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Asia / World Energy Outlook 2011

Growing Uncertainty over International Energy Trends and the Future of Asia

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Projection Outline

● **Objective：** To present a realistic projection of world energy demand and supply. The outlook results from a fully logical and consistent way of quantifying a careful investigation of the current and anticipated socio-economic situations and applying energy fundamentals. The outlook also incorporates a particular analysis of the situation in Asia. The analysis of Asia was carefully implemented through the exchange of information with numerous research institutes and organizations in the region.

● **Projection Period：** **From 2009** to **2035 and 2050**

● **Methodology：** Energy Demand and Supply Model, Macro-Economic Model,
Bottom-up Type Technology Estimation Model

● **Scenarios：**

■ **Reference**

Reference scenario assumes highly probable deployment of energy policies and technologies based on current economic & political situations. The reference scenario provides for a normative future evolution of energy demand and supply

■ **Advanced Technologies Scenario (Adv. Tech.)**

This scenario develops future picture which assumes;

- An accelerated rate of R&D to encourage global deployment of advanced technologies.
- The promotion of a global technological cooperation with technology transfers from developed to developing countries
- The uptake by all the countries of the world of measures promoting advanced technologies.

■ **Low Nuclear Scenario**

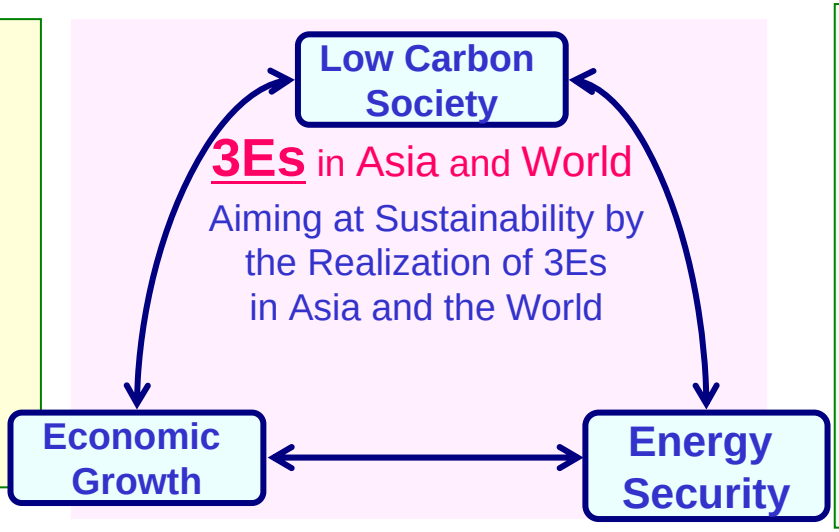
This scenario reflects policy changes after the Fukushima incident and assumes slower diffusion of nuclear power generation both in advanced and developing countries.

Towards the Realization of 3Es in Asia and in the World (Environment, Economy, Energy security)

Agenda on Energy-Environmental Policy

Firm resolutions on ensuring energy security, R&D and address climate change issues

- ■Expansion of non-fossil fuel
- ■Best mix (diversification and efficient energy use)
- ■Oil & gas supply security



Technological Strategy of Japan

Japan should focus on its competitive technological edge.

- ■Accelerated R&D for Advanced Technologies towards 2030&2050
- ■Transfer of low carbon technologies to other countries.
- ■Transfer of knowledge on establishing energy policies to other countries.
- ■Achieving economic growth by establishing new energy & environmental industry

Development and deployment of innovative technology and transformation of social system

2020

- ・Nuclear
- ・PV, Wind, Bio-fuel etc.
- ・Environmentally acceptable use of fossil fuel
  - Clean Coal Technology (IGCC, CCS)
  - MACC
- ・Clean Energy Vehicles (Plug-in Hybrid Vehicles、EV etc.)
- ・Battery technology、Power electronics etc.
- ・Fuel cell
- ・Heat-pump
- ・Smart grid, smart meter etc.

2030 2035

- Energy demand expansion in China, India etc.
- Risk of extraordinary price escalation of fossil fuel (Peak-out of Easy Oil)
- Massive introduction of innovative technologies

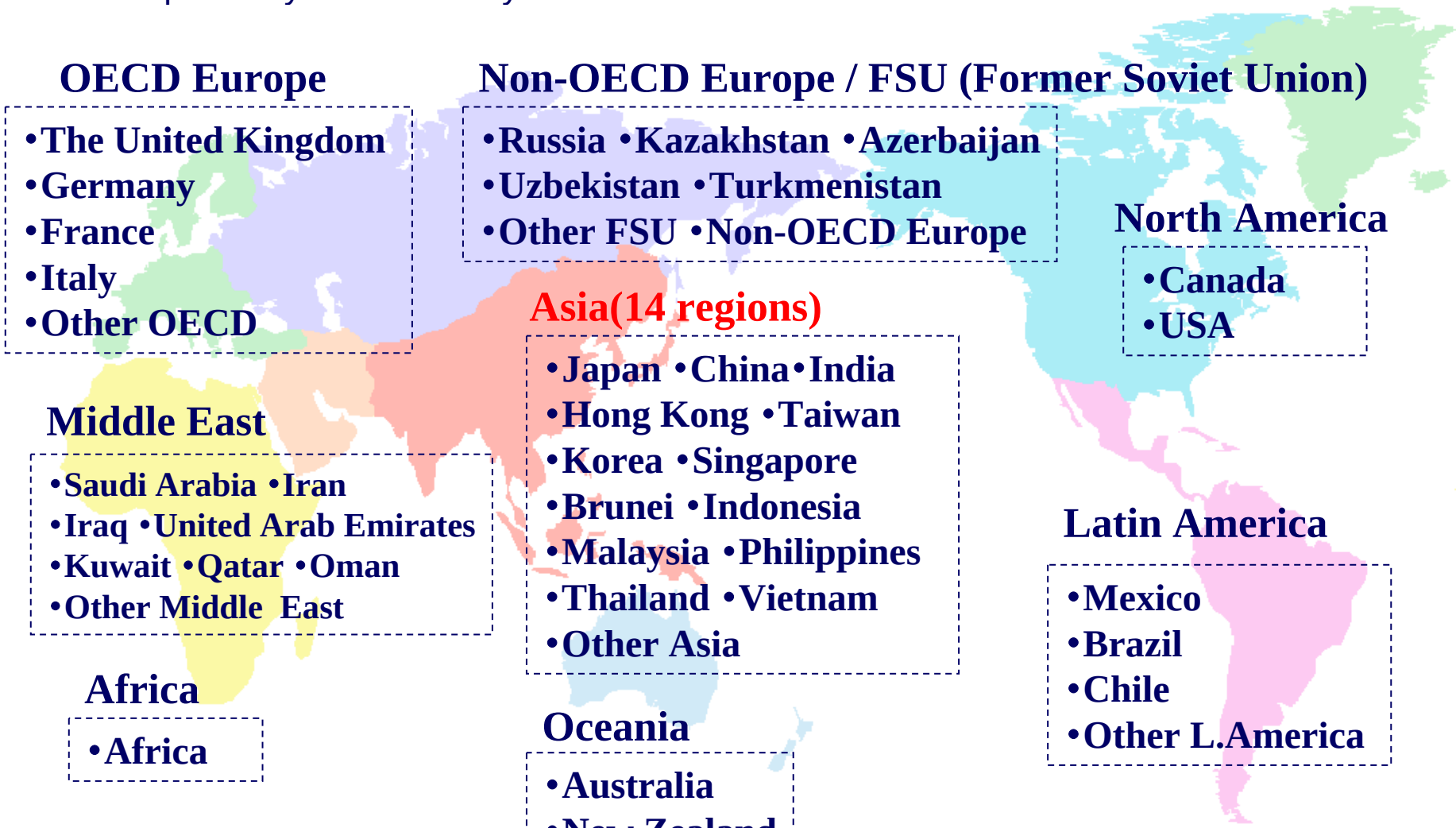
Acceleration of development of low carbon technology
⇒Sustainable economic growth

2050

- ・Fast Breeder Reactor (FBR)
- ・SPS
- ・Innovative industrial process
- ・Geo-engineering
- ・Distributed energy system
- ・Low carbon towns/cities
- ・Hydrogen society
- ・3R (reuse, reduce, recycle) technology

Geographical Coverage

- The world is geographically divided into 43 regions, of which Asia represents 14 regions.
- Geopolitically detailed analysis into Asian countries.



OECD Europe
- The United Kingdom
- Germany
- France
- Italy
- Other OECD

Non-OECD Europe / FSU (Former Soviet Union)
- Russia
- Kazakhstan
- Azerbaijan
- Uzbekistan
- Turkmenistan
- Other FSU
- Non-OECD Europe

North America
- Canada
- USA

Asia(14 regions)
- Japan
- China
- India
- Hong Kong
- Taiwan
- Korea
- Singapore
- Brunei
- Indonesia
- Malaysia
- Philippines
- Thailand
- Vietnam
- Other Asia

Middle East
- Saudi Arabia
- Iran
- Iraq
- United Arab Emirates
- Kuwait
- Qatar
- Oman
- Other Middle East

Latin America
- Mexico
- Brazil
- Chile
- Other L.America

Africa
- Africa

Oceania
- Australia
- New Zealand

Modeling Framework

Macro-Economic Model†

- GDP components
- Price/Labor etc.
- Industrial activities
- Transport activities

GDP, Crude oil price, Exchange rate, Population, Power generation outlook, World trade etc.

† *Development of country-specific macro economic model in China, Korea and ASEAN countries (Indonesia, Malaysia, Philippines, Thailand)*

Energy Demand-Supply Model

- Energy Demand
- Conversion Sector
- Energy Supply

World Trading Model of Crude Oil and Petroleum Products (LP Optimization)

End-use Energy Technology Model (Automobile, Electric Appliances etc.)

CO_2 emissions

These models allow for a better understanding of the interactions among numerous parameters, in a logical and consistent way.

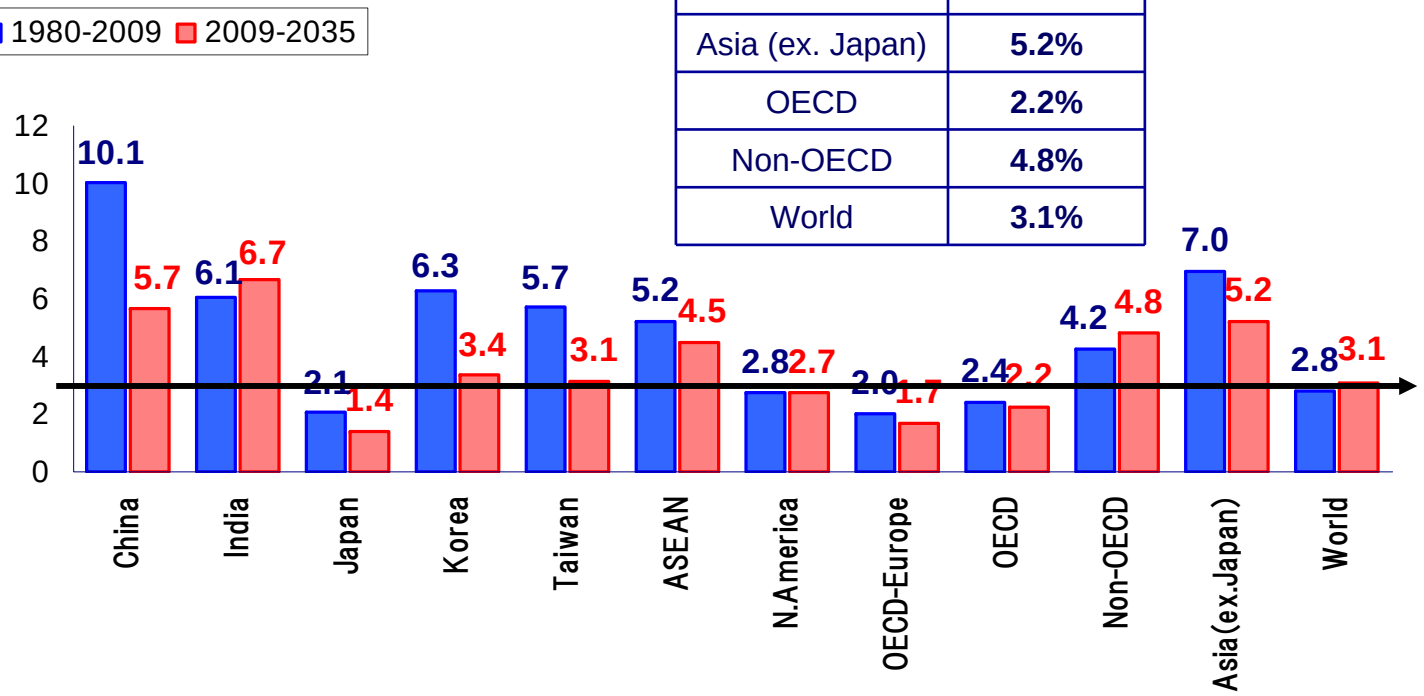
Outline - Asia/World Energy Outlook 2011 -

- **Major Assumptions**
  - GDP, Population, and Energy Prices
- **Separate Projection Results for World and Asia**
  - Primary Energy Demand, and CO_2 Emissions
  - Motorization, Power Generation Mix, and Renewables
  - Nuclear Energy Outlook After Fukushima Incident (Low Nuclear Scenario)
- **Energy Outlook in China and India**
- **Energy Outlook through 2050**
- **Implications**

Major Assumptions： Gross Domestic Product

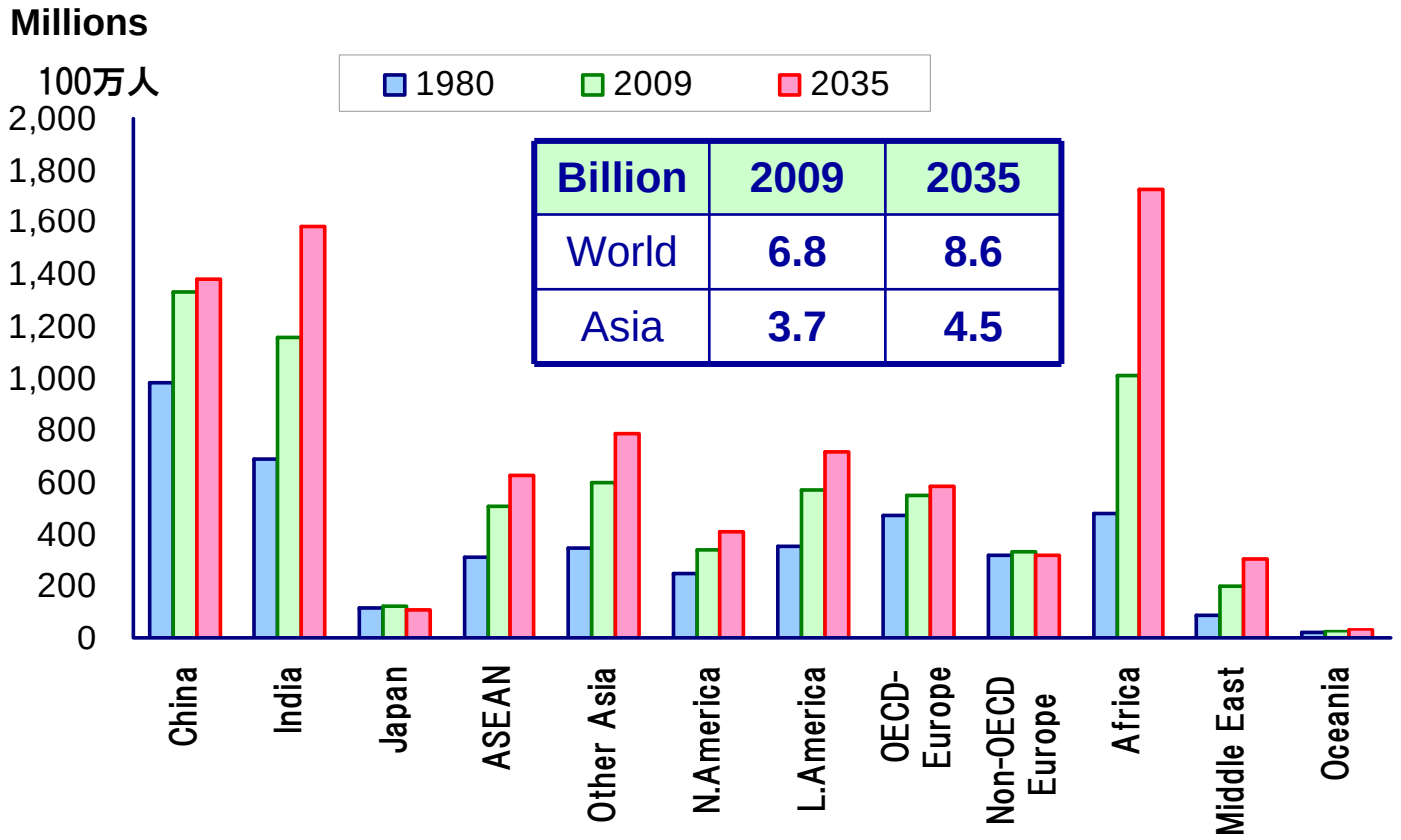
Average Annual Growth Rate (%)

	2009-2035
China	5.7%
India	6.7%
Asia (ex. Japan)	5.2%
OECD	2.2%
Non-OECD	4.8%
World	3.1%



■World economy will continue to grow at more than 3% per annum, through to 2035. The economic stimulus measures by numerous countries will bring an early recovery from the globally felt financial crisis that slowed recent economic growth.
■GDP in China will continue to achieve an annual growth rate of 5.7% shifting from the investment- and export-driven growth to the domestic demand-driven one.
■GDP in India will register high growth at 6.7% per year, reflecting increases in improved labor quality, and liberalization and direct investment from foreign countries.
■ASEAN countries will achieve steady economic growth supported by industrialization and export increases.

Major Assumptions： Population



Billion	2009	2035
World	6.8	8.6
Asia	3.7	4.5

China

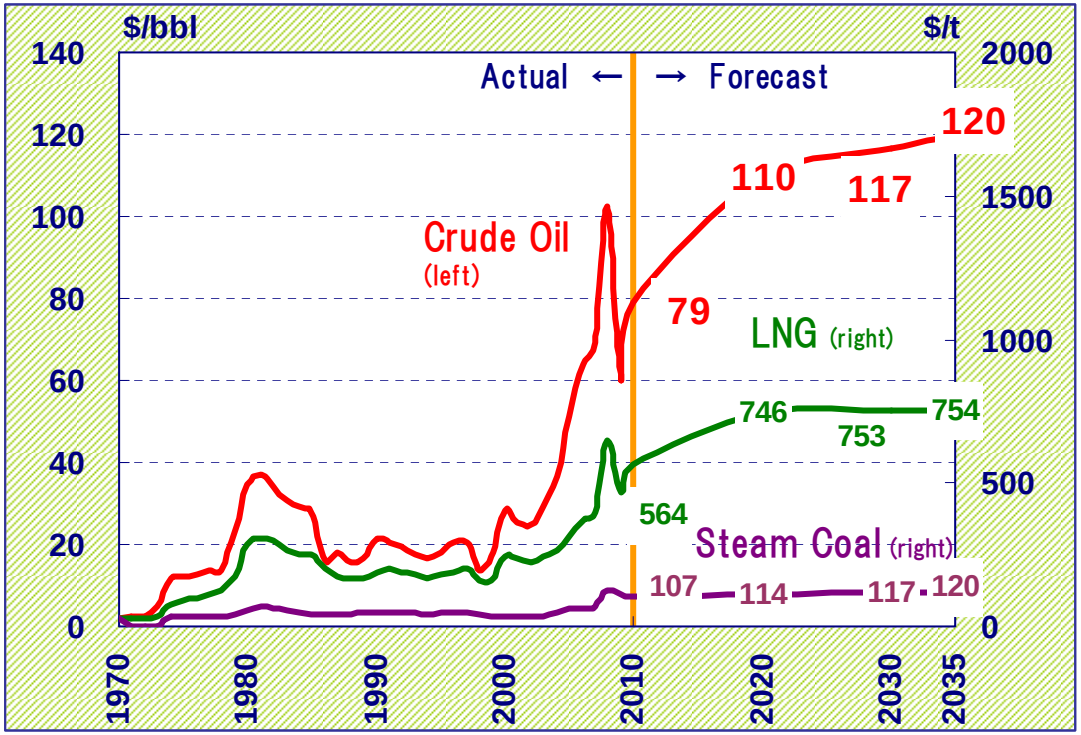
2009
1.33 bil
↓
2035
1.38 bil
(**0.05** bil growth)

India

2009
1.16 bil
↓
2035
1.58 bil
(**0.42** bil growth)

- Developing countries account for roughly 90% of the increase in world population over the period 2009-2035,.
- China's population will peak in 2030 as a result of past and current declining birth rate.
- India's population will surpass China during the 30's representing the biggest in the world by 2035.
- China and India, together, will account to almost 3 billion by 2035 (one third of the world population).

Major Assumptions: Energy Prices (2010 $ real)



In the graph, energy prices are expressed as Japan's import energy prices (on a CIF basis).

- After the record spike to $100 per barrel in 2008, crude oil prices returned to its earlier path and will continue to increase in the future resulting from the tight balance between demand and supply. Oil demand is projected to increase driven mainly by Asia, while upstream investment may not progress at a pace meeting the demand growth.
- LNG price is projected to gradually increase led by oil prices.
- Coal price will show relatively moderate growth compared with the crude oil and LNG.

Energy Prices and Relative Prices

【Real Price & Nominal Price】

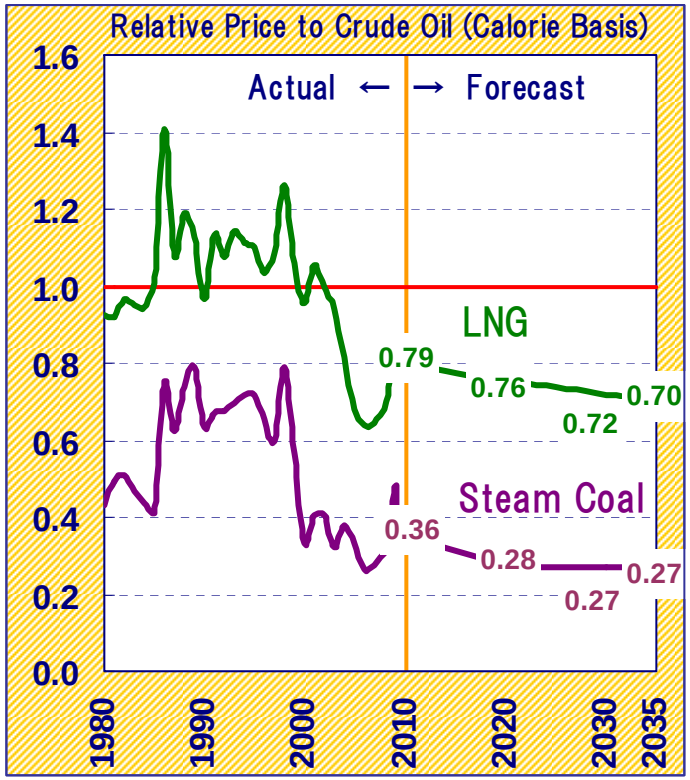
		2000	2010	2020	2030	2035
Crude Oil	Real	35	79	110	117	120
USD/bbl	Nominal	28	79	134	173	197
LNG	Real	297	564	746	753	754
USD/t	Nominal	244	564	910	1,118	1,237
Steam Coal	Real	43	107	114	117	120
USD/t	Nominal	35	107	139	173	197

【LNG Price Relative to Crude Oil】

	2010	2020	2030	2035
Crude Oil	1.0	1.0	1.0	1.0
LNG (Japan)	0.79	0.76	0.72	0.70
LNG (Europe)	0.50	0.54	0.58	0.60
LNG (USA)	0.35	0.37	0.39	0.40

* Real prices are set in 2010.
** Inflation rates are assumed at 2% annually.

【Relative Prices (Crude Oil = 1)】



■ The gap among regional LNG prices will be smaller with time because of increasing inter-regional trade etc.
■ Relative price of coal will remain roughly constant through 2035.

Assumptions on Advanced Technologies Scenario

Countries in the world are assumed to strengthen the numerous measures that contribute to energy security and address global warming issues. Technological development and its international transfer will be promoted and, as a result, advanced technologies will become widely and commercially available internationally.

Regulation, National target, SSL etc.	Promotion of R&D, International Cooperation
Carbon Tax, Emissions Trading, RPS, Subsidy Provisions, FIT, Efficiency Standards, Automobile Fuel Efficiency Standard, Low Carbon Fuel Standard, Energy Efficiency Labeling, and National Target.	Encouragement of Investment for R&D, International Cooperation on Energy Efficient Technology, Support on Establishment of Efficiency Standard

【Demand Side Technologies】

■ Industry

Best available technology on industrial processes will be deployed internationally (steel making, cement, paper, oil refinery, etc.).

■ Transport

Clean energy vehicles will be globally utilized (highly fuel efficient, hybrid, plug-in hybrid, electric and fuel cell vehicles).

■ Building

All available efficient technologies will be widely in use. (electric appliances , water-heating system, air conditioning system, lighting, and insulation technologies）

【Supply Side Technologies】

■ Renewables

Accelerated penetration of Wind, PV, concentrated Solar Power, biomass power generation, and bio-fuels

■ Nuclear

Further expansion of nuclear power plants, and enhancement of operating ratio

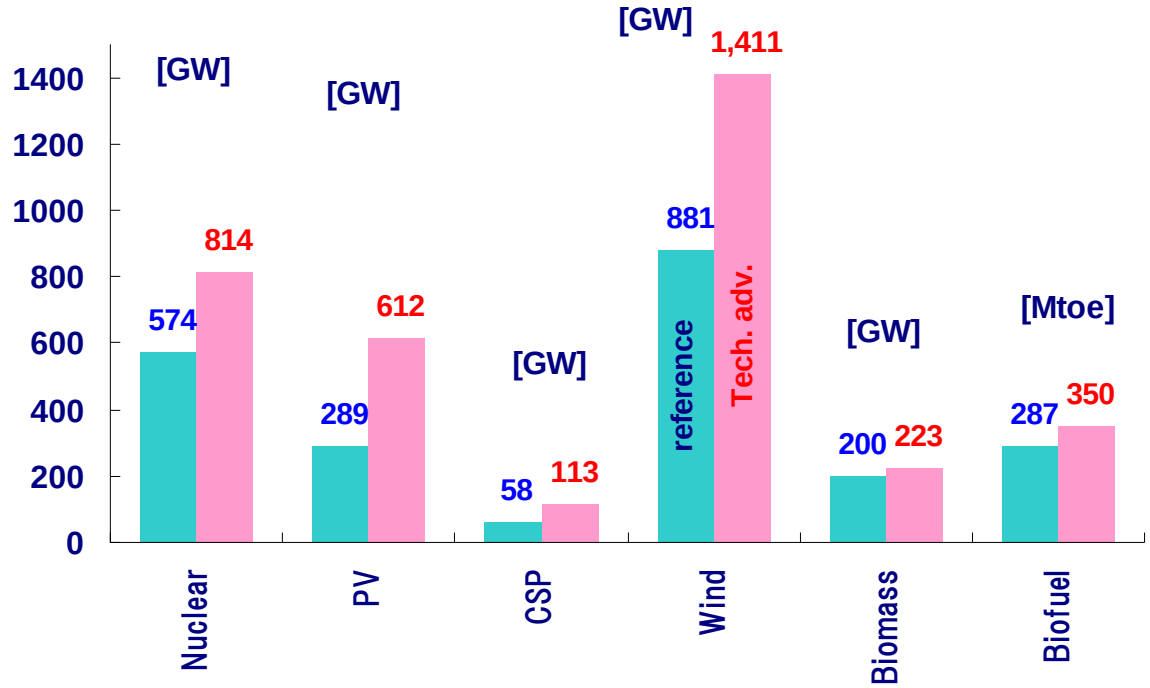
■ Highly Efficient Power Plants

For coal-fired power plant (USC, IGCC, IGFC), For natural gas plants (More Advanced Combined Cycle)

■ CCS

Introduction in fossil fuel-fired power plants as well as in some industrial sectors

Assumptions on Adv. Tech. Scenario (World, 2035)



Non-fossil fuel (Mtoe)

2009
1,400 Mtoe
↓
2035

Reference	Adv.Tech
2,600 Mtoe	**3,400 Mtoe**
(1.9-fold inc)	(2.4-fold inc)

Share of non-fossil fuel

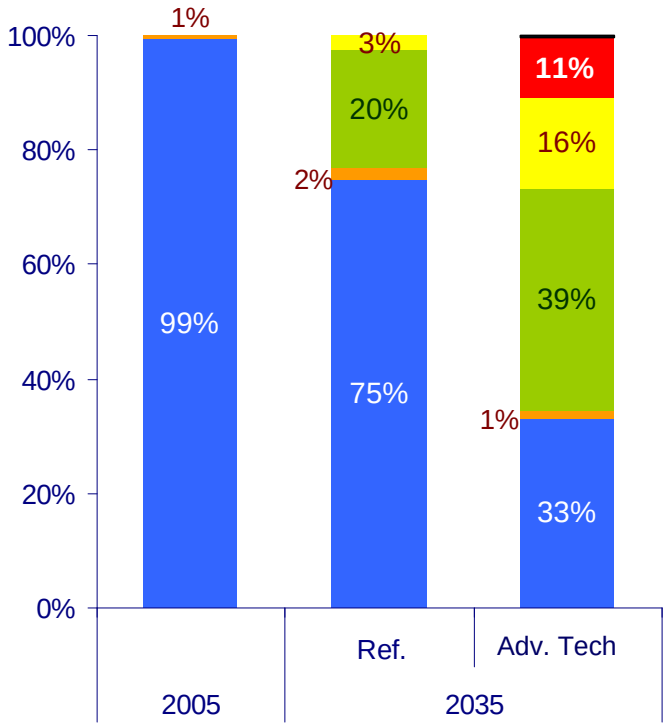
2009
12%
↓
2035

Reference	Adv.Tech.
15%	**23%**

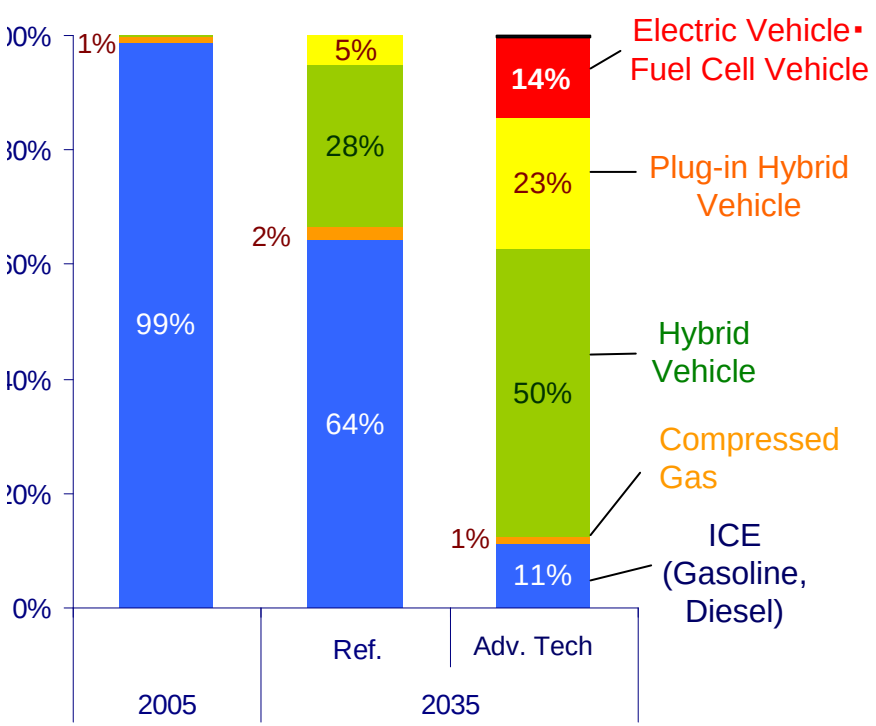
- Further expansion of nuclear and renewables is likely to be realized at the same pace as global electricity demand growth.
- Biofuel will expand substantially when cellulosic biofuel becomes commercially viable. Cellulosic biofuel does not compete with food production and land use.
- By 2035, the industry, building and transport sectors will achieve further savings of 400 Mtoe (13%), 600 Mtoe (16%) and 400 Mtoe (14%) respectively , compared to the reference scenario.
- Average efficiency of fossil fuel-fired power generation will reach 43% by 2035, compared to the reference scenario at 41%.

Vehicle Stock and Sales by Type (World)

【The Share of Vehicle Stocks by Type (World)】



【The Share of Vehicles' Annual Sales by Type (World)】



Share of clean energy vehicles in total stocks (2035)

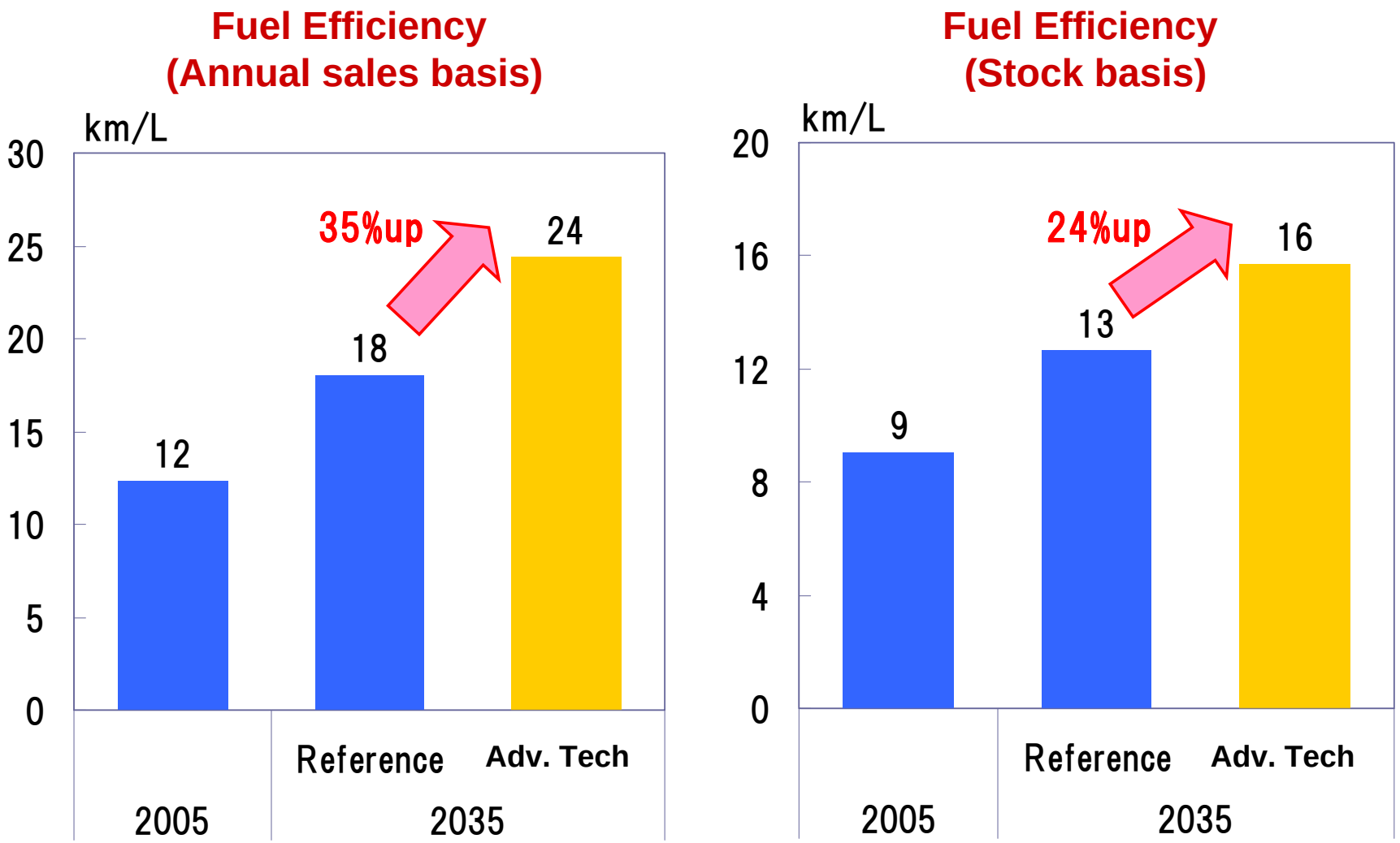
Reference **25 %**
Adv. Tech **67 %**

Share of clean energy vehicles in annual sales (2035)

Reference **36 %**
Adv. Tech **89 %**

In the Advanced Techologies Scenario, clean energy vehicles will gradually account for almost 90% of the annual sales by 2035, and comprise two-thirds of the total stock.

