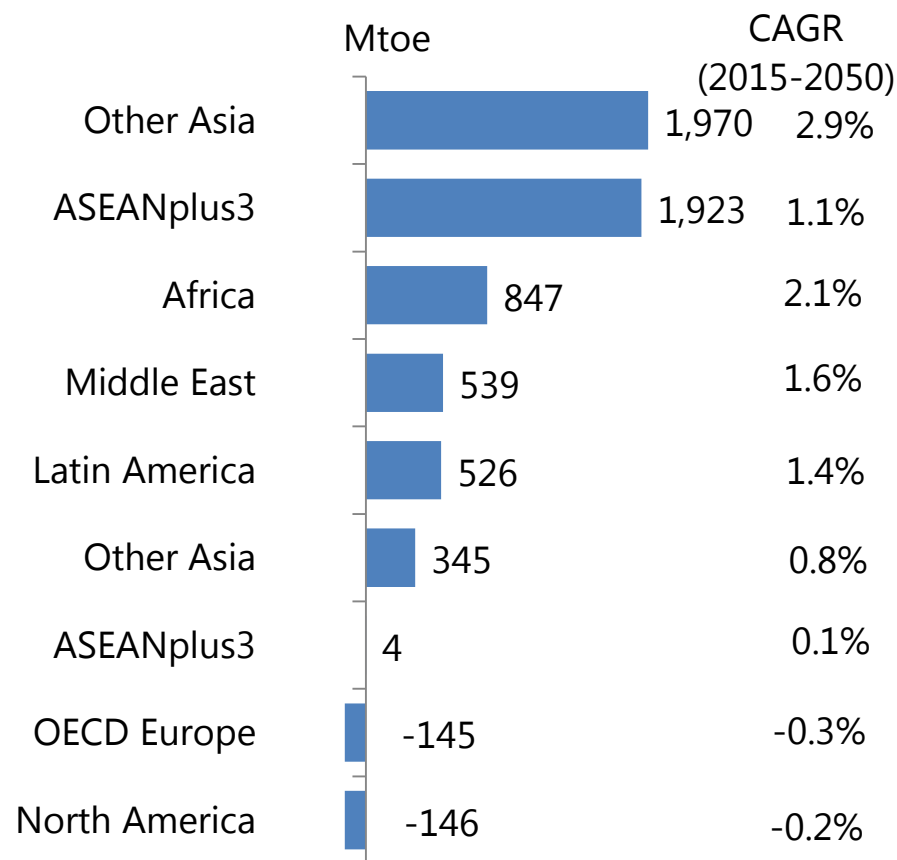
