

6<sup>th</sup> IEEJ/CNPC Joint Seminar

Dec. 6<sup>th</sup>, 2012

A light gray silhouette of a world map is centered in the background of the slide. The map shows the outlines of all continents, with the Asia-Pacific region being the focus of the seminar.

# Energy Supply and Demand Outlook And Major Challenges for Asia-Pacific Economies

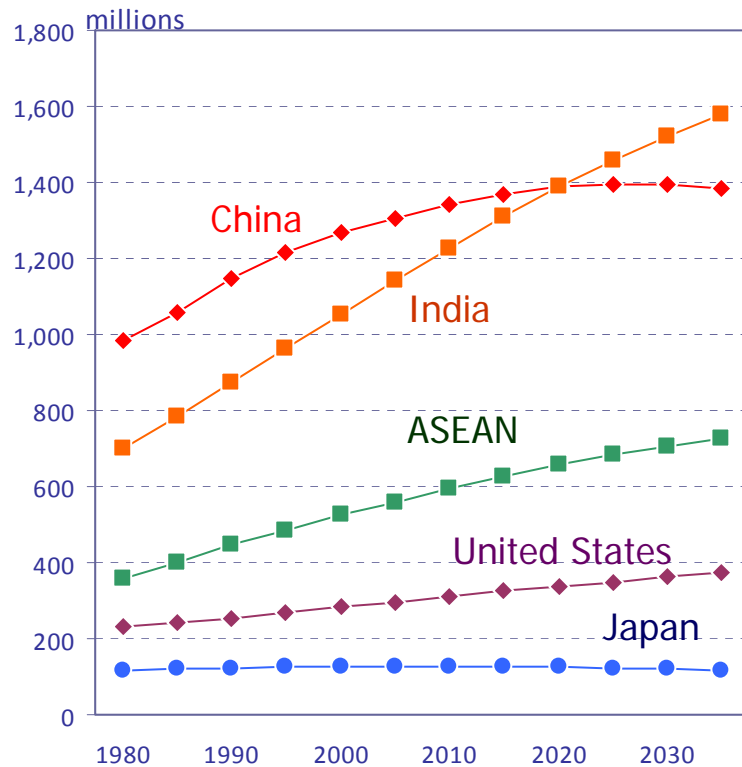
Yuhji Matsuo

Senior Economist

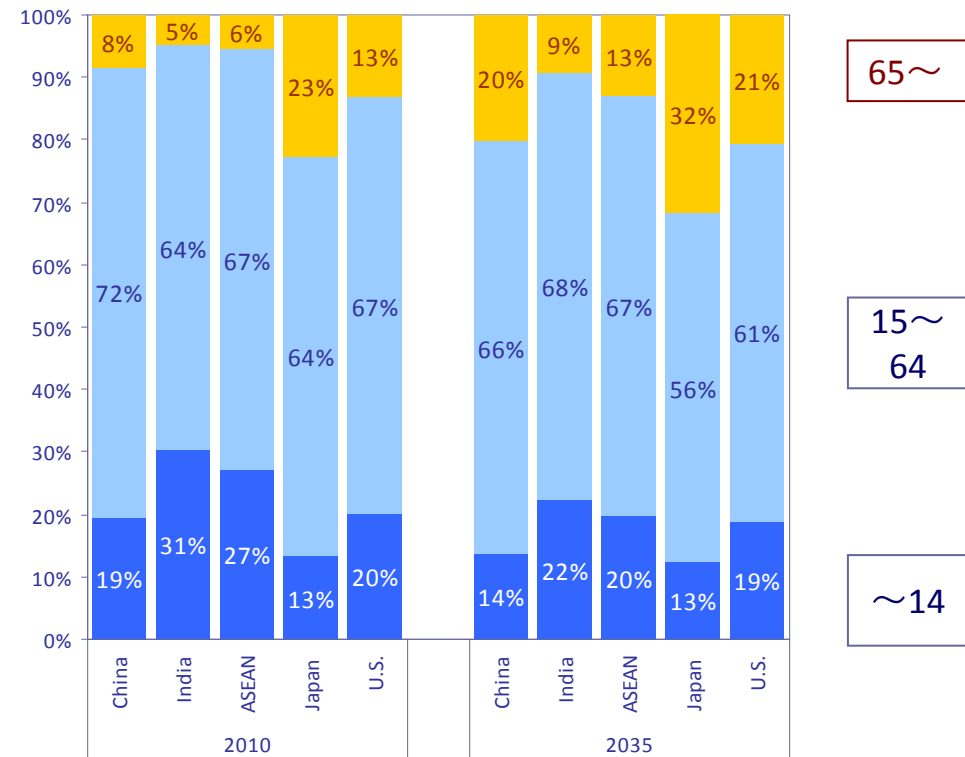
The Institute of Energy Economics, Japan (IEEJ)

# Population outlook

### Population

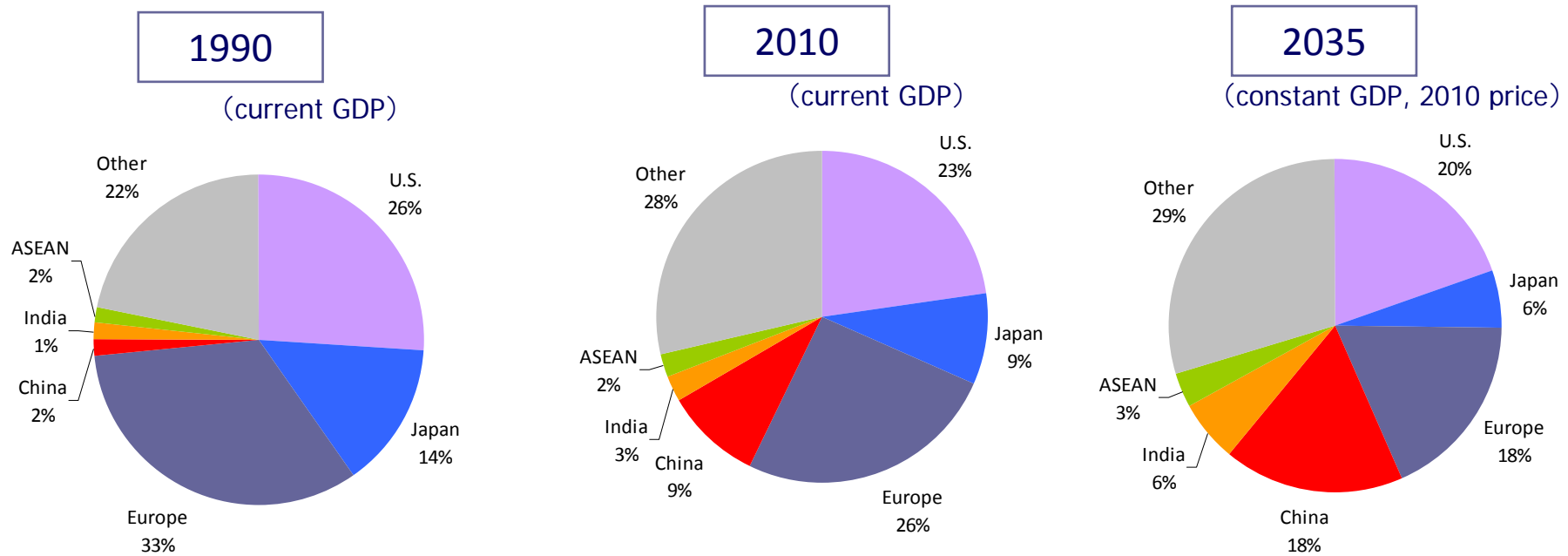


### By Age Groups

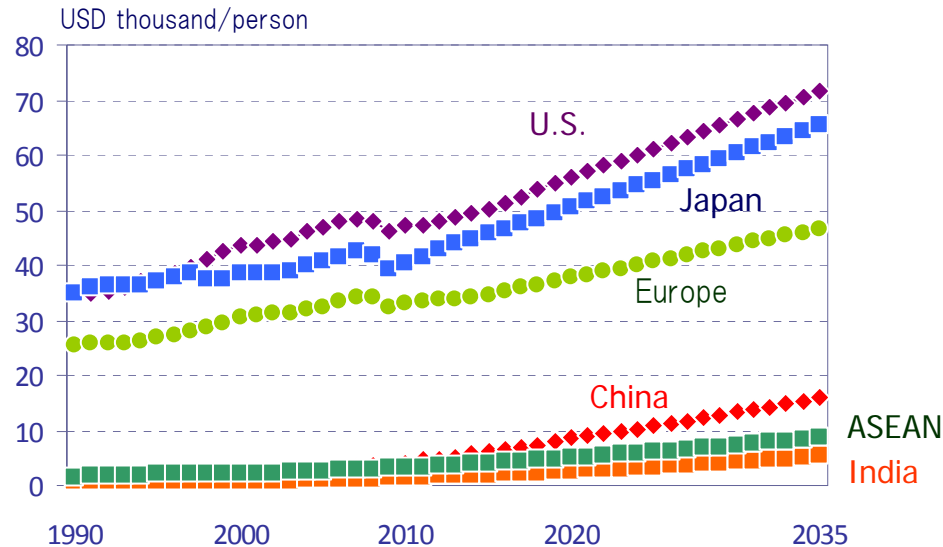


- Population will continue to grow in non-OECD countries.
- Population in China will peak at 1,400 million by 2025, when India will be the most populous country in the world.

# Economic growth outlook

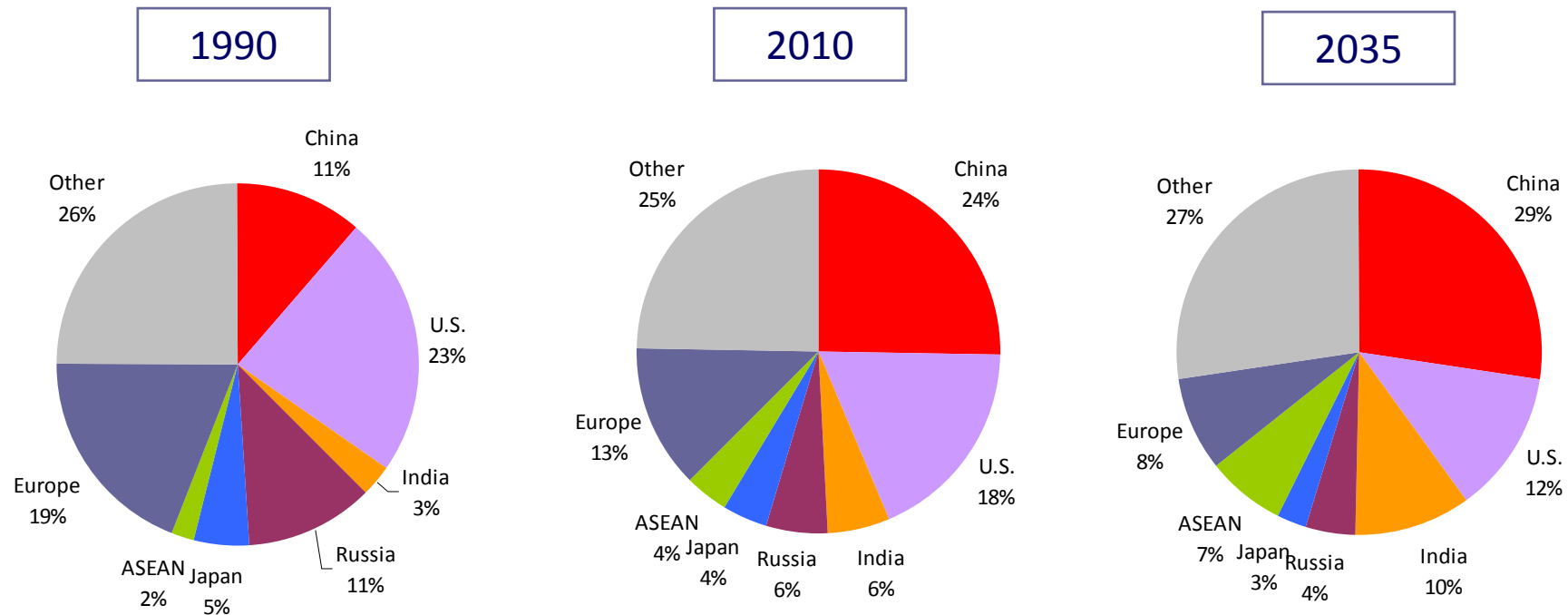


GDP per capita : 2010 price



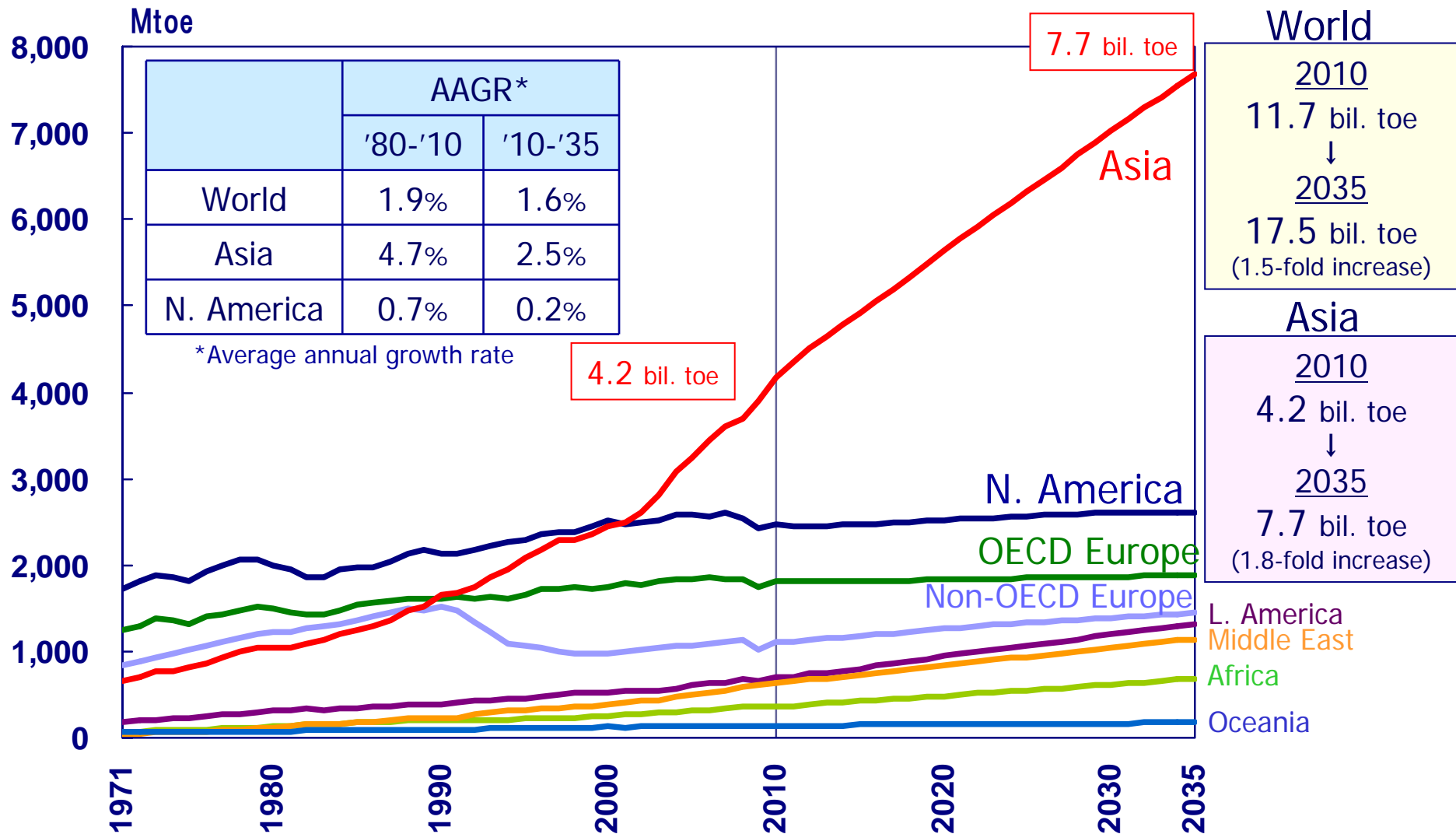
- GDP of China, India and ASEAN countries together accounted for only 5% of global GDP in 1990, but will account for one fourth in 2035.
- But even in 2035, GDP per capita of non-OECD Asian countries are by far lower than that of OECD countries.