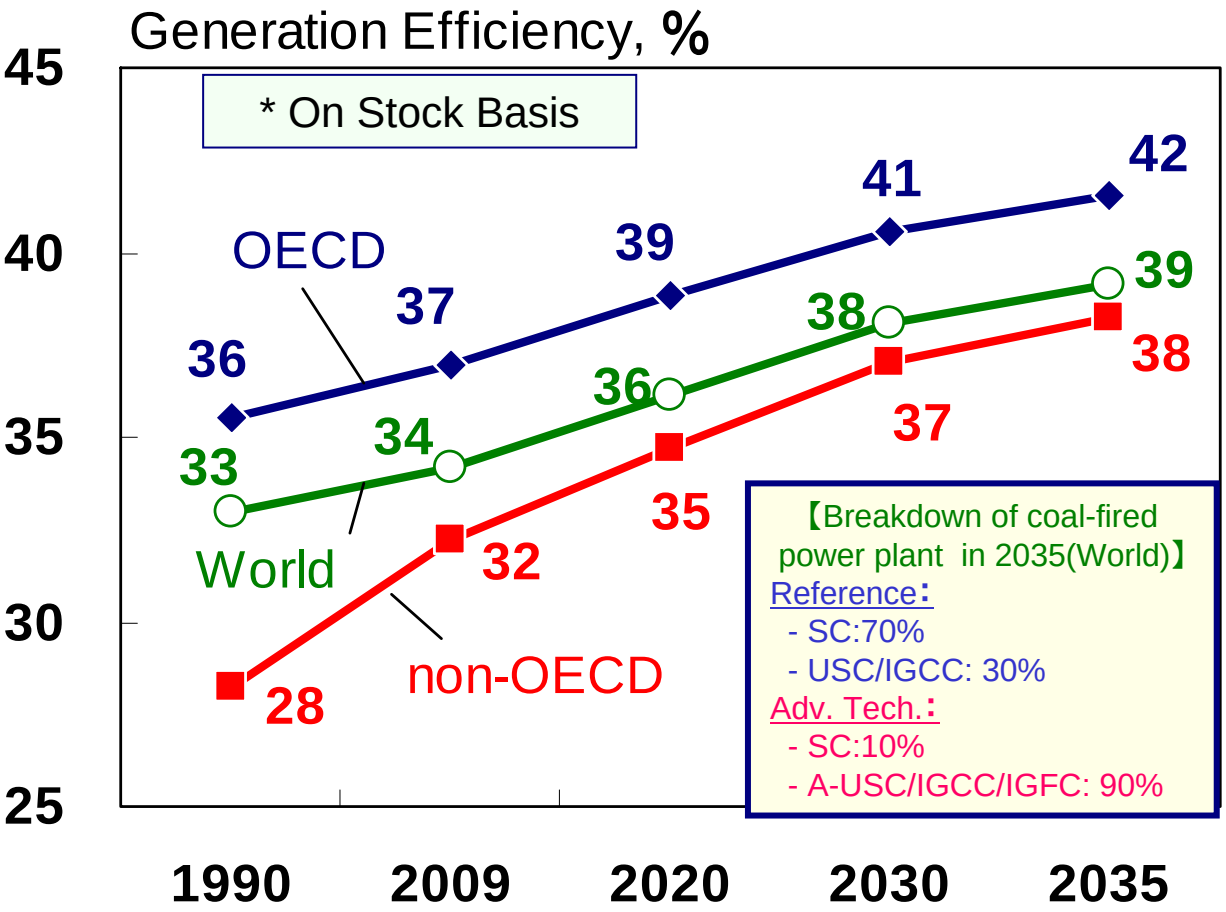
Fuel Efficiency of Passenger Vehicles (World)



In 2035, the passenger vehicles' fuel efficiency in the Adv. Tech. Scenario will achieve a 35% improvement in comparison with the Reference Scenario, raising the average stock by 24%.

Power Generation Efficiency of Coal-fired Power Plant

Power Generation Efficiency of Coal-fired Power Plant *(Reference)

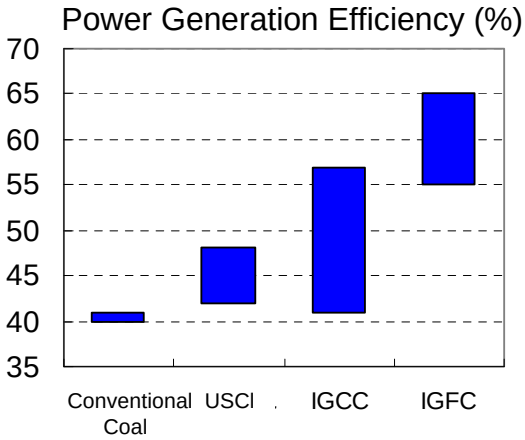


Stock-based Efficiency of Coal-fired Power Plant (World)

2009
34 %
↓
2035

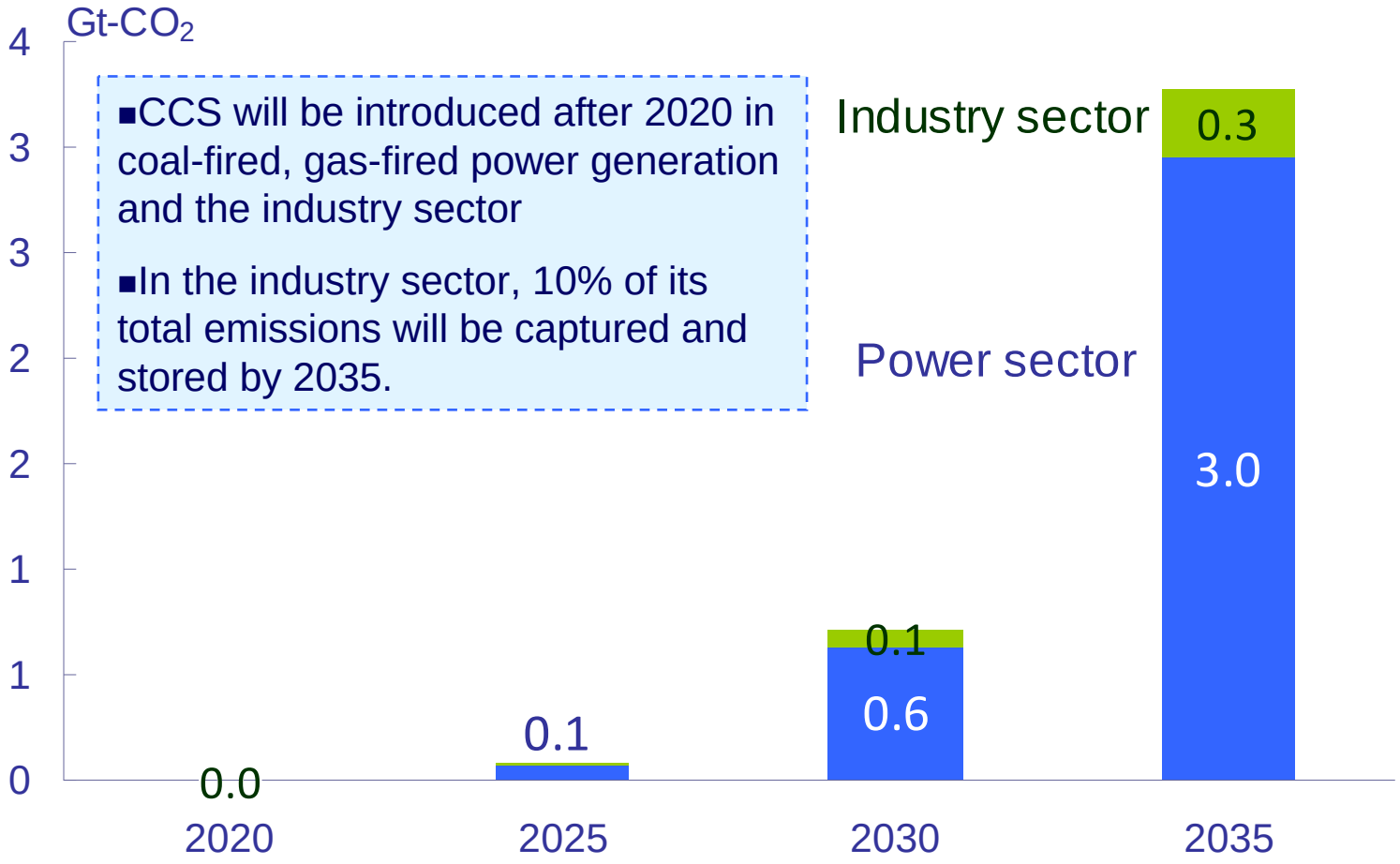
Reference	Adv. Tech
39 %	**42 %**
(**5**points up)	(**7**points up)

Advanced Coal-fired Plant



In the Adv.Tech. Scenario, coal-fired generation efficiency will increase by a further 3 % compared to the Reference Scenario. As a result of this enhancement in efficiency, an additional 1.0 Gt-CO_2 will be reduced.

CO_2 Capture & Storage (CCS)

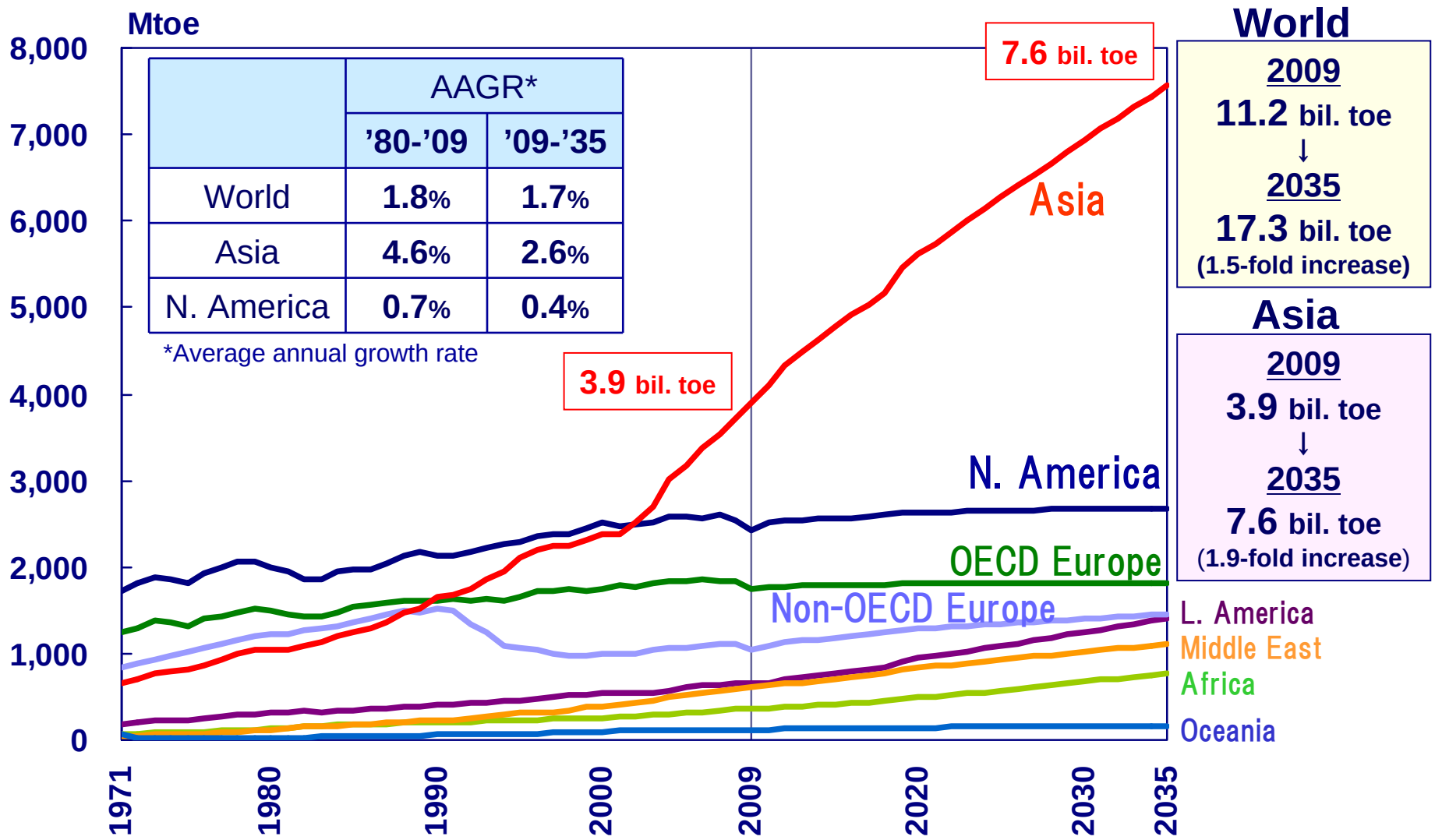


■ Cumulative captured and stored CO_2 from 2020 to 2035 will reach 12 Gt. That projected CO_2 emissions reduction from the CCS in the Tech. Adv. Scenario can be easily accommodated in geological structures (estimated at 10 trillion tons) and in depleted gas, oil and coal fields (estimated at1 trillion tons).

Energy Outlook in Asia and the World 2009-2035

Primary Energy Demand by Region (World)

Reference



■ Reflecting high economic growth for Asian countries, primary energy demand in Asia will double by 2035 from current levels; 3.9 billion toe(2009) → 7.6 billion toe(2035).

■ Non-OECD countries will represent 90% of incremental growth of global energy demand.

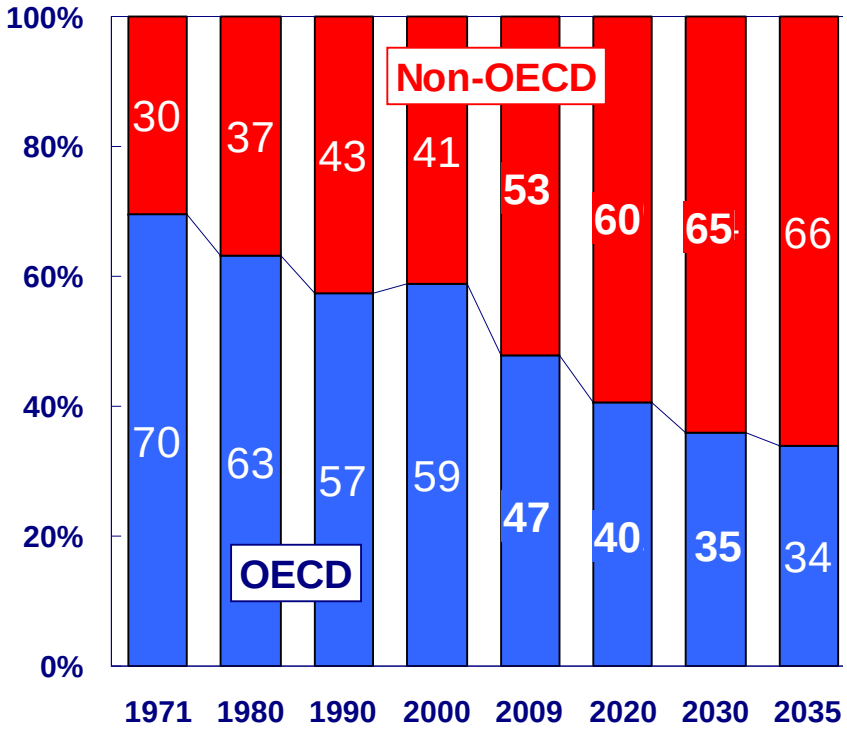
Primary Energy Demand (Regional Share)

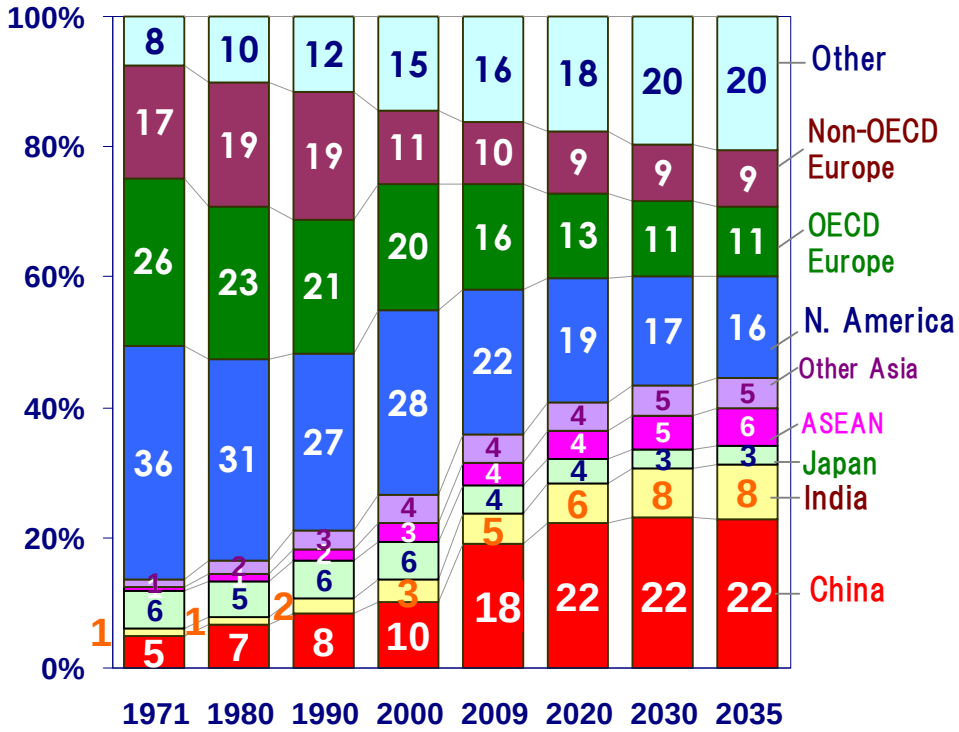
Reference

Share in increase (2009-2035)

China	India	Japan	ASEAN	Other Asia	N. America	OECD Europe
31%	15%	0%	10%	6%	4%	1%

Asia occupies more than 60% of total growth.

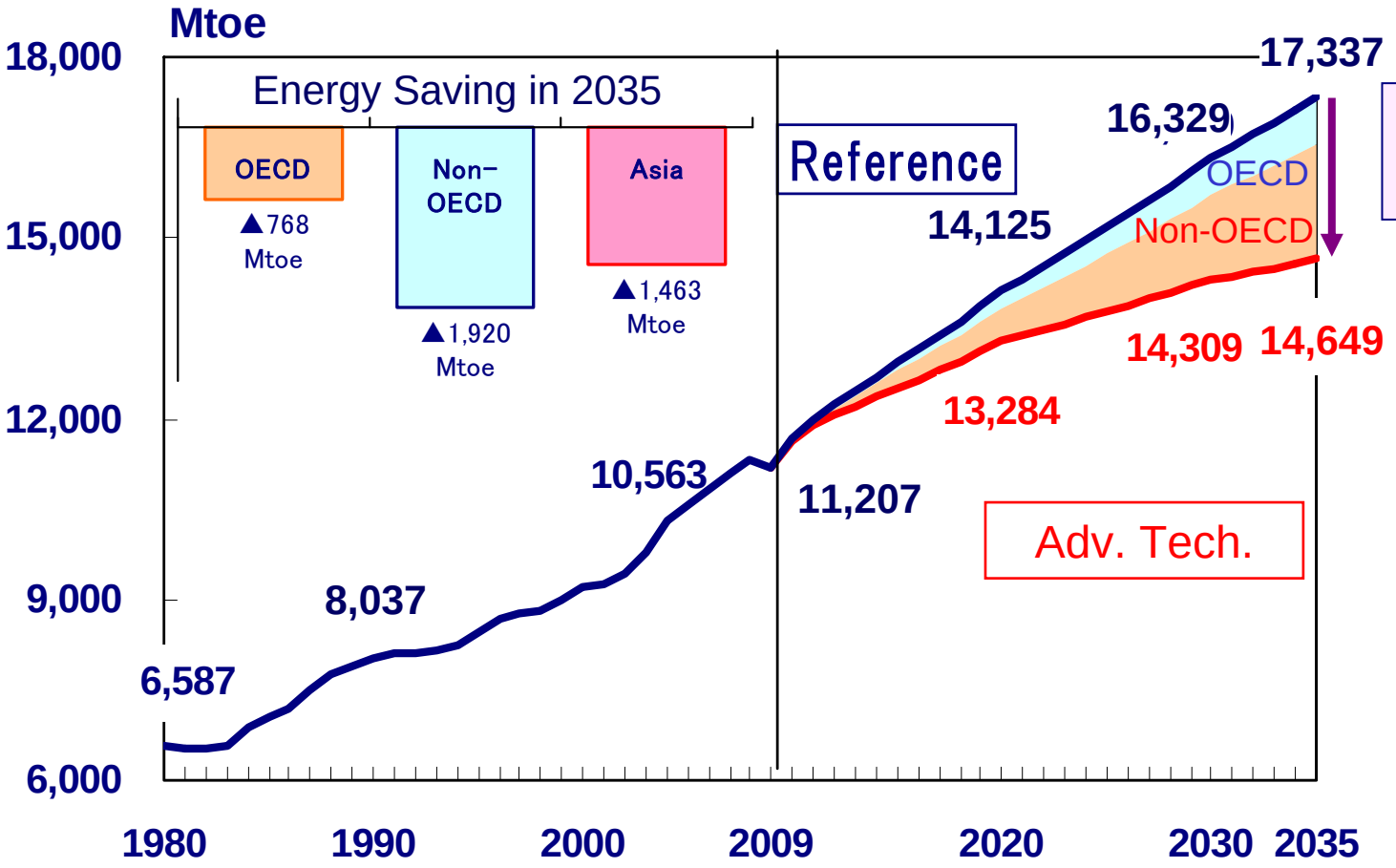




- Reflecting steady economic growth, energy demand in Non-OECD will exceed that of OECD.
- Energy demand in Asia will exhibit a rapid growth, with the share of Asia in the world energy demand expanding from 35% in 2009 to 44% by 2035.
- The share of China in the world energy demand will increase to 22% by 2035, and India to 8% (a total of 30%). The share of Japan will decline from 4% in 2009 to 3% of world energy demand in 2035.

Primary Energy Demand (World)

Reference
Adv. Tech.



▲2,688 Mtoe
(▲16% of total saving)

OECD
▲768 Mtoe
(29% of total saving)

Non-OECD
▲1,920 Mtoe
(71% of total saving)

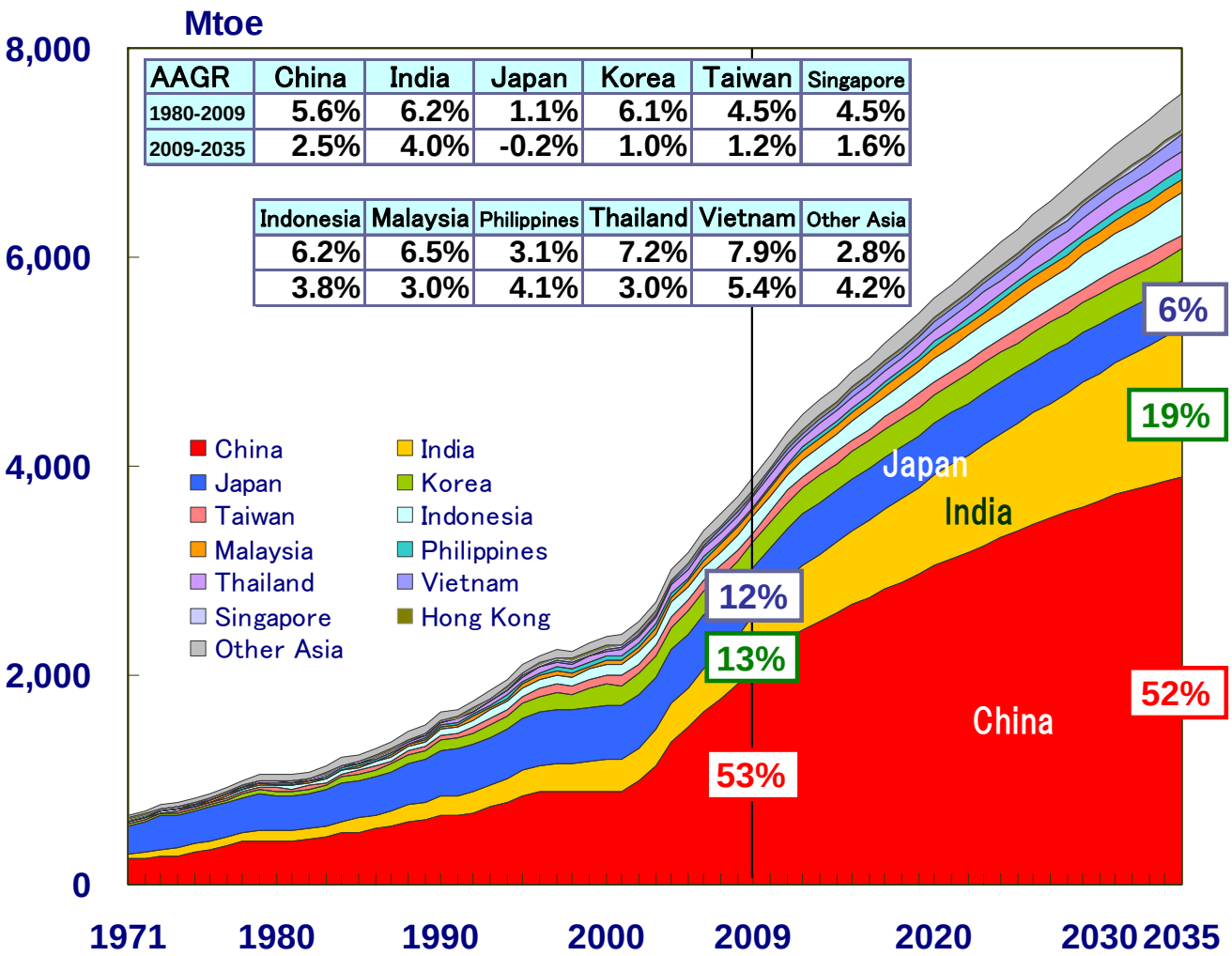
Asia
▲1,463 Mtoe
(54% of total saving)

■ In 2035, total primary energy demand in the Adv. Tech Scenario will be 2,688 Mtoe (about 16%) lower than the Reference Scenario. This saving is more than 5 times Japan's total demand in 2009.

■In the Adv. Tech. Scenario, Non-OECD countries will contribute more than two thirds of the potential savings. The potential in Asia is particularly significant.

Primary Energy Demand (Asia)

Reference



AAGR	China	India	Japan	Korea	Taiwan	Singapore
1980-2009	5.6%	6.2%	1.1%	6.1%	4.5%	4.5%
2009-2035	2.5%	4.0%	-0.2%	1.0%	1.2%	1.6%

Indonesia	Malaysia	Philippines	Thailand	Vietnam	Other Asia
6.2%	6.5%	3.1%	7.2%	7.9%	2.8%
3.8%	3.0%	4.1%	3.0%	5.4%	4.2%

Asia

2009

3.9 bil. toe

↓

2035

7.6 bil. toe

(**1.9-fold increase**)

China / India

2009

2.1 bil. toe / 0.51 bil. toe

↓

2035

3.9 bil. toe / 1.4 bil. Toe

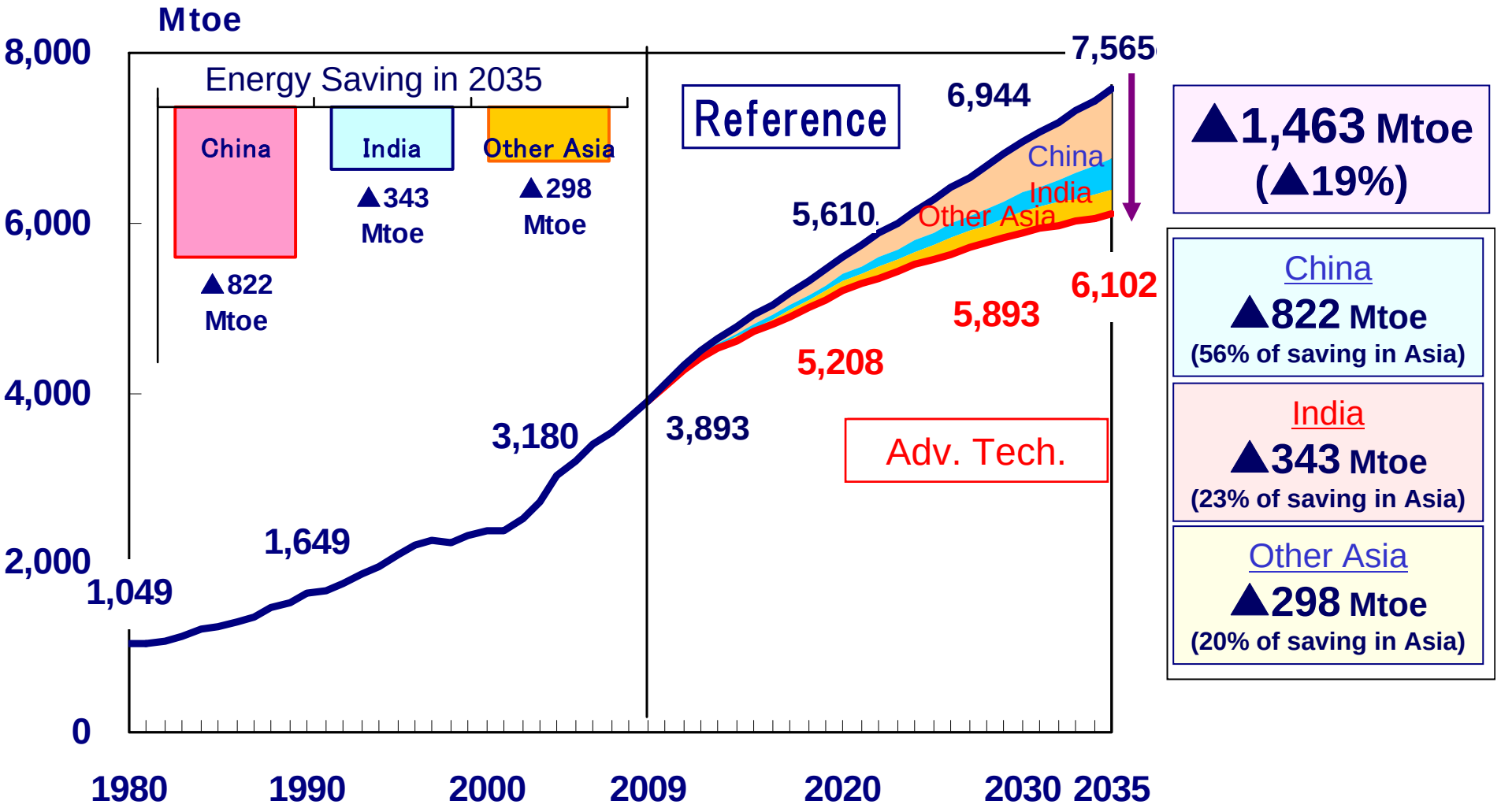
(**1.9-fold inc. / 2.8-fold inc.**)

■ 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 2009 to 6% in 2035.

Primary Energy Demand (Asia)

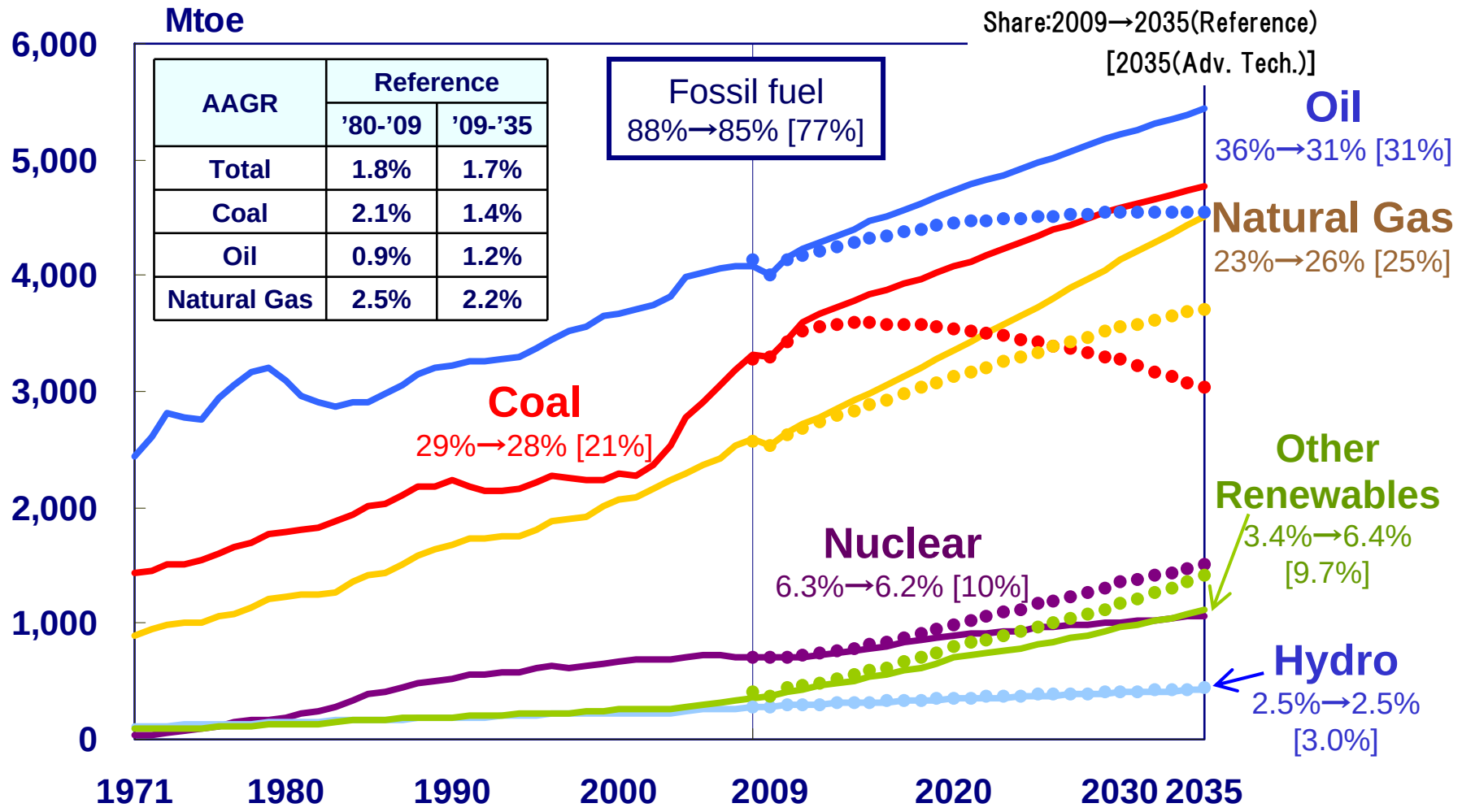
Reference
Adv. Tech.



■ The potential savings in Asia under the Adv. Tech. Scenario will be 1,500 Mtoe (equivalent to about three times Japan's current consumption). China and India which represents 70% of the Asian's demand, will have 80% of the saving potential.

Primary Energy Demand by Type (World)

Solid line: Reference
Dotted line: Adv. Tech.