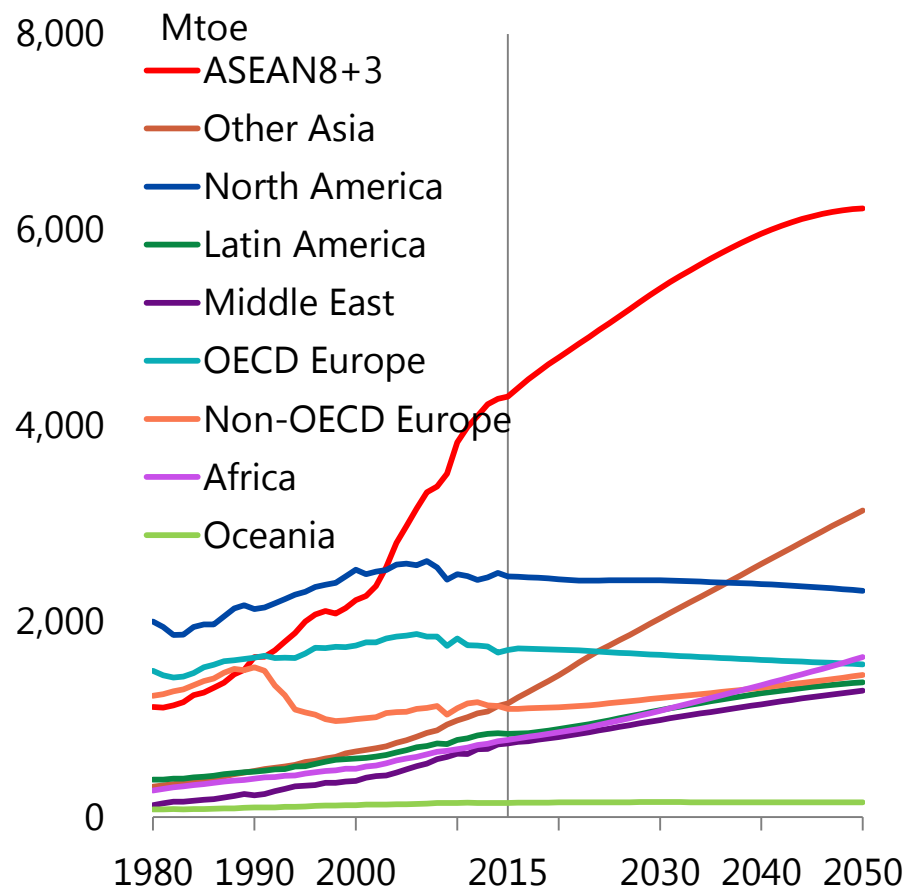
### ■ Carbon capture and storage