# CO<sub>2</sub> emissions by region/country



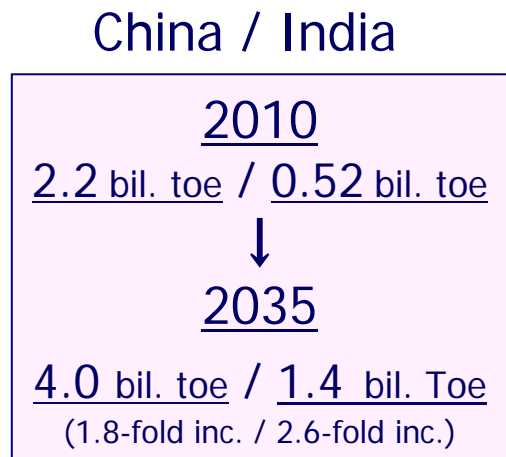
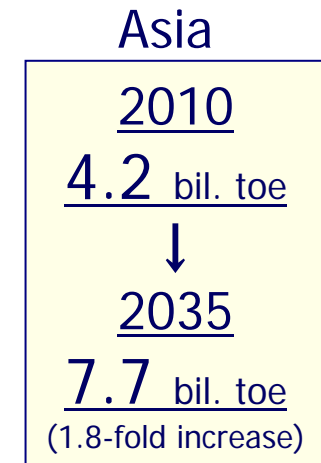
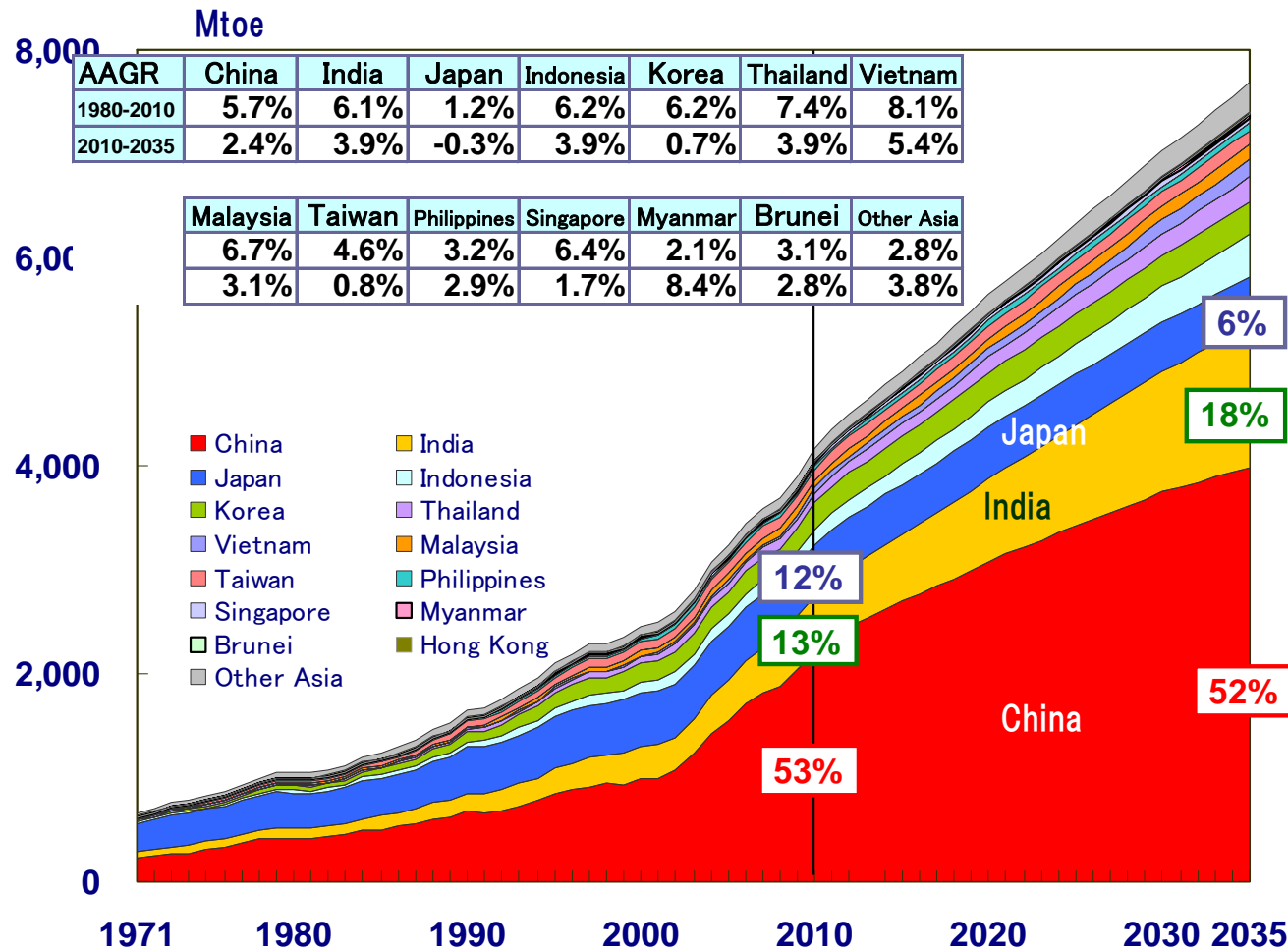
- China, which is now the largest CO<sub>2</sub> emitter, accounts for 24% of global emissions in 2010.
- In 2035, China, India and ASEAN countries together will account for 45% of global emissions.
- Efforts to reduce CO<sub>2</sub> emissions in non-OECD Asian countries are indispensable for addressing global warming issues.

# Primary Energy Demand by Region (World)



- Reflecting high economic growth for Asian countries, primary energy demand in Asia will increase 1.8 times by 2035 from current levels; 4.2 billion toe(2010) → 7.7 billion toe(2035).
- Non-OECD countries will represent 93% of incremental growth of global energy demand.

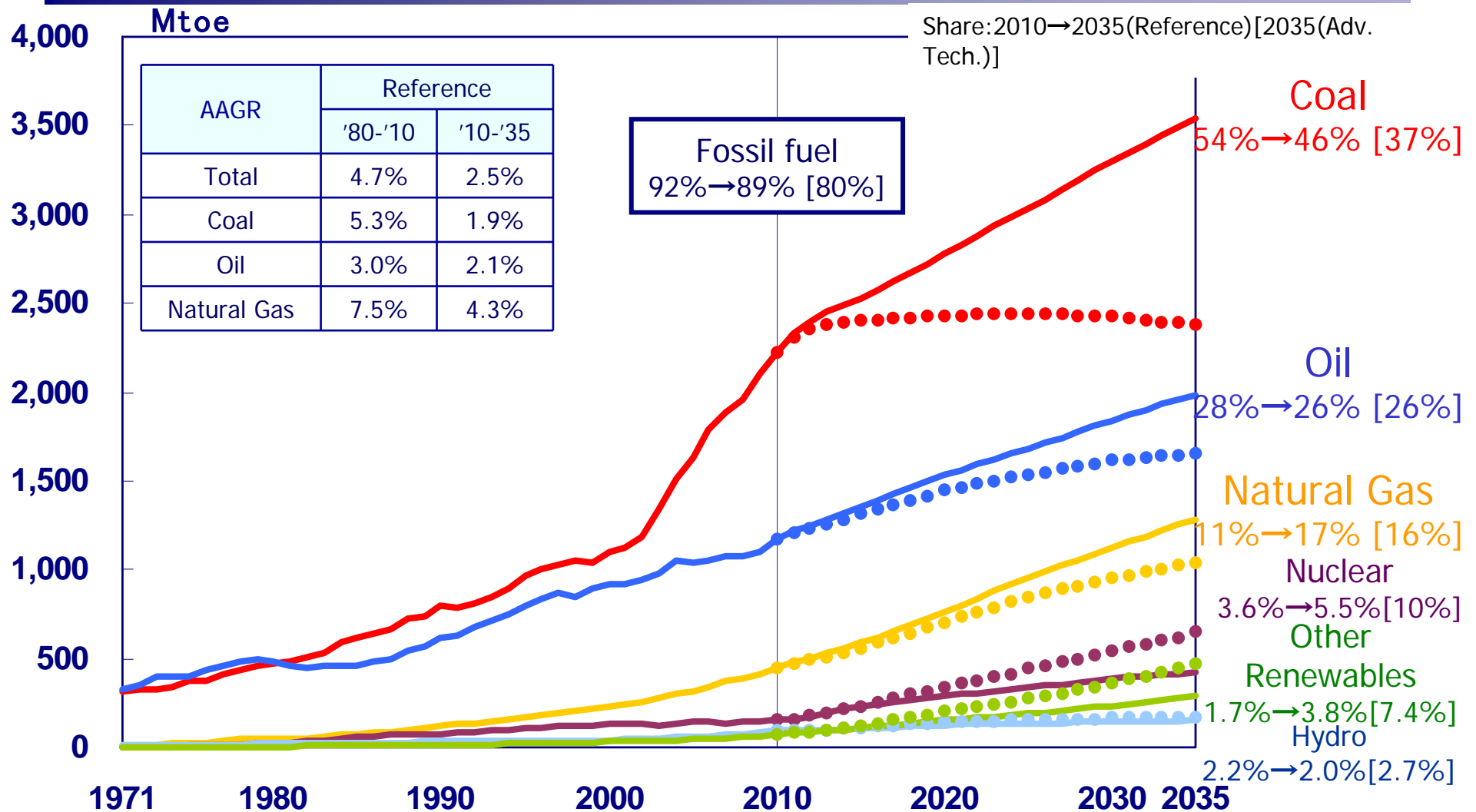
# Primary Energy Demand (Asia)



- The increase in energy demand of China and India reflects the high economic growths of those countries. Together they will represent almost 70% of the Asian primary energy demand by 2035.
- Japan's energy requirements will decline overtime and its share in Asia will substantially decline from 12% in 2010 to 6% in 2035.

# Primary Energy Demand by Source (Asia)

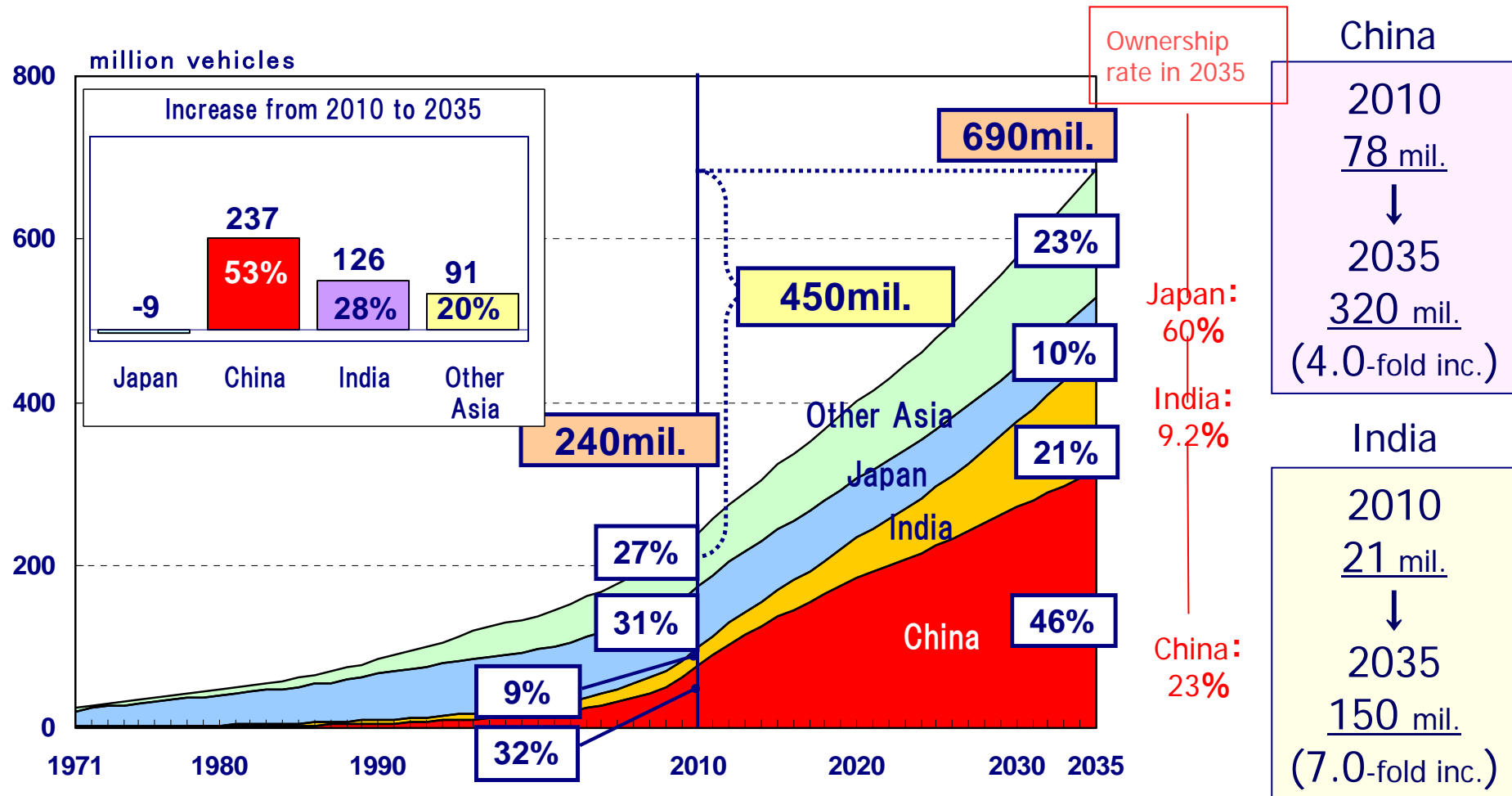
Solid line: Reference  
Dashed line: Adv. Tech.



· Although coal and oil will continue to maintain the dominant share of energy demand through 2035, their combined shares will diminish from 82% today to 72%.

· The share of natural gas will increase substantially reaching 17% by 2035, driven mainly by power generation.

# The Number of Vehicles (Asia)

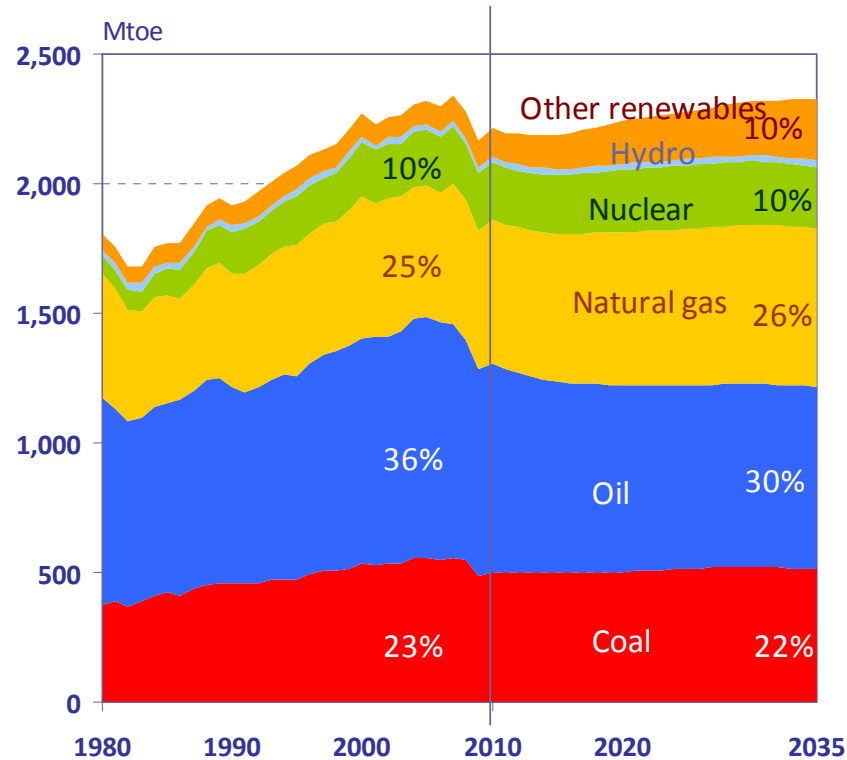


· China vehicle stocks will expand substantially due to an increase in the income level. Number of vehicle stocks in China will increase from 78 million units in 2010 to 320 million units in 2035. India's vehicle stocks will surpass that of Japan around 2025. Number of vehicle stocks in India increase from 21 million units in 2010 to 150 million units in 2035.