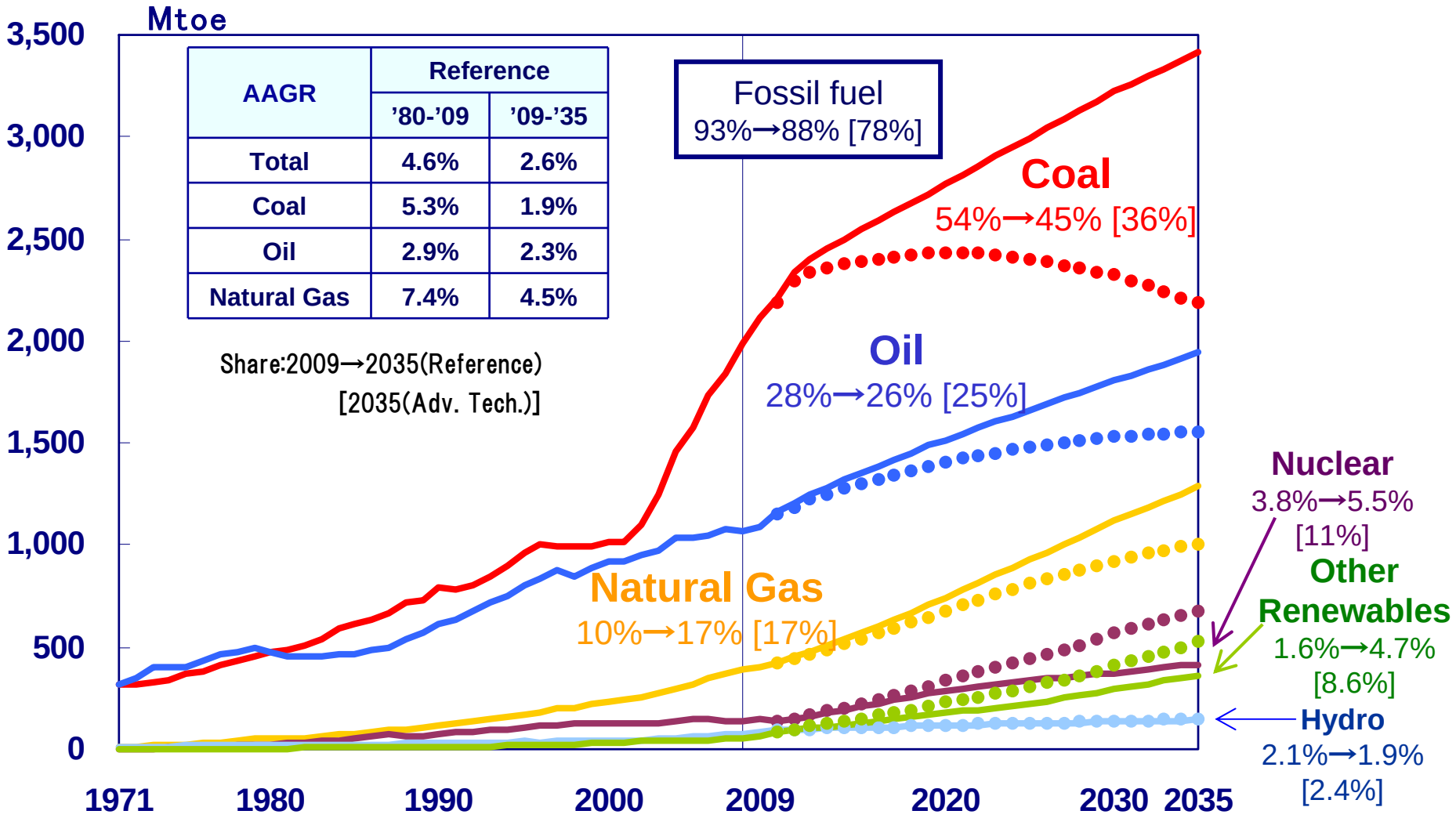
AAGR	Reference	
	'80-'09	'09-'35
Total	1.8%	1.7%
Coal	2.1%	1.4%
Oil	0.9%	1.2%
Natural Gas	2.5%	2.2%

■In the Reference scenario, fossil fuels will continue to increase in use and account for more than 85% of the primary energy mix and each one will maintain their ranking in terms of share.

■In the Adv. Tech. Scenario, however, coal use will start its decline within a few years to reach levels lower than current consumption by 2035. Oil demand will peak by 2030 and natural gas (with its extensive use in various sectors) will continue to grow at a lower pace throughout the period to 2035.

Primary Energy Demand by Type (Asia)

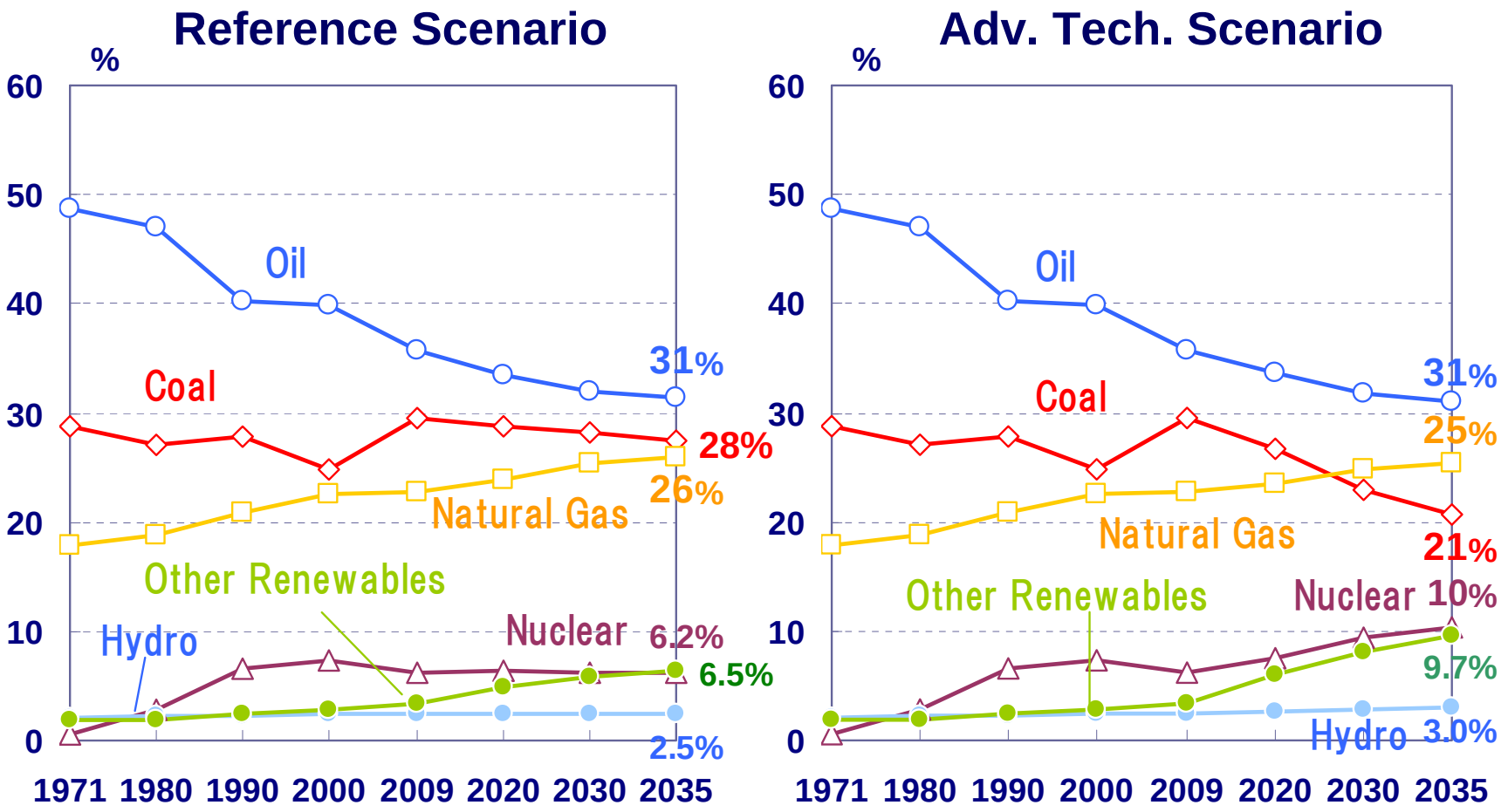
Solid line: Reference
Dotted line: Adv. Tech.



■ Although coal and oil will continue to maintain the dominant share of energy demand through 2035, their combined shares will diminish from over 80% today to 70% and could further be reduced to 60% under Adv. Tech.

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

Primary Energy Mix (World) CHART 28 is better

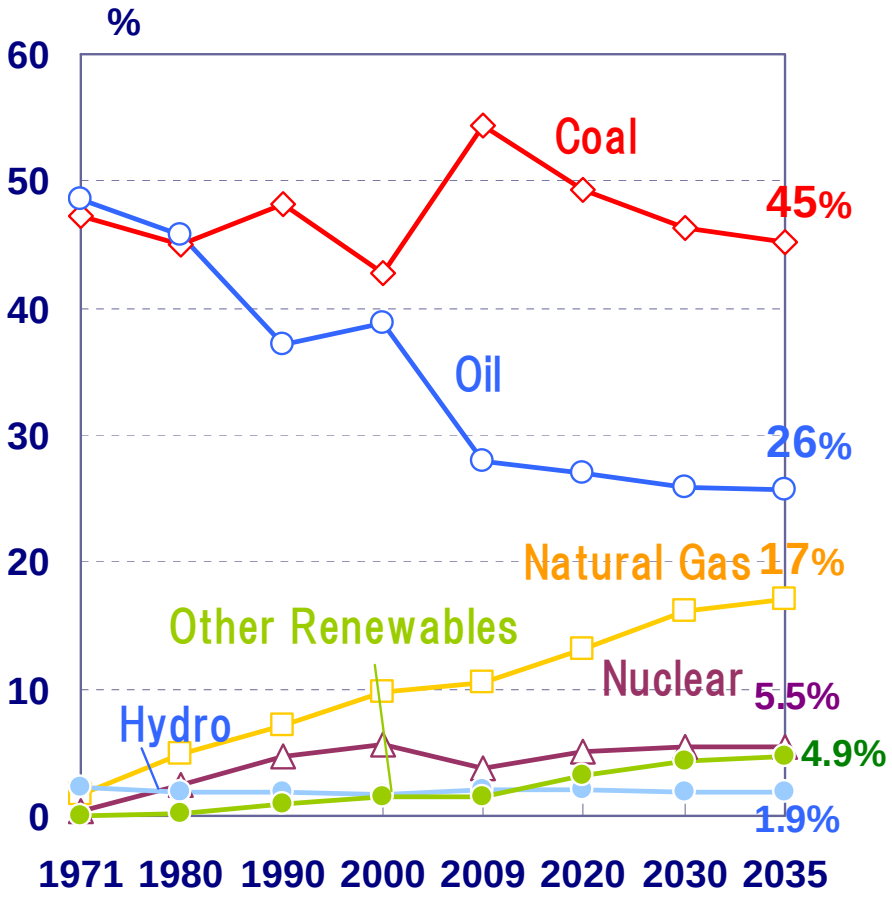


■ In both Scenarios, the oil's share decreases substantially to 31%, while the share of natural gas and renewables will expand substantially.

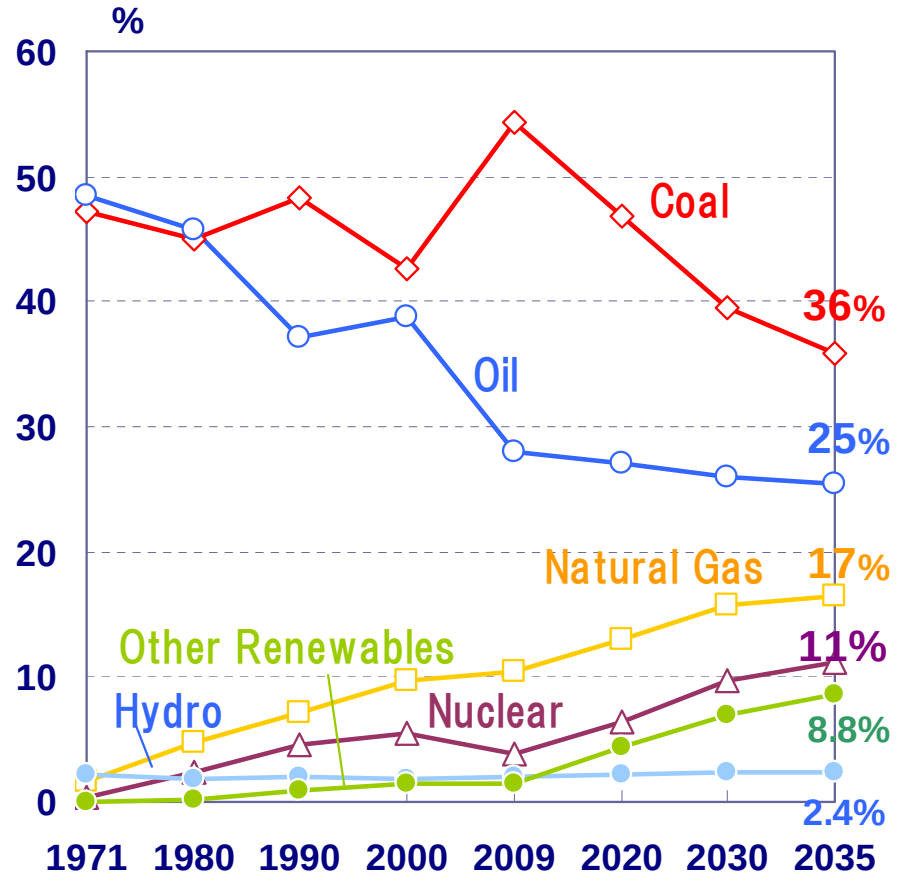
■ In the Adv. Tech. Scenario, coal will significantly decrease mainly in Non-OECD. The share of nuclear and renewables will gradually expand. Fossil fuel will remain the most important fuel in primary energy mix in 2035, maintaining the 77% share.

Primary Energy Mix (Asia) CHART 28 is better

Reference Scenario



Adv. Tech. Scenario

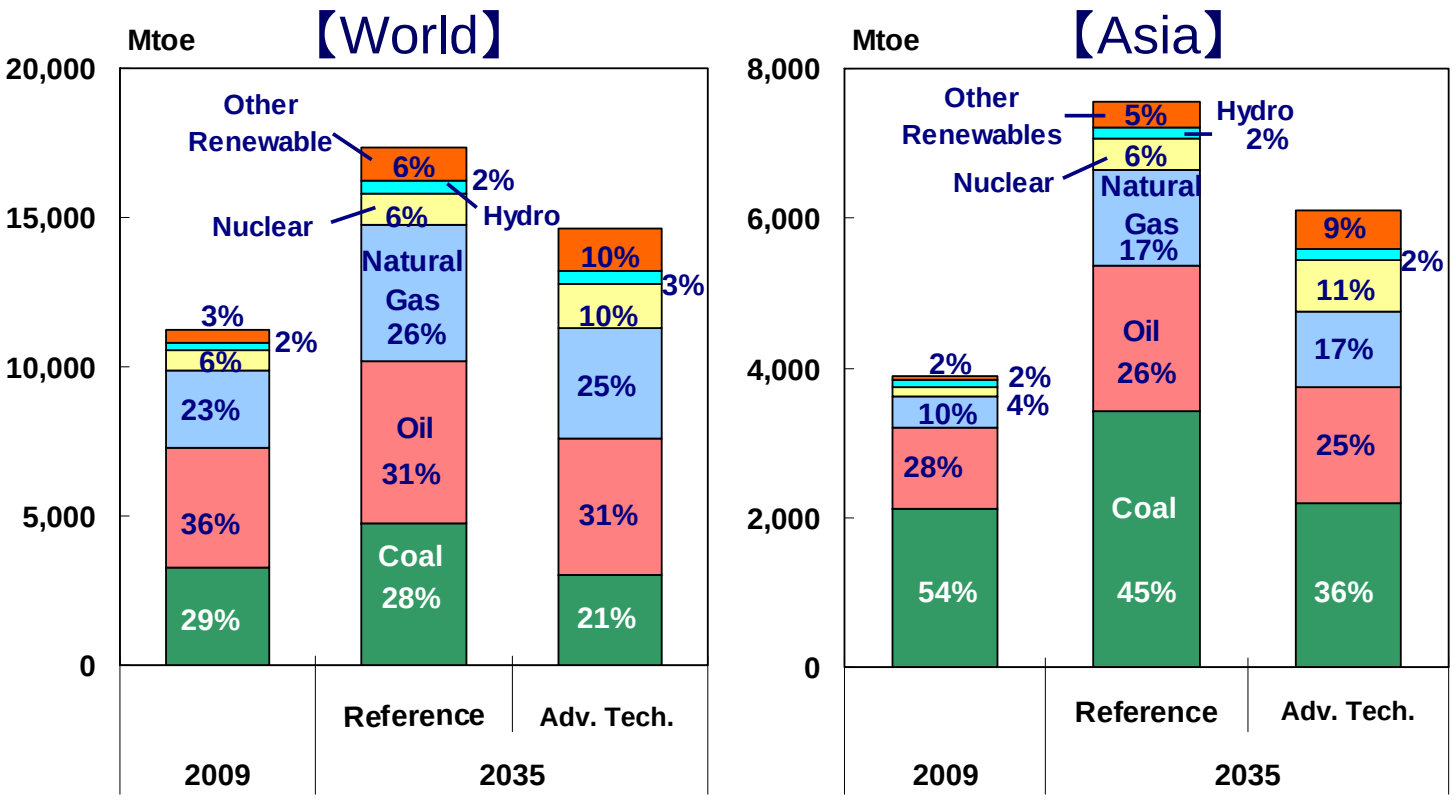


■ Coal will keep the biggest share of primary energy demand driven by the electric power demand through 2035. (The coal's share in Asia: 54% (2009) →45% (2035) in Reference, 36% (2035) in Adv. Tech.)

■ Natural gas in both scenarios will continue to grow. In the Adv. Tech. Scenario, the share of nuclear will gradually increase with active building-up of nuclear power plants in China, India and South Korea.

Primary Energy Mix (World, Asia)

Reference
Adv. Tech.



Share of Non Fossil Fuel (World)

2009
12 %
↓
2035

Reference	Adv. Tech.
15 %	**23 %**
(3%up)	**(11%up)**

Share of Non Fossil Fuel (Asia)

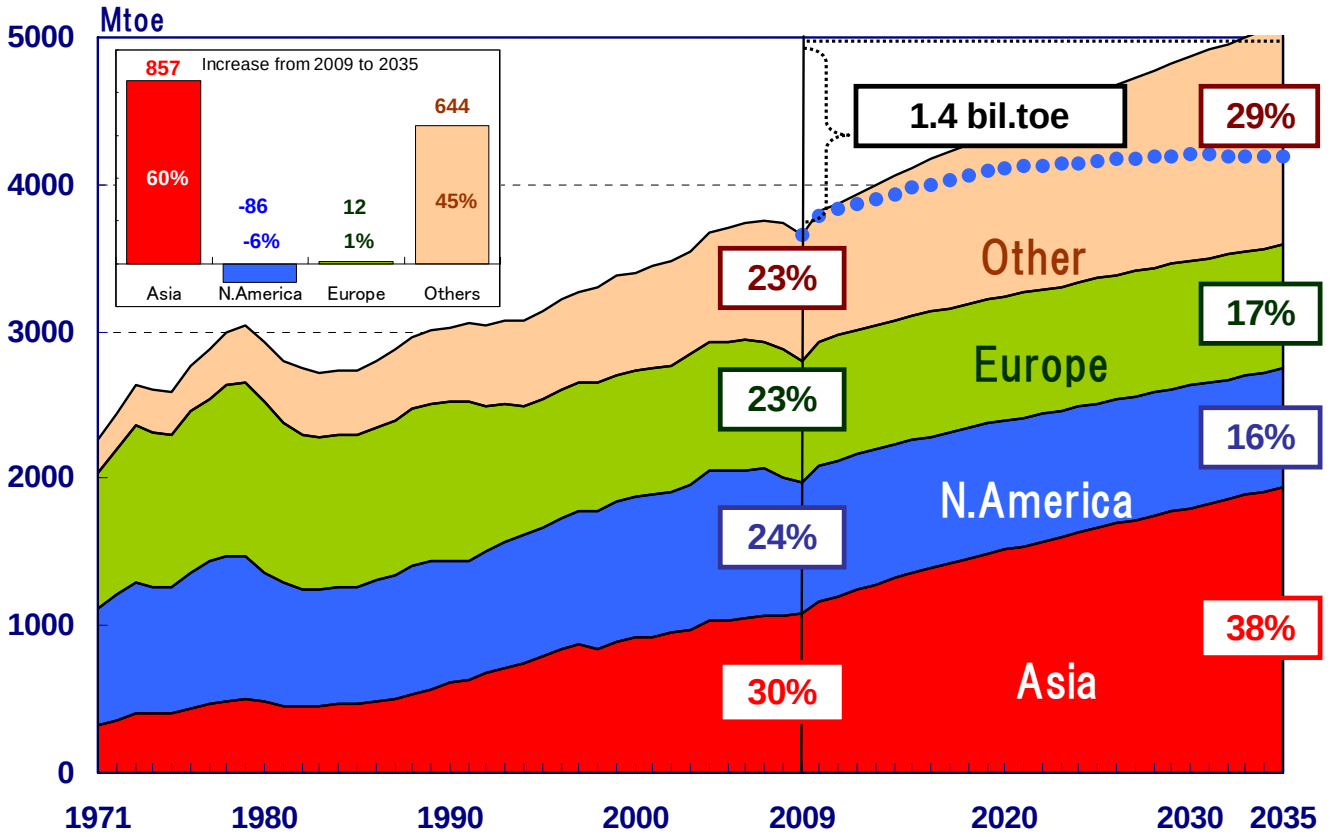
2009
7 %
↓
2035

Reference	Adv. Tech.
12 %	**22 %**
(5%up)	**(15%up)**

- In the Adv. Tech. Scenario, the share of non fossil fuel in the energy demand will increase to 22/23%, in 2035.
- Of course fossil fuel will continue to be the most important fuel in the world and Asia by 2035.

Oil Demand by Region (World)

Solid line: Reference
Dotted line: Adv. Tech.



0.90 bil
(18%)
Saving

2009
4.0 bil
(81 mbd**)**

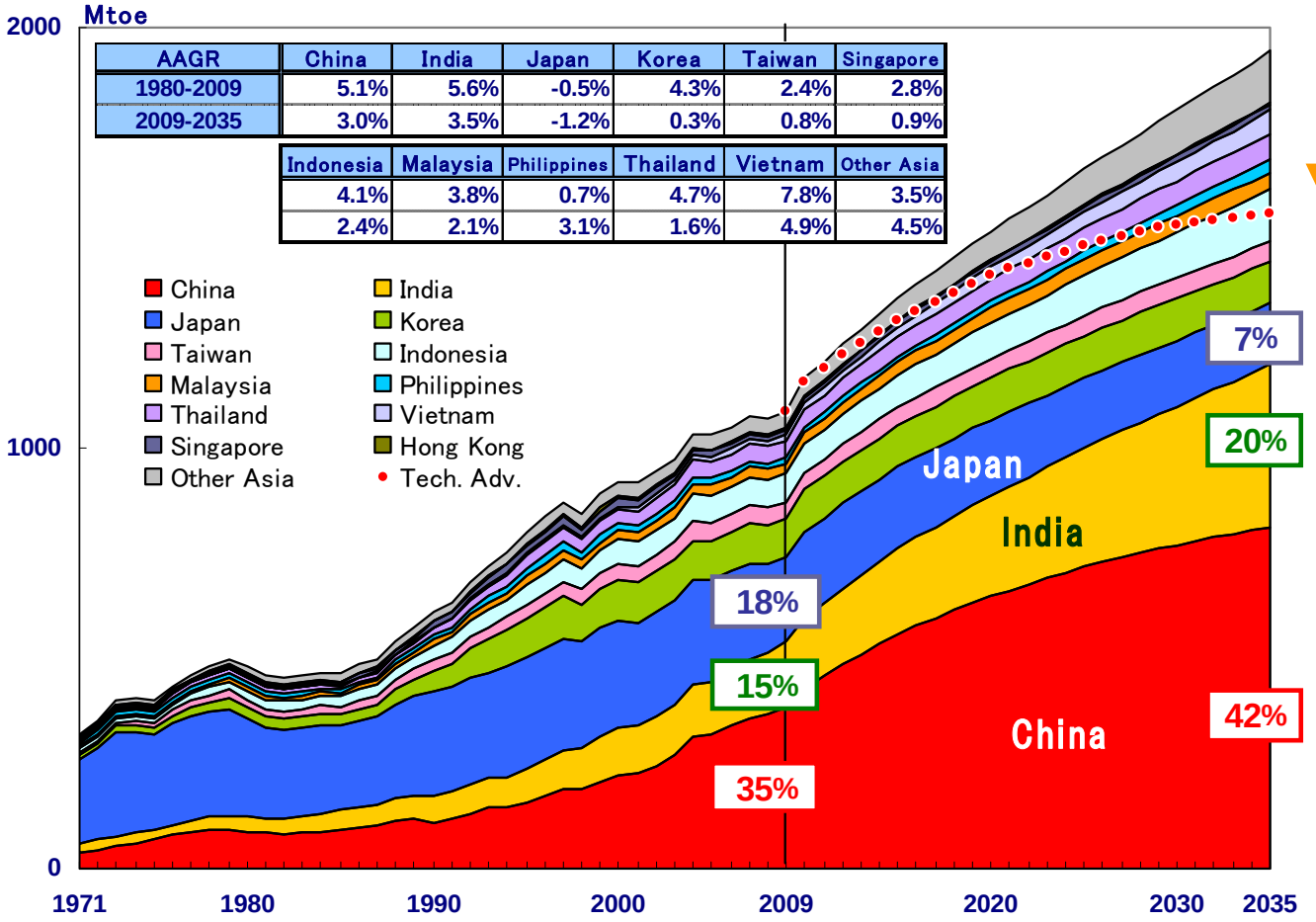
2035
Reference
5.4 bil **(110** mbd**)**

Adv. Tech.
4.5 bil **(92** mbd**)**

- The share of Asia in the world oil demand will increase from 30% (2009) to 38% (2035). About 60% of the global oil growth will take place in Asia,
- Oil demand in OECD started to decrease in 2005. As this trend will continue through 2035, the share of OECD will decrease from about 50% in 2009 to 33% in 2035.
- In the Adv. Tech. the world oil demand will peak in 2030 as a result of vehicle fuel efficiency improvement. Oil demand will be 0.90 billion ton (18%) lower in 2035 compared with the Reference Scenario.

Oil Demand by Region (Asia)

Reference
Adv. Tech.



AAGR	China	India	Japan	Korea	Taiwan	Singapore
1980-2009	5.1%	5.6%	-0.5%	4.3%	2.4%	2.8%
2009-2035	3.0%	3.5%	-1.2%	0.3%	0.8%	0.9%

Indonesia	Malaysia	Philippines	Thailand	Vietnam	Other Asia
4.1%	3.8%	0.7%	4.7%	7.8%	3.5%
2.4%	2.1%	3.1%	1.6%	4.9%	4.5%

0.39 bil
(20%)
Reduction

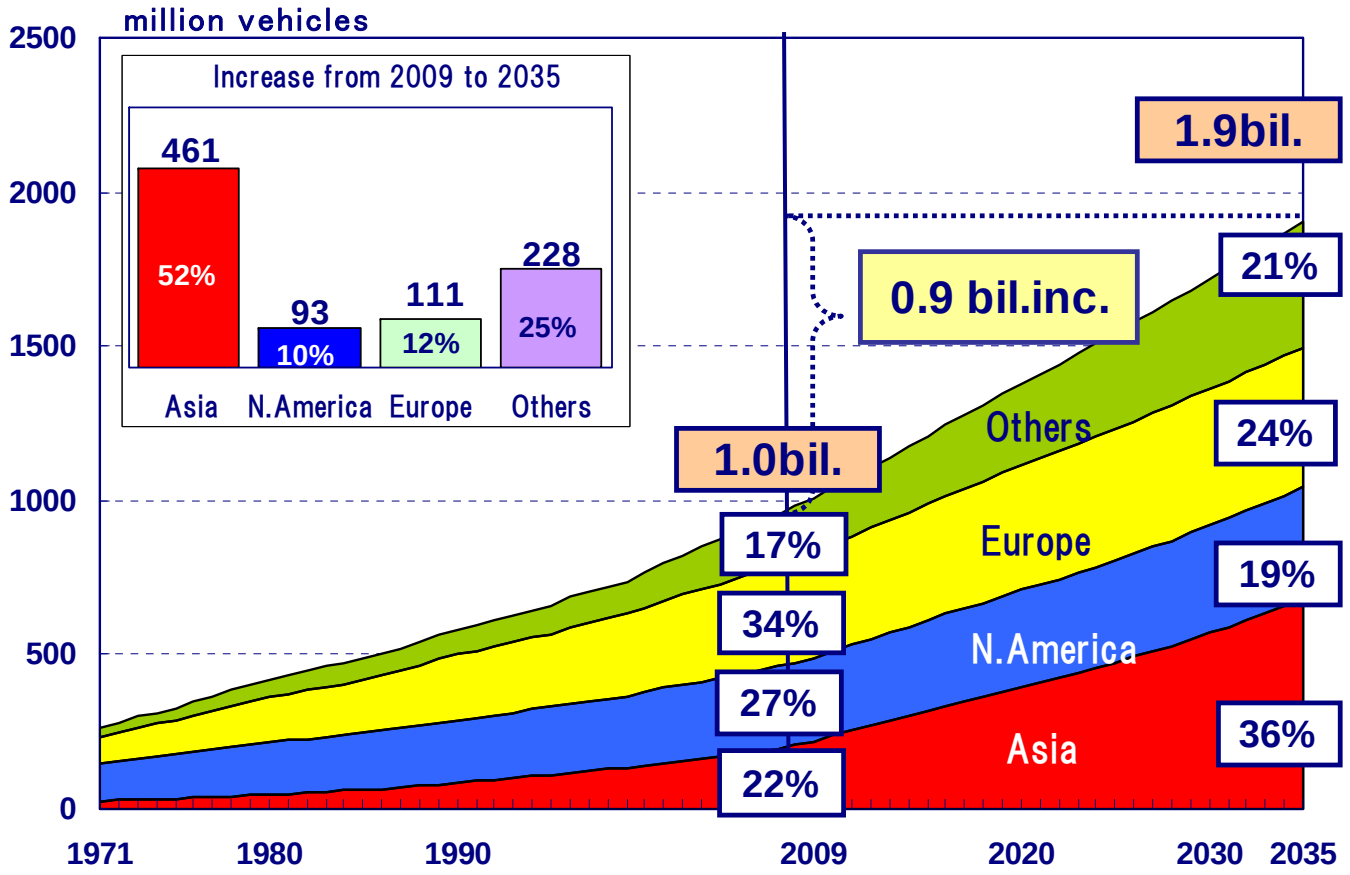
2009
1.09 bil
(22.7 mbd**)**
↓
2035
Reference
1.95 bil **(40.5** mbd**)**
Adv. Tech.
1.56 bi l**(32.4** mbd**)**

■ Though the vehicles' fuel efficiency may be improved, and clean energy vehicles may expand, oil demand in Asia will expand from 22.7 million B/D in 2009 to 40.5 million B/D in 2035, due mainly to its escalating vehicle ownership. The share of China and India together in Asian oil demand will grow from 50% in 2009 to 62% in 2035.

■ Even in the Adv. Tech. Scenario, oil demand will not peak out and grow continuously. Projected oil demand saving will be equal to 20% of the Reference Scenario in 2035.

The Number of Vehicles (World)

Reference
Adv. Tech.



World

2009
1.0 bil.
↓
2035
1.9 bil.
(**1.9**-fold inc.)

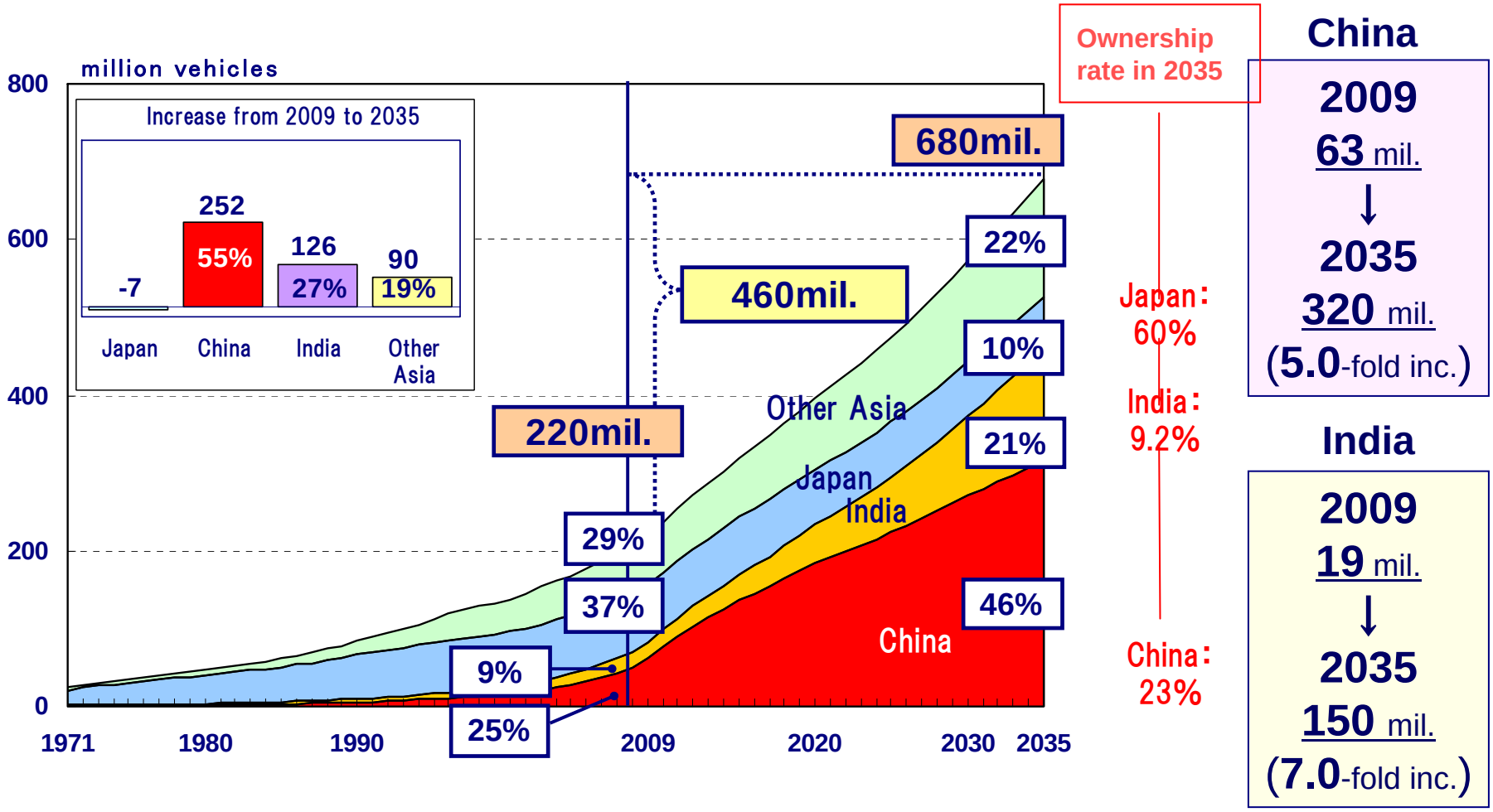
Asia

2009
0.22 bil.
↓
2035
0.7 bil.
(**3.0**-fold inc.)

■Approximately 36% of the world vehicle stocks will be concentrated in Asia.
■The share of vehicle stocks in OECD will decline from 61% in 2009 to 43% in 2035.The stock in Non-OECD will surpass that of OECD by 2035.

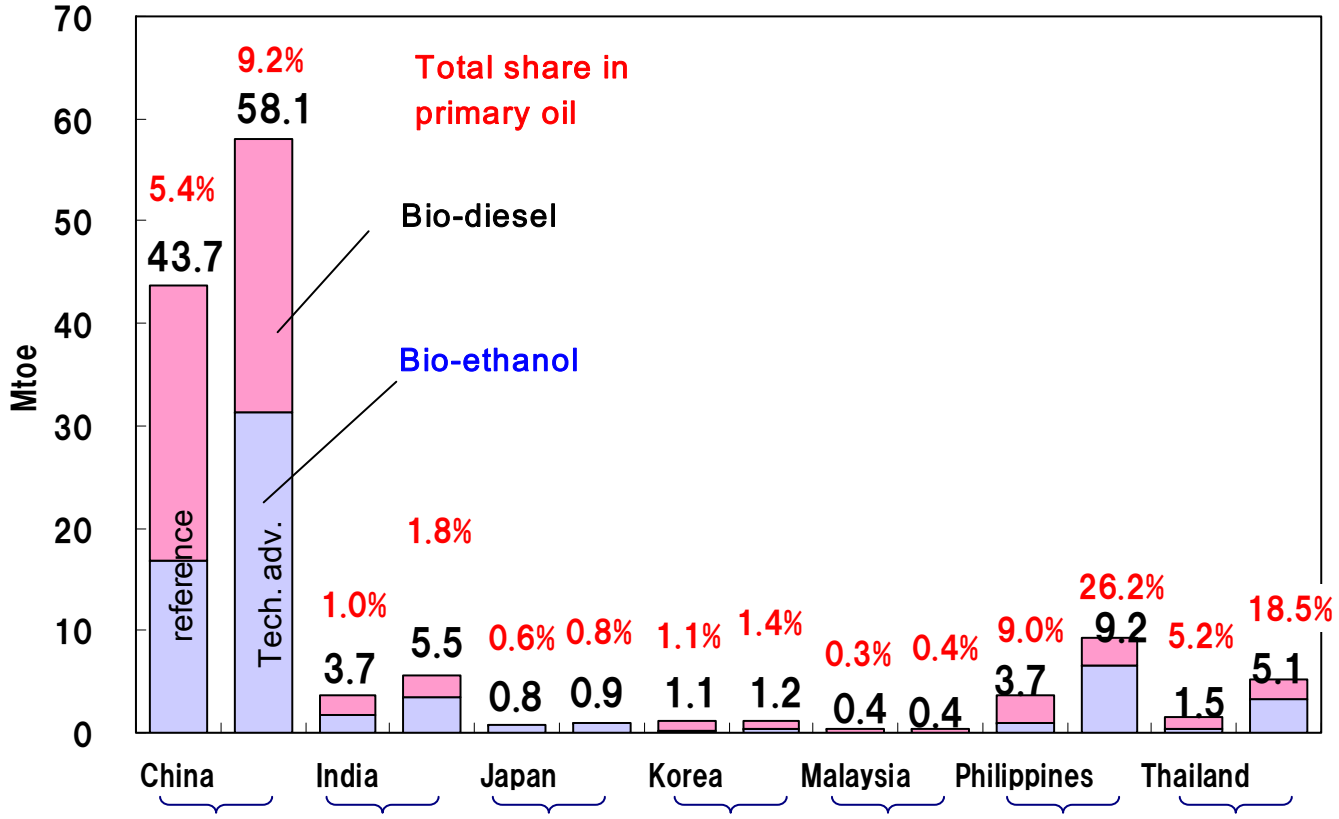
The Number of Vehicles (Asia)

Reference
Adv. Tech.