\*SC: Super Critical, USC: Ultra Super Critical, A-USC: Advanced Ultra Super Critical



# Primary energy demand by region

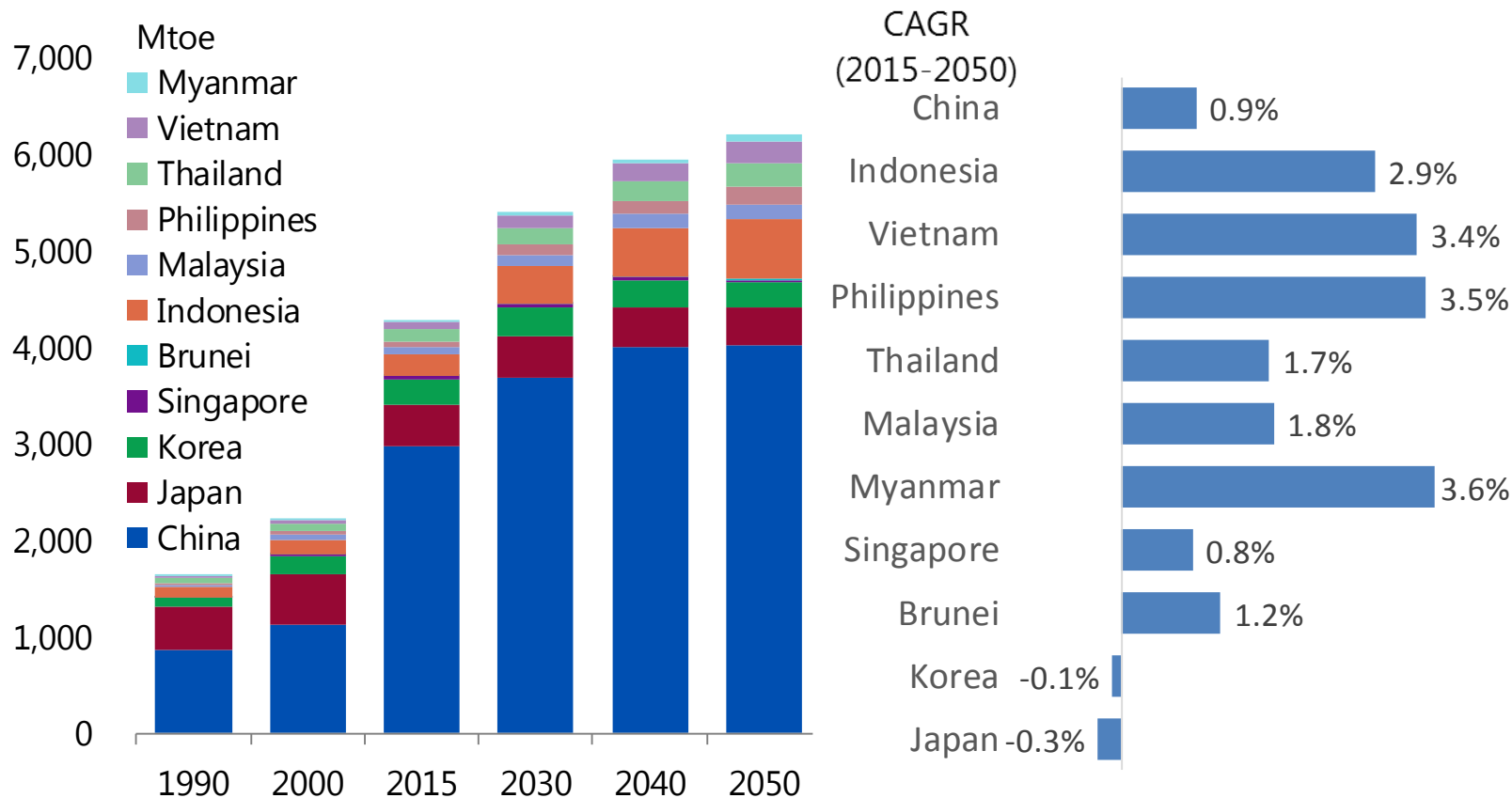
- Under the steady economic growth assumption, ASEAN8+3 countries energy consumption increases 45% from 2015 to 2050 (4.3Btoe → 6.2Btoe)
- The share in the world stays at 31% (World : 13.6Btoe → 19.8Btoe)
- The increment from ASEAN8+3 accounts for 31%.