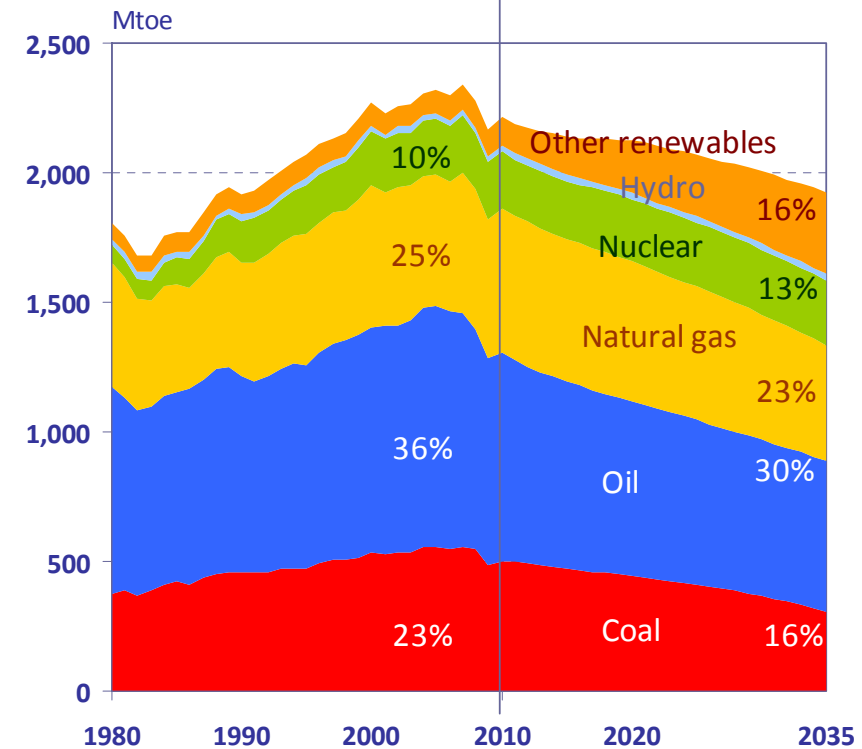


# Primary Energy Demand (U.S.)

## Reference Scenario

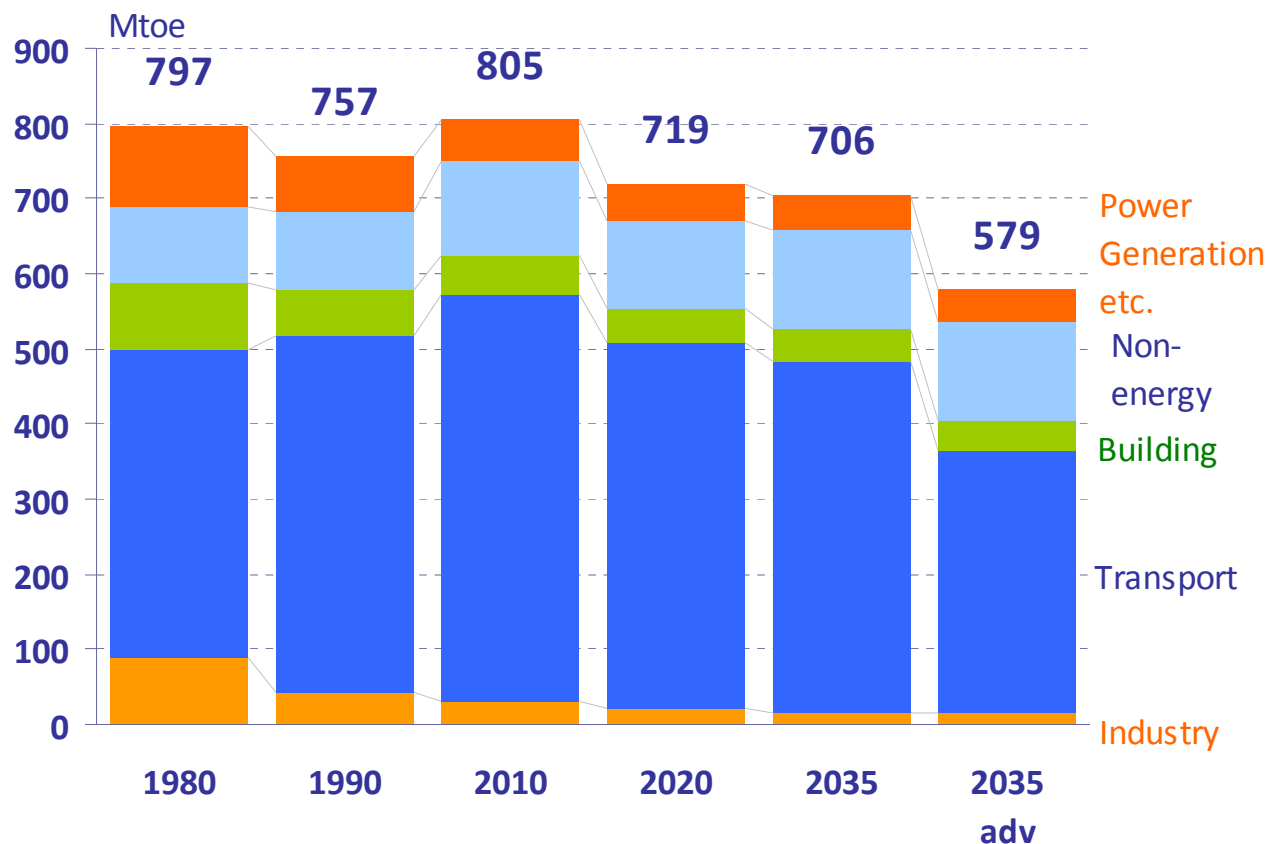


## Advanced Technology Scenario



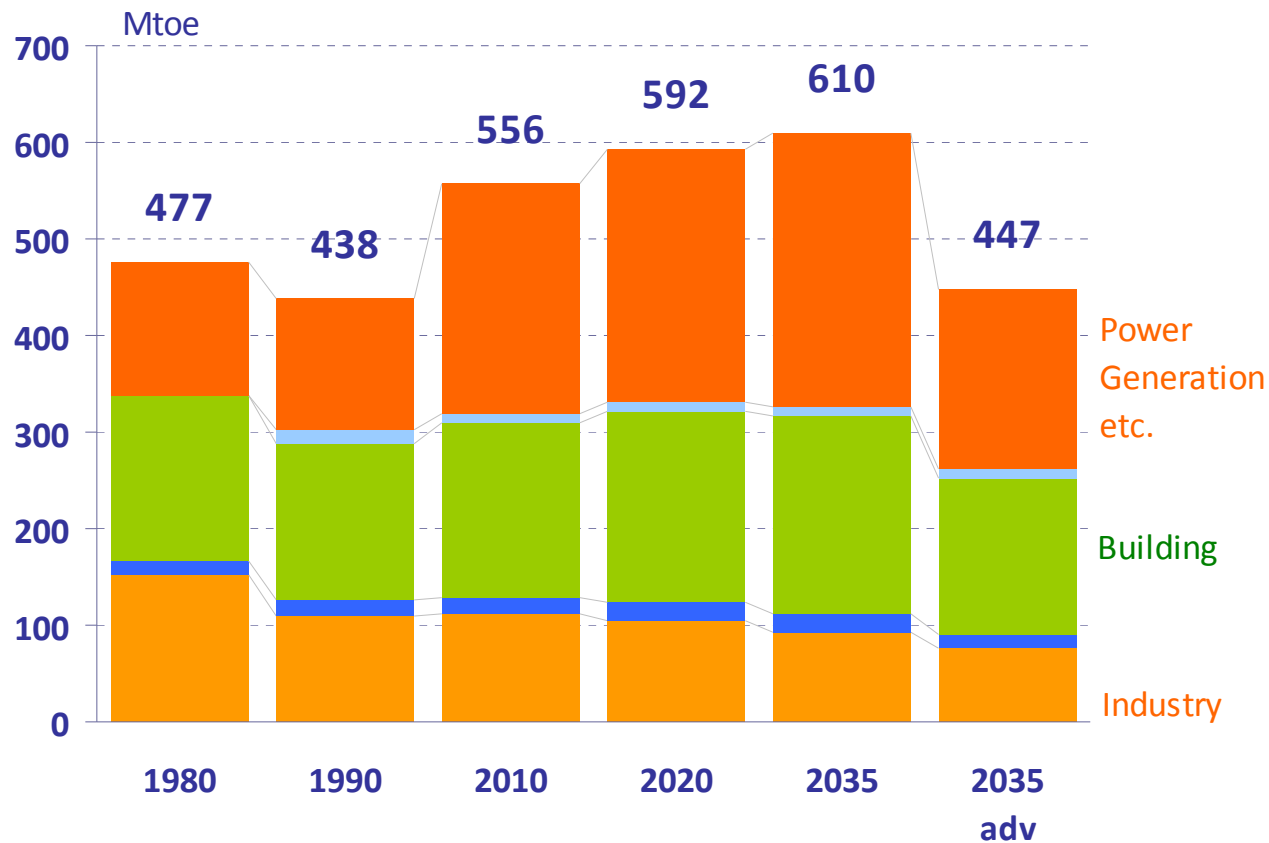
- Primary energy demand in the United States will increase slightly from 2,216 Mtoe in 2010 to 2,324 Mtoe in 2035 in the Reference Scenario.
- In the Advanced Technology Scenario, primary energy demand will be reduced by 17% from the Reference Scenario in 2035.

# Oil Demand by Sector (U.S.)



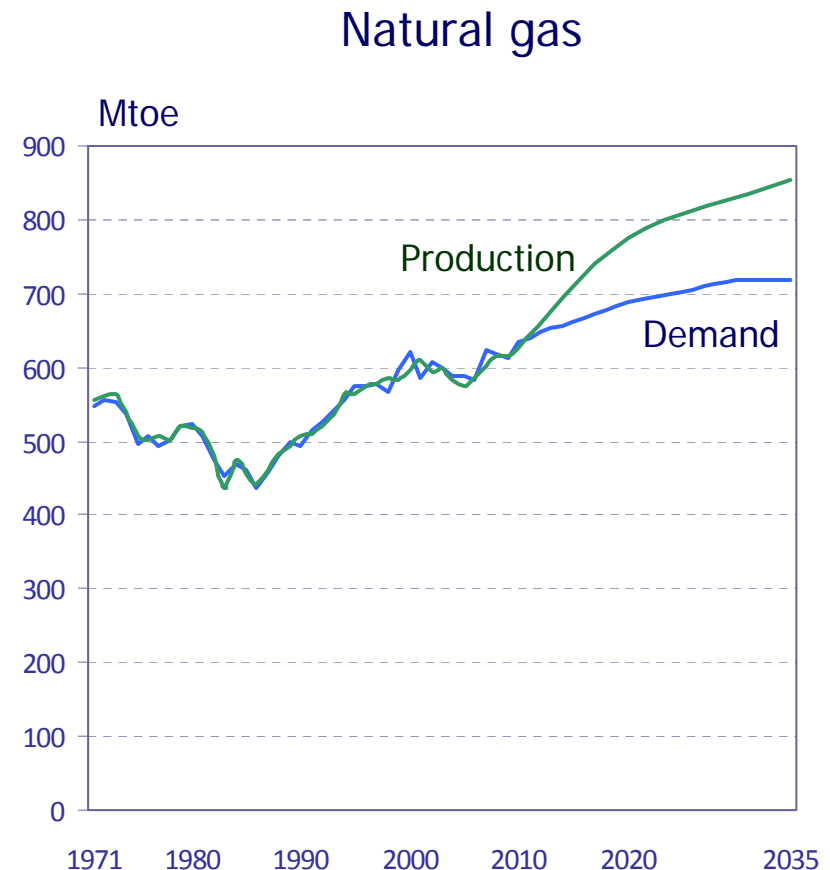
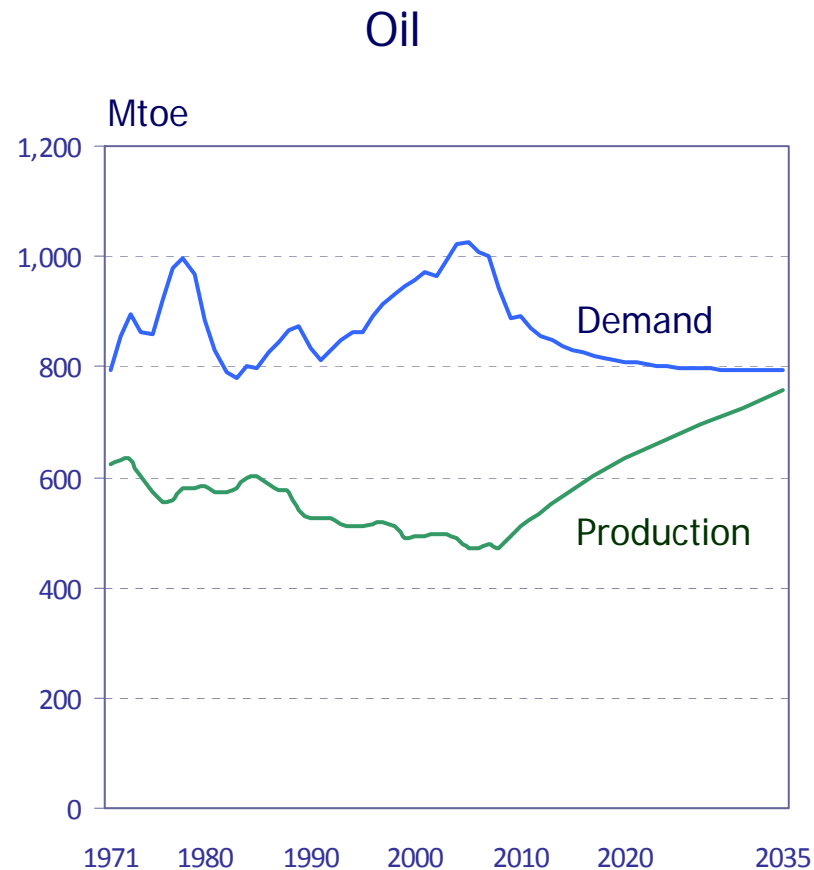
- Due to the improvement in fuel economy, oil consumption in the transport sector will decrease in spite of the growing automobile ownership.
- In the Adv. Tech. Scenario, oil consumption will be reduced by 30% from the current level in 2035.