China and India's vehicle stocks will expand substantially due to an increase in the ownership rate.

Biofuel Outlook in Asia and the World (2035)



World

2009
43 mil. toe
↓
2035
290 mil. toe
(**6.7**-fold inc.)

Asia

2009
2.4 mil. toe
↓
2035
71 mil. toe
(**30**-fold inc.)

■In the Reference Scenario, the world biofuel demand is expected to reach 290 Mtoe by 2035 mainly driven by the growth in North America, Europe and Latin America. Asia will consume 71 Mtoe of bio-fuel by 2035. The share of bio-fuel in global liquid fuel will amount to 5% in 2035.
■In Asia, ethanol demand will mainly increase in China, India and Japan, while biodiesel will increase in Korea, Indonesia, and Malaysia.
■In the Adv. Tech. Scenario, the world bio-fuel demand will reach 350 Mtoe 2035, and that of Asia will reach 97 Mtoe.

Oil Production Outlook

Million B/D	2009	2020	2030	2035	2009-2035
OPEC	34	44	47	49	15
Middle East	23	33	34	35	12
Other OPEC	11	11	13	14	3.5
non-OPEC	52	51	58	60	8.5
N.America	14	16	20	20	6.4
L.America	3.9	6.0	8.0	9.0	5.1
Europe, Former USSR	18	17	18	19	1.1
Middle East	1.7	1.3	1.2	1.2	▲ 0.5
Africa	2.6	2.8	3.0	3.2	0.6
Asia	8.1	8.5	8.0	7.8	▲ 0.3
China	3.9	4.2	4.1	4.0	0.1
India	0.8	1.0	1.0	1.0	0.2
Indonesia	1.0	1.0	0.8	0.8	▲ 0.2
Malaysia	0.7	0.7	0.6	0.6	▲ 0.1
Vietnam	0.3	0.3	0.3	0.3	0.0
World (Ref.)	85	95	105	109	24
World (Tech. Adv.)				91	

OPEC

2009
34 mbd
↓
2035
49 mbd
(**15** mbd inc.)

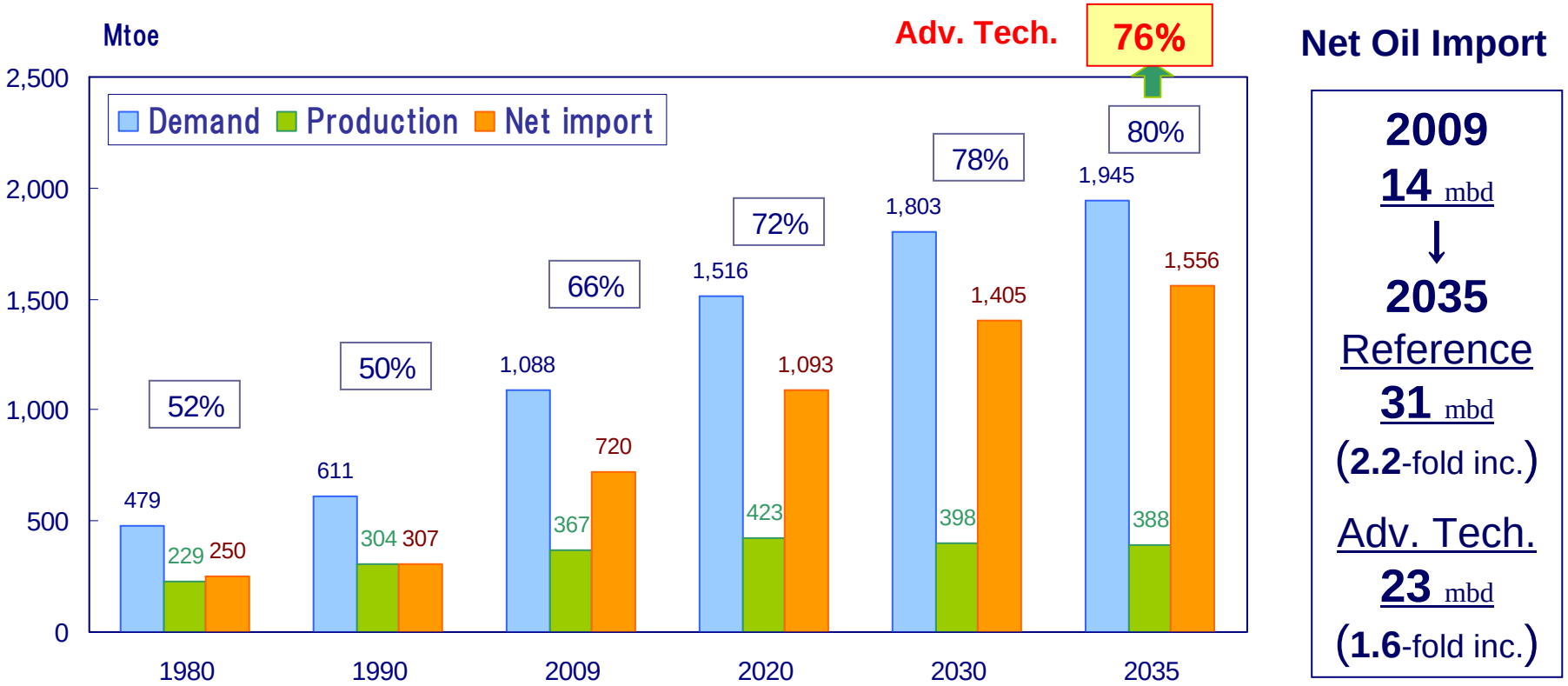
Non-OPEC

2009
52 mbd
↓
2035
60 mbd
(**9** mbd inc.)

Share in world oil production growth from 2006-2030
OPEC 65% (**15**mbd)
Non-OPEC 35% (**7**mbd)

- In Asia, oil production is projected to decline at 0.3% per year through 2035.
- OPEC will account for approximately 70% of world oil production growth; the OPEC's share in the world oil production is likely to expand to 45% by 2035 from about 39% in 2009.
- In some Middle East countries of OPEC, domestic oil demand is increasing steadily. Unless sufficient upstream investments are channeled, the international oil market will become much tighter in the future.
- Interests in developing non conventional oil such as shale oil and oil sands will increase as access to easy oil becomes limited.

Oil Supply and Demand in Asia



Net Oil Import

2009

14 mbd

↓

2035

Reference

31 mbd

(**2.2**-fold inc.)

Adv. Tech.

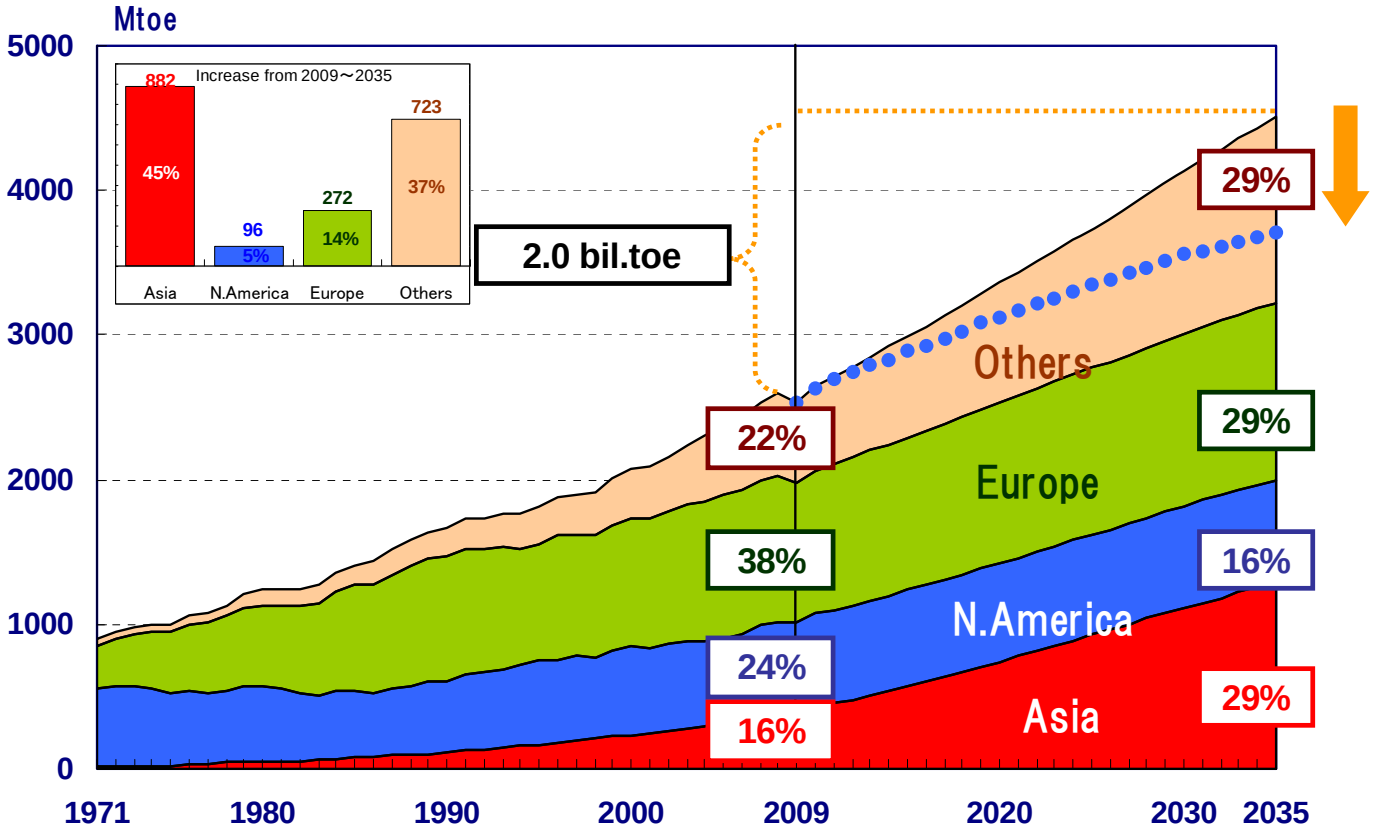
23 mbd

(**1.6**-fold inc.)

- Net oil import in Asia will expand from 14 mb/d (720 Mtoe) in 2009 to 31 mb/d (1,560 Mtoe) in 2035.
- Oil production in Asia (such as China, India, Indonesia and Malaysia) will marginally increase, not keeping pace with the steady increase in oil demand. Therefore, net oil import ratio will reach 80% in the Reference Scenario, and 76% in the Adv. Tech. Scenario by 2035 (compared with 66% in 2009).

Natural Gas Demand by Region (World)

Reference
Adv. Tech.



800 mil.
(18%)
Reduction

2009
2.5 billion toe
(2.8 trillion m^3**)**
(2.1 bil.tonnes LNG**)**

↓

2035

Reference
4.5 billion toe
(5 trillion m^3**)**
(3.7 bil.tonnes LNG**)**

Adv. Tech.
3.7 billion toe
(4.1 trillion m^3**)**
(3.0 bil.tonnes LNG**)**

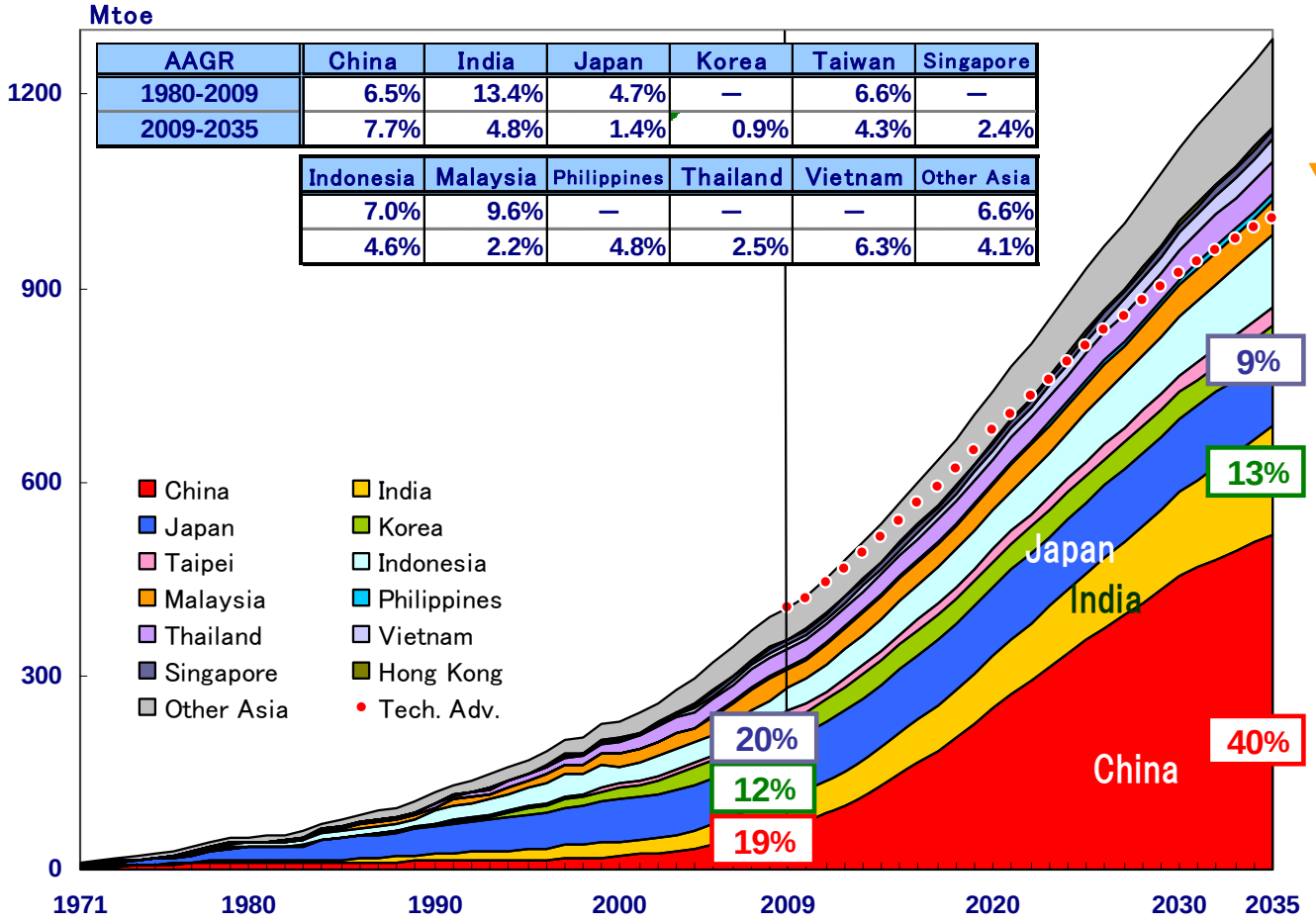
■ The world natural gas demand is expected to increase from 2.8 trillion cubic meters (tcm) in 2009 to 5.0 tcm in 2035, a 1.8-fold increase.

■ Non-OECD will account for 84% of the growth in the world natural gas demand from 2009 to 2035,

■ In the Adv. Tech. Scenario, natural gas demand will be 0.9 tcm lower than the Reference Scenario. Despite the projected saving, natural gas demand will continue to grow in the Adv. Tech. Scenario suggesting further needs of energy resources development.

Natural Gas Demand by Country (Asia)

Reference
Adv. Tech.



AAGR	China	India	Japan	Korea	Taiwan	Singapore
1980-2009	6.5%	13.4%	4.7%	—	6.6%	—
2009-2035	7.7%	4.8%	1.4%	0.9%	4.3%	2.4%

Indonesia	Malaysia	Philippines	Thailand	Vietnam	Other Asia
7.0%	9.6%	—	—	—	6.6%
4.6%	2.2%	4.8%	2.5%	6.3%	4.1%

280 mil.
(22%)
Reduction

2009
0.41 billion toe
(450 billion m^3**)**
(0.33 bil.tonnes LNG**)**

↓

2035

Reference
1.29 billion toe
(1.4 trillion m^3**)**
(1.05 bil.tonnes LNG**)**

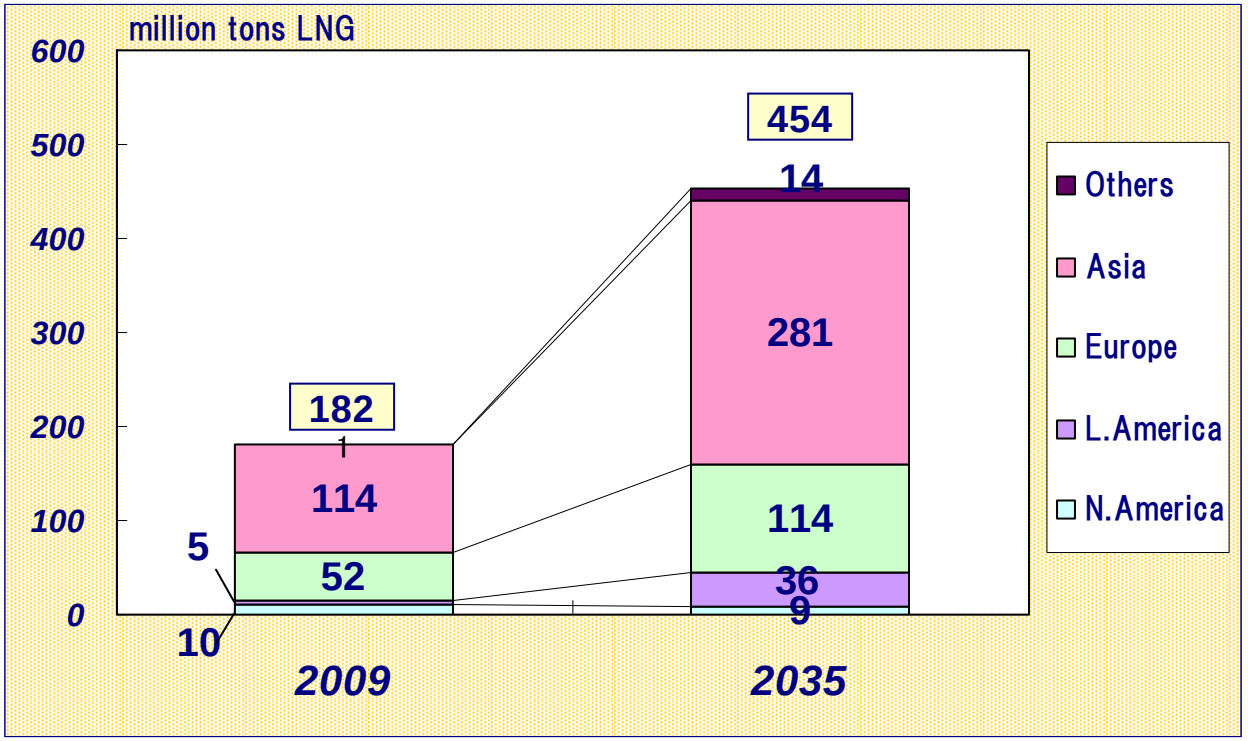
Adv. Tech.
1.00 billion toe
(1.1 trillion m^3**)**
(0.82 bil.tonnes LNG**)**

■ Natural gas demand in China will considerably increase (8%/y) due mainly to the increasing demand for power generation and gas use in urban areas. India's natural gas demand will also expand but at a lower pace (5%/y), representing a three-fold increase from 2009 to 2035.

■ In the Adv. Tech. Scenario, the world natural gas demand will be 310 bcm (or 22%) lower than the Reference Scenario by 2035. Despite the gains, natural gas demand will increase at a relatively fast pace of 3.6% per year through 2035.

LNG Demand Outlook (World)

Reference

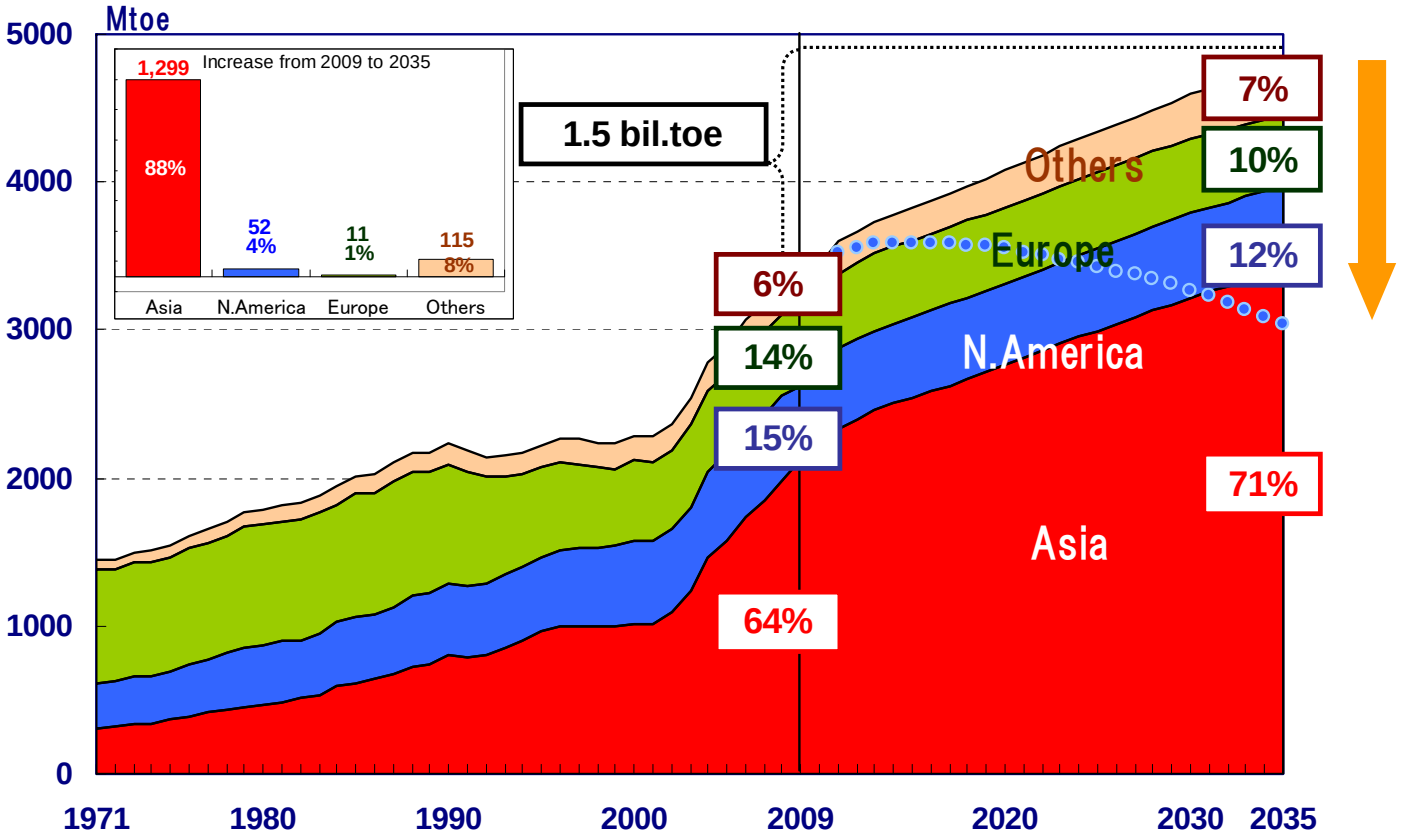


■ World LNG demand will expand 150% from 182 million tons in 2009 to 454 million tons in 2035.

■ Asia's LNG demand will increase by 167 million tons, accounting for 60% of the world's LNG demand growth through 2035. Growth of LNG in Europe (62 million tons) will account for 20% of the world LNG demand growth, whereas LNG import to north America will not increase in the future.

Coal Demand by Region (World)

Reference
Adv. Tech.



▲1.7 billion toe
(▲36%)

2009
3.3 billion toe
(4.7 billion tce*)

↓

2035

Reference
4.8 billion toe
(6.8 billion tce*)

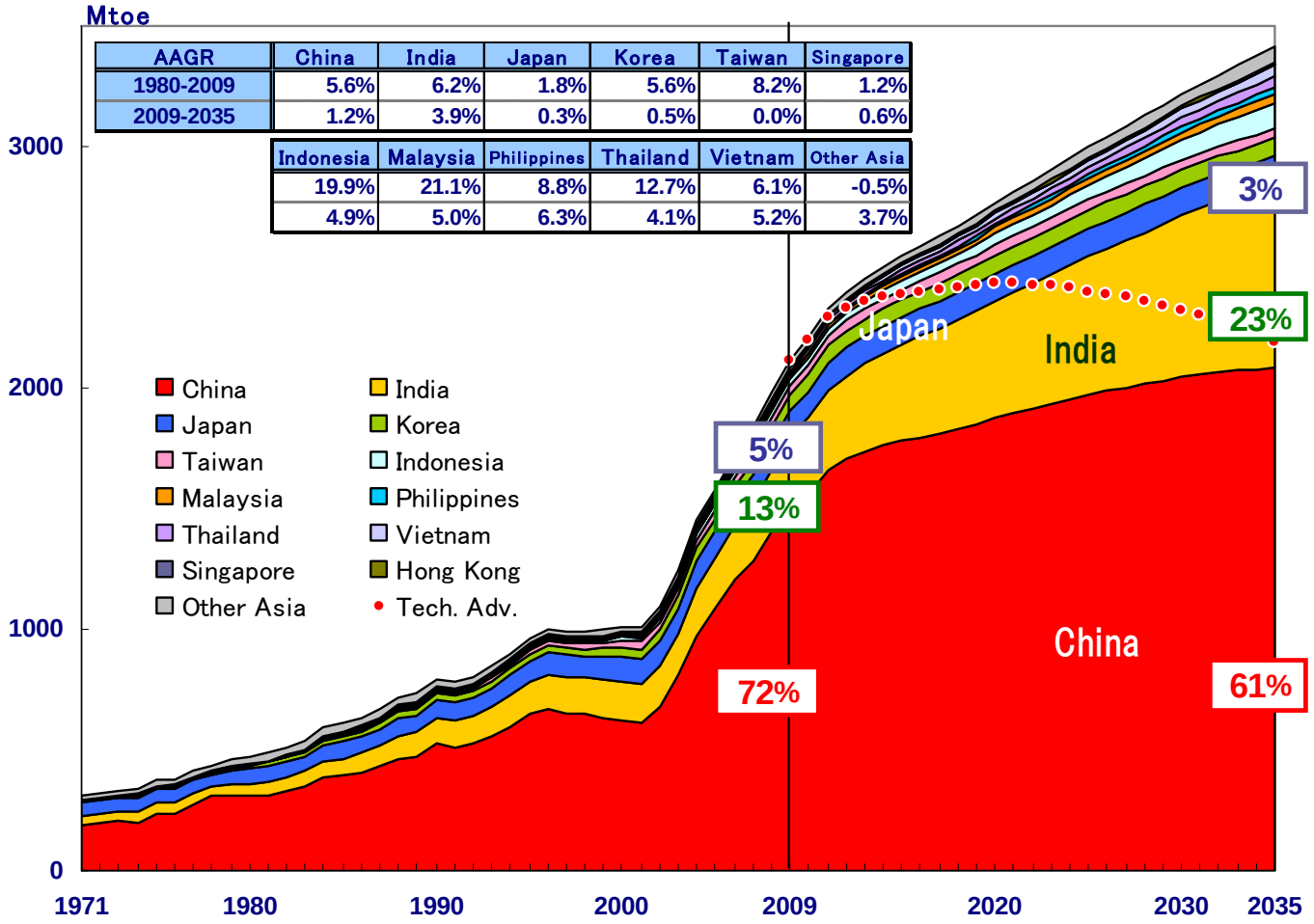
Adv.Tech.Scenario
3.0 billion toe
(4.3 billion tce*)

*Tons of coal equivalent

- Asia will account for about 90% of the world coal demand growth through 2035, and the share of Asia in total coal demand will expand to 71% in 2035 from 64% in 2009.
- OECD will account for only 3% of the world coal demand growth through 2035 (Non-OECD 97%).The share of OECD in coal demand will decrease from 31% in 2009 to 23% in 2035, and Non-OECD will increase from 69% in 2009 to 77% in 2035.
- In the Adv. Tech. Scenario, the world coal demand in 2035 will be 1.7 billion toe (or 36%) lower compared with the Reference Scenario.

Coal Demand by Country (Asia)

Reference
Adv. Tech.



AAGR	China	India	Japan	Korea	Taiwan	Singapore
1980-2009	5.6%	6.2%	1.8%	5.6%	8.2%	1.2%
2009-2035	1.2%	3.9%	0.3%	0.5%	0.0%	0.6%

Indonesia	Malaysia	Philippines	Thailand	Vietnam	Other Asia
19.9%	21.1%	8.8%	12.7%	6.1%	-0.5%
4.9%	5.0%	6.3%	4.1%	5.2%	3.7%

▲1.2 billion toe (▲36%)

2009
2.1 billion toe
(3.0 billion tce)
↓
2035
Reference
3.4 billion toe
(4.9 billion tce*)

Adv.Tech.Scenario
2.2 billion toe
(3.1 billion tce*)

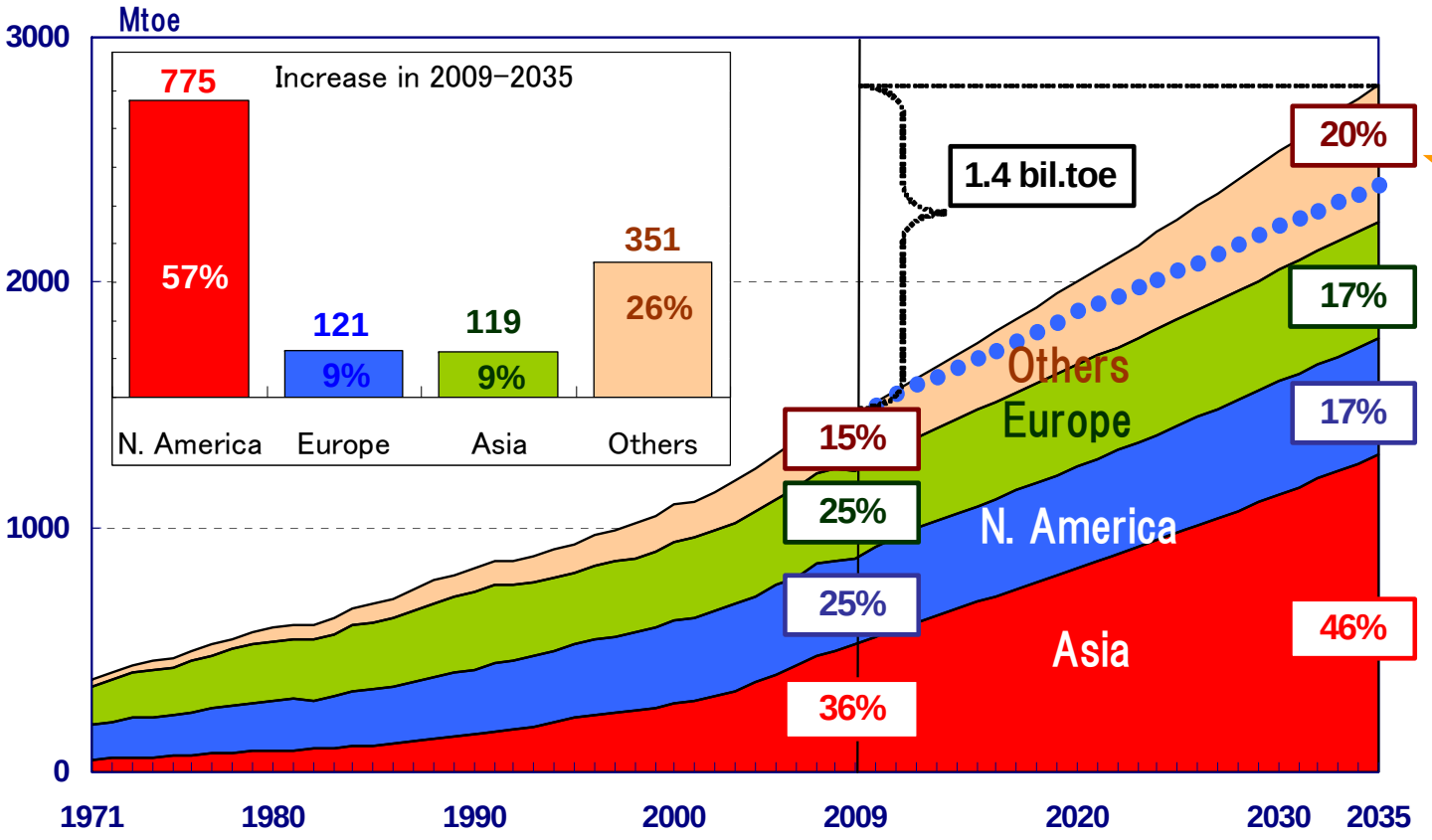
*Tons of coal equivalent

■ The power sector, mainly in China and India, will drive coal demand. Both those countries have abundant domestic coal reserves.

■In the Adv. Tech. Scenario, Asian coal demand in 2035 will be 1.2 billion toe (or 36%) lower due to shift to natural gas and enhancement of power generation efficiency compared with the Reference Scenario.

Electricity Demand by Region (World)

Reference
Adv. Tech.



▲0.41billion toe
(▲15%)

2009
1.4 billion toe
(2.0 billion tce*)

↓

2035

Reference
2.8 billion toe
(4.0 billion tce*)

Adv.Tech.Scenario
2.4 billion toe
(3.4 billion tce*)

*Tons of coal equivalent

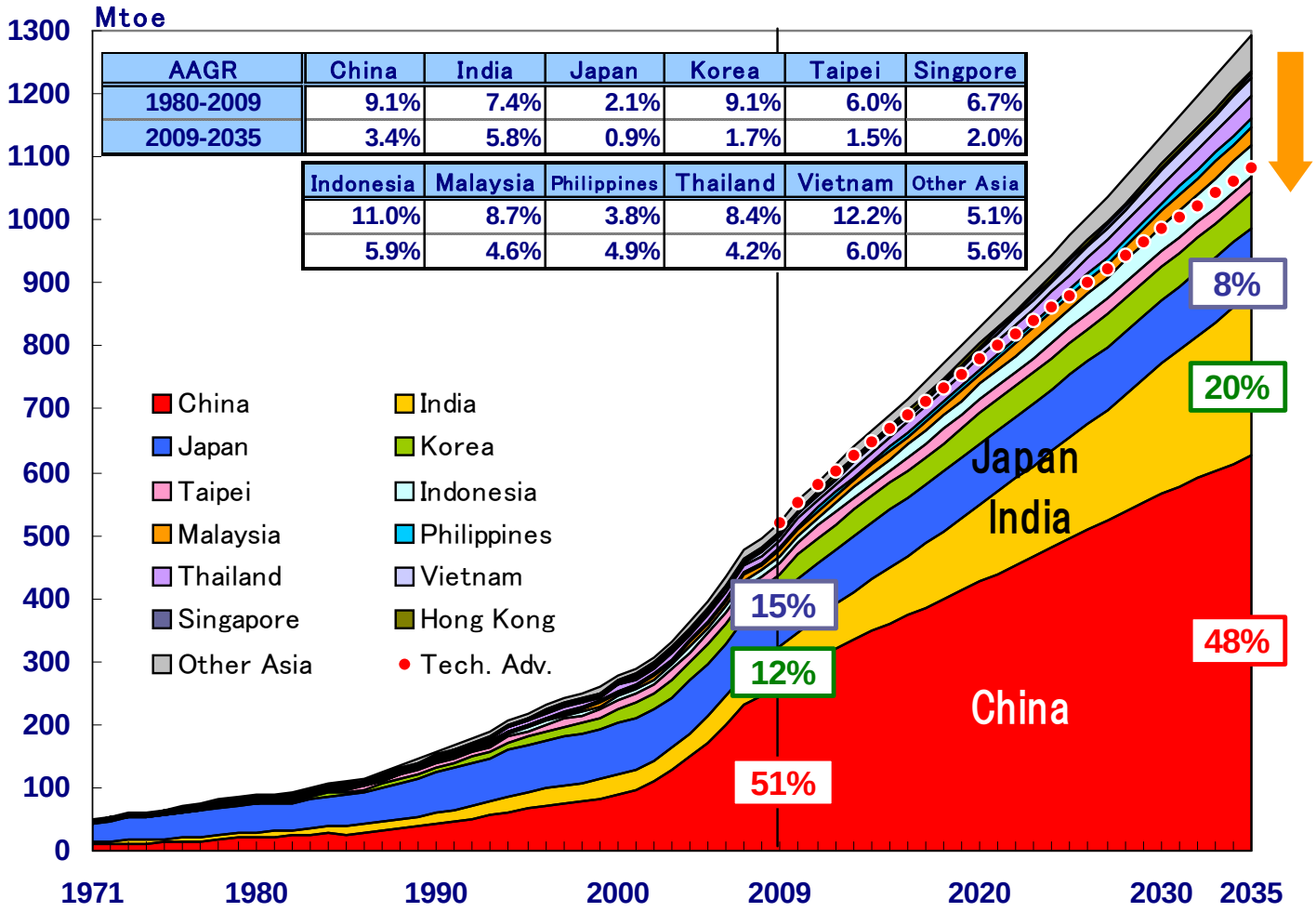
- Asia will account for 60% of the world electricity demand growth through 2035, and the share of Asia in total electricity demand will expand to almost 50%.
- OECD is responsible for 20% of the world electricity demand growth through 2035, and Non-OECD is responsible for the rest. The share of OECD in electricity demand will decrease from 53% in 2009 to 37% in 2035, and Non-OECD will increase from 47% in 2009 to 63% in 2035.
- In the Adv. Tech. Scenario, the world electricity demand in 2035 will be 0.41 billion toe (or 15%) lower compared with the Reference Scenario.