# Primary energy demand by country in ASEAN8+3

- China remains the largest energy consumer, but the share will decrease. Demand of Japan and Korea will decline.
- Most of ASEAN countries will keep the robust growth of energy demand.

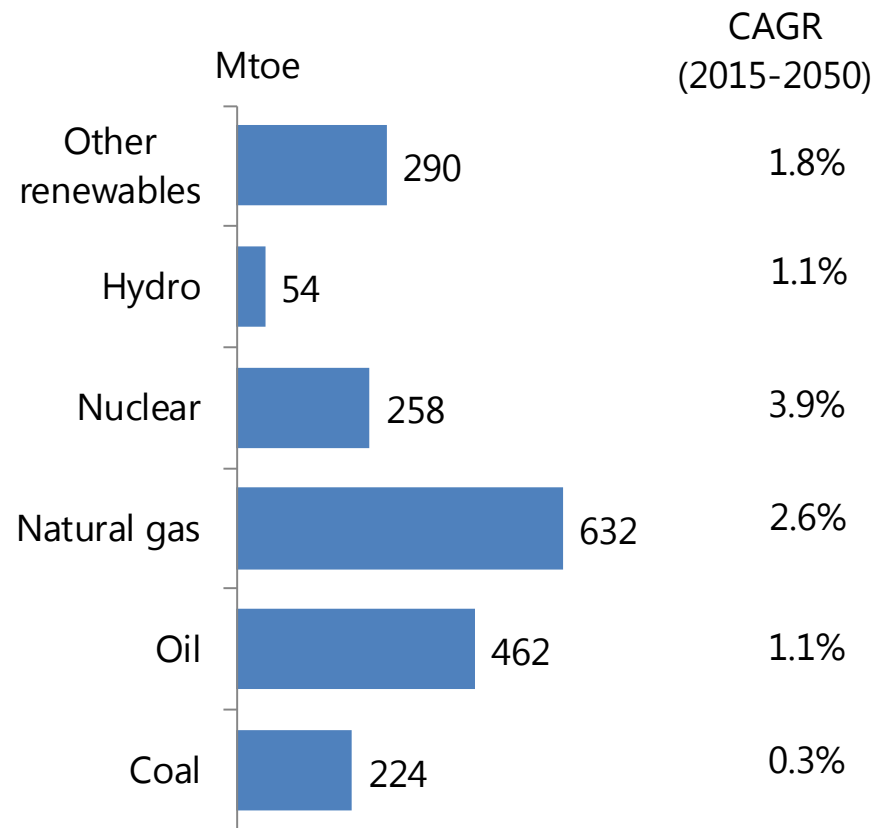
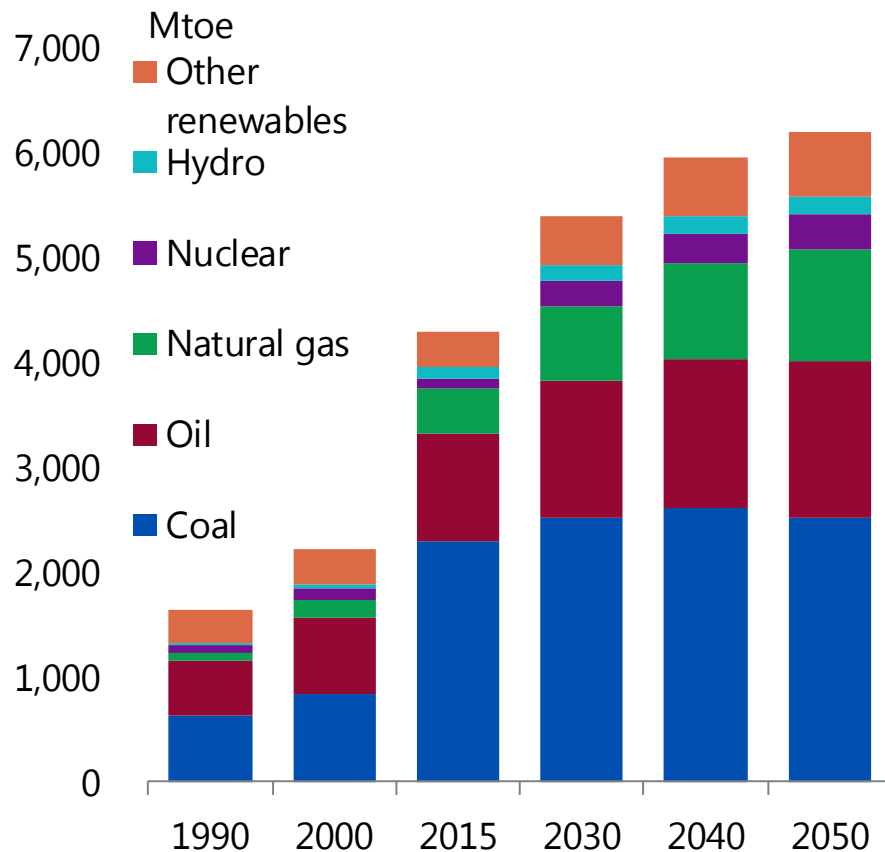
## AAGR of Primary energy demand



(Source: IEEJ, IEA)