# Natural gas Demand by Sector (U.S.)



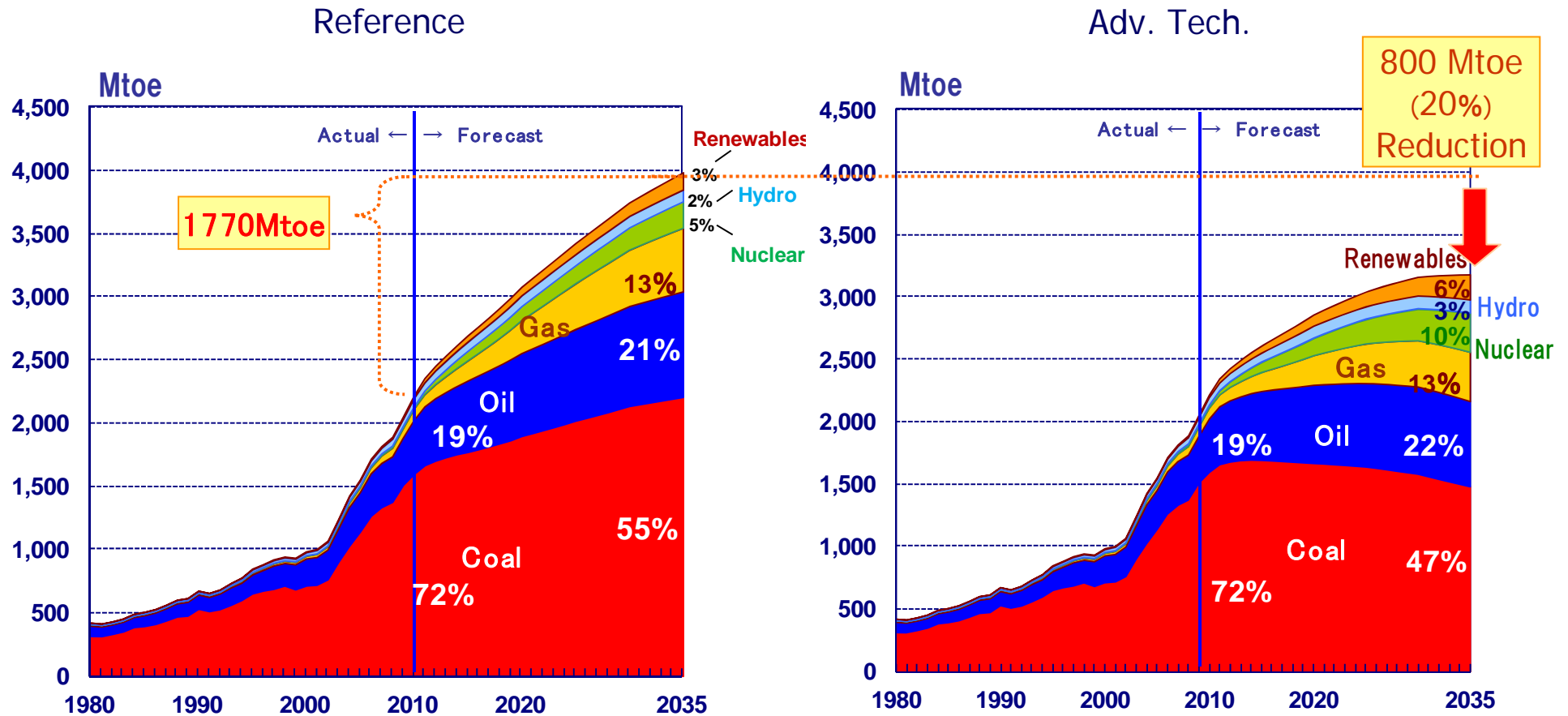
- In the Reference Scenario, natural gas consumption will increase mainly in the power sector.
- In the Adv. Tech. Scenario, it will decline to the 1990 level in 2035 due mainly to electricity saving.

# Oil/Natural gas Supply and Demand (North America)



- In north America oil and natural gas production will increase substantially due to unconventional resources development.
- On the other hand, demand will not grow in the future. Thus north America will go in the direction of energy self-sufficiency.

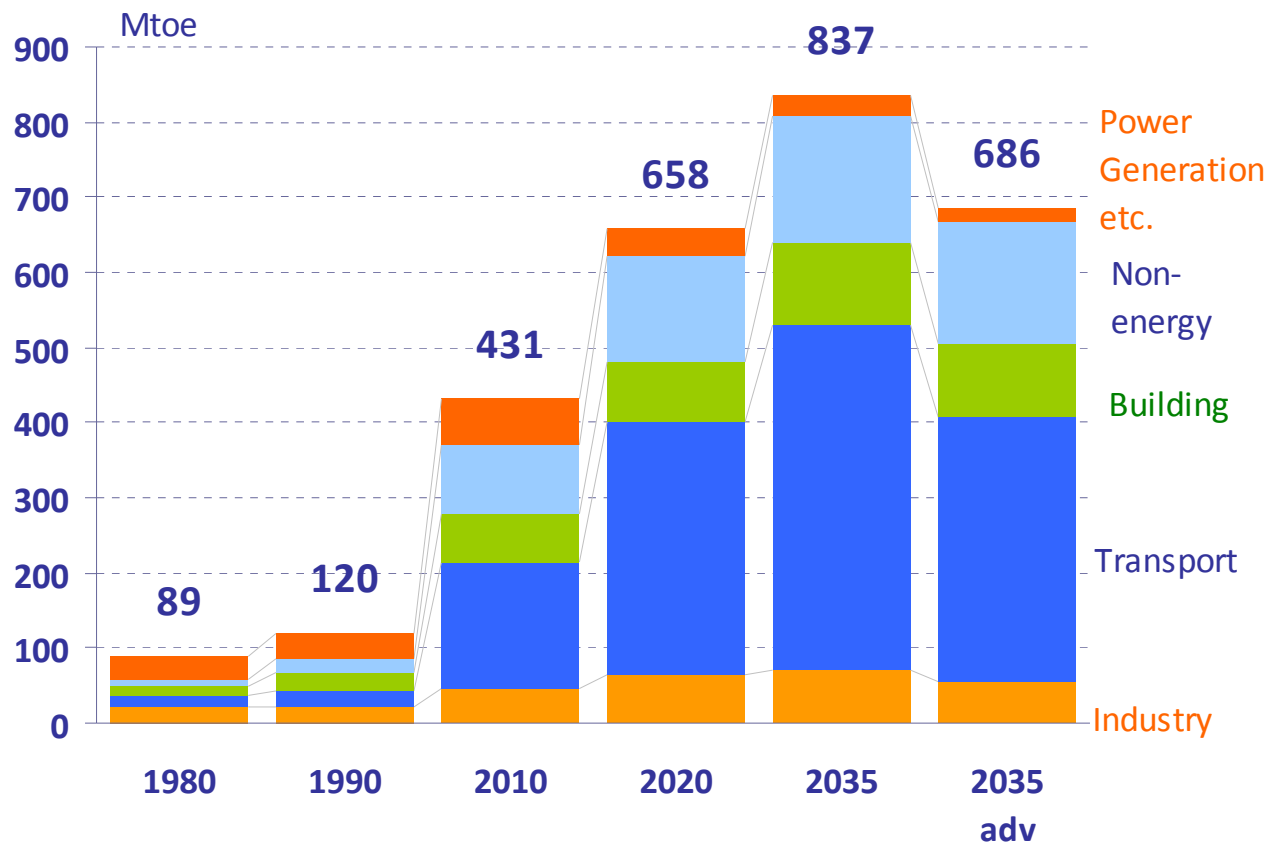
# Primary Energy Demand (China)



· TPED will increase at an annual rate of 2.4% in the Reference Scenario at the back of robust economic growth. Coal will grow substantially driven by the power sector, and oil will expand reflecting rapid motorization. Natural gas will increase sharply for the household and commercial usage, especially in urban areas.

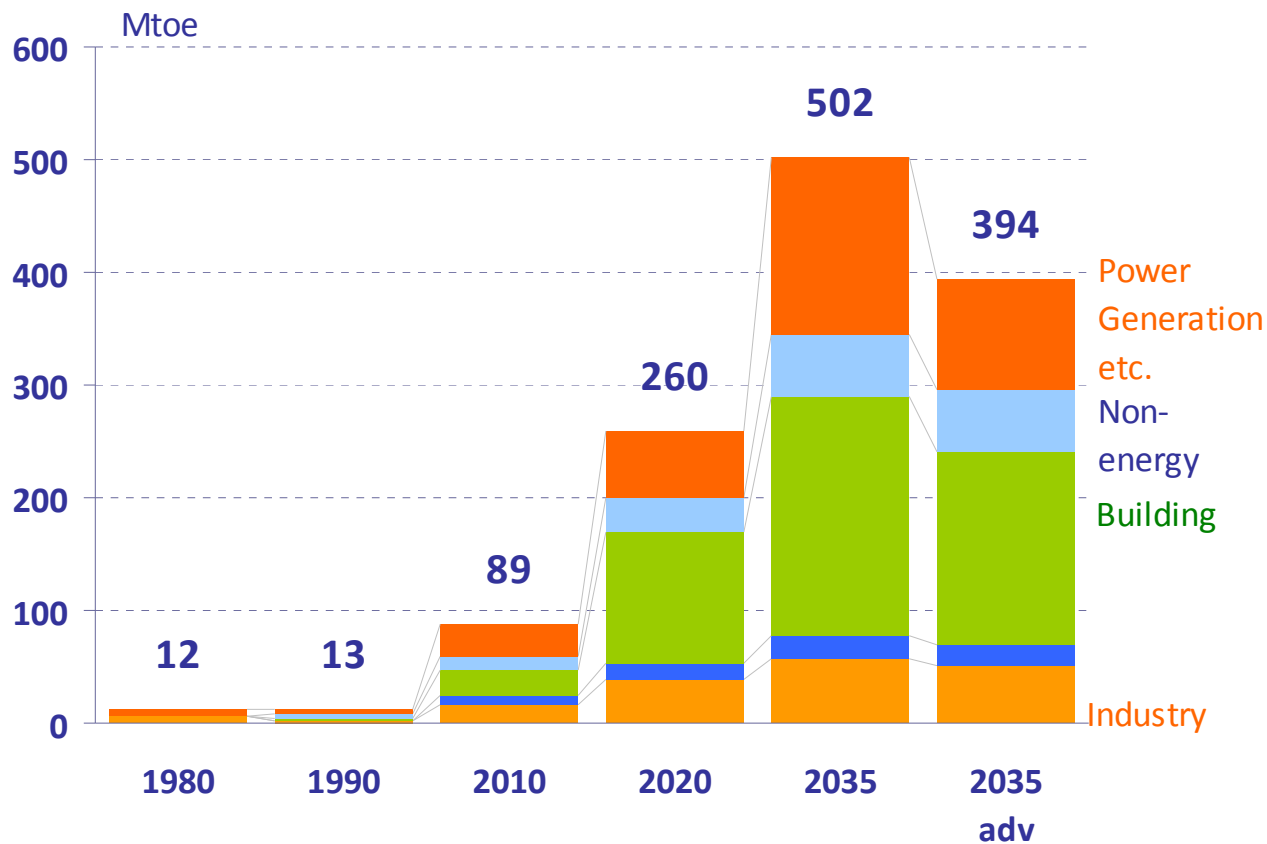
· In the Adv. Tech. Scenario, coal demand will decrease, especially in power generation, accounting for 800 Mtoe (20% down) reduction compared with Reference Scenario in 2035.

# Oil Demand (China)



- Oil consumption will expand mainly in the transport sector. Thus measures in this sector (introduction of clean energy vehicles, etc) will be one of the largest factors that decide the oil demand.

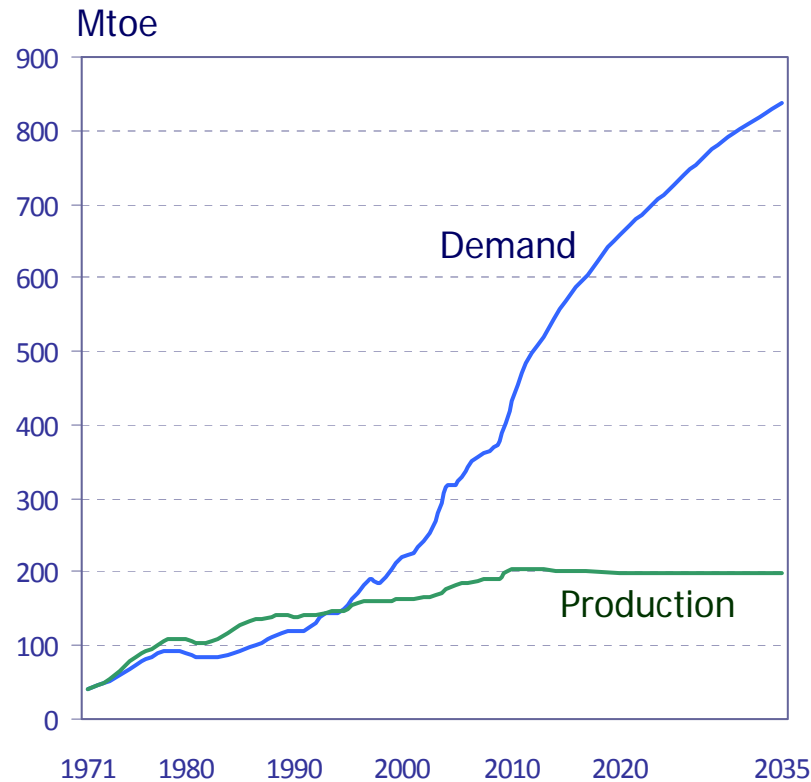
# Natural Gas Demand (China)



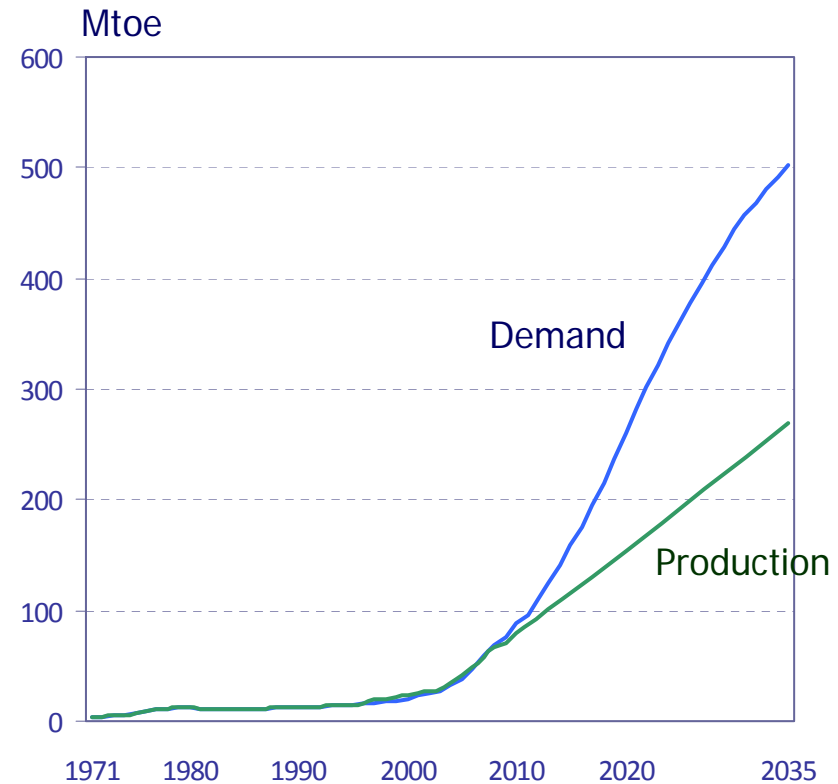
- Natural gas demand grows even more rapidly than oil demand. It will expand in the buildings sector, power generation sector, etc.