Electricity Demand by Country (Asia)

Reference
Adv. Tech.

AAGR	China	India	Japan	Korea	Taipei	Singpore
1980-2009	9.1%	7.4%	2.1%	9.1%	6.0%	6.7%
2009-2035	3.4%	5.8%	0.9%	1.7%	1.5%	2.0%

Indonesia	Malaysia	Philippines	Thailand	Vietnam	Other Asia
11.0%	8.7%	3.8%	8.4%	12.2%	5.1%
5.9%	4.6%	4.9%	4.2%	6.0%	5.6%



▲0.21 billion toe
(▲16%)

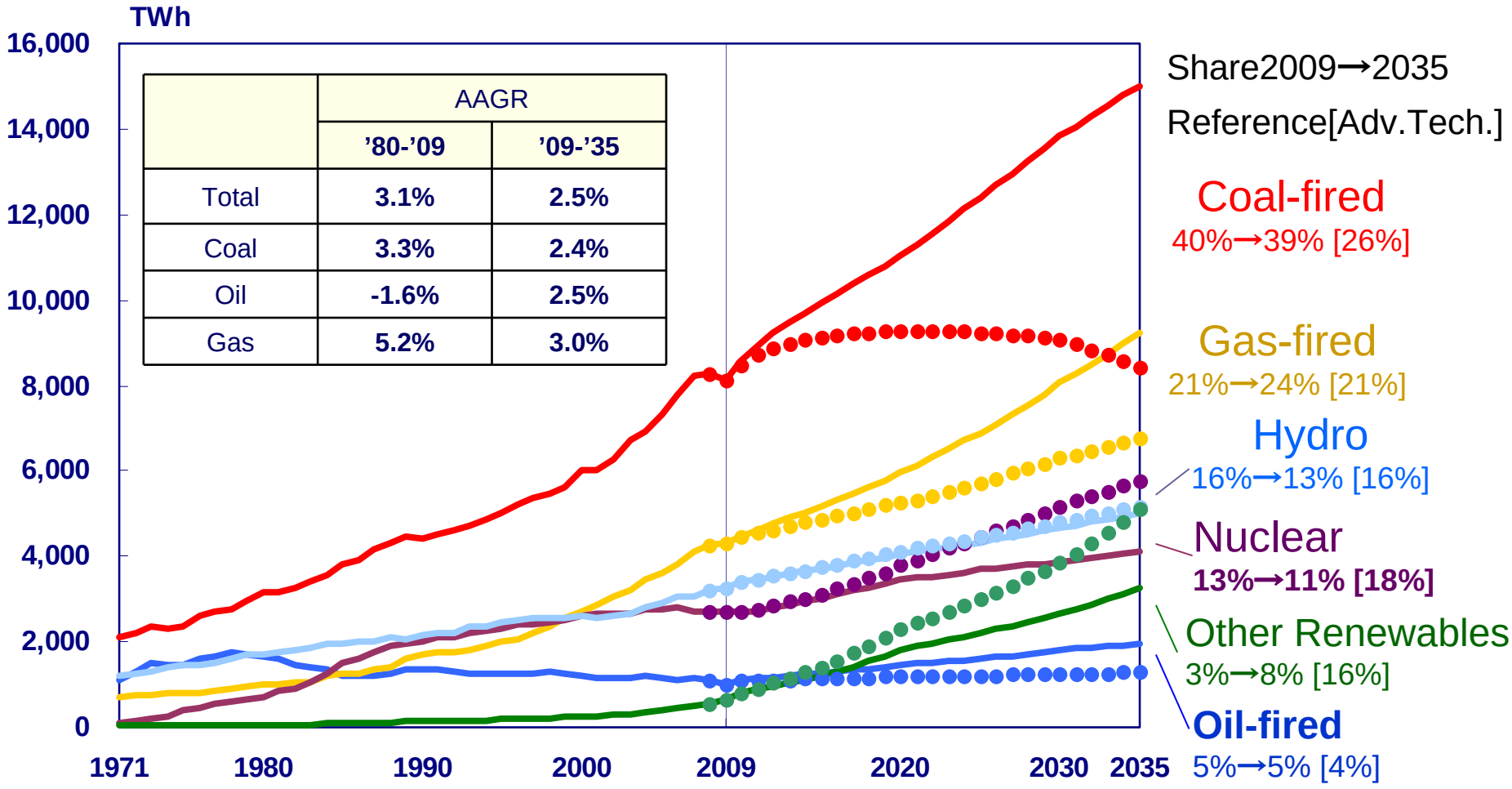
2009
0.52 billion toe
(0.75 billion tce)
↓
2035
Reference
1.3 billion toe
(1.83 billion tce)

Adv. Tech.Scenario
1.08 billion toe
(1.52 billion tce)

- Electricity demand in Asia will increase rapidly driven by the improvement of living standards. Electricity demand in China will expand 240% by 2035, and India will expand by 430% during the same period.
- Through 2035, electricity demand will increase at a faster rate than final energy demand (Reference Scenario at 2.6% per year, and Adv. Tech. Scenario at 1.9% per year).

Power Generation Mix by Fuel (World)

Solid line: Reference
Dotted line: Adv. Tech.



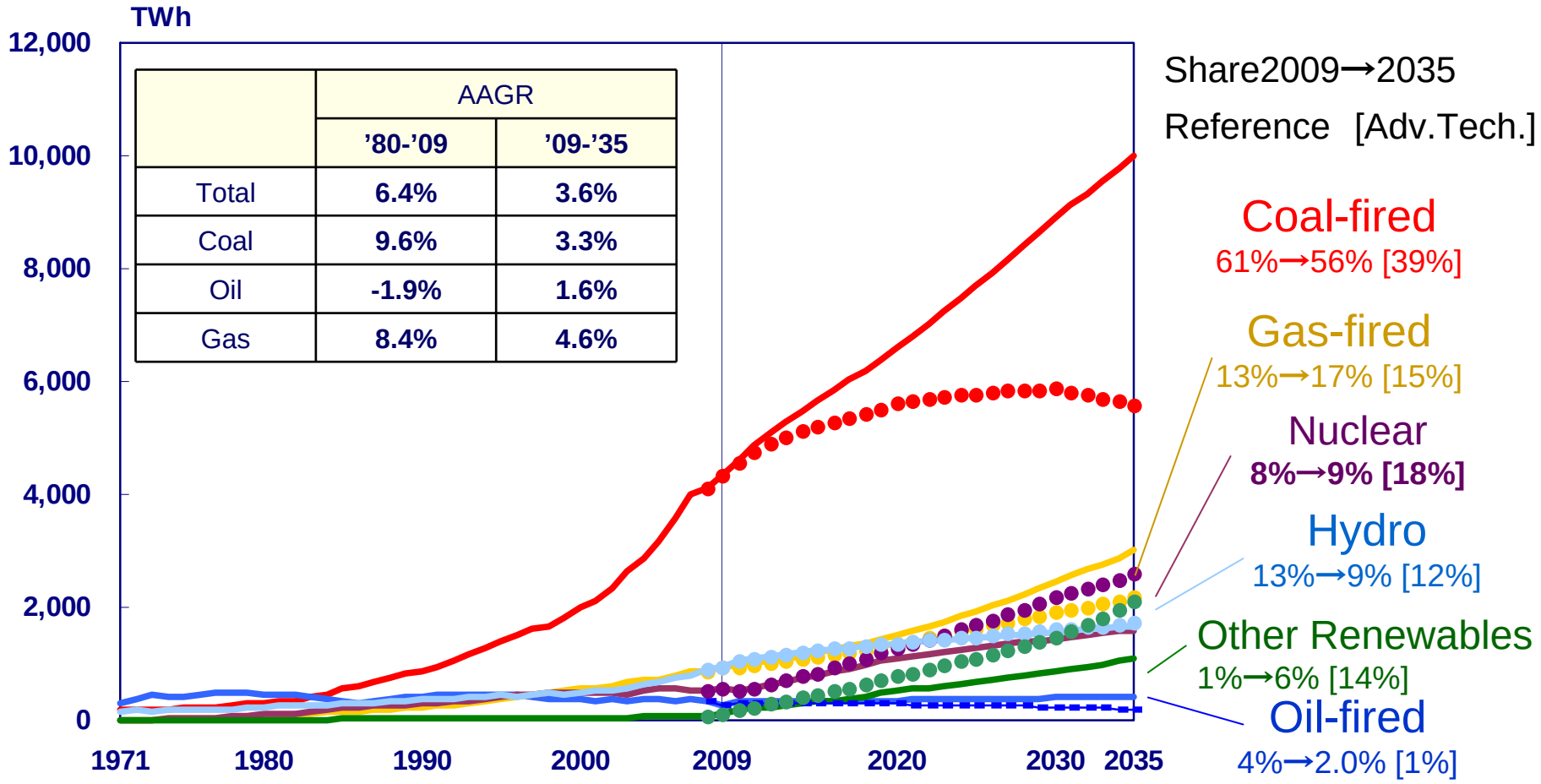
	AAGR	
	’80-’09	’09-’35
Total	3.1%	2.5%
Coal	3.3%	2.4%
Oil	-1.6%	2.5%
Gas	5.2%	3.0%

■ While natural gas-fired generation is projected to increase significantly, coal-fired generation will continue to dominate power generation mix by 2035.

■ In Adv. Tech. Scenario, the share of coal-fired generation in 2035 will decline rapidly to 26%, while nuclear and renewables are expanding.

Power Generation Mix by Type (Asia)

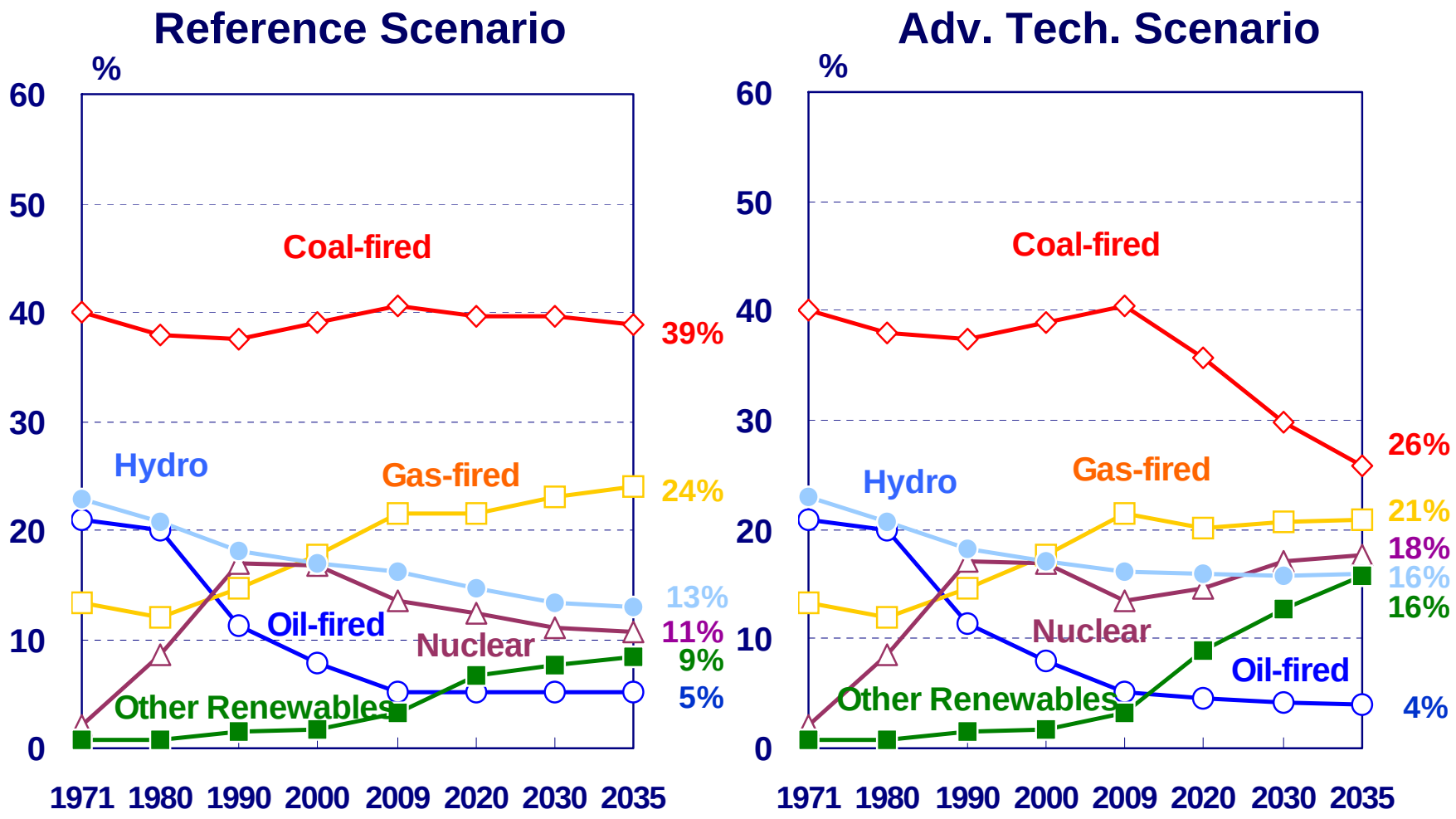
Solid line: Reference
Dotted line: Adv. Tech.



	AAGR	
	’80-’09	’09-’35
Total	6.4%	3.6%
Coal	9.6%	3.3%
Oil	-1.9%	1.6%
Gas	8.4%	4.6%

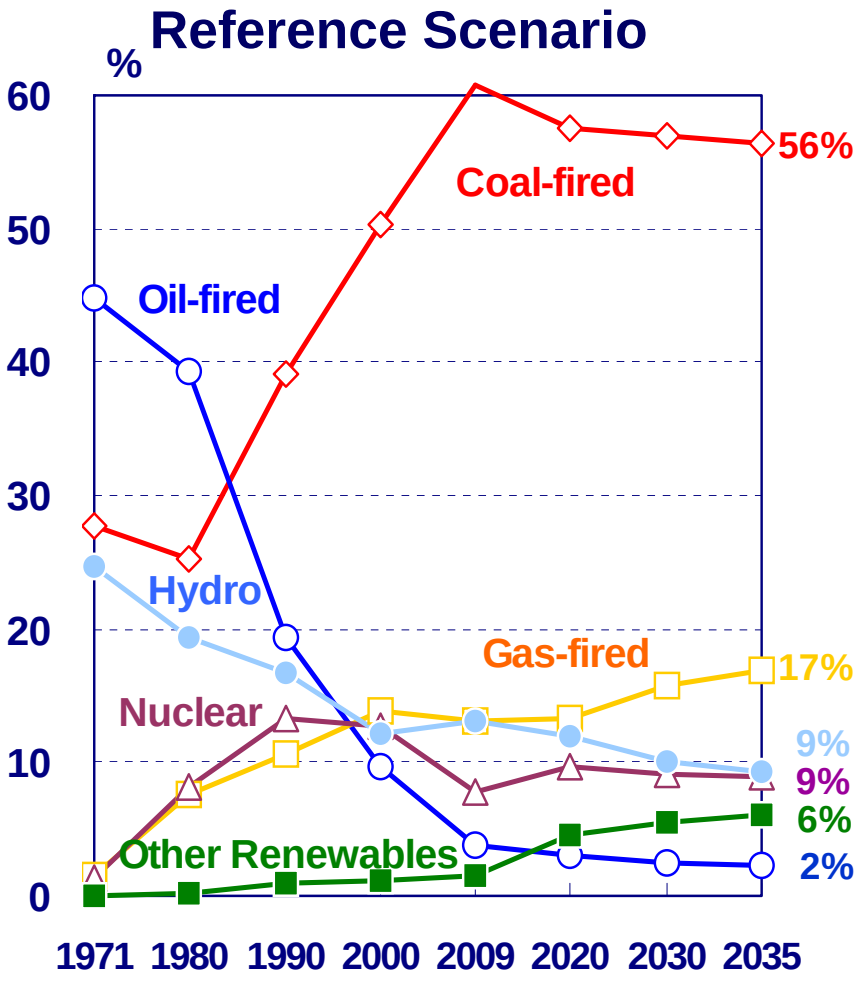
- The Asia’s share of coal in the generation mix will remain higher than 50%, reflecting resources availability
- The share of natural gas will increase from 13% in 2009 to 17% in 2035. The share of nuclear power generation will remain 9% in 2035.
- In the Adv. Tech. Scenario, the share of coal will decline from 61% in 2009 to 39% in 2035. Clean coal technology (CCT) is expected to play an important role in addressing global warming issues.

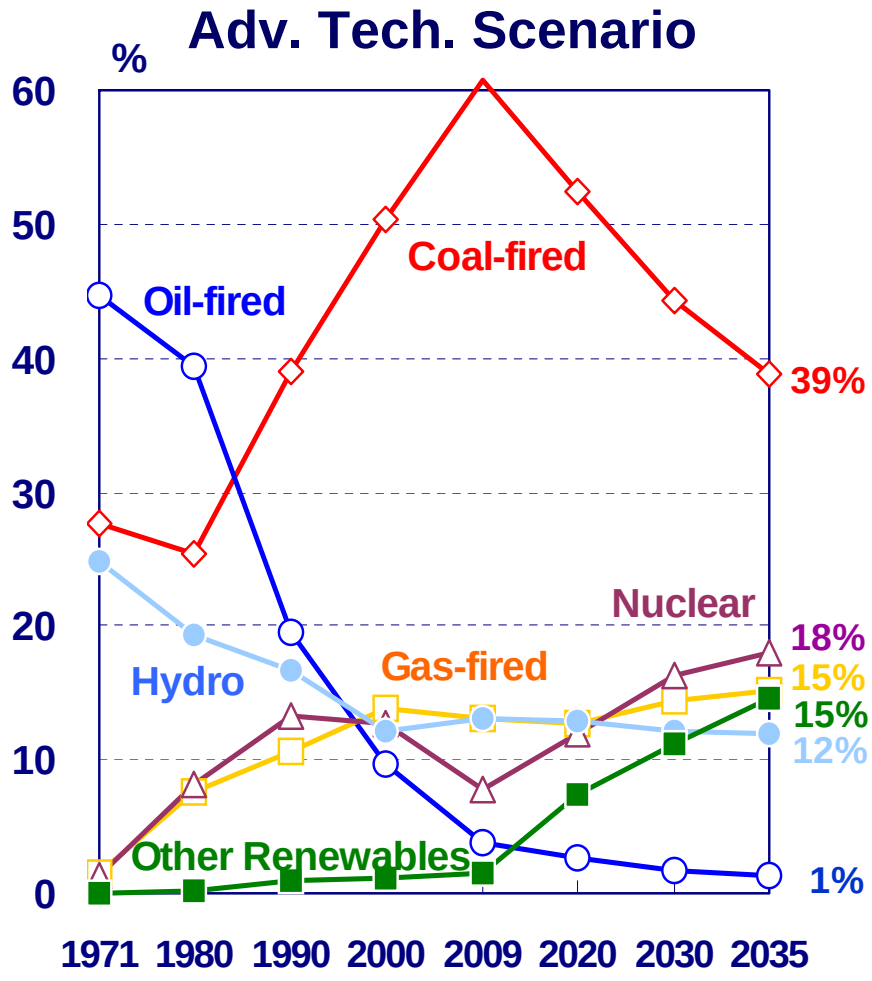
Power Generation Mix by Fuel (World)



- Coal-fired generation will maintain the biggest share in the power generation mix by 2035.
- In the Adv. Tech. Scenario, the share of coal-fired generation will decrease substantially, while that of renewable energy and nuclear will increase.

Power Generation Mix by Fuel (Asia)

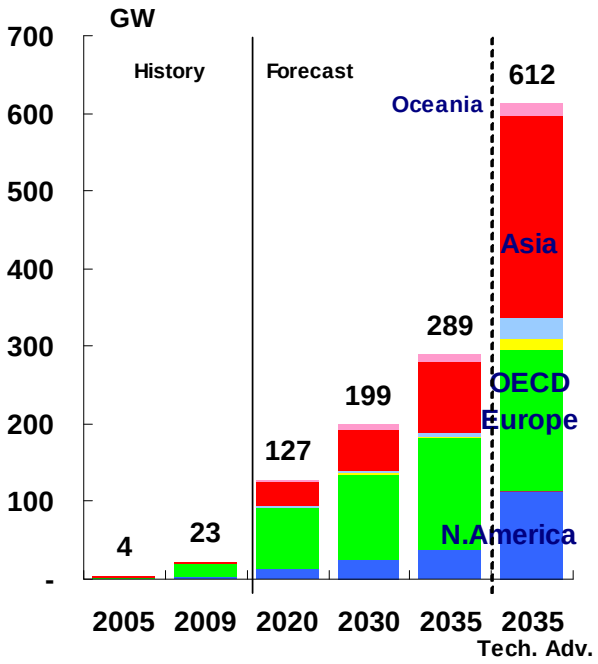




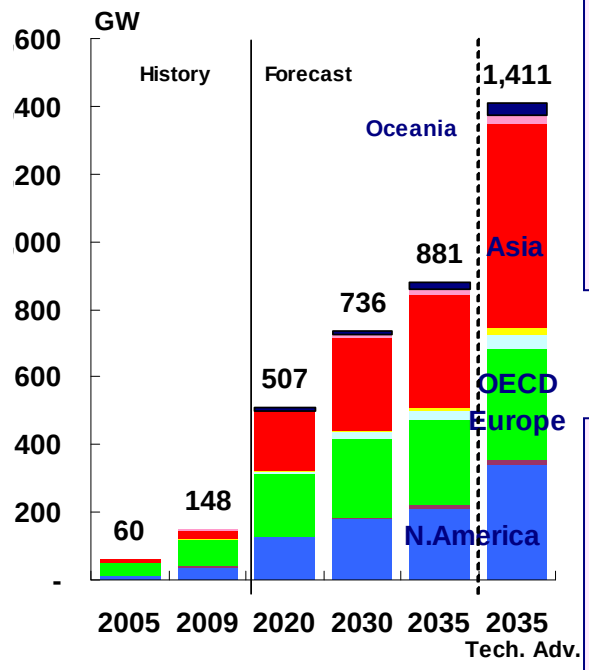
- In Asia, the share of coal-fired generation will increase to meet growing electricity demand.
- In the Adv. Tech. Scenario, the share of coal-fired generation will decrease substantially, which will be substituted by the increases in renewable energy, hydro and nuclear share.

Photovoltaic, Wind Power (World)

Photovoltaic (PV)



Wind Power



Photovoltaic (PV)

World	Asia
2009 23 GW ↓ 2035 Ref. Adv. Tech. 289GW 612GW	2009 4 GW ↓ 2035 Ref. Adv. Tech. 93GW 261GW

Wind Power

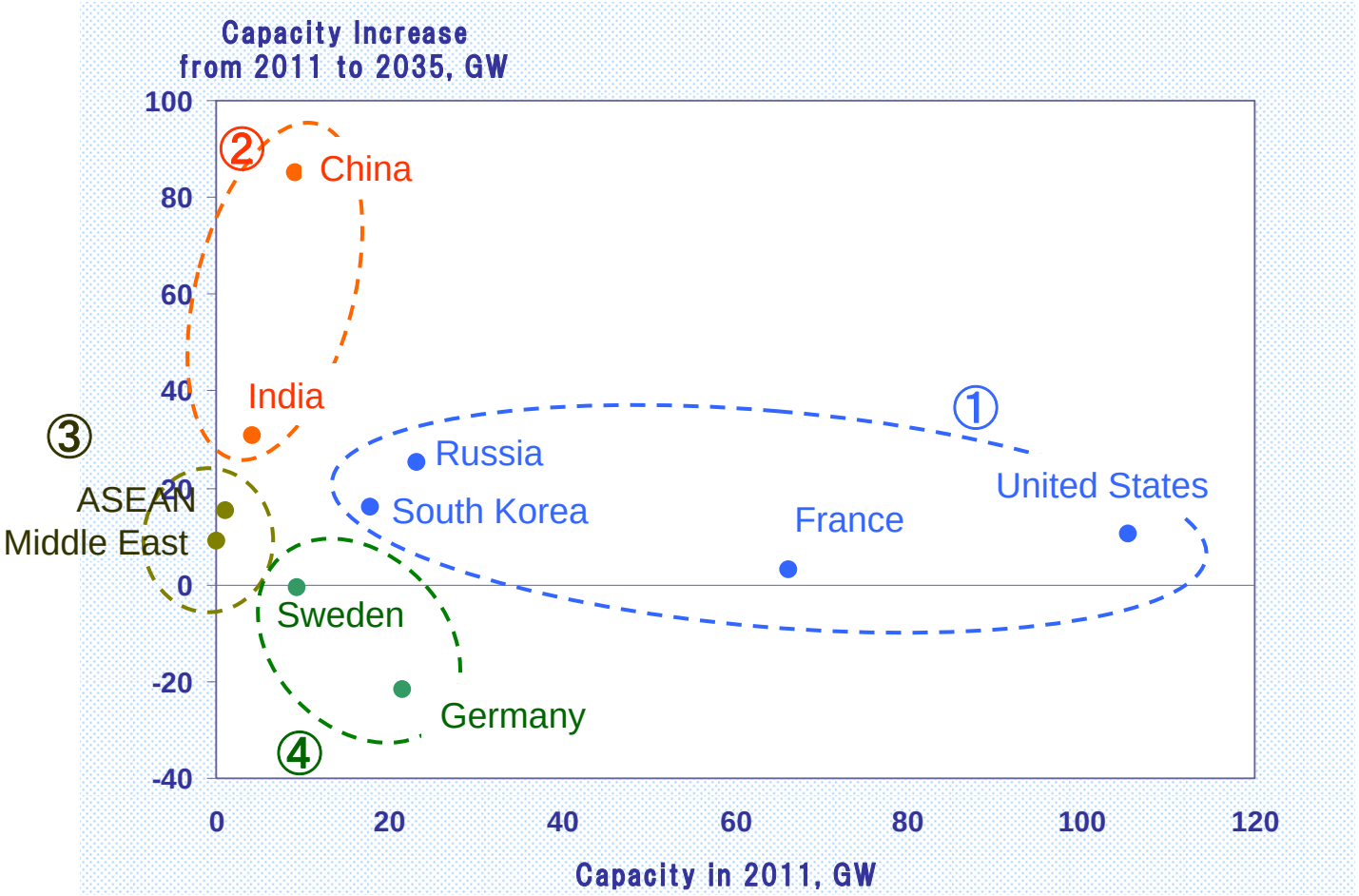
World	Asia
2009 148 GW ↓ 2035 Ref. Adv. Tech. 881GW 1,411GW	2009 25 GW ↓ 2035 Ref. Adv. Tech. 271GW 334GW

■ Renewables are expected to expand due to technological advancement and supportive political measures such as feed-in tariff and subsidization.

■ World PV generating capacity will grow to 289GW by 2035 and world wind power capacity will reach 881 GW by 2035, both under the Reference Scenario.

■ The share of power generation from wind and PV together in total global power generation will grow from 1.5% in 2009 to 5.3% in 2035 in the Reference Scenario. In the Advanced Technologies Scenario, PV grows 2.1 times of Reference Scenario, and Wind 1.6 times.

Nuclear Policies after Fukushima Incident



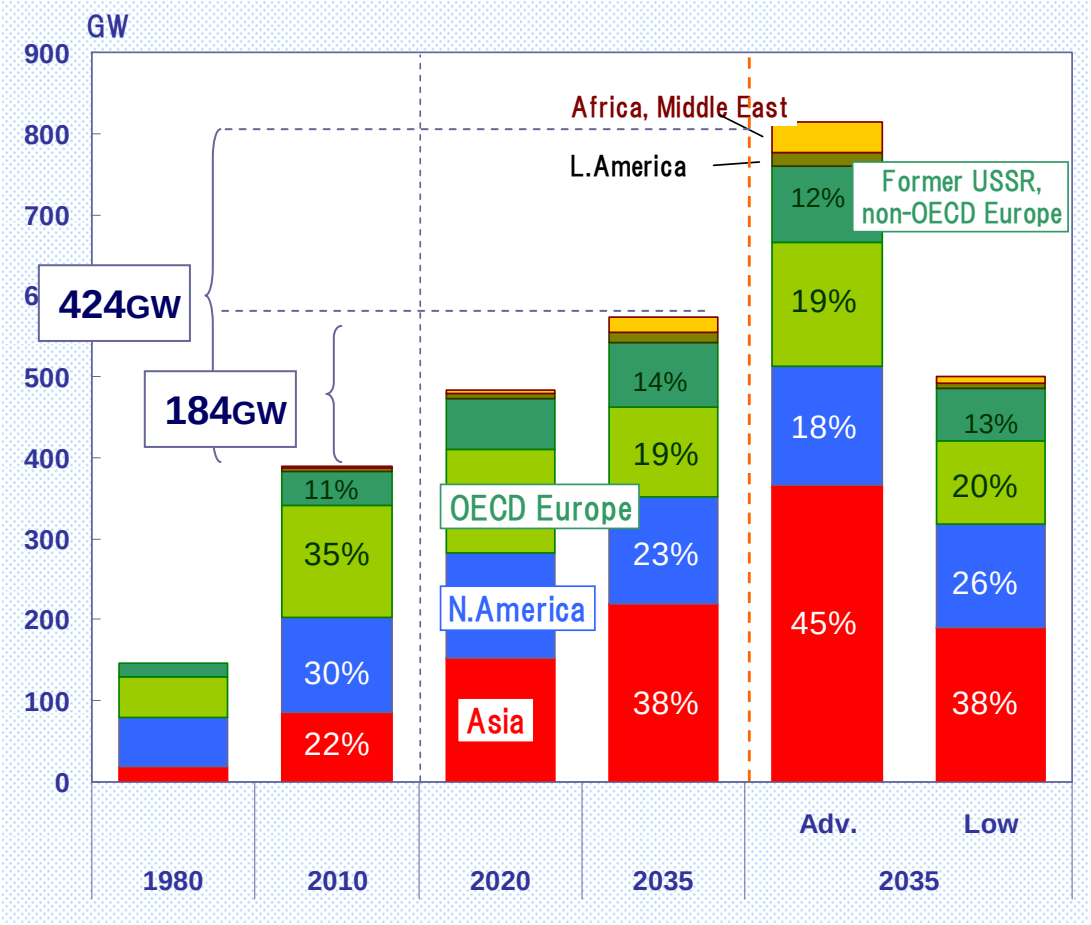
① Nuclear Promoting Countries (US, France, etc.) : Continue to make the best use of nuclear power.

② Emerging Countries (China and India) : No change of massive construction plans

③ Newcomer Countries (ASEAN and Middle East) : Reevaluate the construction plans in some countries

④ Phasing-out Countries (Germany, etc.) : Stop nuclear power after some decades of operation.

Nuclear Power Generation Capacity (World)



World

2010

390GW

↓

2035

Reference

574GW

(**184**GW increase)

Adv. Tech.

814GW

(**424**GW increase)

Low nuclear

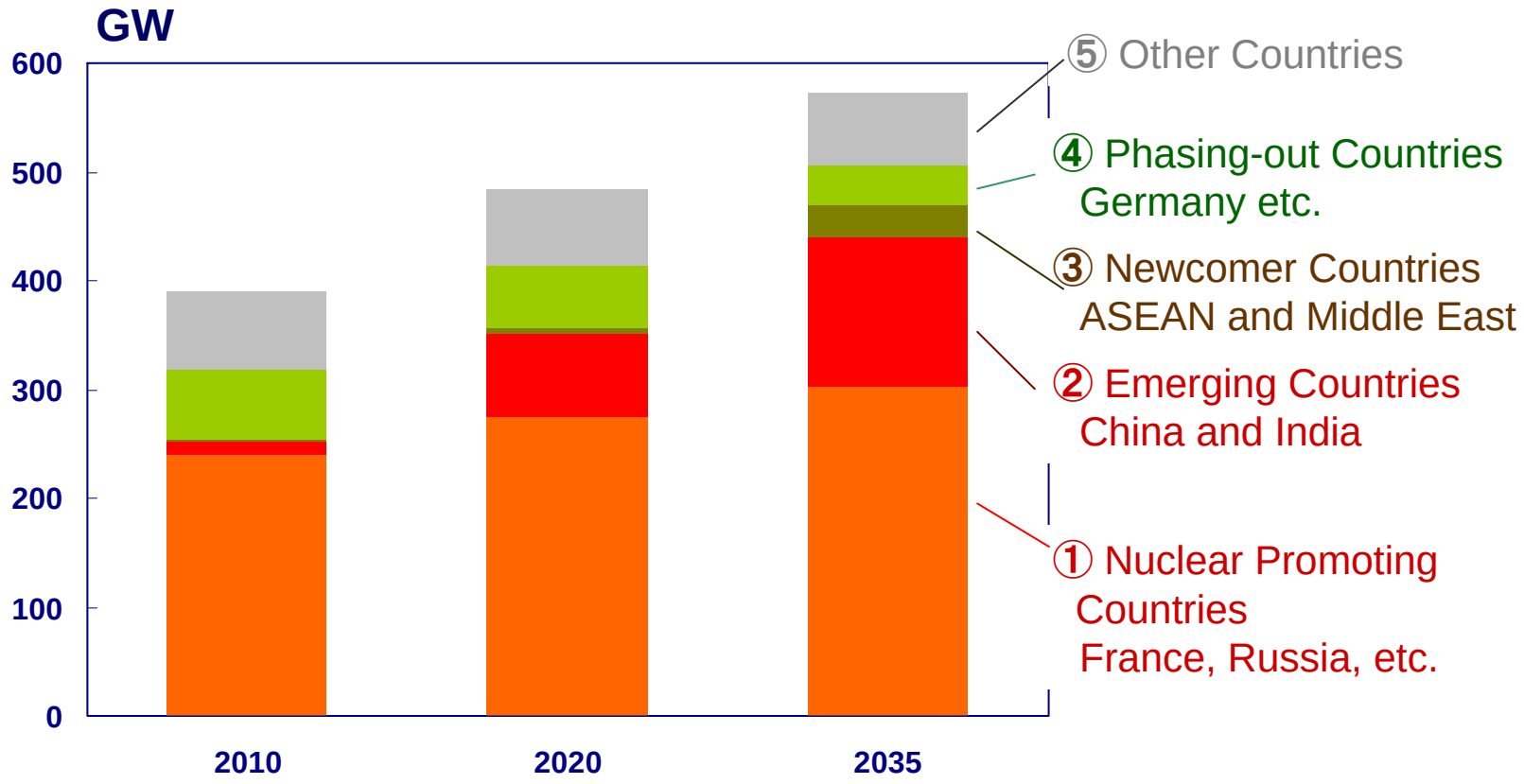
500GW

(**110**GW increase)

- Nuclear capacity is projected to grow from 390 GW in 2010 to 574 GW in 2035 (an increase of 184 GW). More than 2/3 of the increase is expected in Asia.
- Current nuclear capacity is expected to double in the Adv. Tech. Scenario, reaching 814 GW by 2035.
- In the low nuclear scenario, the capacity will increase in Asia and decrease in Europe, reaching 500 GW by 2035.