# Primary energy demand of ASEAN8+3 by source

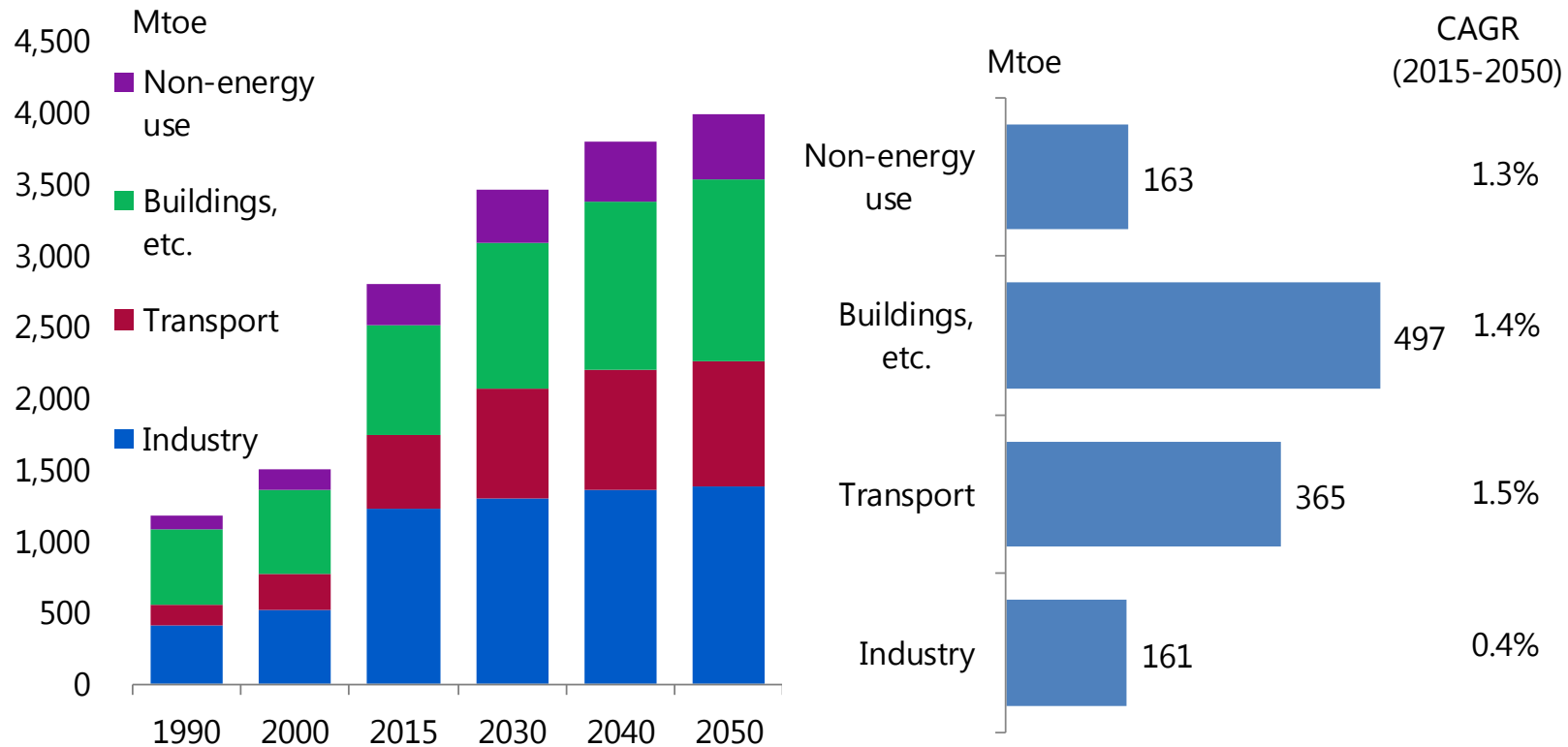
- Coal has been the dominant energy source mainly used for coal-fired power generation and industrial usage, while the share decreases.
- Oil keeps the second most because of the increase in transport sector.
- Natural gas has been the third most, shows the fastest growth by 2050.