# Oil/Natural gas Supply and Demand (China)

Oil



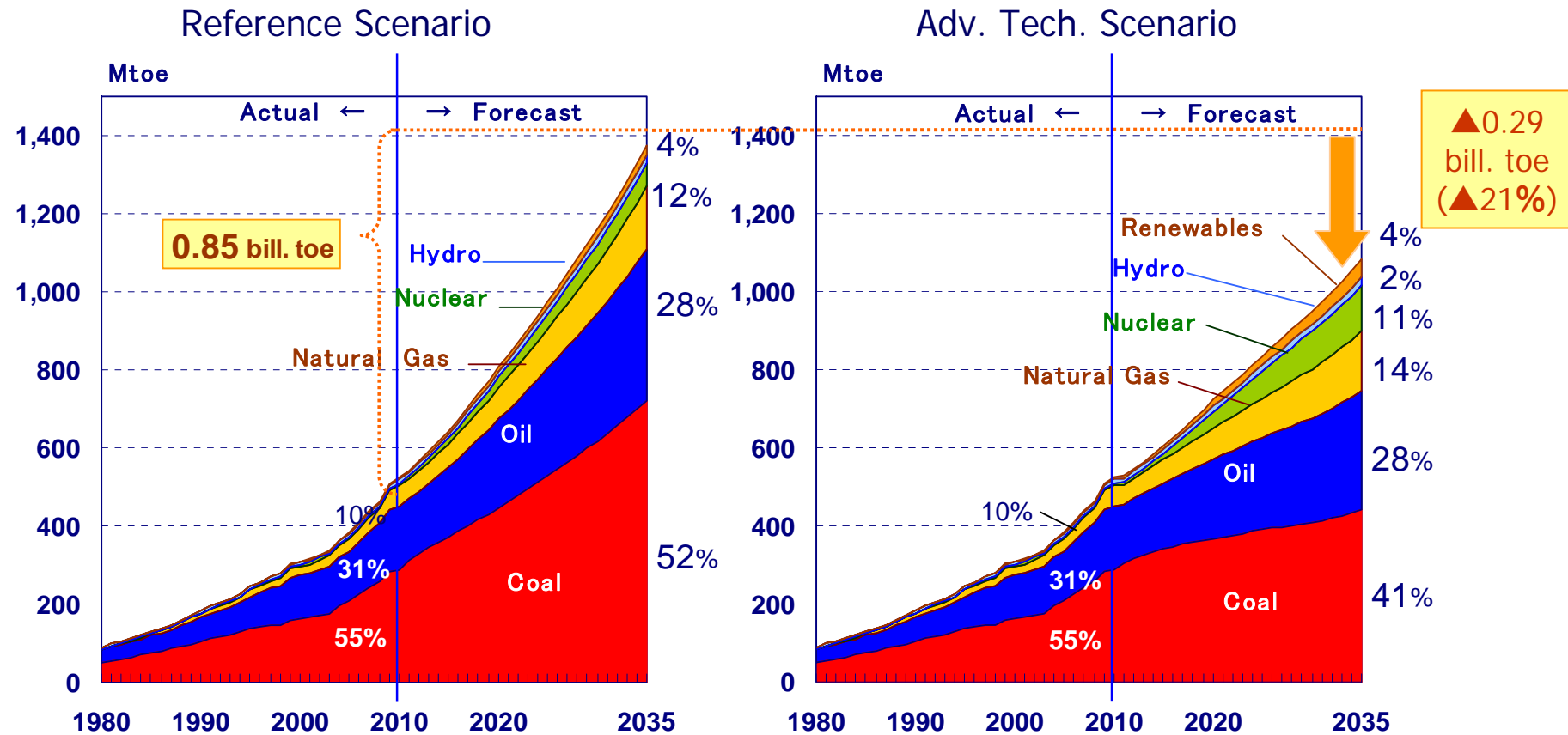
Natural gas



- Natural gas production in China will increase in the future. However, it will not be enough to meet the domestic demand, thus natural gas import will expand in the future.
- Crude oil production will not grow for coming decades. Thus, increase in demand will directly result in increase in import.



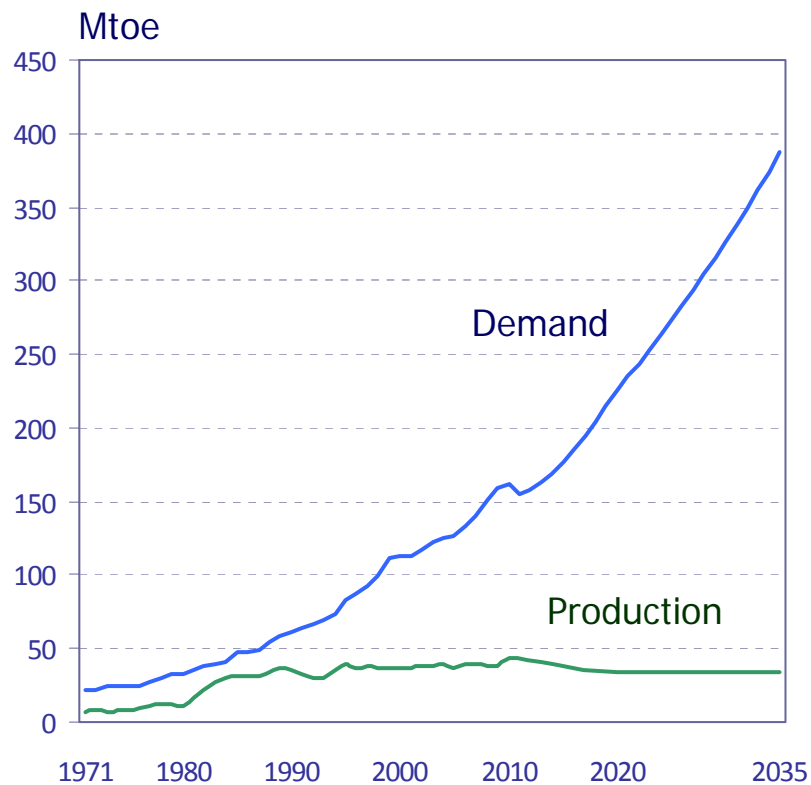
# Primary Energy Demand (India)



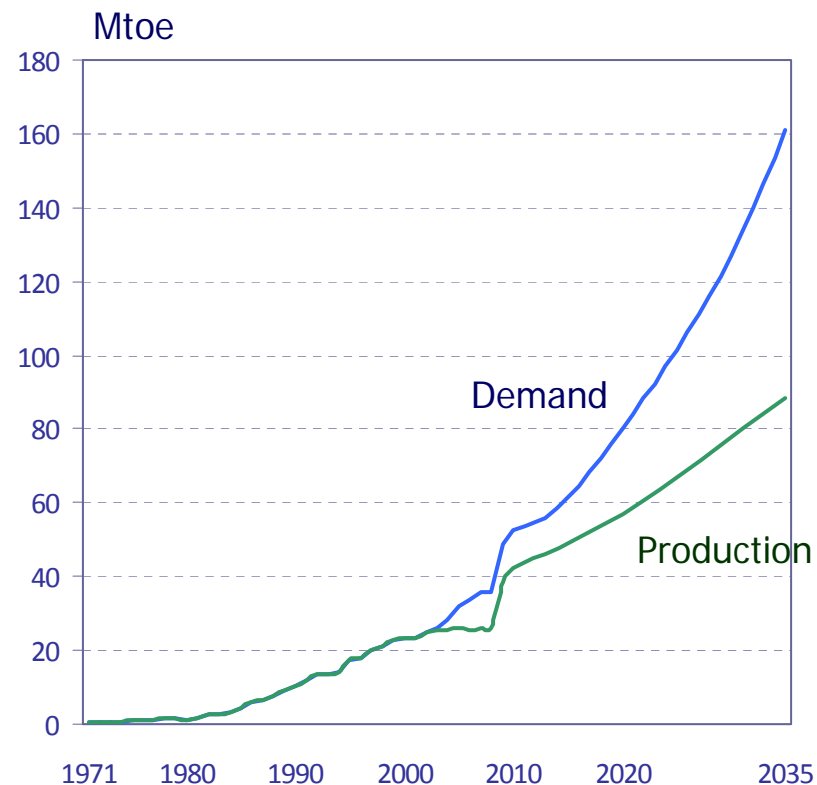
- In the Reference Scenario, TPED will increase at an annual rate of 3.8%. Fossil fuels will account for 90% of the incremental energy growth by 2035.
- Driven by the power and industry sectors, coal demand will maintain the largest share at about 51% throughout the projection period.
- The power and industry sectors will lead natural gas demand growth. Development of domestic resources is expected, while much of the natural gas demand should be met by import.
- By 2035, compared with the Reference Scenario, TPED will be 290 Mtoe lower (21%) in the Adv. Tech. Scenario.

# Oil/Natural gas Supply and Demand (India)

## Oil



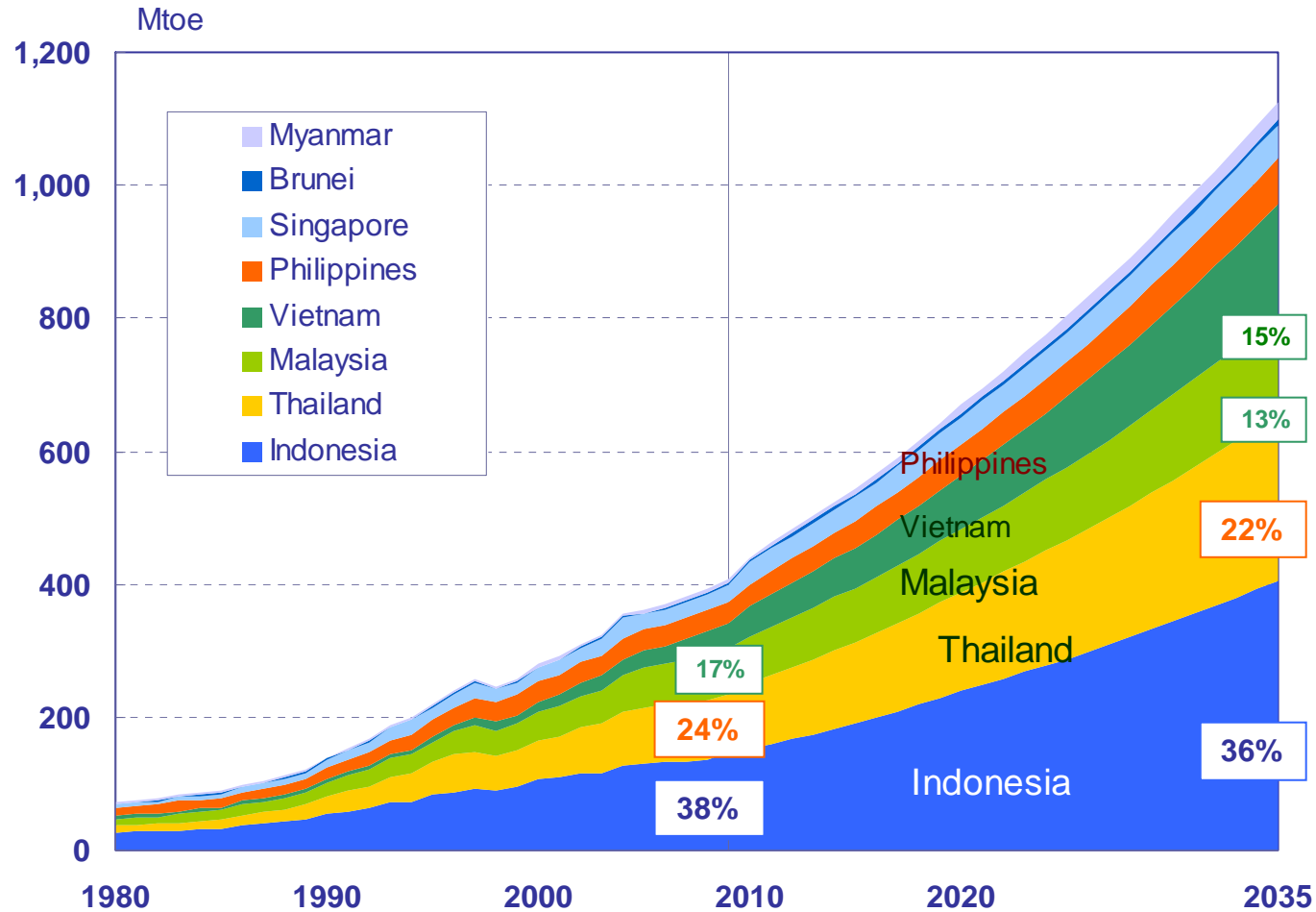
## Natural gas



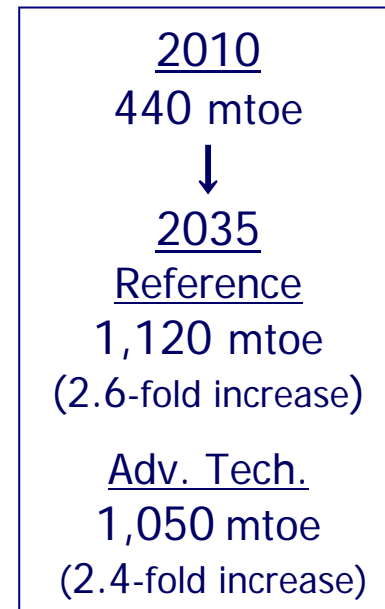
- In India, Oil production will not increase in the future.
- Natural gas production will increase, but will not be able to meet the rapidly growing demand.

# Primary Energy Demand of ASEAN Countries

Reference Scenario



TPED  
(ASEAN 8)

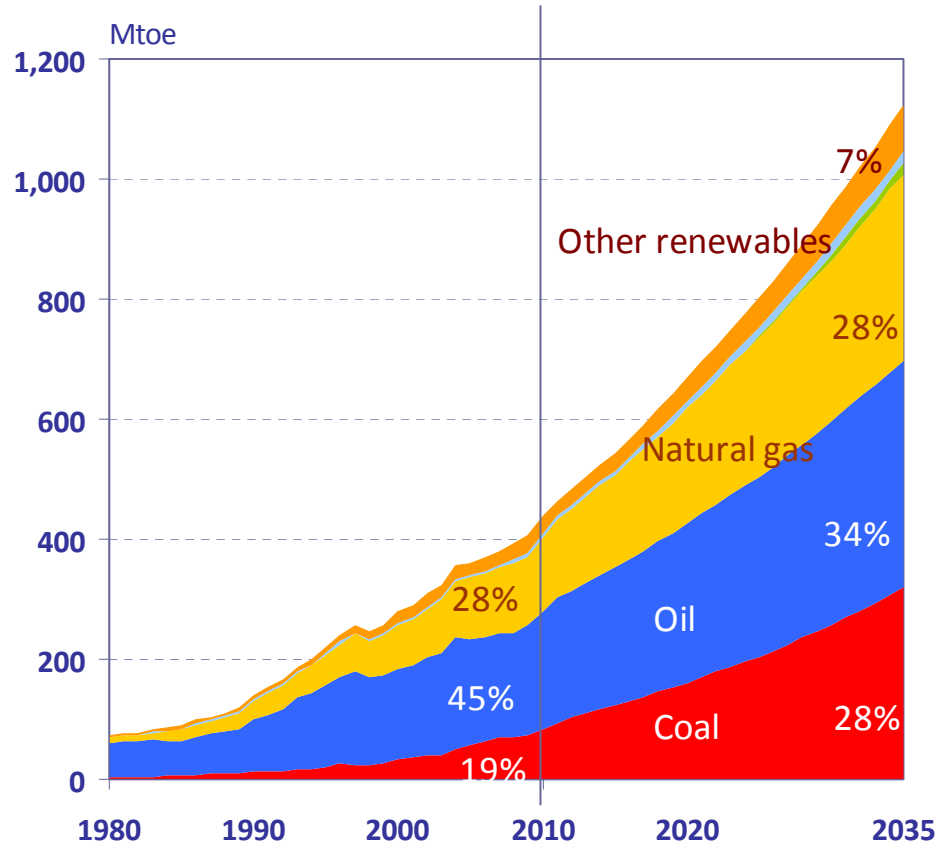


• Total primary energy demand in ASEAN countries will grow at 3.9% annually, reaching 1.1 billion toe in 2035.