Nuclear Power Generation Capacity (World)

Reference



■ More than 60% of the world's total nuclear capacity belong to the nuclear promoting countries and emerging countries, where the capacity will grow towards 2035.

Nuclear Power Capacity in Asia

(GW)

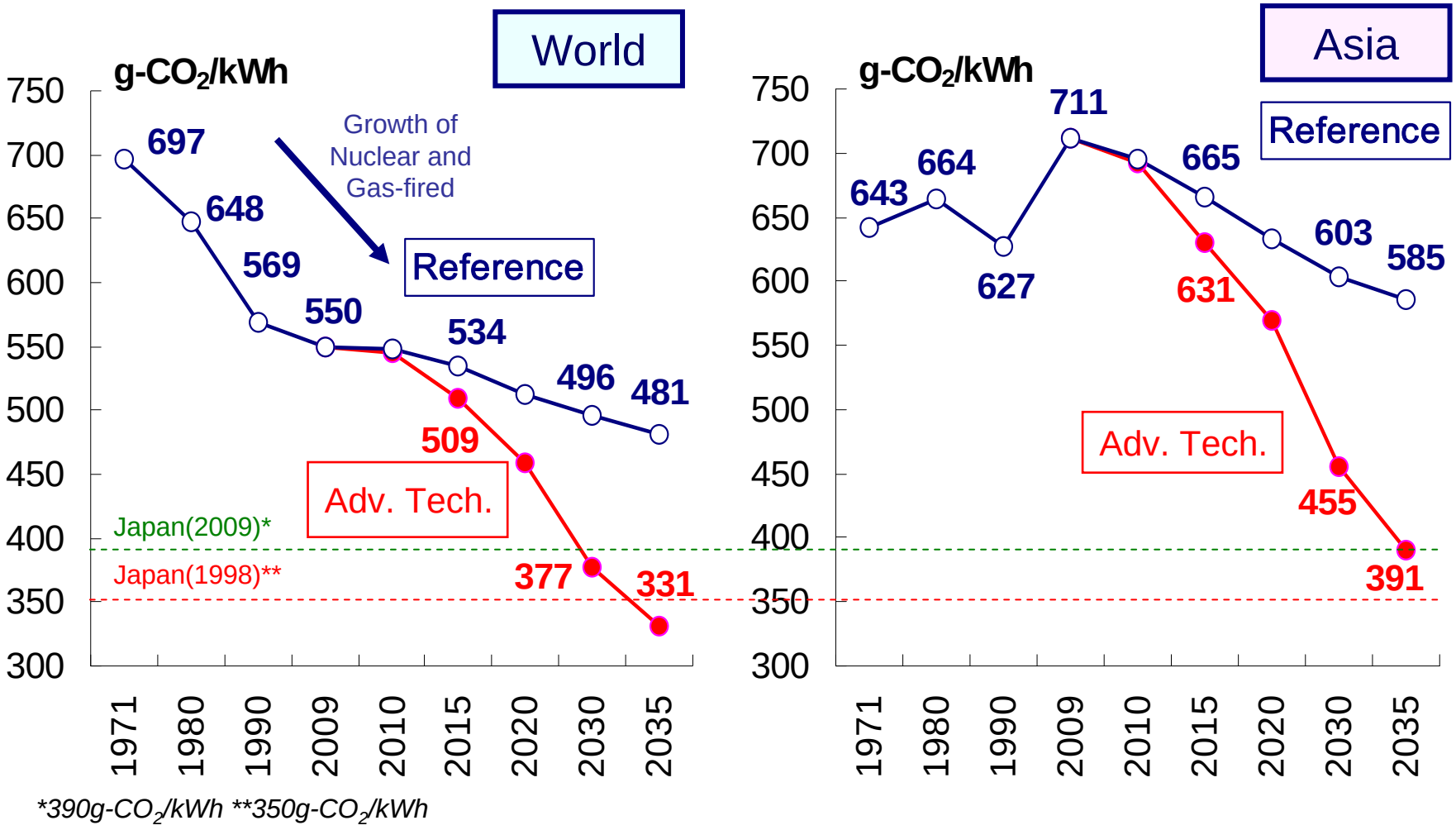
	2010	2020			2035		
		Ref.	Adv.	Low	Ref.	Adv.	Low
China	9	60	70	60	104	158	104
Taiwan	5	8	8	5	6	8	4
S. Korea	18	24	32	24	34	48	34
ASEAN	0	0	0	0	9	26	3
India	4	18	26	18	35	72	35
Asia	85	153	179	139	220	366	190

- In the Adv. Tech. Scenario, nuclear power capacity in China will expand to 70 GW in 2020 - the largest in Asia.

- Nuclear power capacity in India will increase using the overseas light-water nuclear reactor technologies in addition to domestically developed thorium fuel cycle.

- Even in the low nuclear scenario, Asia's nuclear capacity will grow due to massive construction in China and India.

Carbon Intensity of Electricity (CO_2 Emissions per kWh)

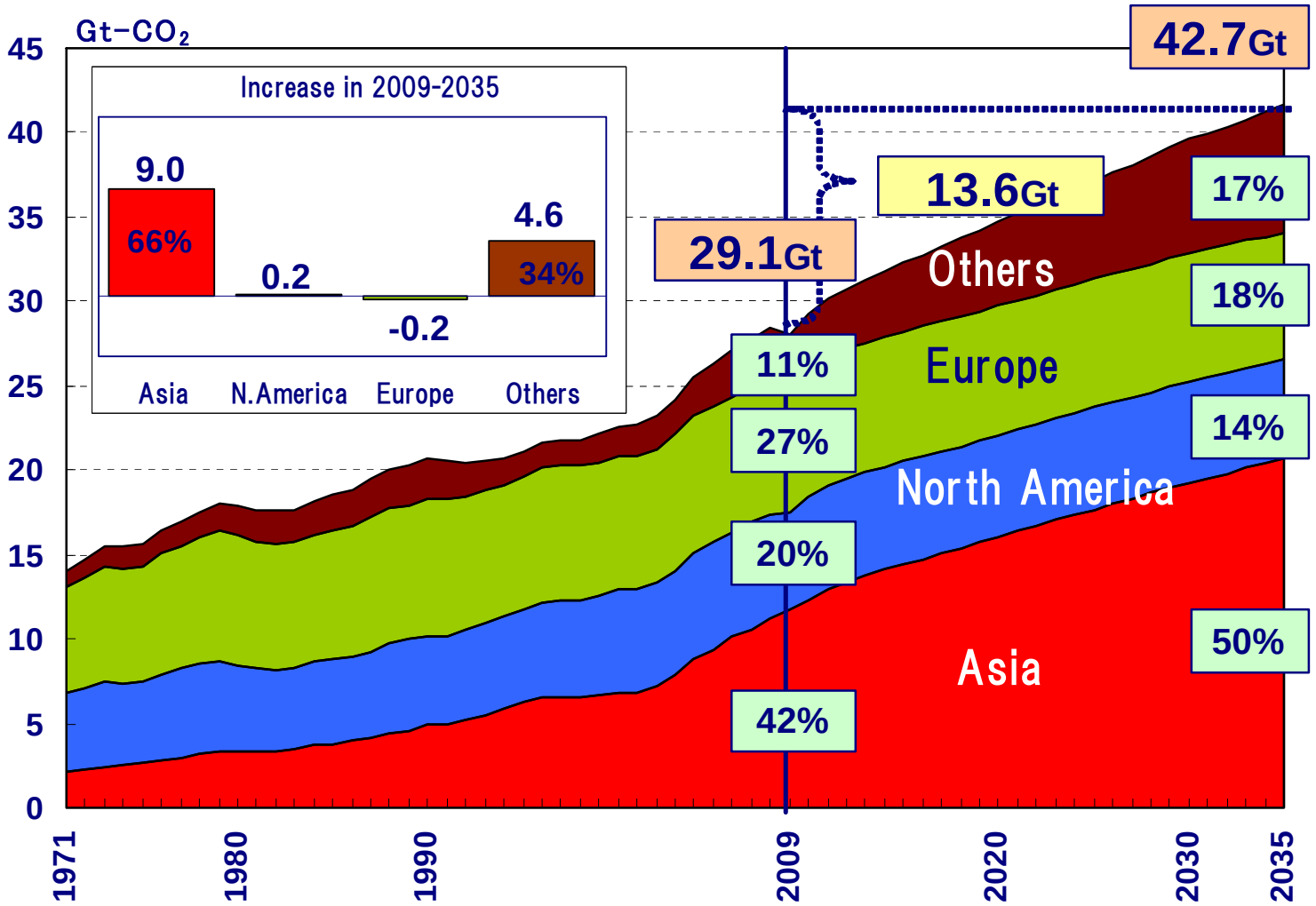


*390g-CO_2/kWh **350g-CO_2/kWh

- The average CO_2 emissions per kWh will be reduced substantially reflecting the expansion in nuclear and renewable energy as well as efficiency improvements in fossil-fired power generation.
- In the Adv. Tech. Scenario, the average CO_2 emissions per kWh in 2035 will be 40% less than the 2009 level. In Asia the reduction will reach 45%.

CO_2 Emission by Region (World)

Reference



World

2009
29.1Gt
↓
2035
42.7Gt
(1.5-fold inc.)

Asia

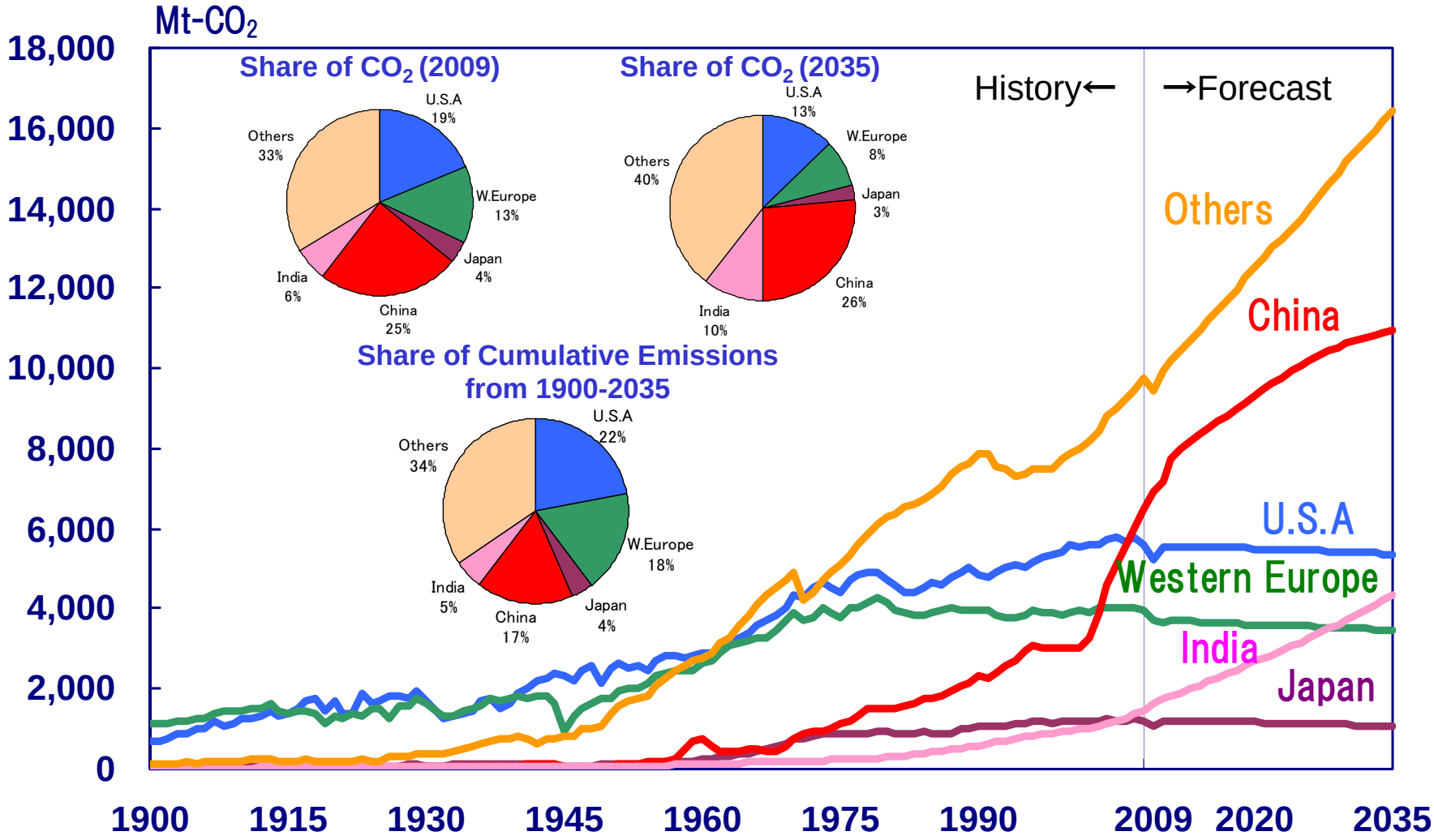
2009
11.7Gt
↓
2035
20.7Gt
(1.8-fold inc.)

■ Non-OECD accounts for over 90% of the growth in global CO_2 emissions, through 2035. Asia alone will account for about 70% of global growth.

■ The share of OECD will decrease from 43% in 2008 to 30% in 2035.

CO_2 Emissions (World)

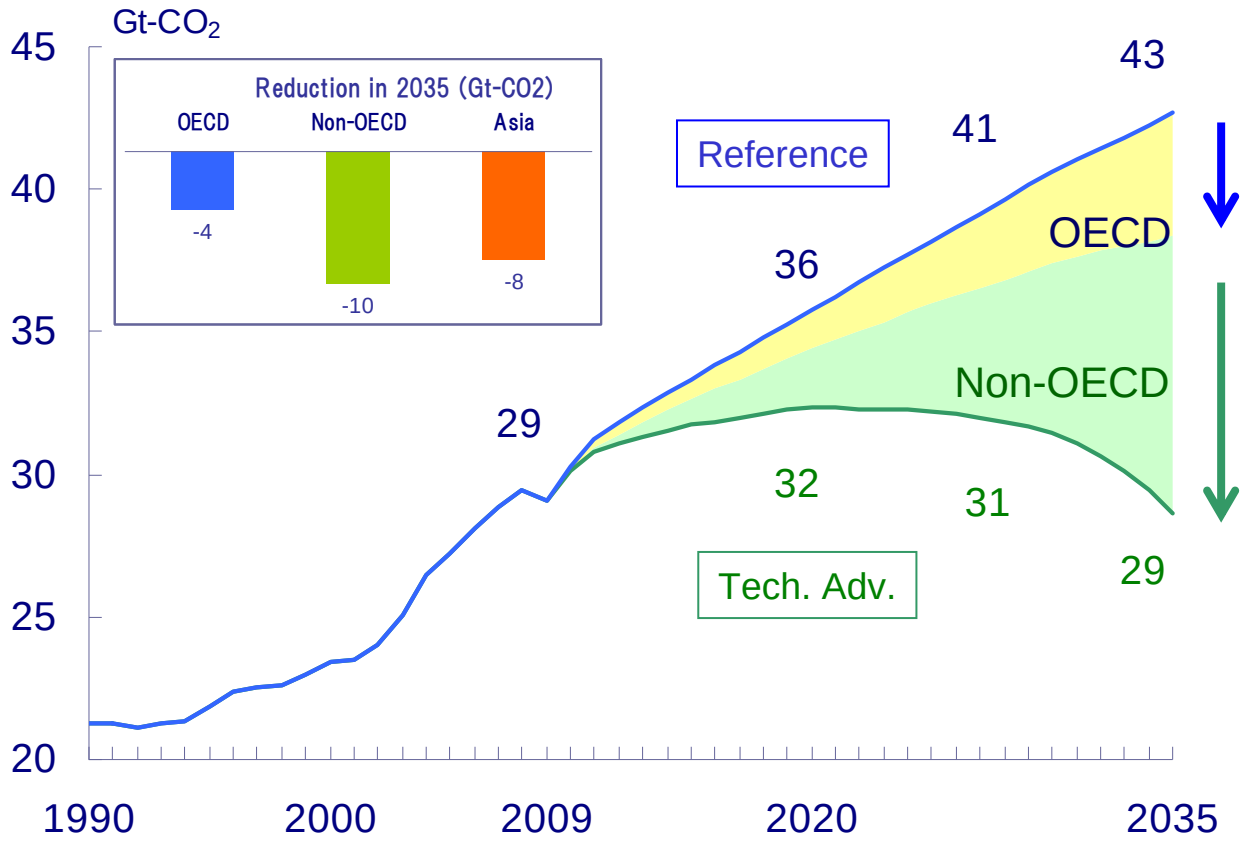
Reference



- China overtook USA as world's biggest CO_2 emitter in 2007. By 2035, India will emit almost as much as the USA.
- India's cumulative CO_2 emissions from 1990 will surpass that of Japan by 2025.

CO_2 Emissions Reduction by Region (World)

Reference
Adv. Tech.



Total **14.1** Gt
(33% reduce)

4.2 Gt
(30% of total)

9.9 Gt
(70% of total)

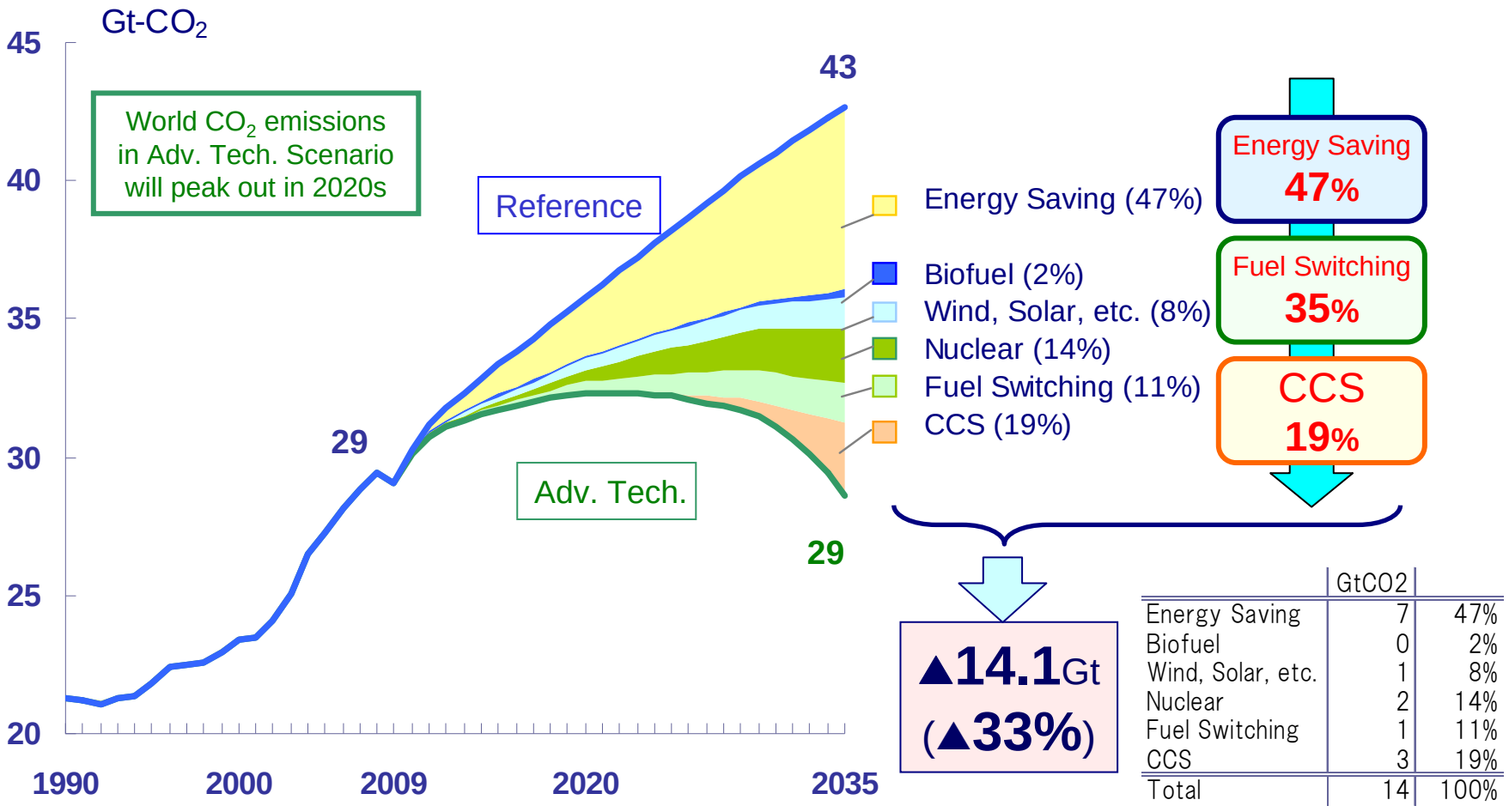
Asia
8.0 Gt
(57% of total)

■ In 2035, Non-OECD's CO_2 emissions reduction (between the Reference and the Adv. Tech. Scenario) is estimated to reach 9.9 Gt, more than twice that of OECD at 4.2 Gt. Among Non-OECD's projected CO_2 emissions reduction, Asia will account for over 80%.

■ Technology transfer and swift deployment of advanced technology in Asia is indispensable in order to address global warming issues.

CO_2 Emissions Reduction by Technology (World)

Reference
Adv. Tech.



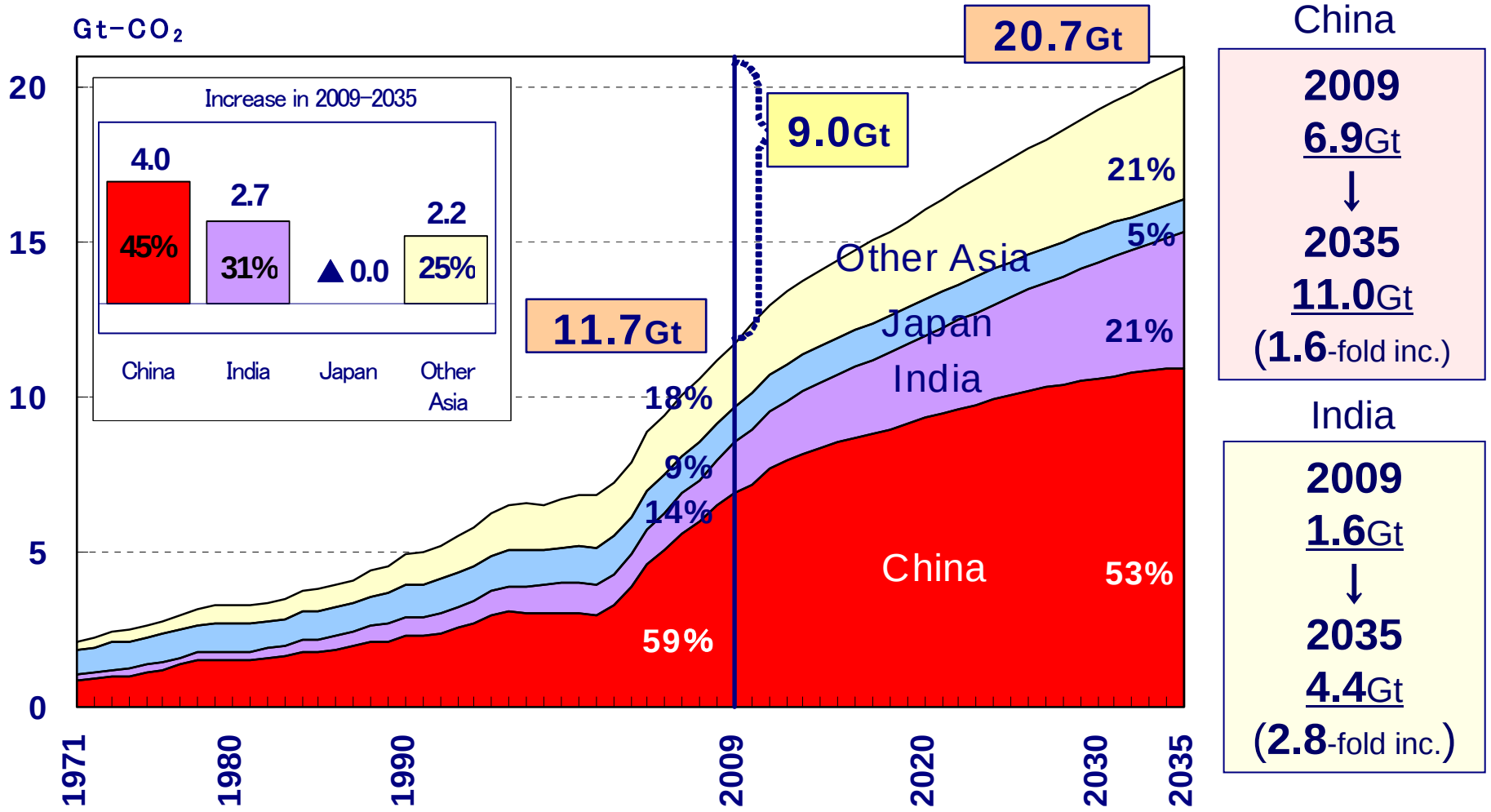
	GtCO2	
Energy Saving	7	47%
Biofuel	0	2%
Wind, Solar, etc.	1	8%
Nuclear	2	14%
Fuel Switching	1	11%
CCS	3	19%
Total	14	100%

■ In the Adv. Tech. Scenario, between 2005 and 2020 the world CO_2 emissions will increase by 5.1 Gt-CO_2 (or 19% up from the 2005 level), while the CO_2 emissions will reach its peak during 2020s with the introduction of advanced energy and environmental technologies.

■ Various technological options, including energy saving, enhancement of power generation efficiency, renewables, nuclear, and CCS altogether contribute to massive CO_2 emissions reduction.

CO_2 Emission by Region (Asia)

Reference



China

2009
6.9Gt
↓
2035
11.0Gt
(1.6-fold inc.)

India

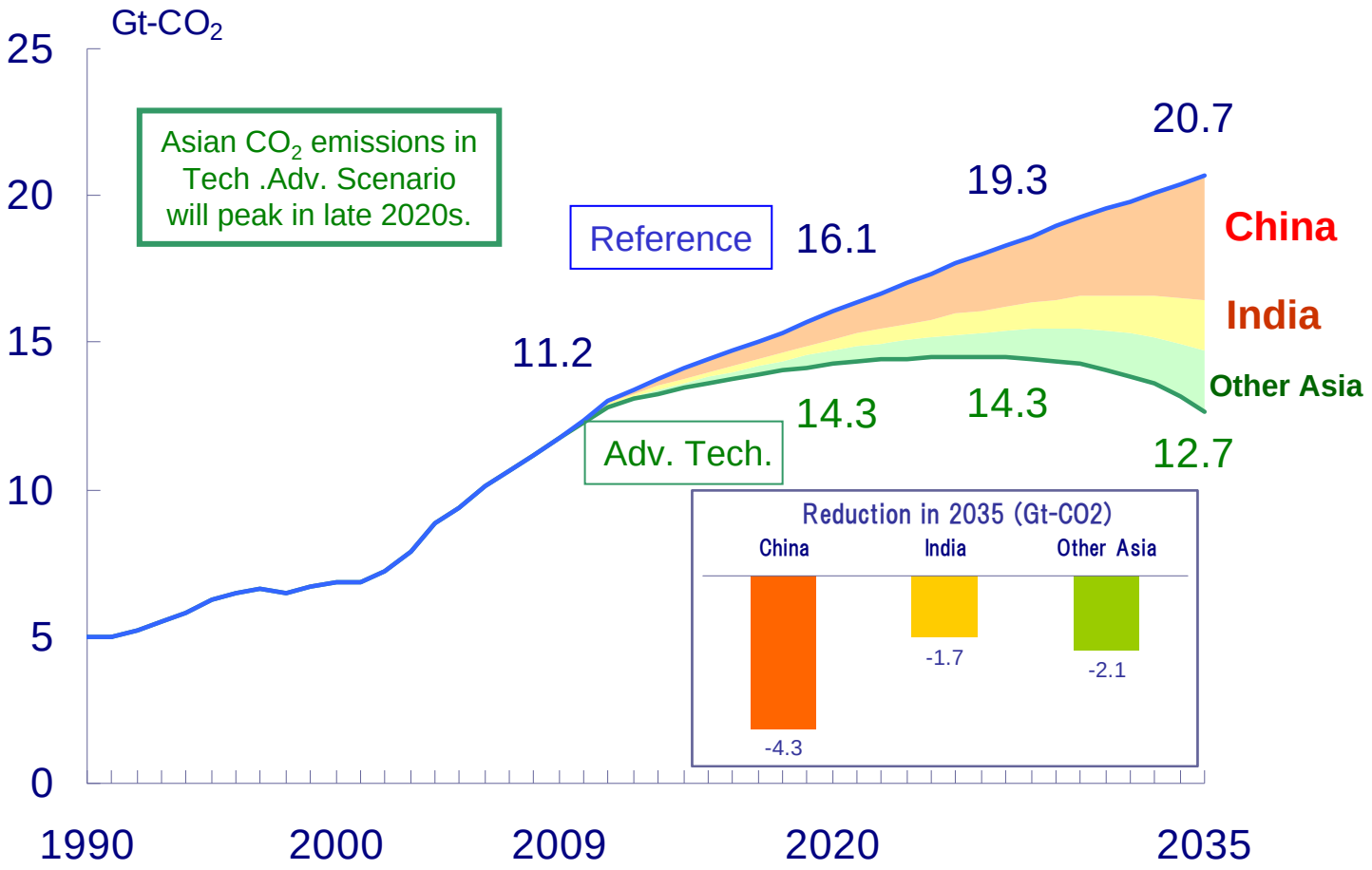
2009
1.6Gt
↓
2035
4.4Gt
(2.8-fold inc.)

■CO_2 emissions in Asia will steadily increase driven by coal consumption. The China and India combined share of the Asian total remains constant throughout the exercise at almost 75%. Japan's major loss of share is taken up by "Other Asian"

■ Increase in Asia will account for about 70% of the world CO_2 emissions growth through 2035.

CO_2 Reduction by Region (Asia)

Reference
Adv. Tech.



Total **8.0**Gt
(39% reduction)

China
4.3 Gt
(53% of total)

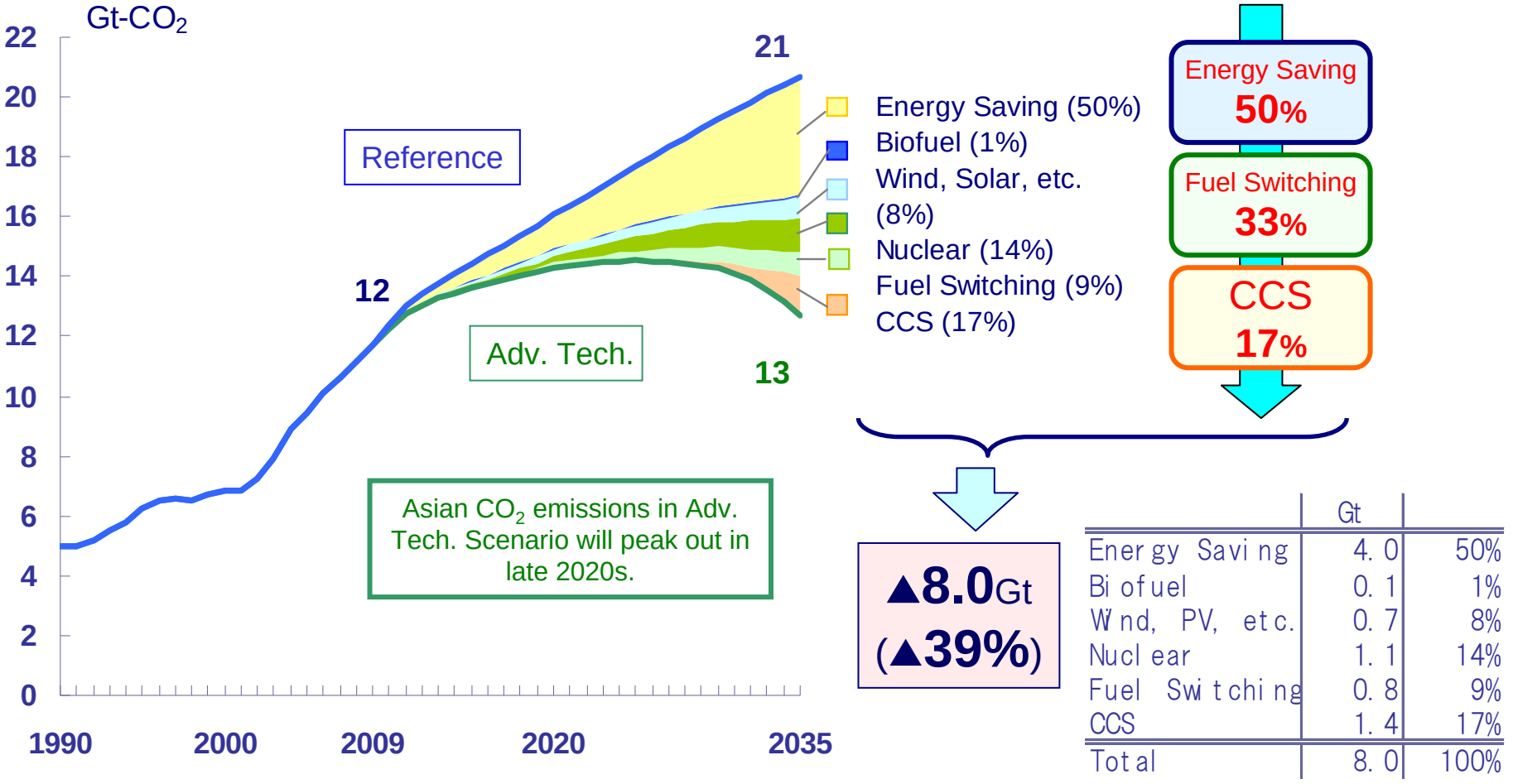
India
1.7 Gt
(21% of total)

Other Asia
2.1 Gt
(26% of total)

■ In the Adv. Tech. Scenario, CO_2 emissions in Asia will continue to increase by 24% from 2009 to 2025. The emissions will reach their peak in late 2020s.
■ China and India have great potential to reduce CO_2 emissions. China's CO_2 emissions reduction will account for 53% of Asia's reduction in 2035. India and other Asian countries will account for the remaining 47%.

CO_2 Emissions Reduction by Technology (Asia)

Reference
Adv. Tech.



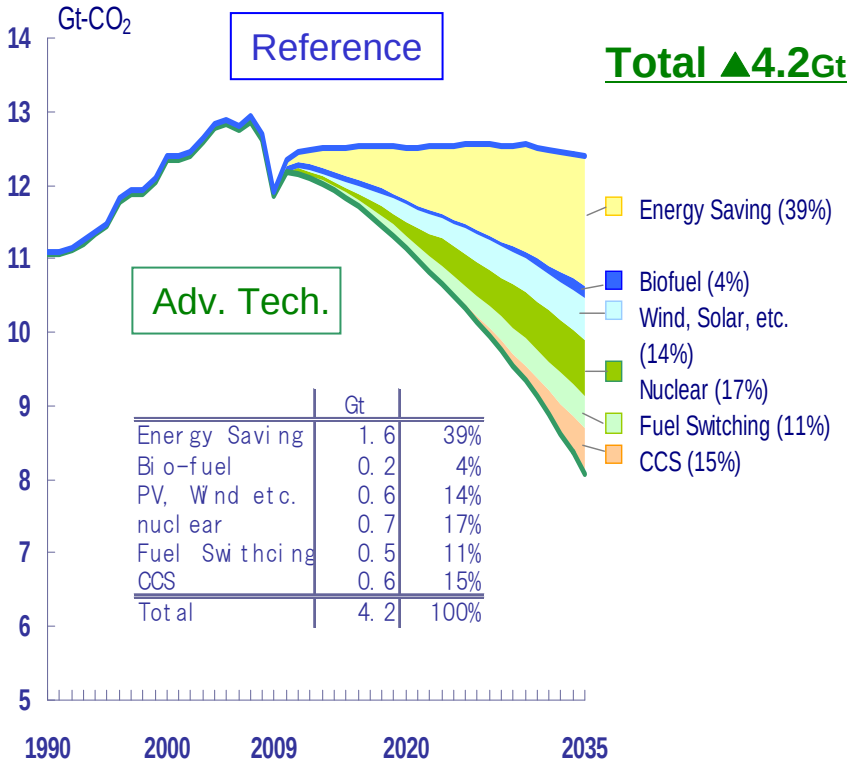
	Gt	
Energy Saving	4.0	50%
Biofuel	0.1	1%
Wind, PV, etc.	0.7	8%
Nuclear	1.1	14%
Fuel Switching	0.8	9%
CCS	1.4	17%
Total	8.0	100%

■ Aggressive development and deployment of advanced technologies in Asia enables to considerably reduce CO_2 emissions and realize its peak by late 2020s.