# Final energy demand of ASEAN8+3 by sector

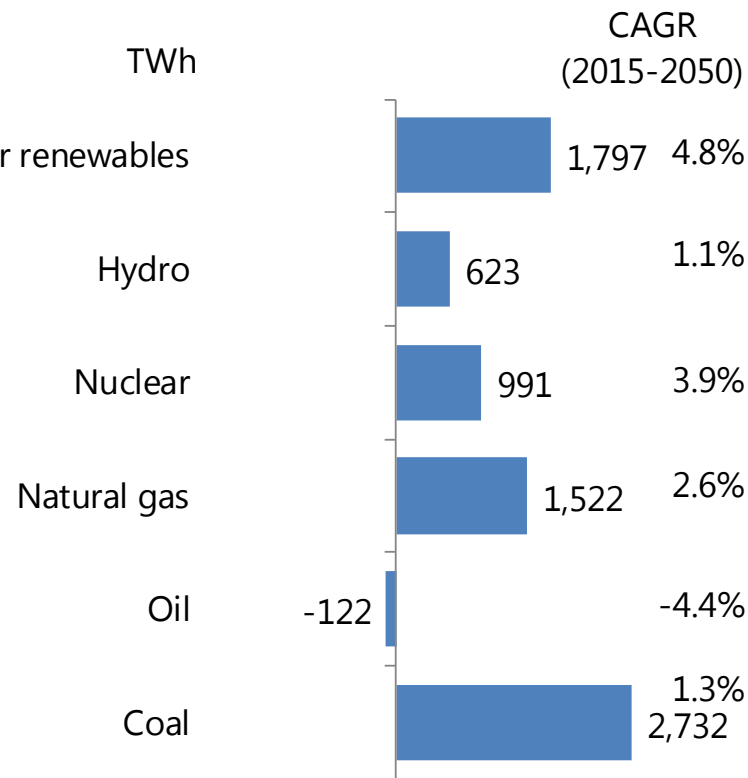
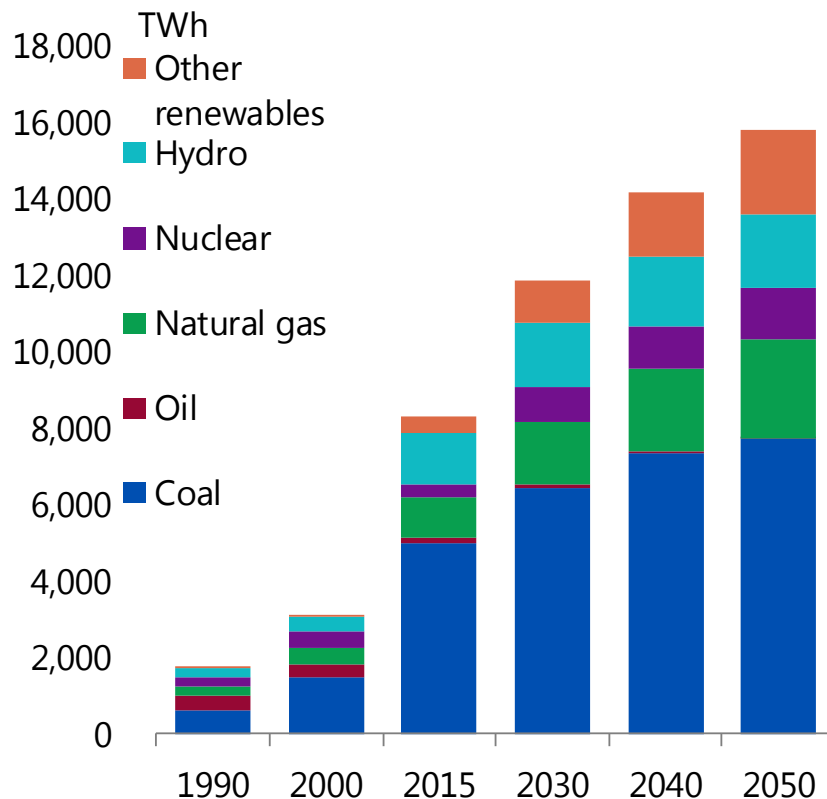
Reference Scenario

- Industry continues to be the largest energy consumer, while the share drops.
- Demand in Residential and Commercial accounts for 42% of the total increment, derived from the substantial growth of GDP per capita.
- Transport increases most rapidly at AAGR of 1.5%, accounts for 31% of of the total increment.



# Power generation mix of ASEAN8+3

- The share of coal remains the largest and accounts for 51% of the increment.
- Natural gas replaces hydro in second largest share, supported by high efficiency and less CO<sub>2</sub> emissions than coal.
- The share of Nuclear reaches to 9%. And renewables will also increase rapidly.



# Fossil fuel demand of ASEAN8+3 (Reference & Adv. Tech.)

**Coal** : China continue to be the dominant. ASEAN increases the presence.  
 Large reduction potential in power generation.