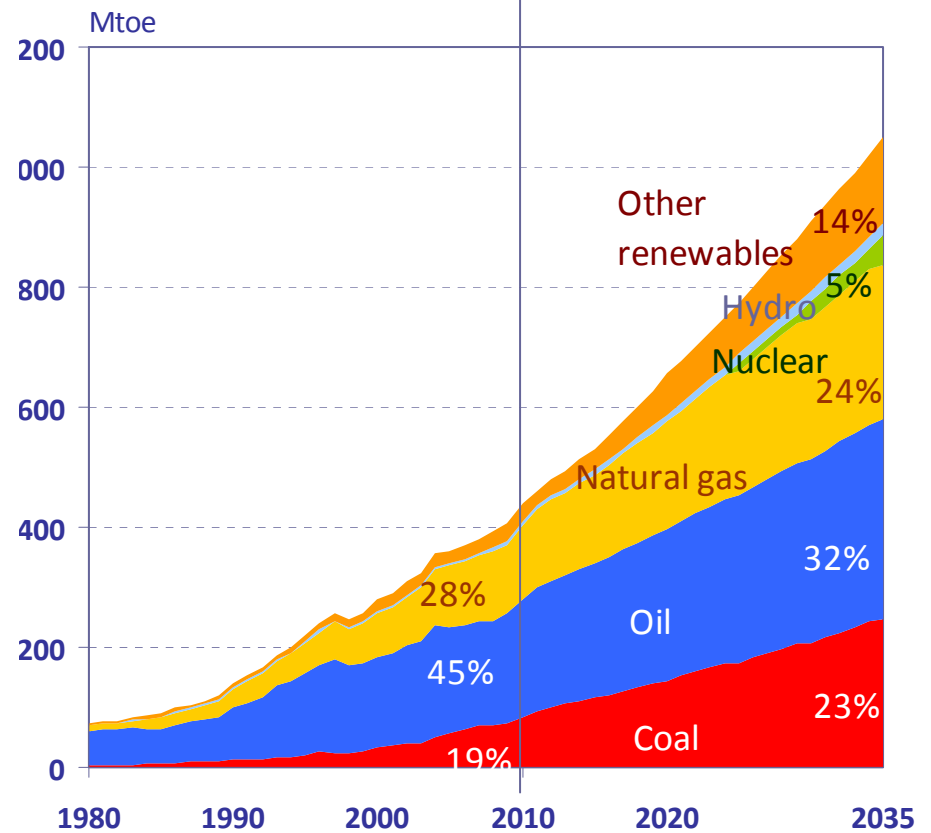
# Primary Energy Demand (ASEAN: by Energy Source)



Reference Scenario



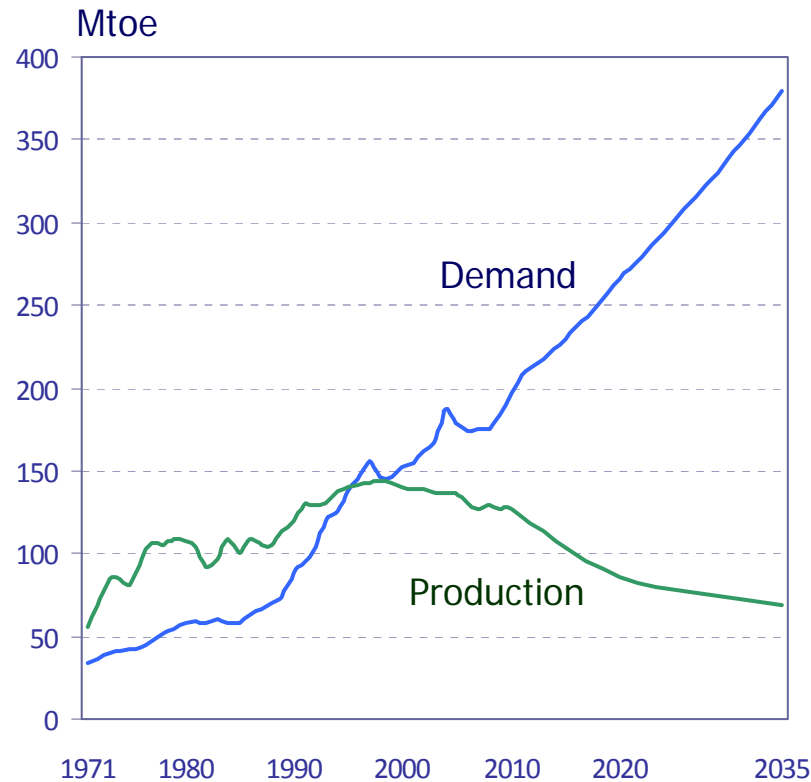
Advanced Technology Scenario



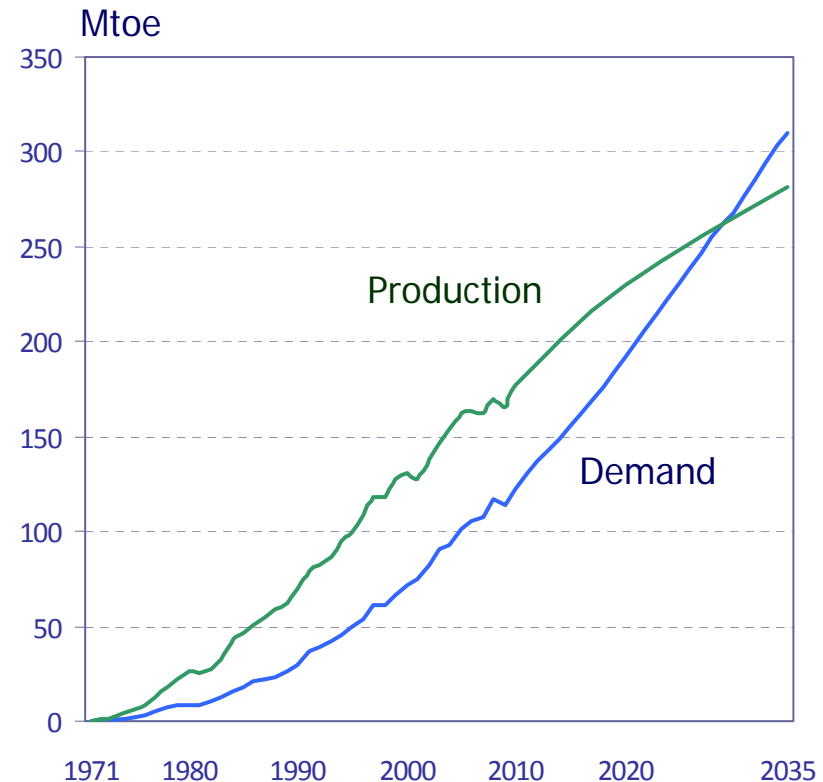
- Supply of coal, natural gas and renewables will grow considerably in the future in ASEAN countries.
- In the Advanced Technology Scenario, large scale introduction of nuclear power is assumed, but the share of nuclear of total primary energy supply will be only 5% in 2035.

# Oil/Natural gas Supply and Demand (ASEAN)

## Oil

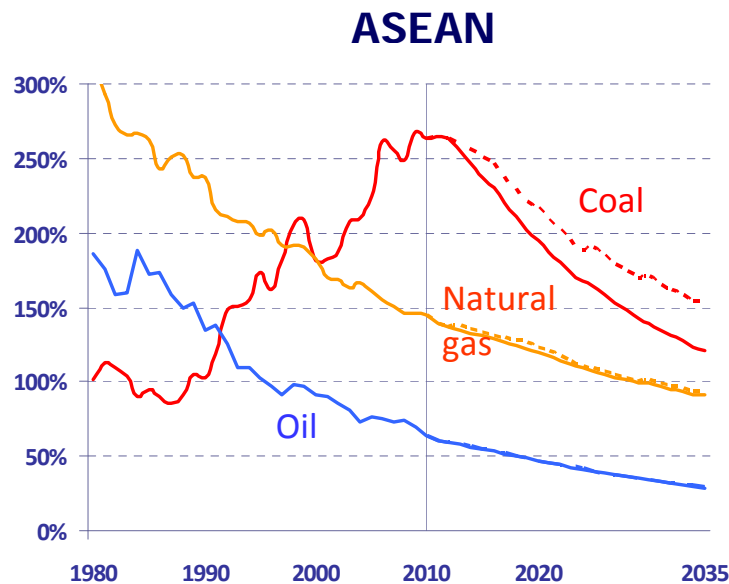
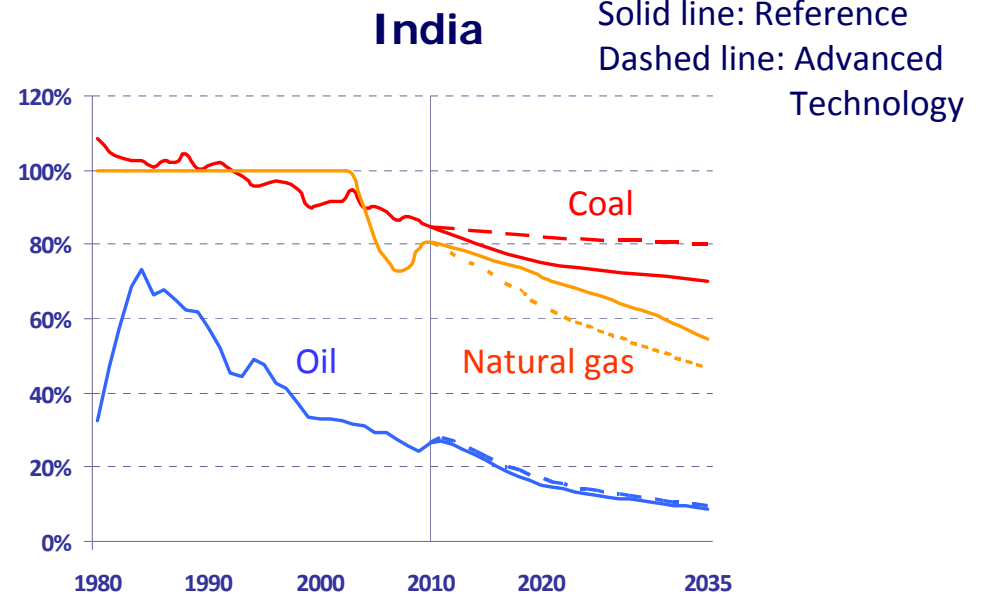
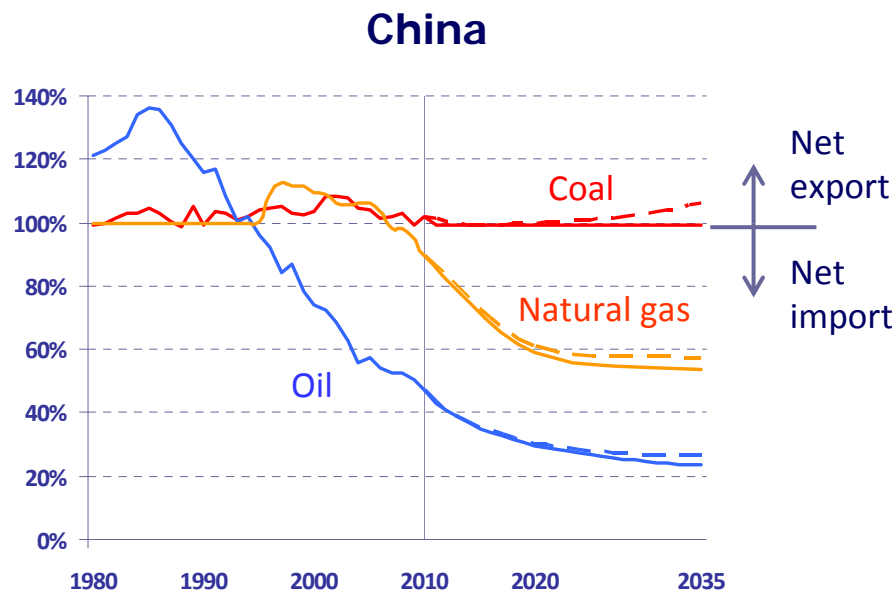


## Natural gas



- ASEAN turned a net importer of oil right before 2000.
- Natural gas production has been growing considerably. However, due to the rapid increase in domestic demand, export capacity has been declining rapidly. In this analysis, ASEAN is forecast to be a net importer of natural gas around 2030.

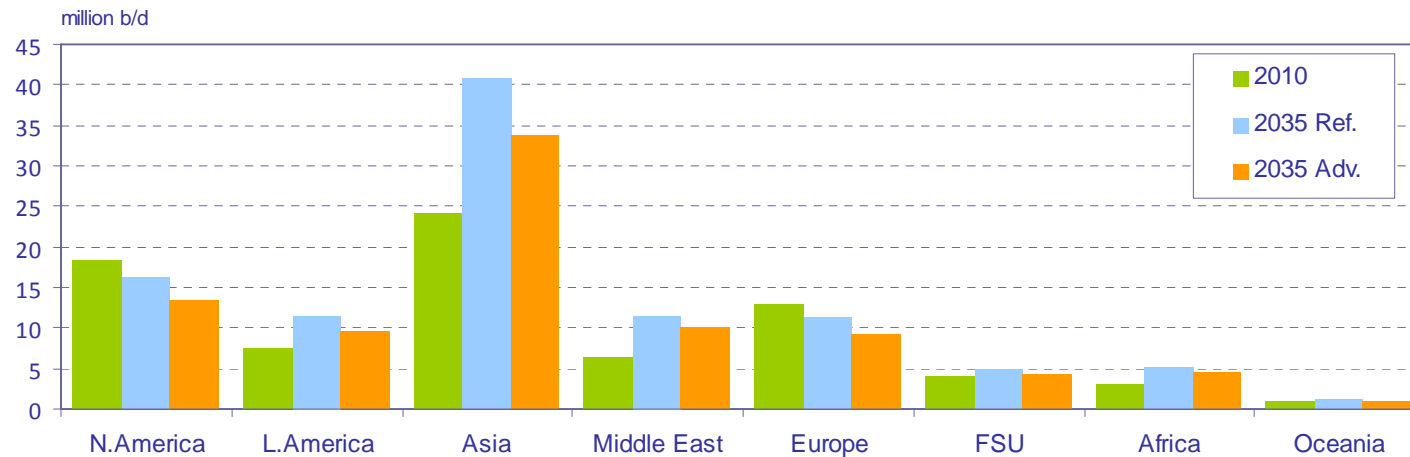
# Challenge 1 Fossil Fuel Procurement : Outlook for Self-Sufficiency of Fossil Fuel



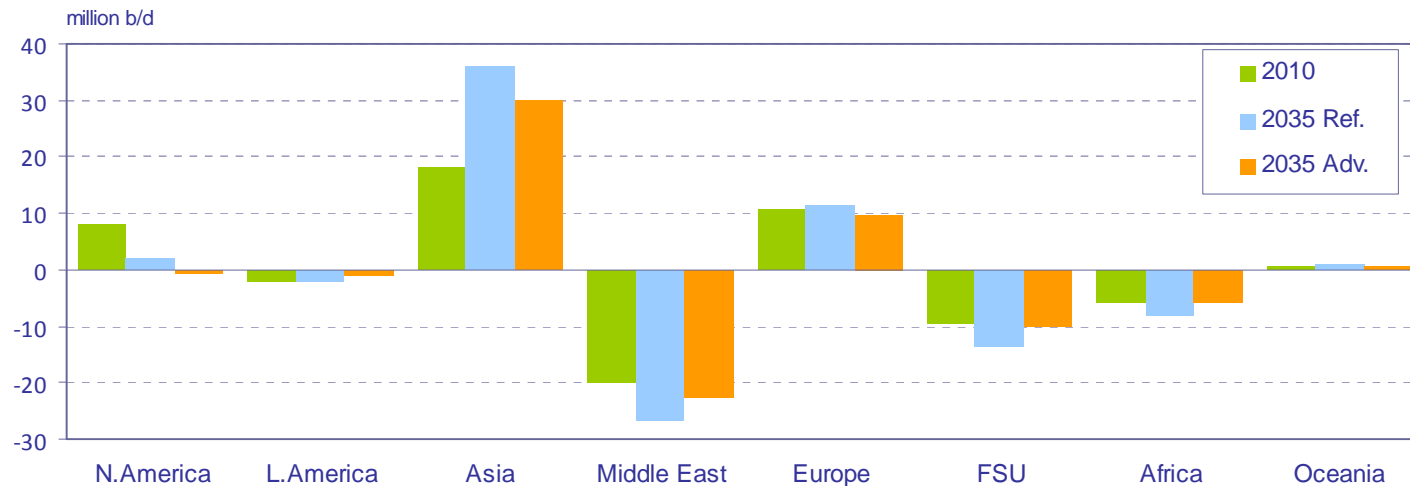
- The self-sufficiency rates of oil and natural gas have already fallen below 100% in China and India, and are declining further.
- In ASEAN countries, the self-sufficiency rate of oil dropped below 100% in the 1990s and continues to decline. Although the self-sufficiency rate of natural gas remains at 150%, ASEAN countries are expected to become net importers around 2030.
- The self-sufficiency rate of coal remains relatively high in every country/region.