CO_2 Emissions Reduction by Technology (OECD, and Non-OECD)

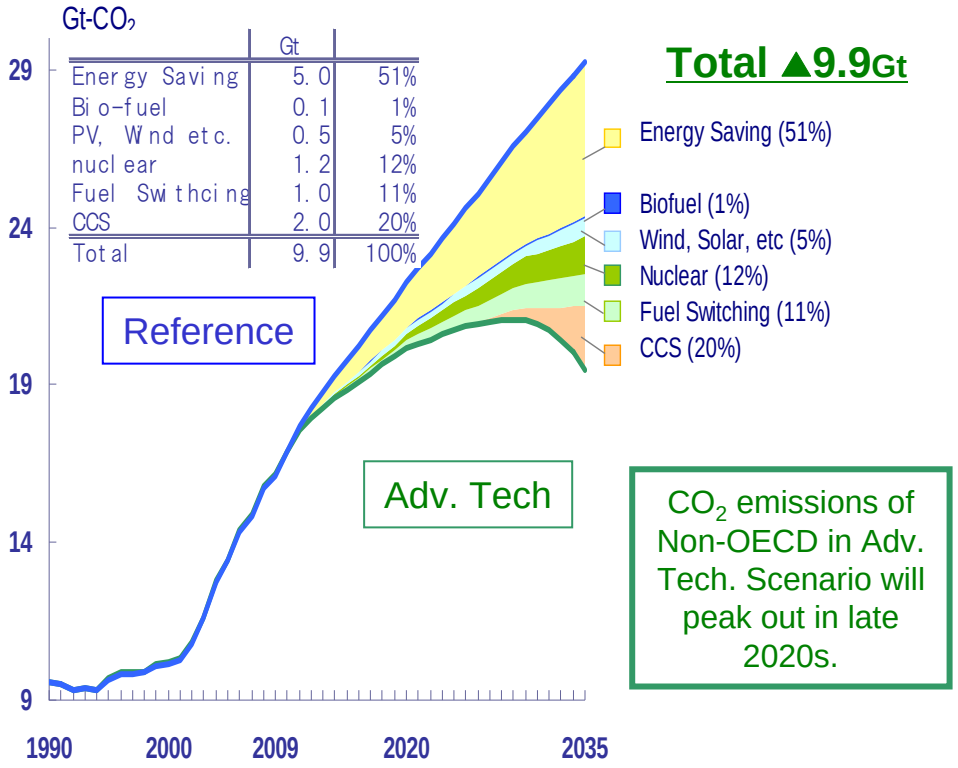
Reference
Adv. Tech.

OECD



	Gt	
Energy Saving	1.6	39%
Bio-fuel	0.2	4%
PV, Wind etc.	0.6	14%
nuclear	0.7	17%
Fuel Swithcing	0.5	11%
CCS	0.6	15%
Total	4.2	100%

Non-OECD



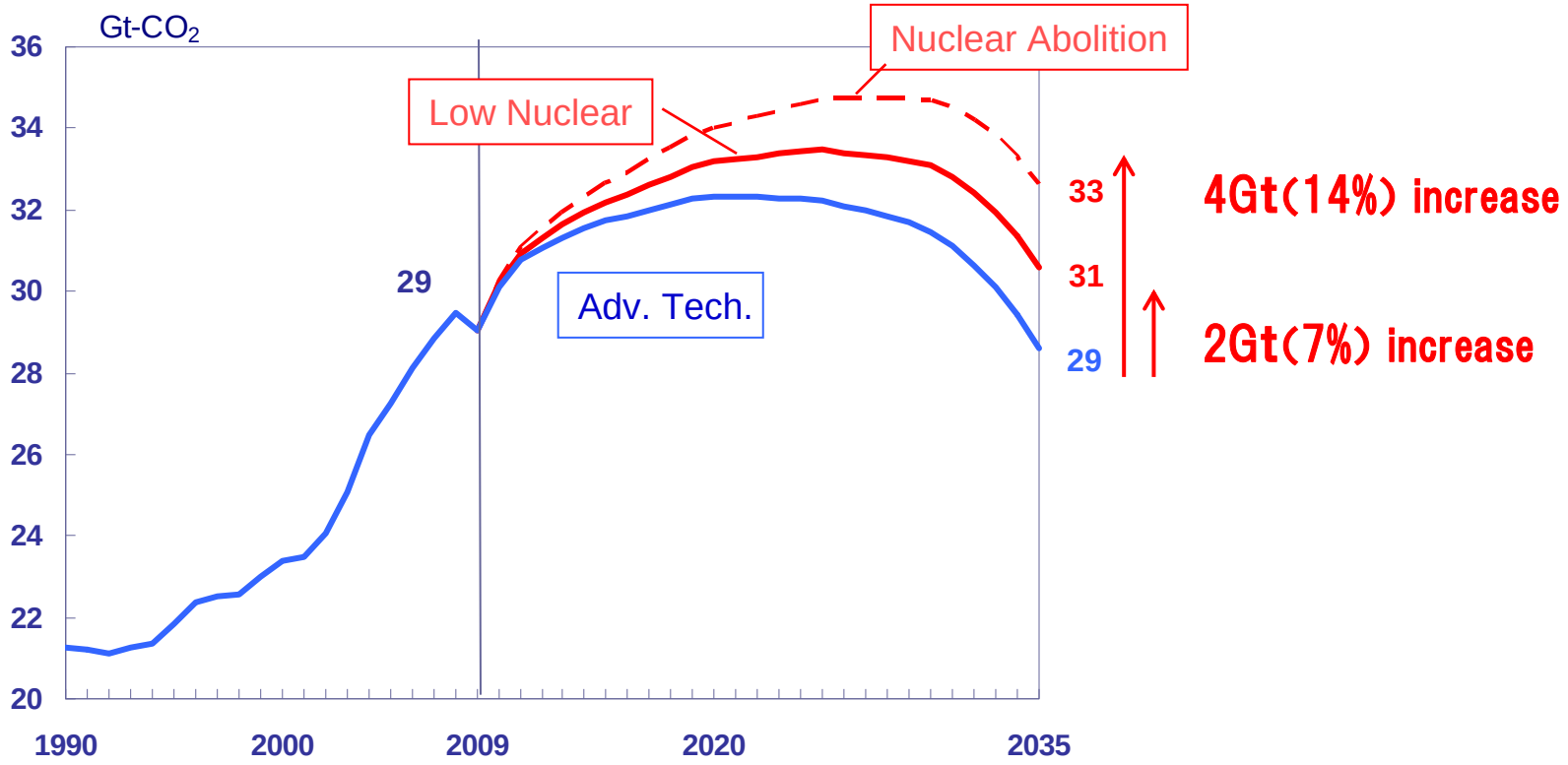
	Gt	
Energy Saving	5.0	51%
Bio-fuel	0.1	1%
PV, Wind etc.	0.5	5%
nuclear	1.2	12%
Fuel Swithcing	1.0	11%
CCS	2.0	20%
Total	9.9	100%

CO_2 emissions of Non-OECD in Adv. Tech. Scenario will peak out in late 2020s.

■ Various technologies are needed to reduce CO_2 emissions. In OECD, energy saving will be responsible for the largest share at 39% (or 1.6 Gt). It is followed by nuclear at 17% (or 0.7 Gt), renewable energy at 14% (or 0.6 Gt), fuel switching at 11% (0.5 Gt), and CCS at 15% (0.6 Gt).

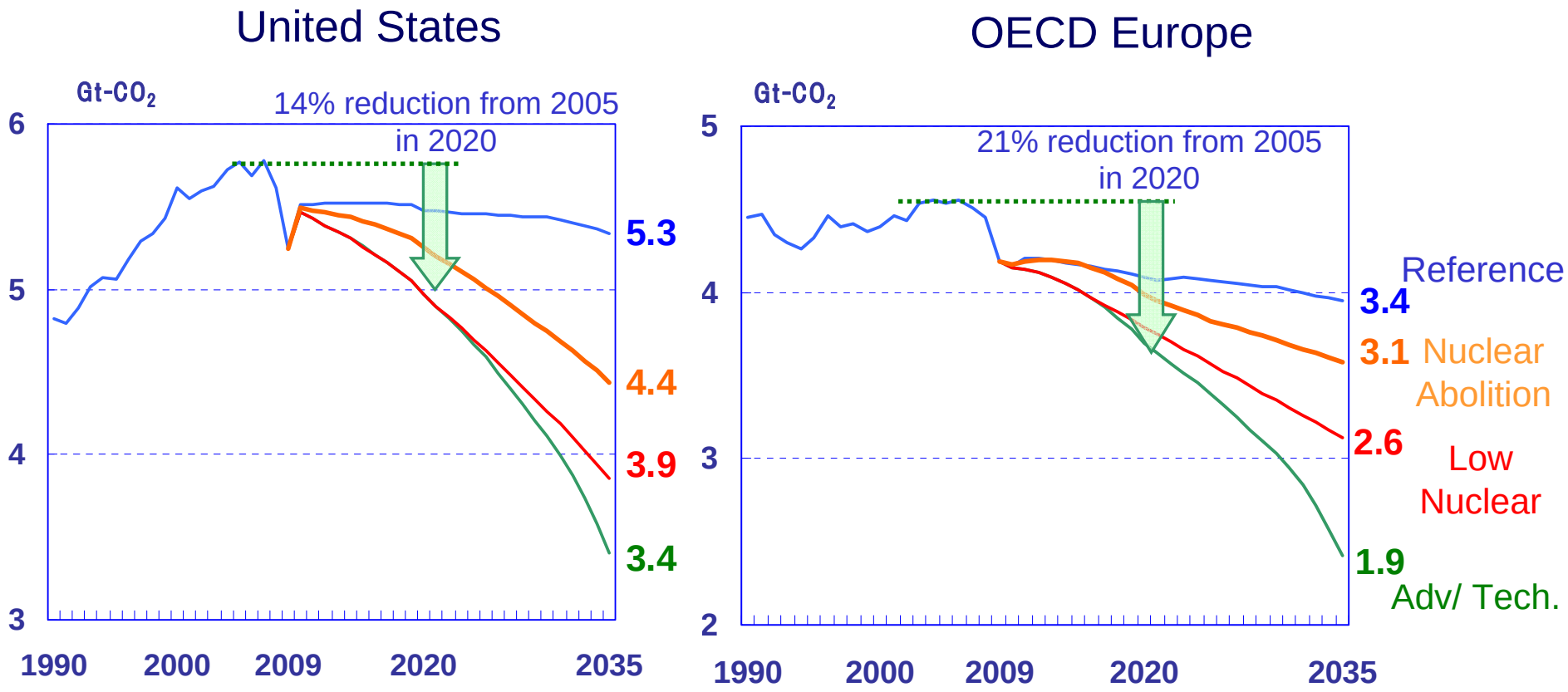
■ In Non-OECD, energy saving will be responsible for more than half of the 9.9 Gt reduction. Supportive measures concerning technology transfer and the establishment of efficiency standards are important to realize those CO_2 emissions reduction while further enhancing energy security.

CO_2 Emissions (Low Nuclear and Nuclear Abolition Scenarios)



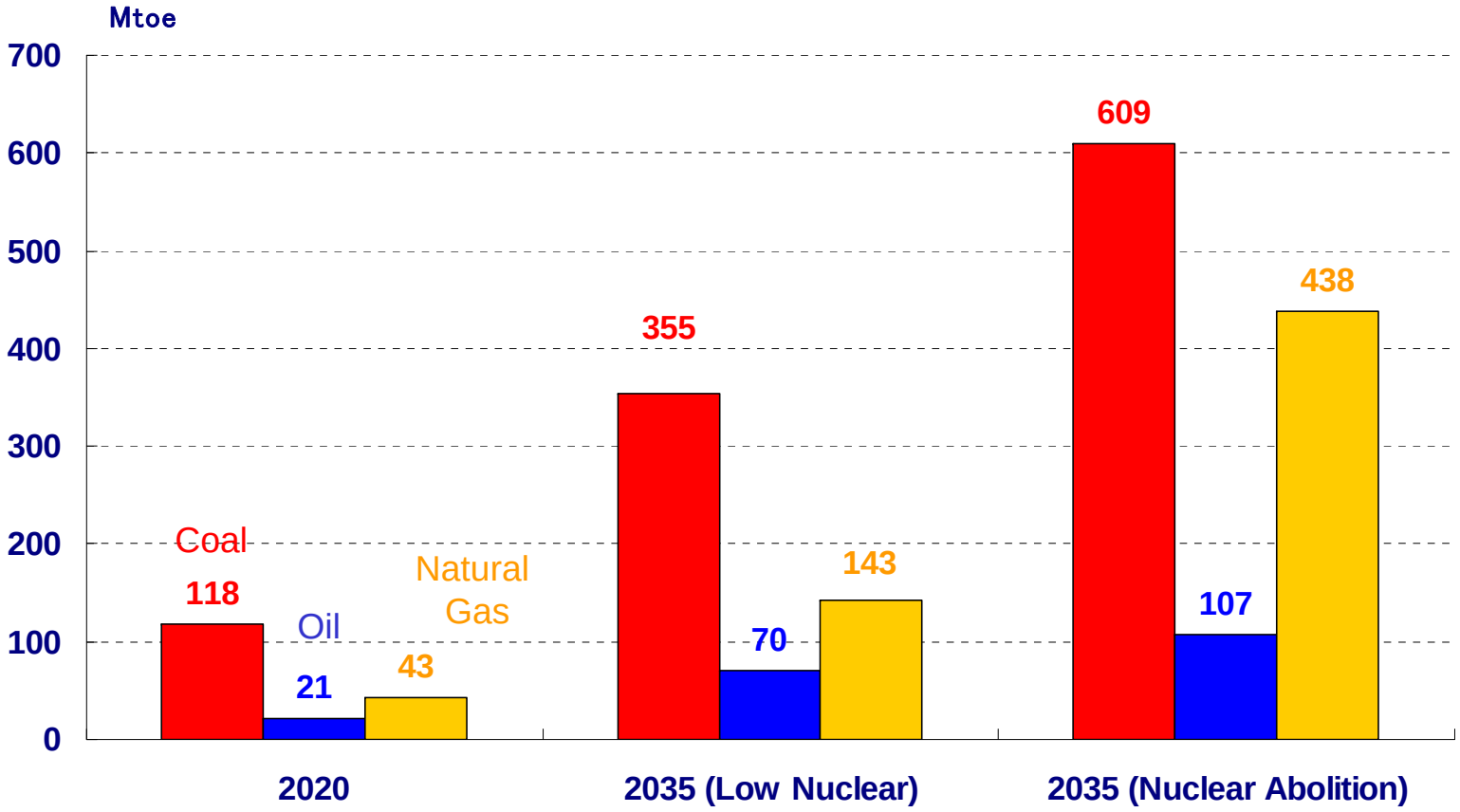
■ In the low nuclear scenario, CO_2 emission in 2035 will increase by 2Gt or 7% if nuclear is replaced by fossil fuel-fired power generation.
■ If nuclear power is completely shut-down by 2035, CO_2 emissions will increase by 4Gt or 14% in 2035.

CO_2 Emissions in USA and Europe (Low Nuclear Scenario)



■ In the United States and OECD Europe, CO_2 emission in the Low Nuclear scenario will be larger than that in the Advanced Technologies scenario by 0.4 Gt and 0.3 Gt in 2035. In the nuclear abolition scenario, CO_2 will increase by 0.7 Gt and 0.8 Gt.

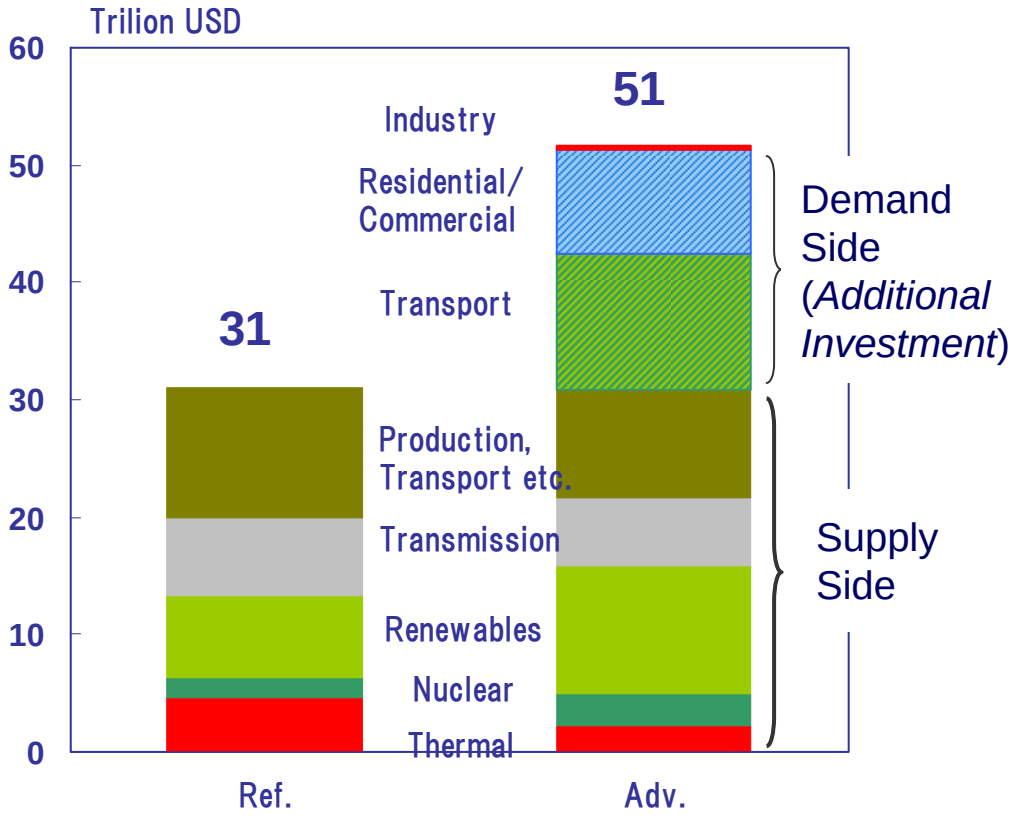
Effects on Fossil Fuel Consumption (Low Nuclear and Nuclear Abolition Scenarios)

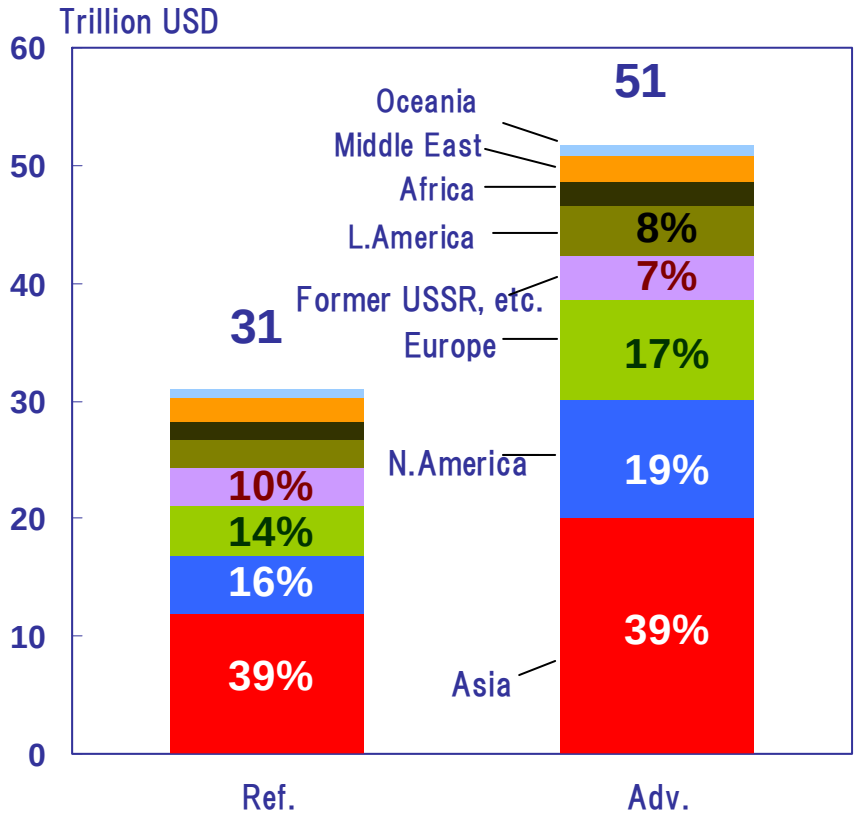


■ In the low nuclear scenario, world coal and natural gas consumption will increase by 0.5 billion tons (360 Mtoe) and 140 bcm (140 Mtoe). The natural gas demand increase is equivalent to about half of the world's LNG trade in 2010, or Qatar's annual natural gas production.

World Investment Requirements (2009-2035)

Reference
Adv. Tech.

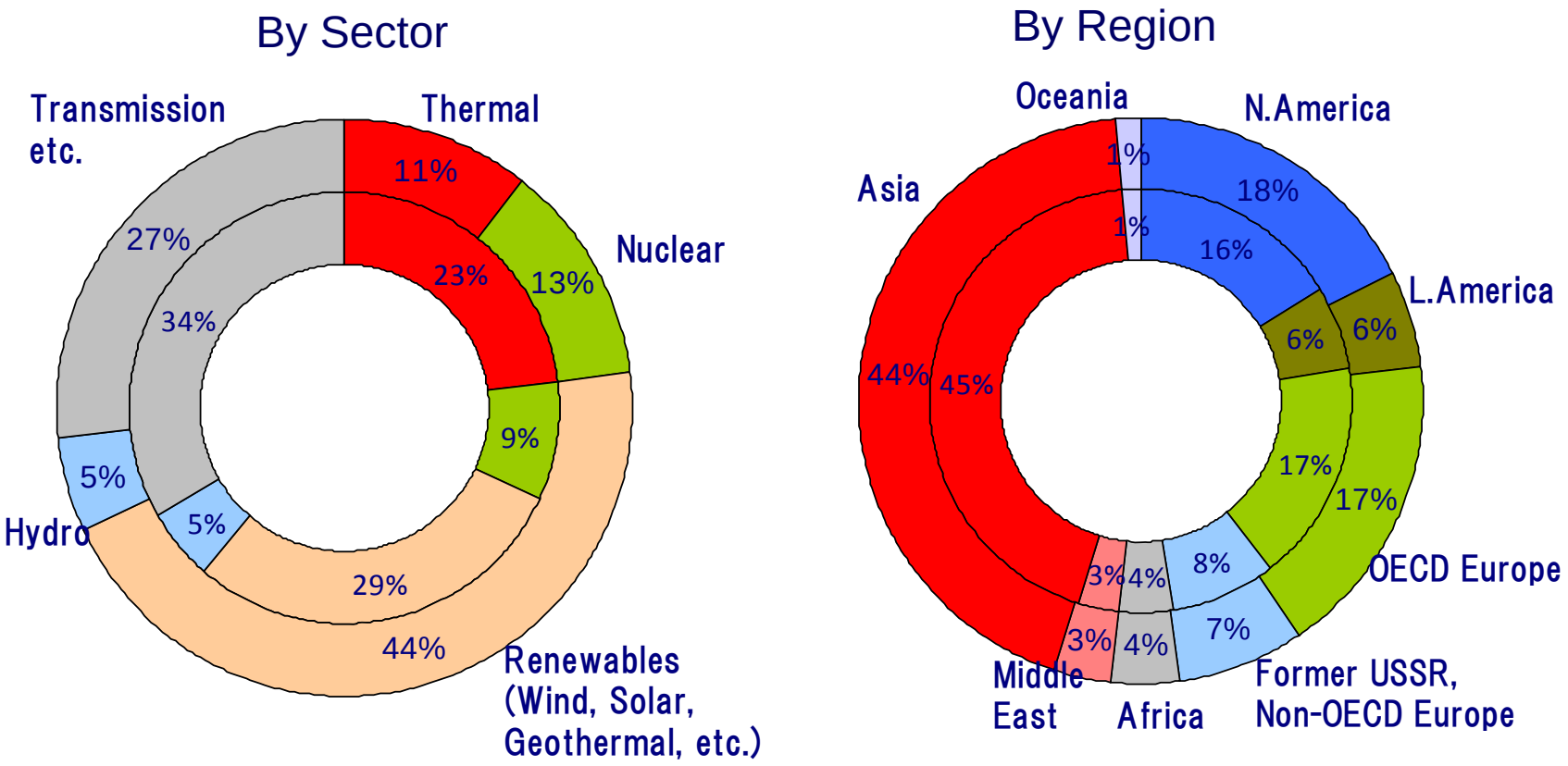




■ To meet the world's energy demand growth in the Reference Scenario, about US$ 31 trillion (between 2009 and 2035) is needed for the supply side.
■ In the Adv. Tech. Scenario, additional investments of USD 20 trillion will be needed to support the different energy demand sectors.
■ By region, Asia will account for the largest share in the world's energy investment requirements.

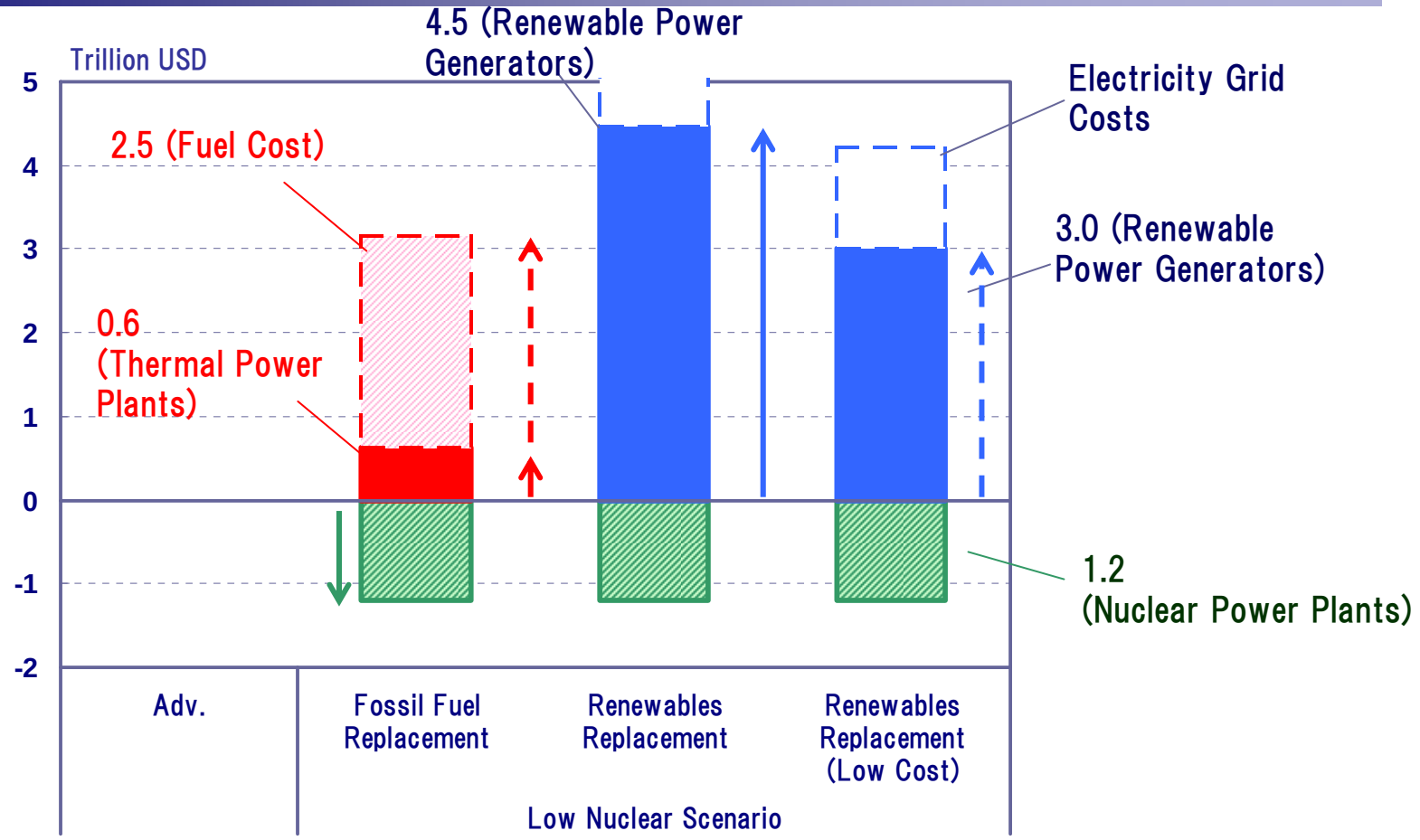
Electricity Sector Investment Requirements (2009-2035)

Reference
Adv. Tech.



- In the Reference Scenario, the world will require cumulative of US$ 20 trillion by 2035 to develop electricity generation plans and transmission/distribution network.
- Investment to renewable power generation will significantly expand in the Adv. Tech. Scenario.
- By region, Asia will account for the largest share at 44-45% in the total electricity sector world' investment requirements.

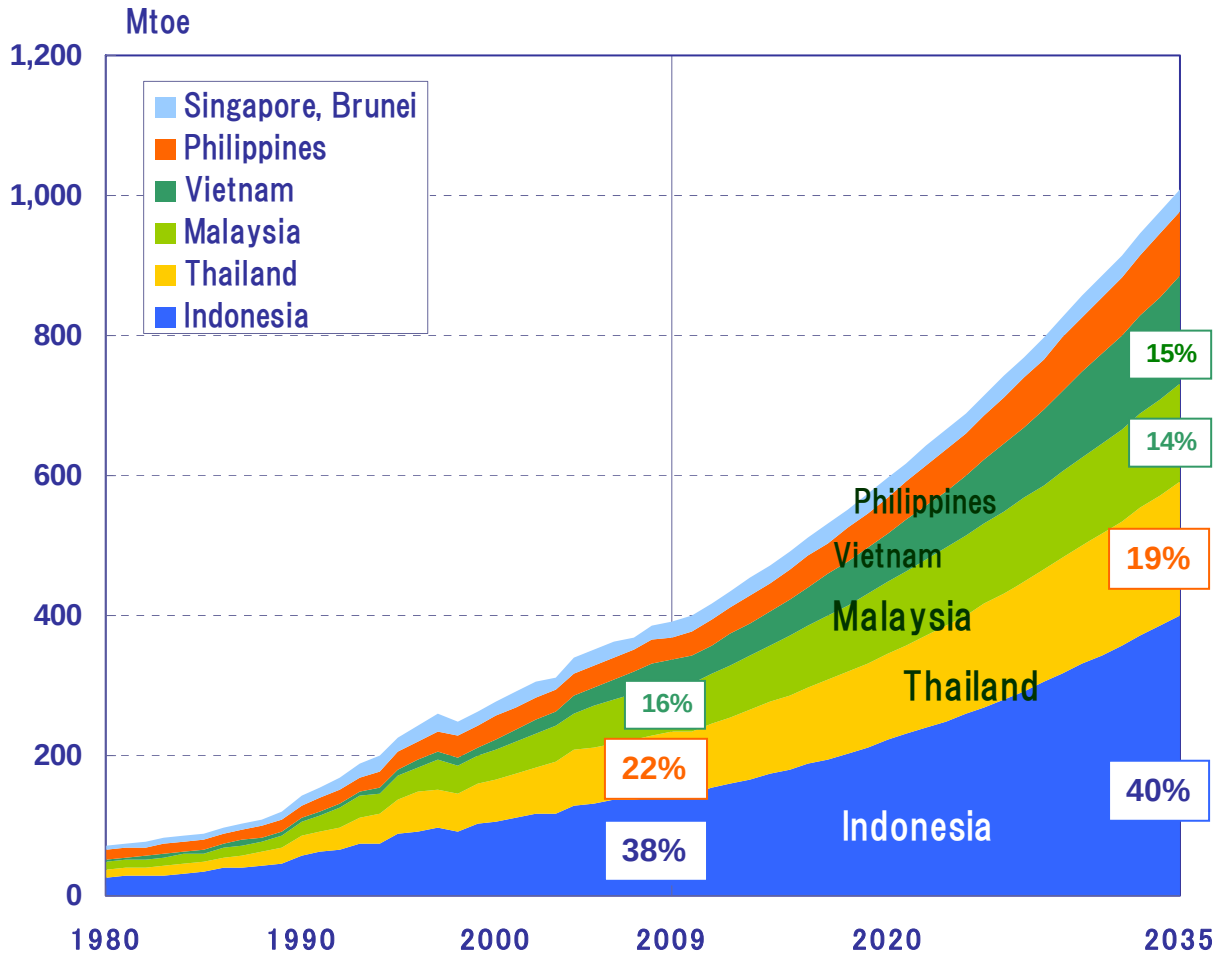
Increase in Cumulative Investment up to 2035 (Low Nuclear Scenario)



- In the low nuclear scenario, cumulative investment to power plants will decrease by USD 0.6 trillion (0.6 thermal power minus 1.2 nuclear), whereas fossil fuel cost will increase by USD 2.5 trillion.
- If nuclear is replaced by renewable power generation, cumulative investment will increase by USD 1.8 to 3.3 trillion. In this case, additional investment to the electricity grid will be needed.

Energy Demand of ASEAN Countries

Reference Scenario



TPED (ASEAN 7)

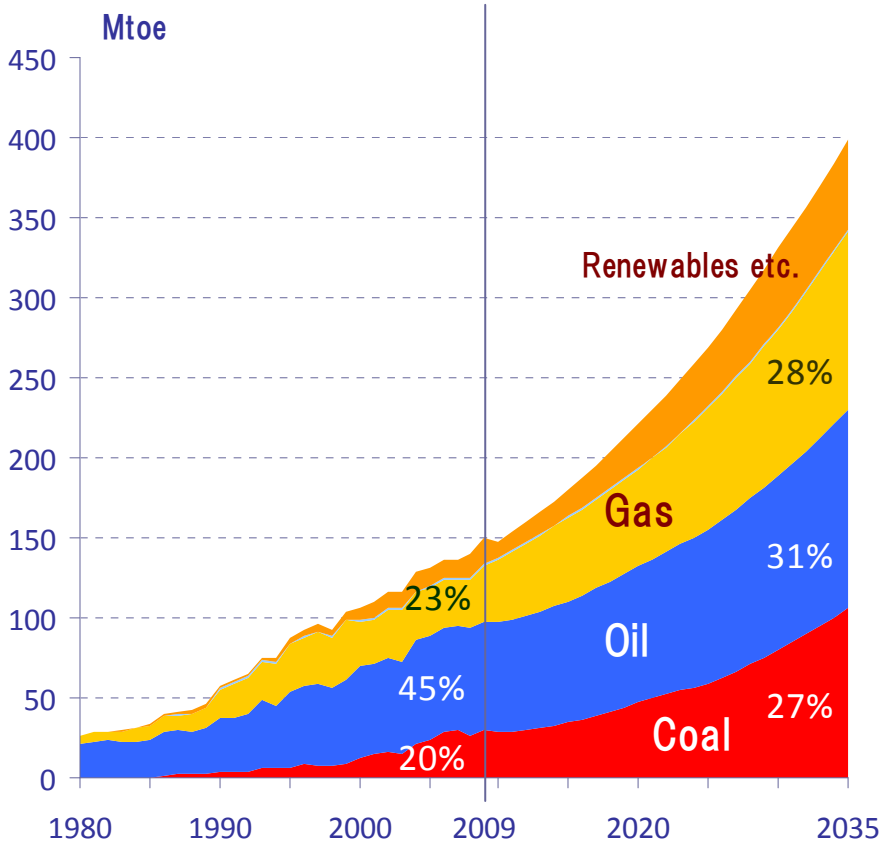
2009
390 mtoe
↓
2035
Reference
1,000 mtoe
(2.5-fold increase)

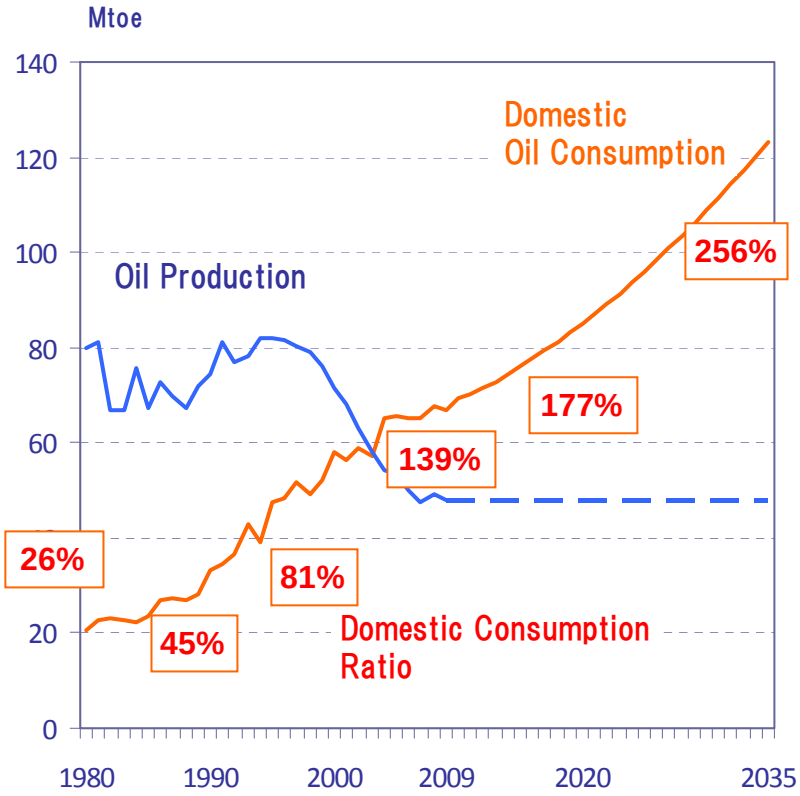
Tech. Adv.
860 mtoe
(2.2-fold increase)

■ Total primary energy demand in ASEAN countries will grow at 3.7% annually, reaching 1.0 billion toe in 2035.