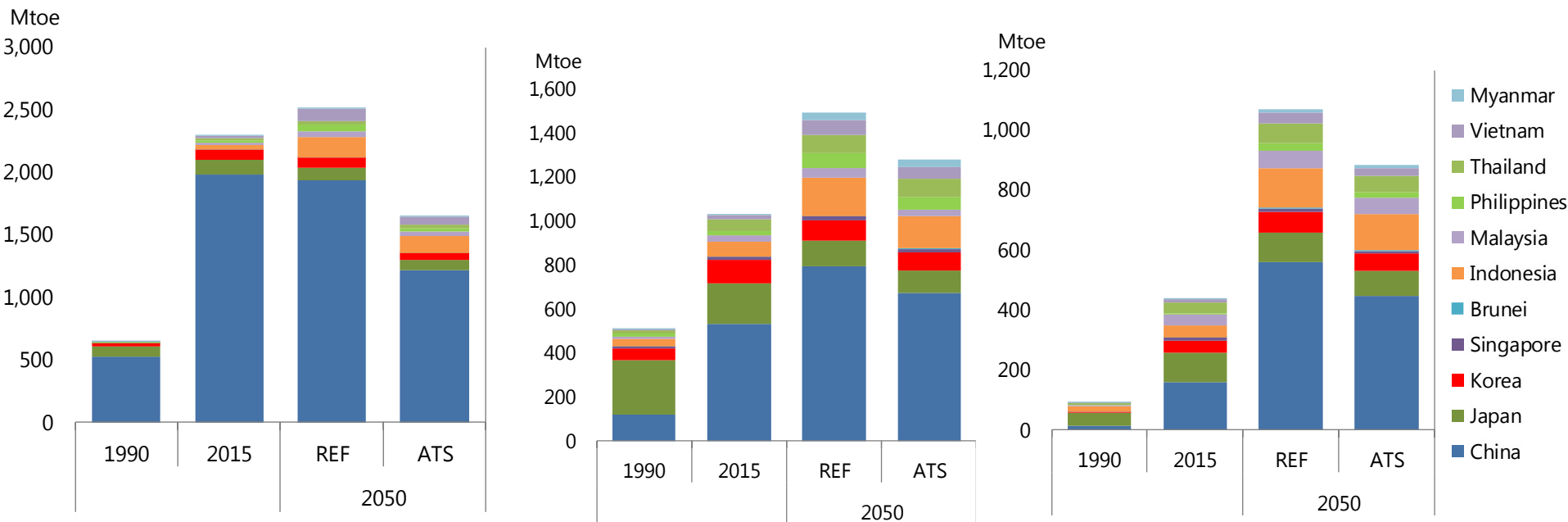
**Oil** : Steady growth in most of ASEAN8+3 except Japan, Korea and Singapore.  
 Most of the saving potential comes from the transport sector.

**Natural gas** : Rapid growth in China, Indonesia, Myanmar, Philippines and Vietnam.  
 Growth could be decelerated by energy saving and increase of renewable and nuclear.