# Challenge 1 Fossil Fuel Procurement : Oil Supply and Demand by Region

Demand

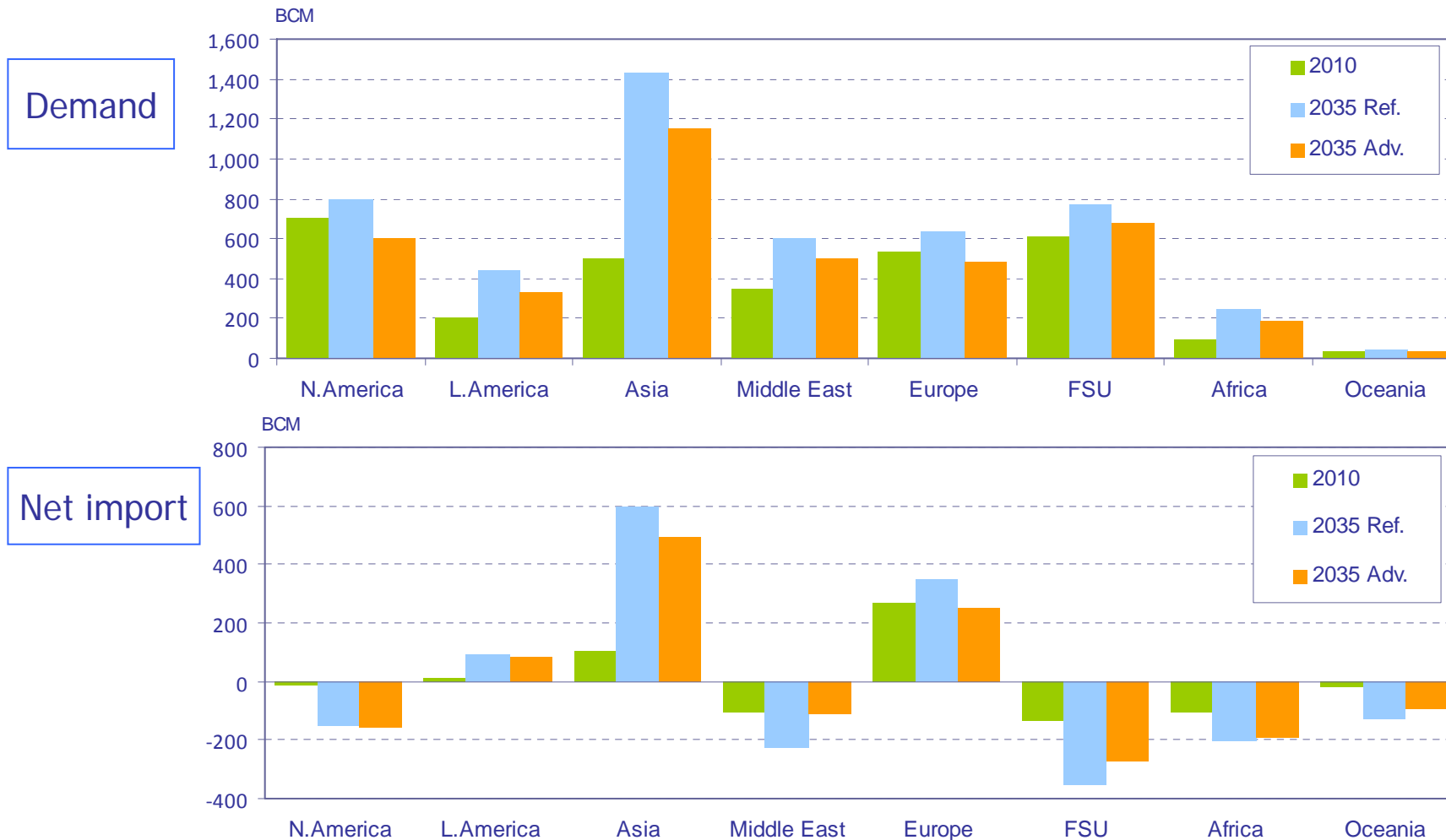


Net import



- Demand for oil will grow especially in Asia in the future, while North America is heading toward achieving self-sufficiency. Oil imports in Europe are likely to decline.
- The Middle East needs to increase production to meet the growing demand in Asia. The share of Asia as an export destination is increasing.

# Challenge 1 Fossil Fuel Procurement : Natural gas Supply and Demand by Region

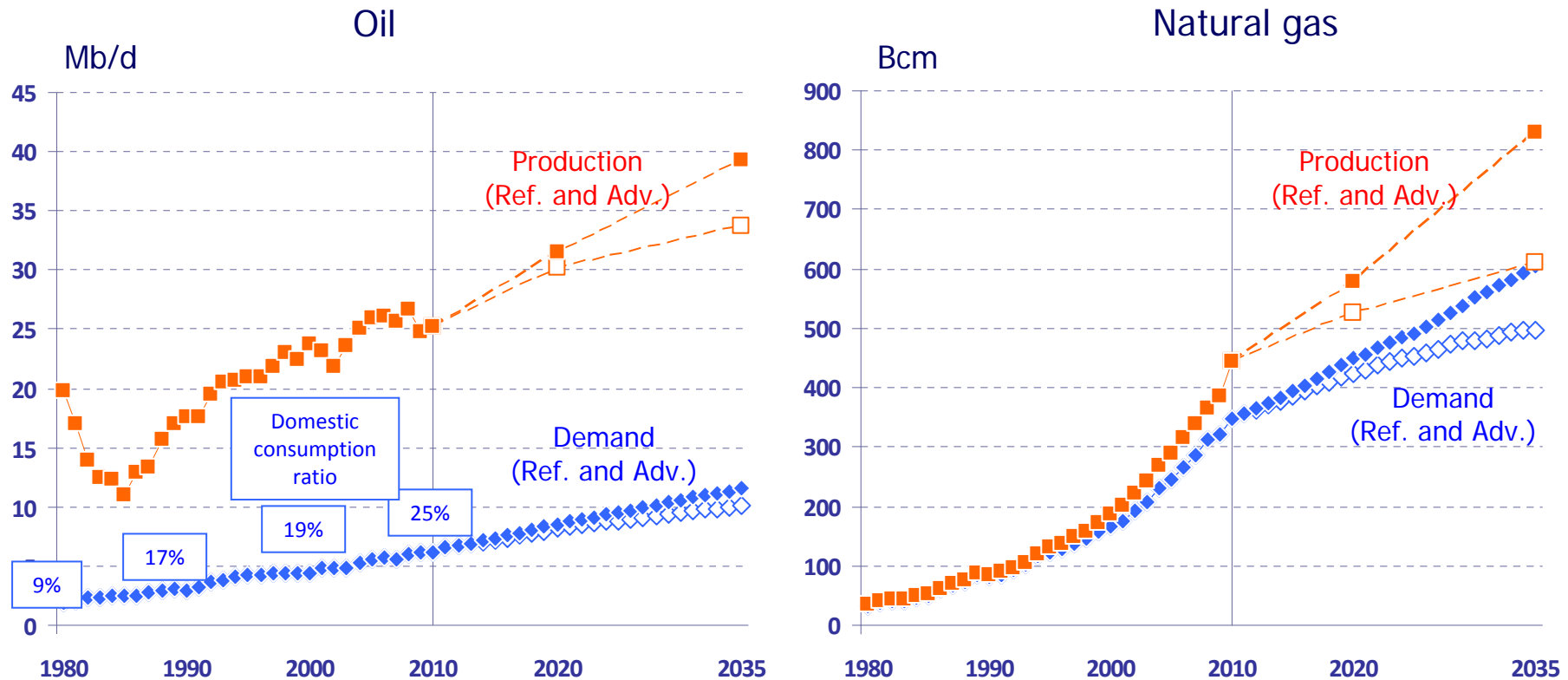


- Demand for natural gas is growing in Asia, Central and South America, the Middle East and Africa. Especially in the Advanced Technology Scenario, demand will decrease in North America and Europe.
- Exports from North America will increase, while imports to Asia will rise strongly. Diversification of supply sources will become a critical issue.



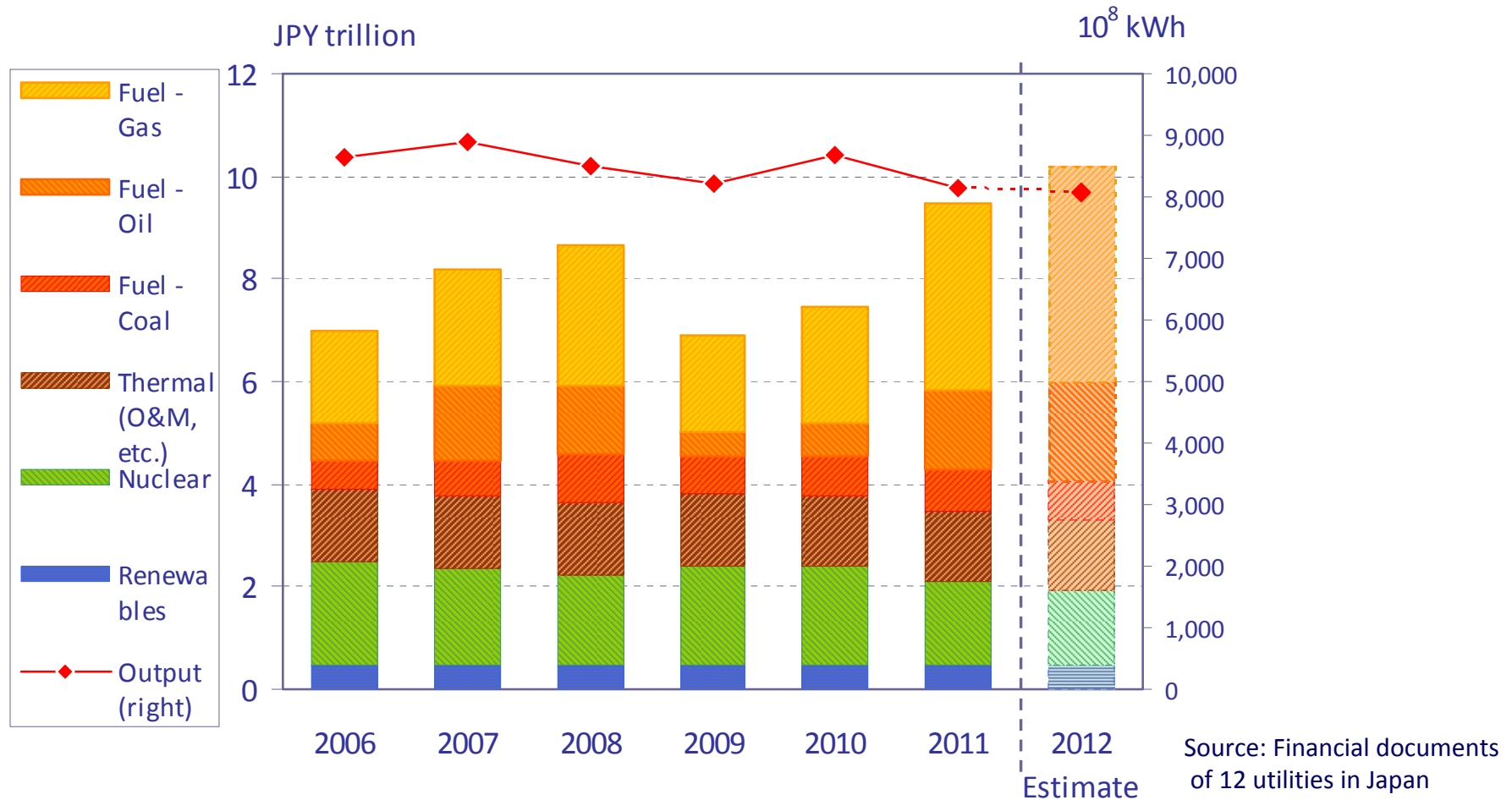
# Challenge 1 Fossil Fuel Procurement : Energy Supply and Demand in the Middle East

Middle East



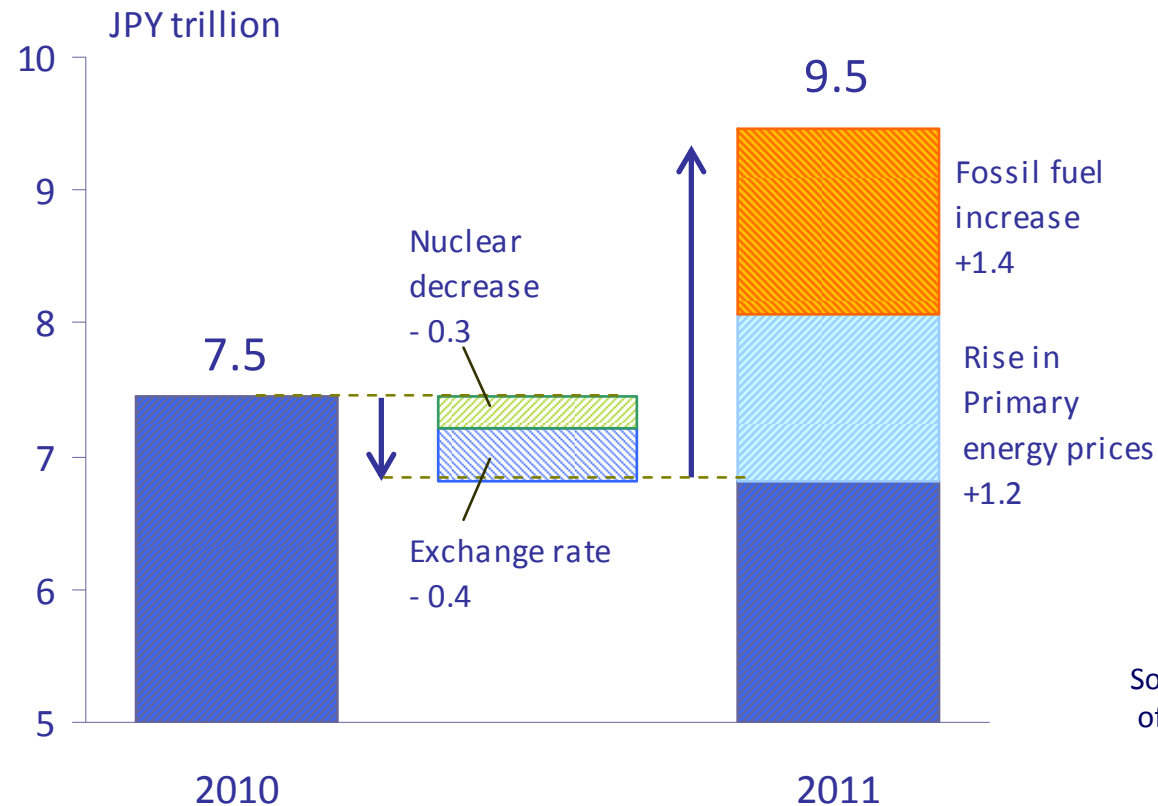
- Demand for oil and natural gas is projected to rapidly increase in the Middle East. A considerable increase in production is required even in the Advanced Technology Scenario in order to meet the increase in demand in the region and the increase in exports to Asia, especially for oil.

# Challenge 2 Risk of Rising Fossil Fuel Prices: Expenses for Electricity Generation in Japan (12 utilities)



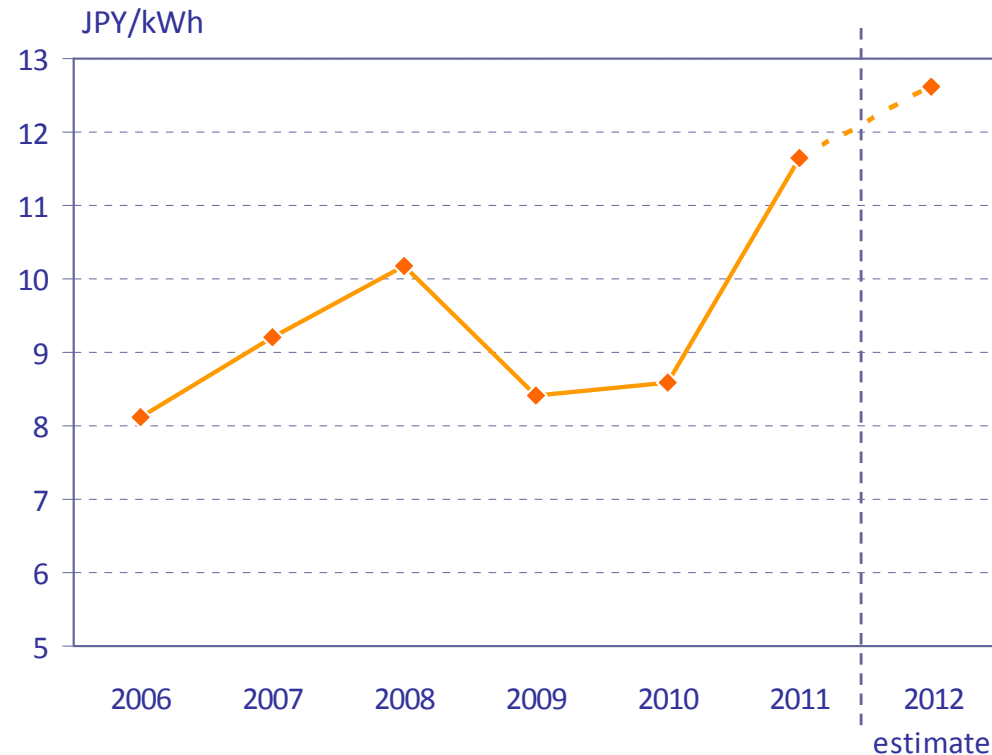
- Fossil fuel import bills rose from (FY)2010 to 2011 by JPY 2.3 trillion for the 12 utilities in Japan.