Coal

Oil

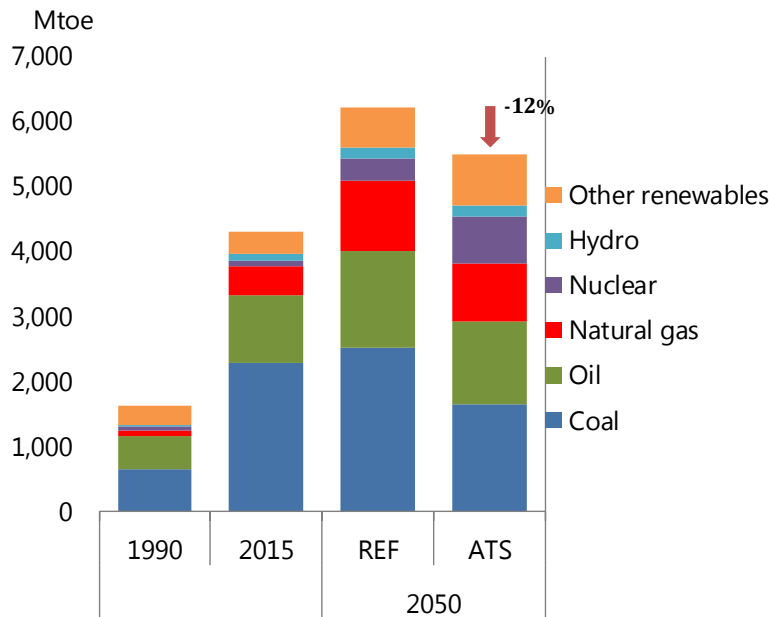
Natural gas



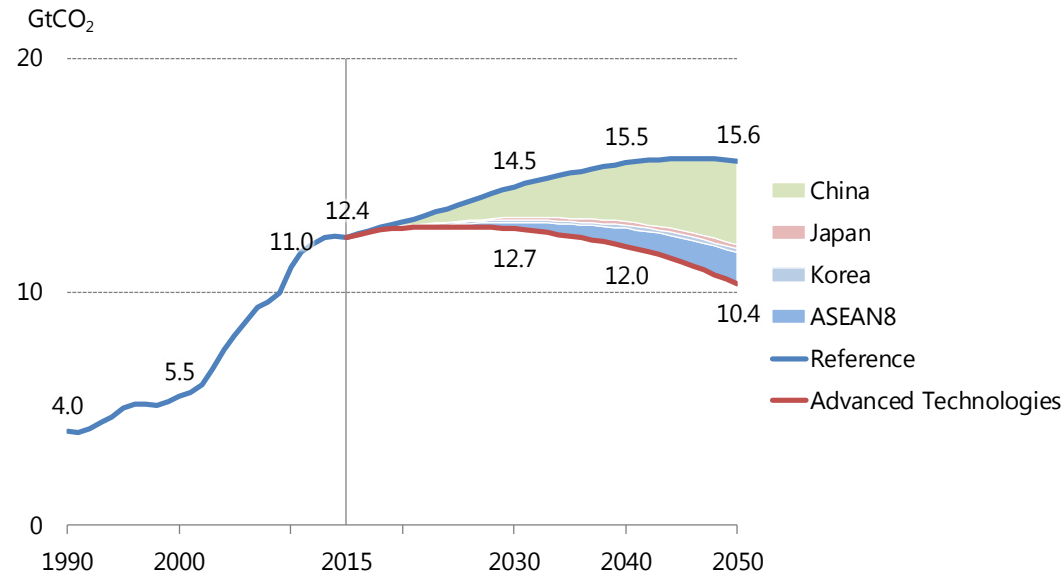
(Source: IEEJ, IEA)

- Energy-related CO<sub>2</sub> emissions increases from 12.4 Gt-CO<sub>2</sub> in 2015 to 15.6 Gt-CO<sub>2</sub> in 2050 (keeping 35% in the world)
- In the Advanced Technologies scenario, 11% of the energy demand can be saved from the Reference scenario. And with the accelerated growth of nuclear and renewable power generation, CO<sub>2</sub> emissions drops 34%.

## Primary energy demand



## CO<sub>2</sub> Emission



(Source: IEEJ, IEA)

All Rights reserved IEEJ

(Source: IEEJ, IEA)

- Energy demand in ASEAN8+3 is estimated to keep the largest share in the major regions around the world. In terms of both TPES and Power generation, Coal seems stay dominant energy source dropping its share. In the FEC by sector, Residential and Commercial, Transport will play more important role than past decades.
- To deal with climate change issues, ASEAN8+3 countries are recommended to accelerate policies to reduce the fossil fuel consumption with various methods such as energy conservation, more efficient use of fossil fuels, fuel switching, nuclear, wind, solar, etc.
- In order to address and solve the energy-related issues above, ASEAN8+3 countries could cooperate together with utilizing many kinds of our natural and human resources efficiently and effectively.





**Thank you.**