## Challenge 2 Risk of Rising Fossil Fuel Prices: Increase in Electricity Generating Costs (2010-2011)



- The increase of fossil fuel thermal power generation, which was caused by the nuclear shutdown, accounted for JPY 1.4 trillion increase from 2010 to 2011.
- Rise in primary energy prices (crude oil and natural gas prices) accounted for JPY 1.2 trillion.

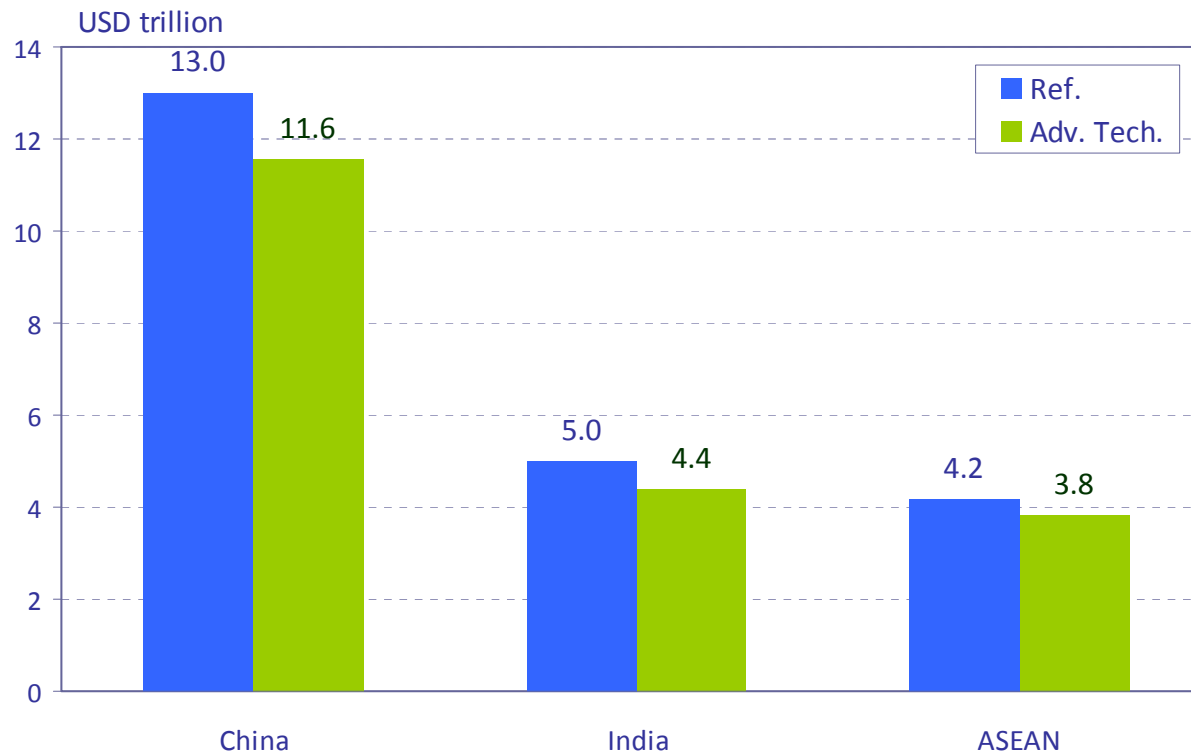
## Challenge 2 Risk of Rising Fossil Fuel Prices: Average Power Generation Cost



Source: Financial documents  
of 12 utilities in Japan

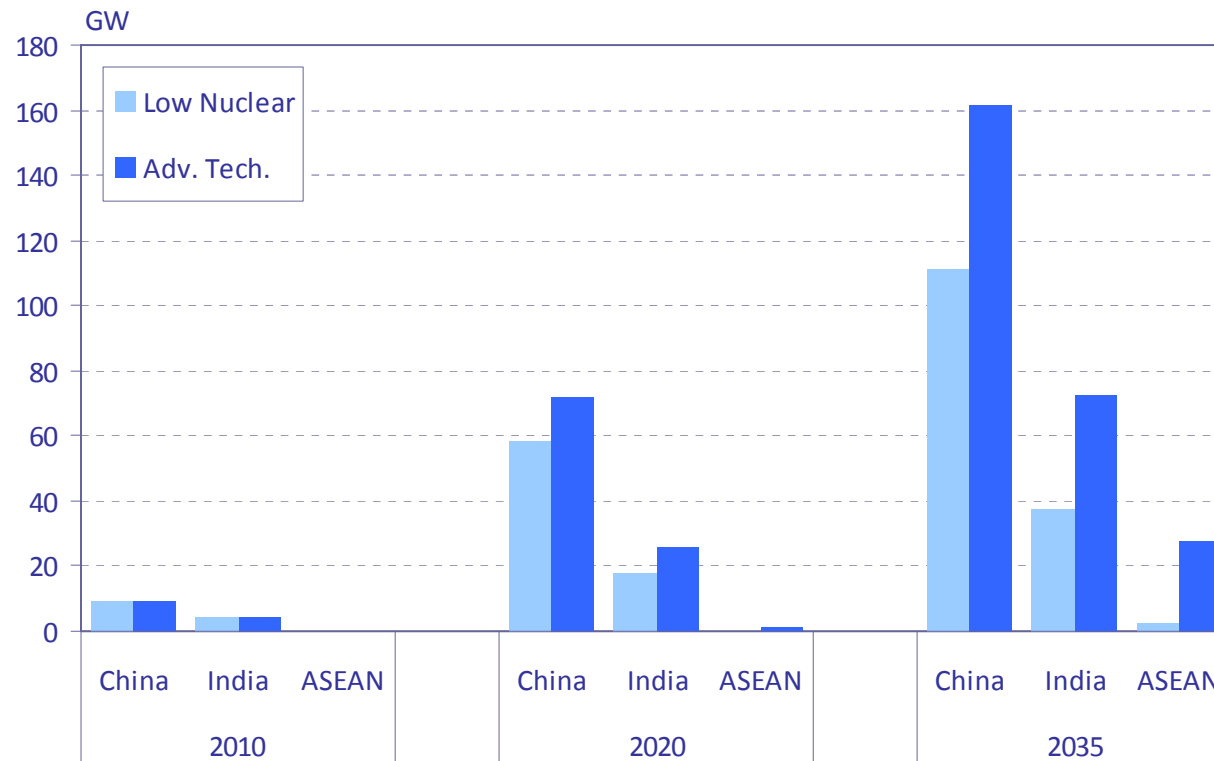
- The Average power generation cost of 12 utilities rose from JPY 8.6/kWh in 2010 to 11.6/kWh in 2011, due to the lack of restarting of nuclear power plants. It will rise further to JPY 12.6 in 2012.
- It should be noted that the risk of high fossil fuel prices and/or low exchange rate has become enormous because of the increase in thermal power generation. In case the yen-based primary energy prices become 1.5 times the current assumption, the average generating cost rises to some JPY 17/kWh.

## Challenge 2 Risk of Rising Fossil Fuel Prices: Cumulative Fuel Import Bills till 2035



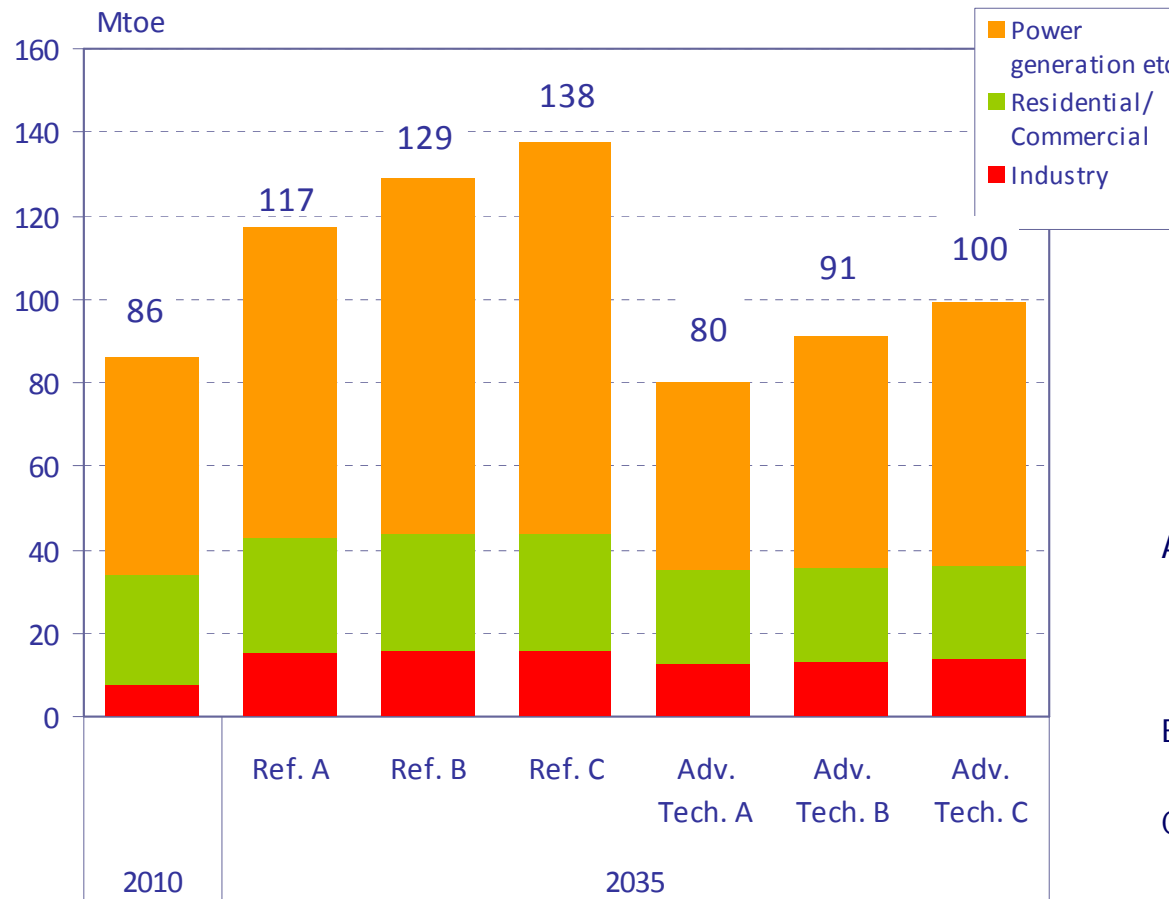
- Cumulative fuel import bills till 2035 are USD 13 trillion for China, 5 trillion for India and 4.2 trillion for ASEAN in the Reference Scenario, assuming that crude oil price will rise to USD 125/bbl in 2035. In the Advanced Technology Scenario they will be reduced by about 10% from the Reference Scenario.
- Rise in primary energy prices can cause a great impact to the economy. Fossil fuel procurement at reasonable prices is of great importance to energy importing countries.

## Challenge 3 Nuclear Safety



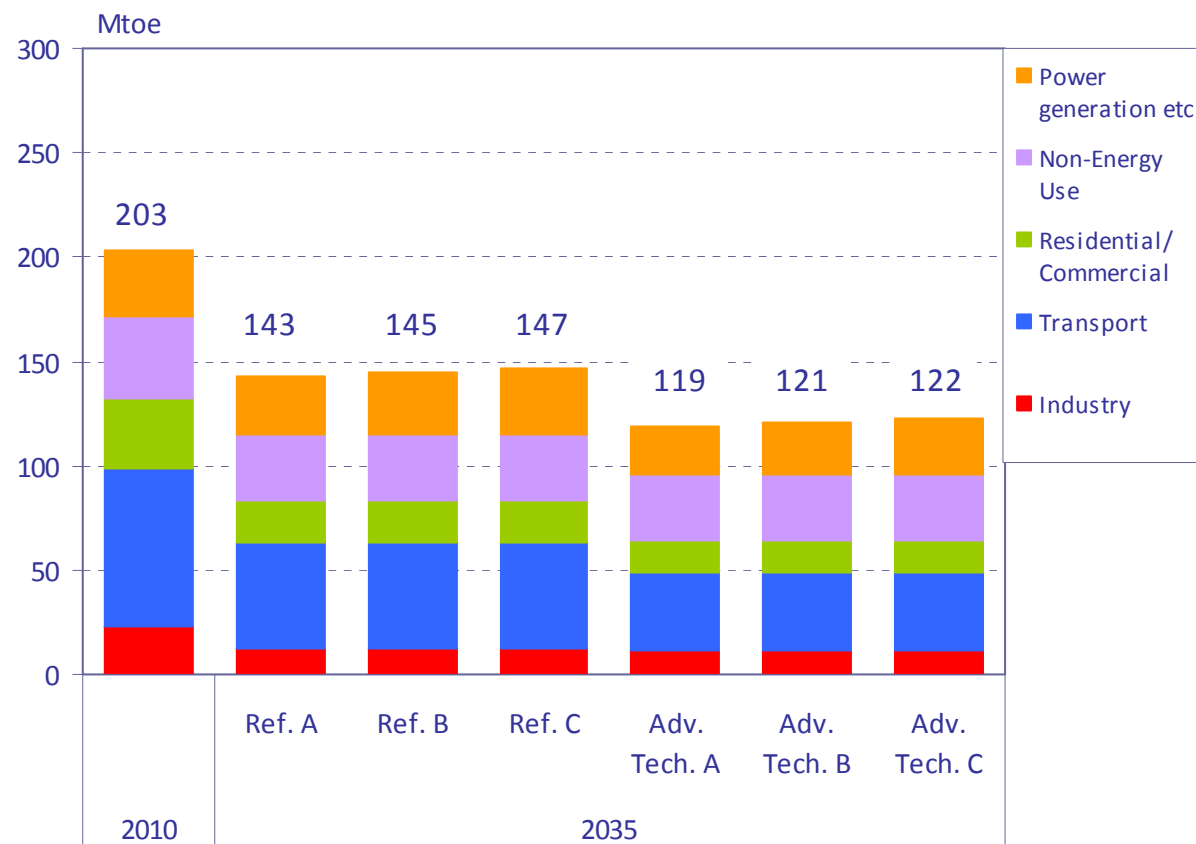
- Nuclear power generating capacity will expand rapidly, especially in such countries as China and India. In 2035, China's nuclear power capacity will exceed that of the United States in the Advanced Technology Scenario. Safety issues are particularly important for these countries. International cooperation should be stepped up to ensure the safe operation of nuclear facilities.

## Natural Gas Demand in Japan (2035)



- Japan's natural gas demand can vary greatly depending on nuclear policies.
- Right decisions on future energy mix and feasible plans to realize it are strongly needed.

## Oil Demand in Japan (2035)



- Oil demand in Japan will decline especially in the transport sector. The uncertainty due to the undecided nuclear policies is rather small, compared with natural gas and coal.



## Conclusions

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- Global energy demand will continue to grow rapidly lead by Asian economic growth. In spite of substantial diffusion of nuclear and renewable energies, fossil fuel will continue to be the most important energy source through 2035.
- Because of the decline in domestic demand and the development of unconventional resources, north America will head toward achieving self-sufficiency.
- In Asia, where crude oil production will not grow in the future, increase in oil demand directly results in increase in oil imports.
- Natural gas production can grow in Asia, but will not be able to meet the rapidly increasing demand.
- The stable increase of production by continuing to invest in development in the resource-rich countries is essential for securing the supply of oil and natural gas. On the other hand, for Asia, it is crucial to try to diversify the supply sources.
- As fossil fuel imports increase, the economy becomes more vulnerable to fossil fuel price fluctuations. As net fuel importers, Asian countries should seek to cooperate in order to strengthen price competitiveness.
- International cooperation should be stepped up to ensure the safe operation of nuclear facilities in non-OECD Asian countries. In Japan, it is especially important to make a right decision on future energy mix, with a concrete and feasible plan to realize it.