Energy Demand and Supply in Indonesia

Reference Scenario

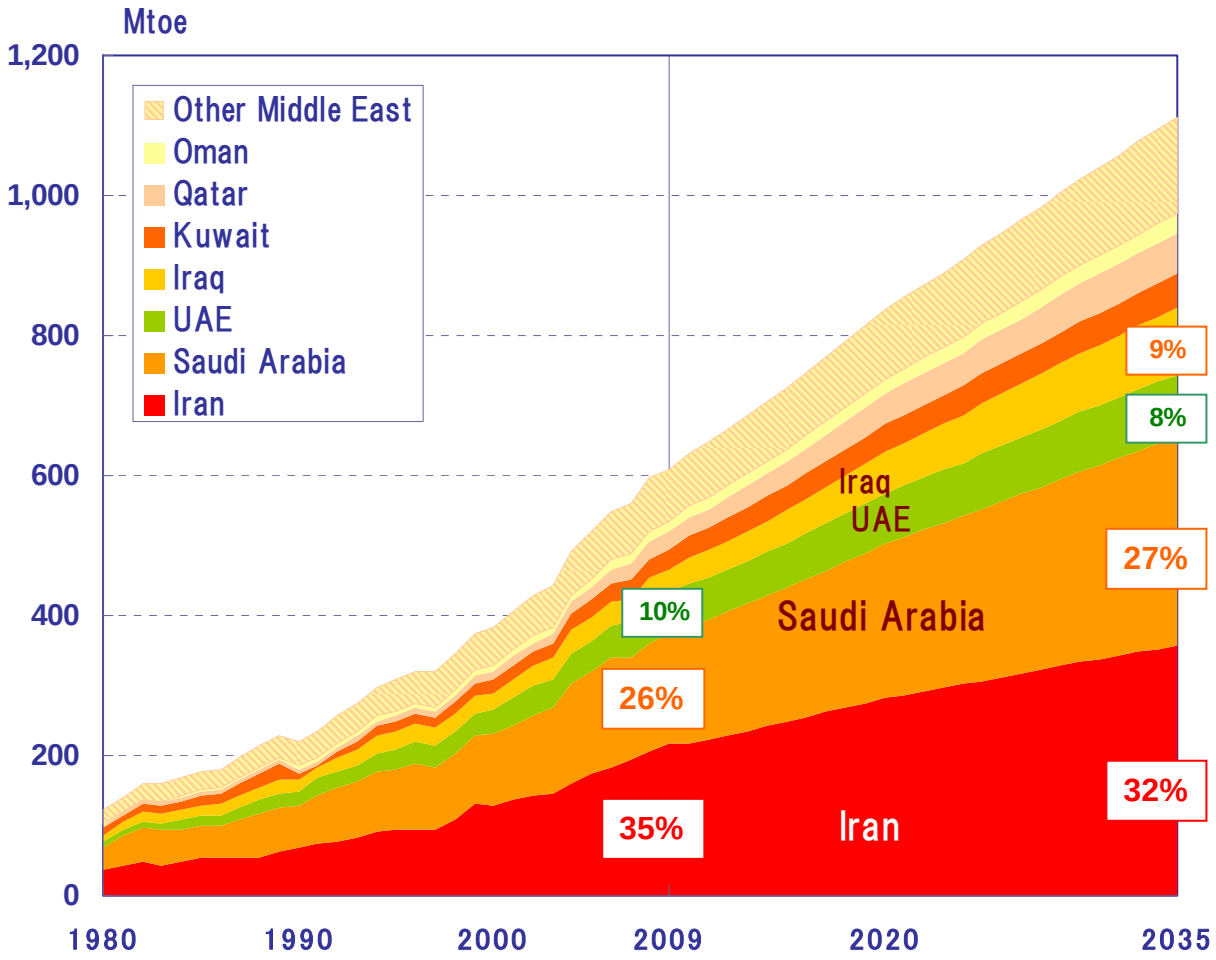




■ Indonesia became a net oil importer after 2000, and the oil consumption will continue to grow in the future. Net oil import to Indonesia will reach 1.5 million B/D in 2035 in the Reference Scenario, and 1.1 million B/D in the Tech. Adv. Scenario.

Energy Demand in Middle East

Reference Scenario



TPED (Middle East)

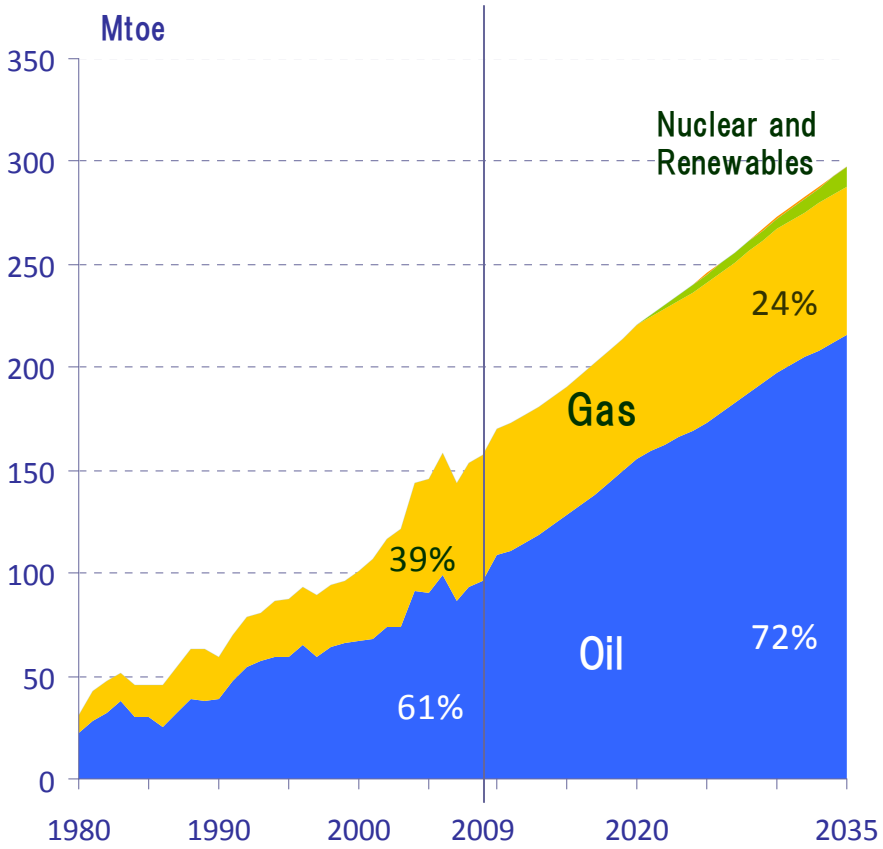
2009
610 mtoe
↓
2035
Reference
1,100 mtoe
(1.8-fold increase)

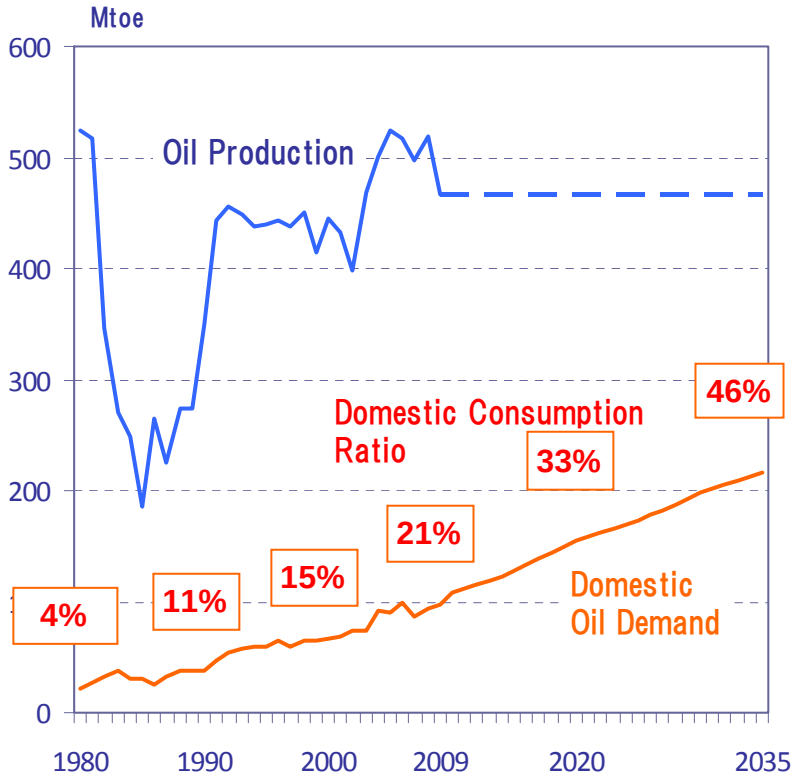
Tech. Adv.
990 mtoe
(1.6-fold increase)

■ Total primary energy demand in Middle East will nearly double by 2035, due to high economic growth.

Energy Demand and Supply in Saudi Arabia

Reference Scenario



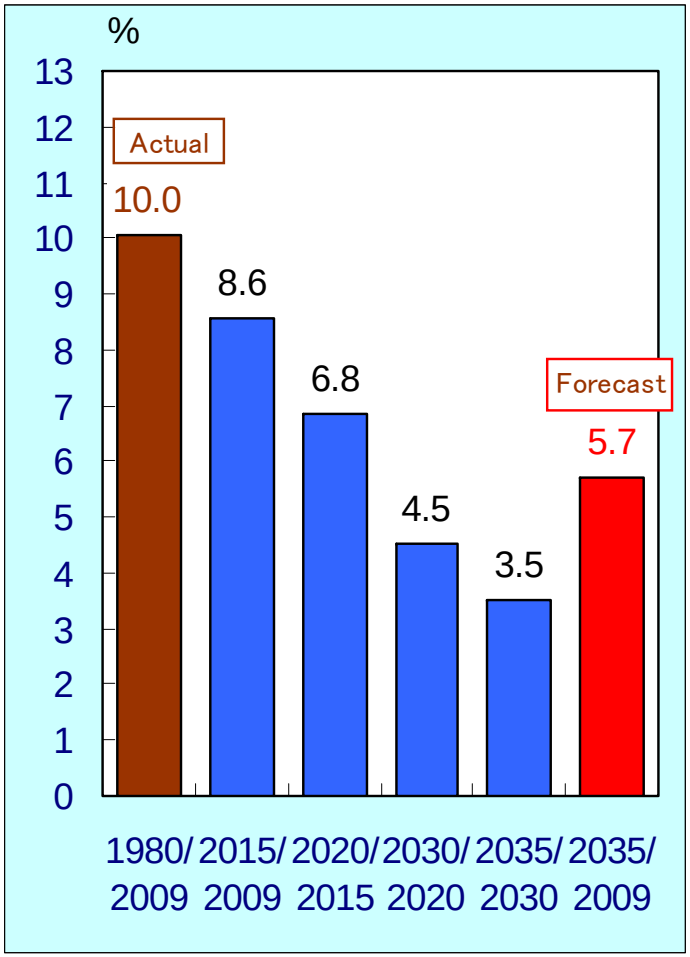


■ Saudi Arabia's domestic oil demand will grow from 1.9 million B/D in 2009 to 4.3 million B/D in 2035, which will be almost half of its oil production.

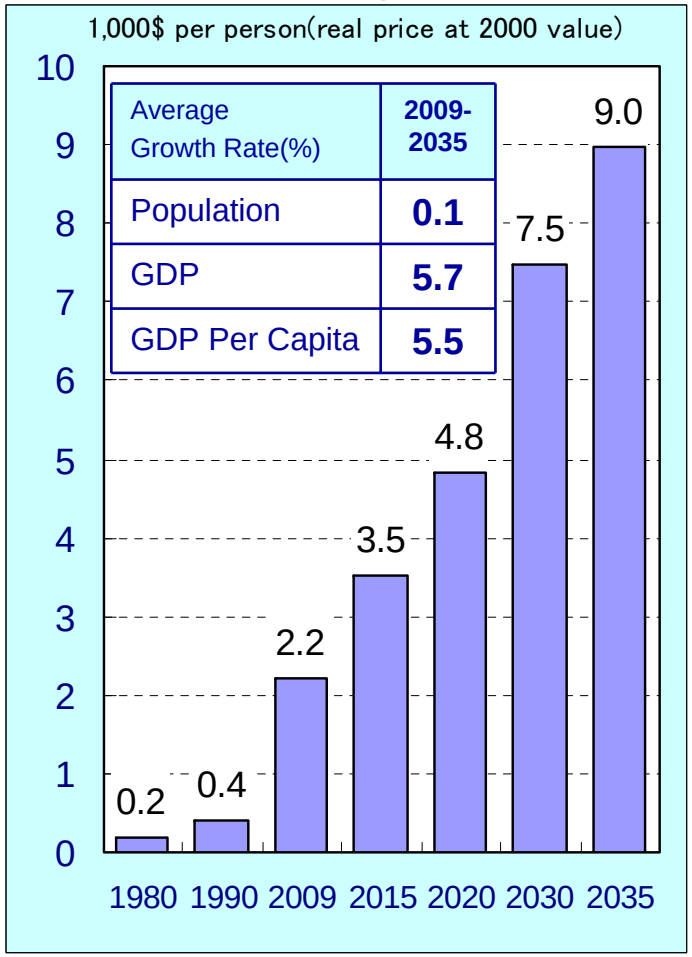
Energy Demand and Supply in China

GDP Growth of China

【 GDP Growth Rate 】



【 GDP Per Capita 】



GDP

2009
2.9 T.USD
↓
2035
12.4 T.USD
(**4.2**times)

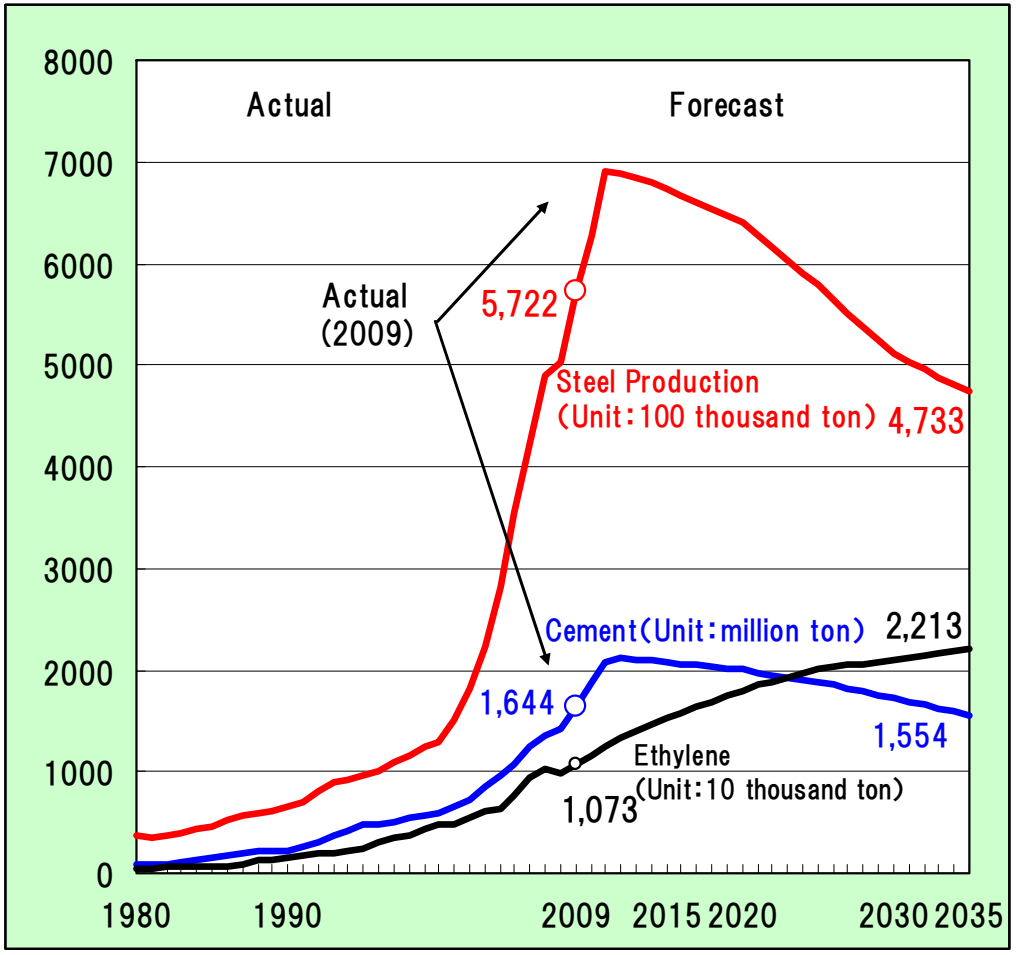
2009
44.0%
↓
2035
64.9%
(**20.9**points up)

■ In the future, China's economy will gradually grow at a moderate pace due to the shift from export and investment-driven growth to domestic consumption-led growth. Other factors, including decrease in labor, environmental considerations and resource constraints, are additional reasons for the moderate growth.

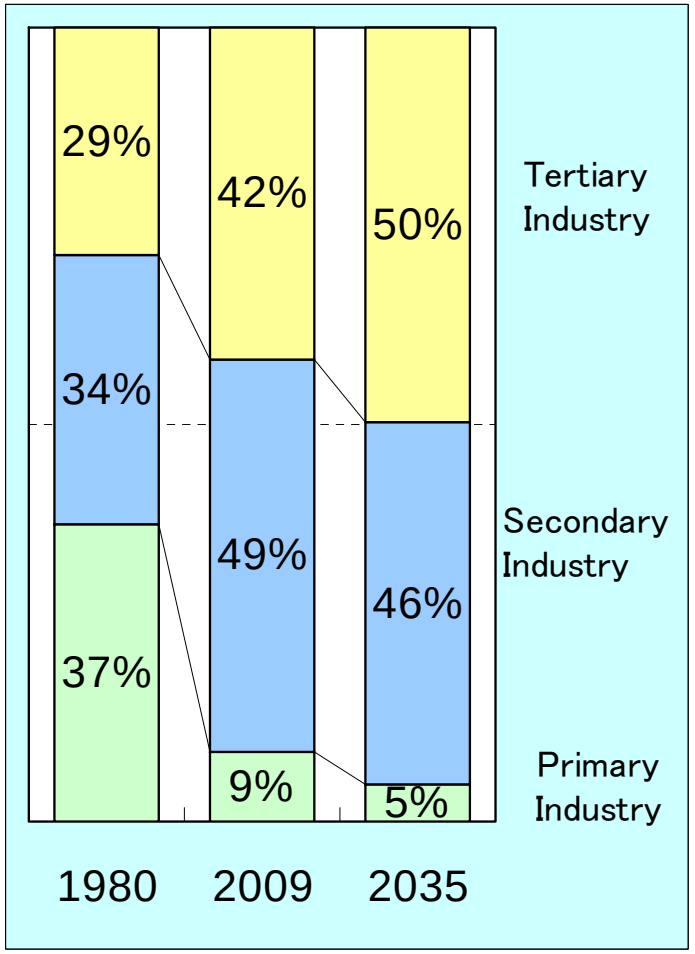
■ GDP per capita (at 2000 price) is expected to reach 9 thousand USD in 2035, a four-fold increase from the 2009 level.

Raw Material Production and Industrial Structure in China

【 Raw Material Production 】



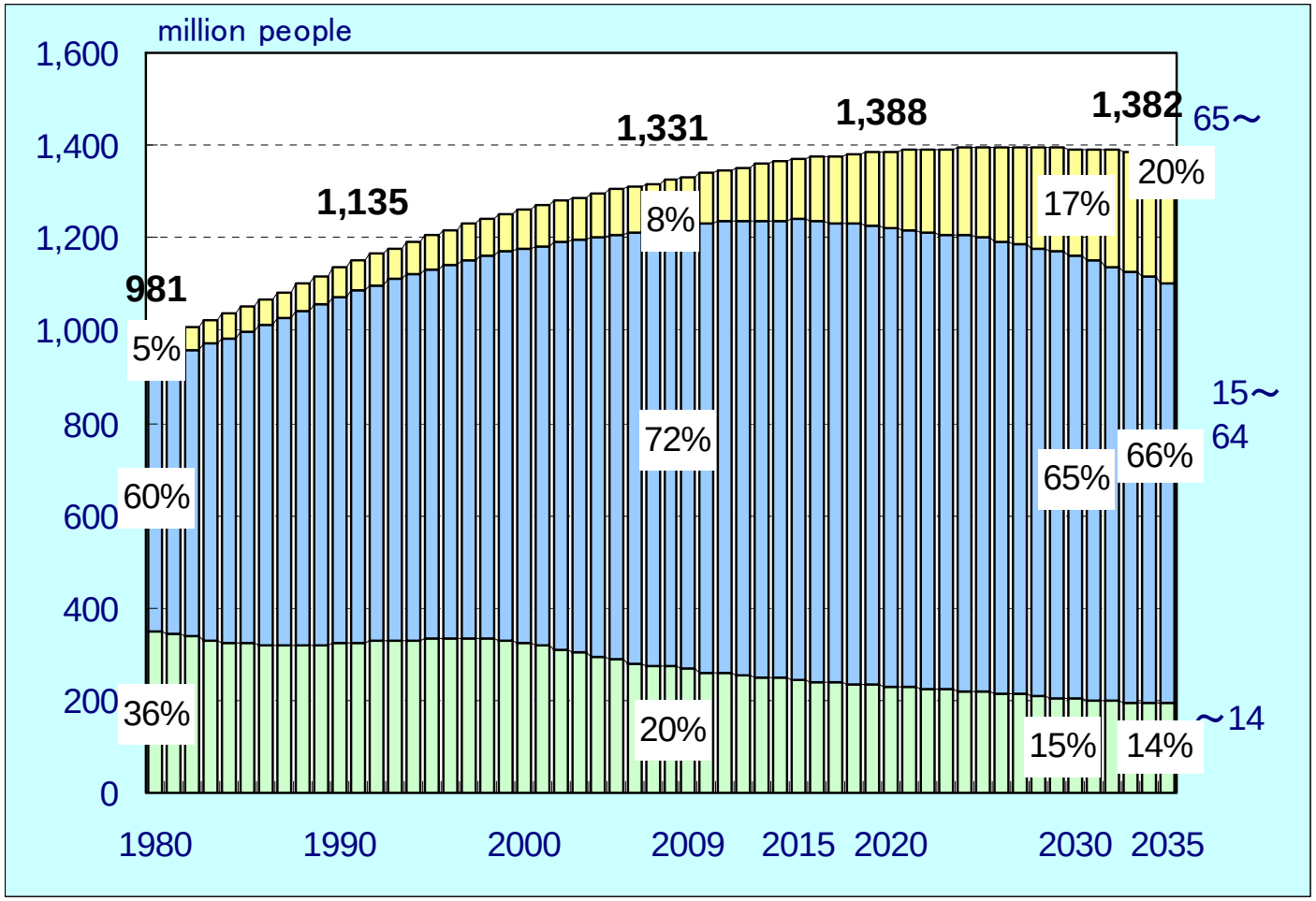
【 Industrial Structure 】



■ Raw materials production will reach peak in the future. Steel production will decrease from about 600 million ton currently to below 500 million ton by 2035.

■ As the share of tertiary industries is increasing rapidly, the share of heavy primary industries is likely to decrease over time. The share of secondary industry will remain at similar levels throughout.

Population in China



Average Growth Rate (%)	2009-2035
Total	0.1
Over 65	3.7

Total Population (Million)

2009
1,330
↓
2035
1,380
(**1.04** times)

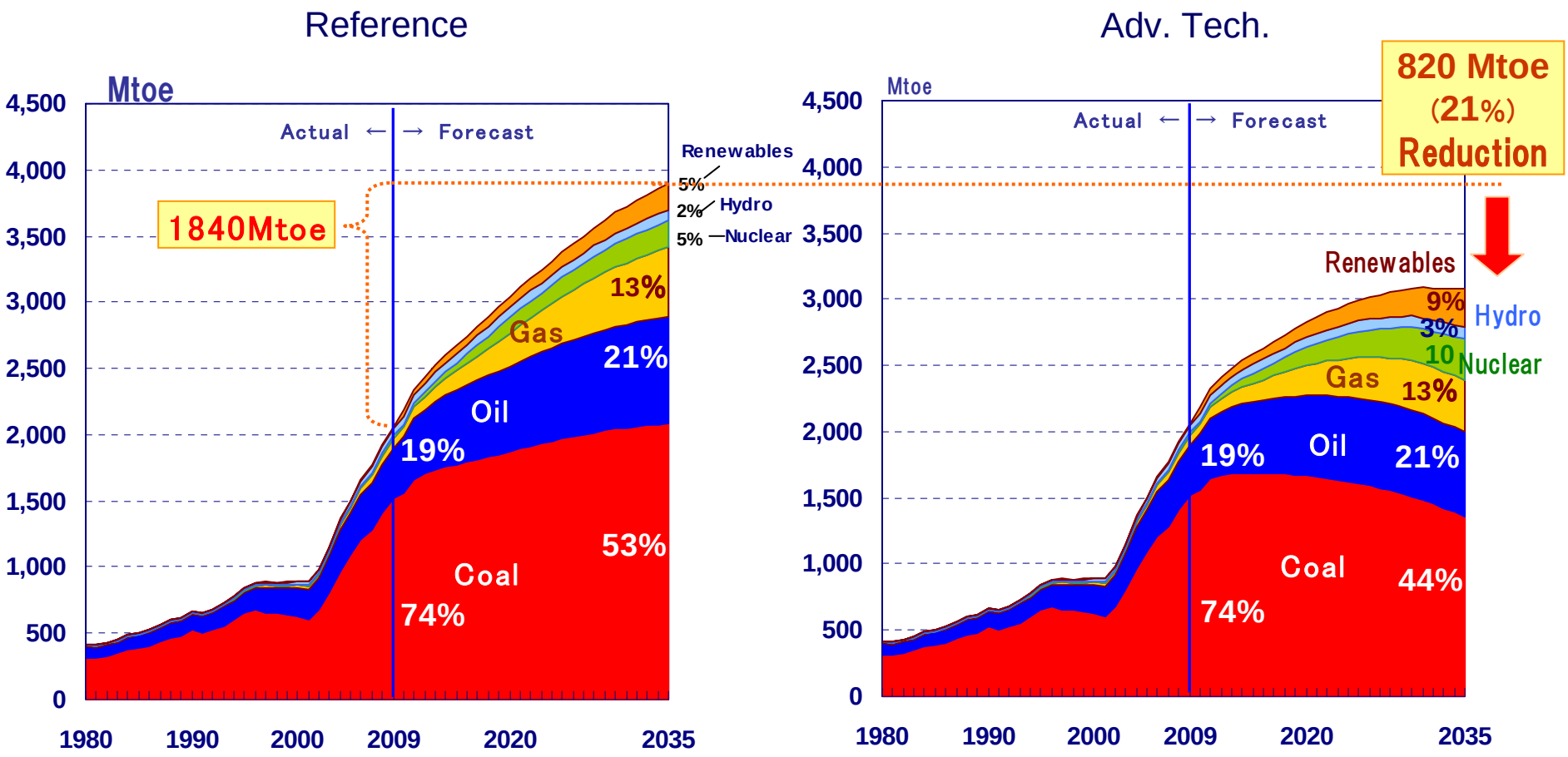
Urbanization Rate

2009
44.0%
↓
2035
64.9%
(**20.9** points up)

■ Population will increase at 0.4% annually and will peak at around 1,400 million by 2025. By then it will be surpassed by India.
■ The share of population over 65 will reach 20% in 2035 from 8% in 2009. Labor force population will peak by 2015 and begin to decrease.

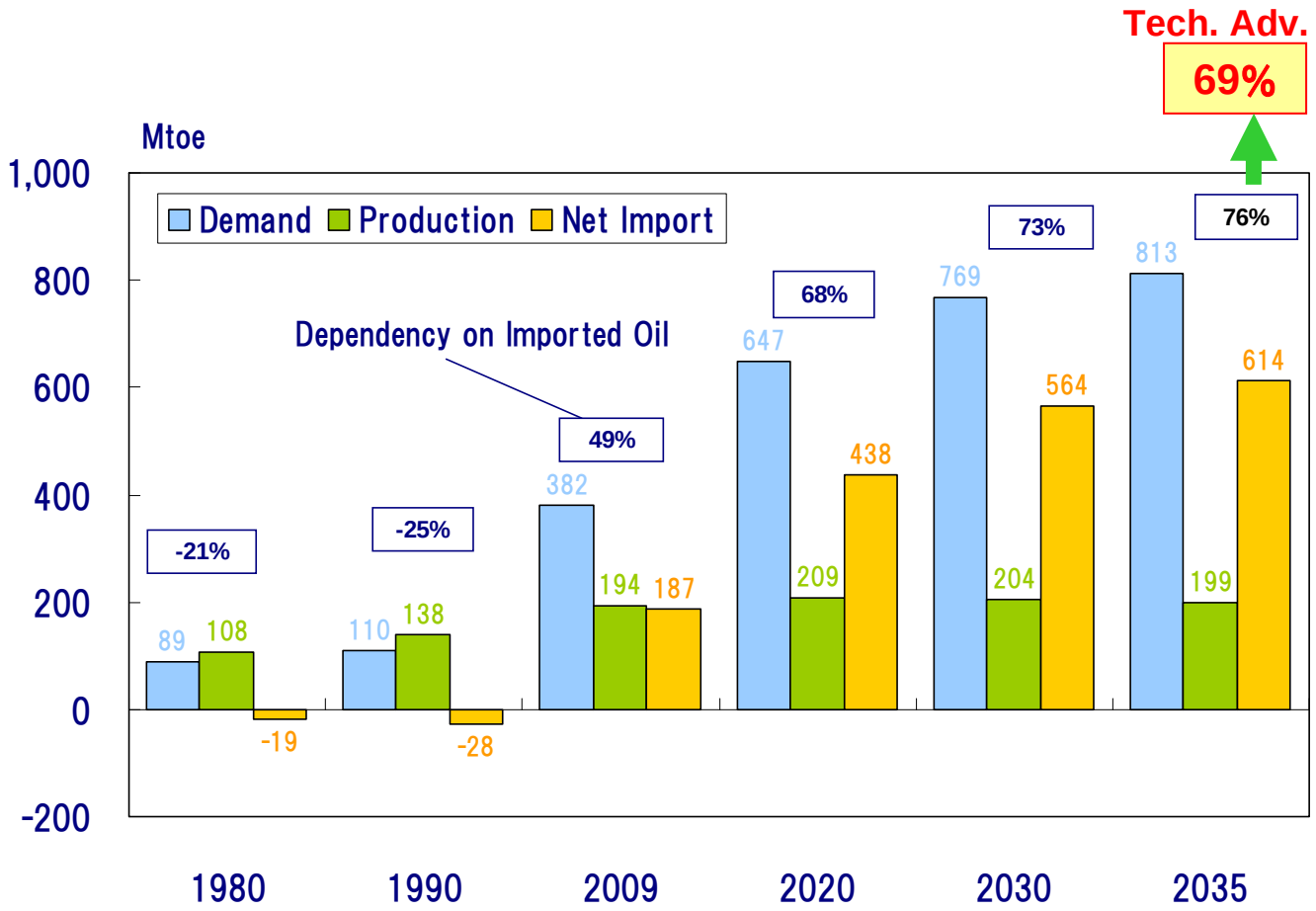
Primary Energy Demand in China

Reference
Adv. Tech.



■ TPED will increase at an annual rate of 2.5% 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 820 Mtoe (21% down) reduction compared with Reference Scenario in 2035.

Oil Demand and Supply in China



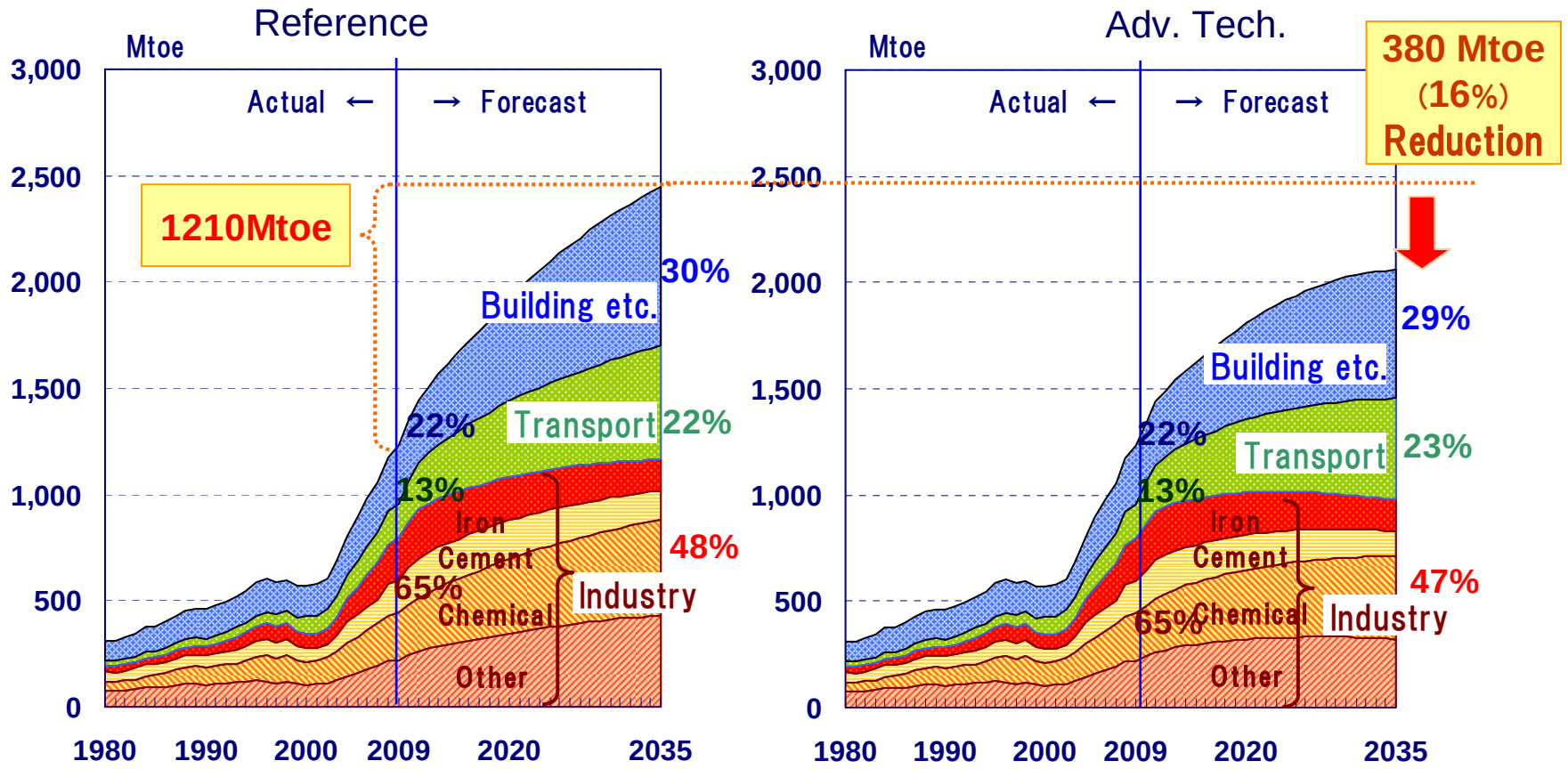
Net Oil Import

2009
3.8MB/D
↓
2035
Reference
12.0MB/D
(**3.3**times)

Tech. Adv.
9.05MB/D
(**2.3**times)

- Net oil import is projected to expand from 190 million ton (3.8 mb/d) in 2009 to 615 million ton (12 mb/d) in 2035. As a result, net oil import ratio will reach 76% in 2035 from 49% in 2009.
- In the Adv. Tech. Scenario, oil demand will grow at a relatively slow rate, but net oil import ratio will still increase to 69% in 2035.
- In order to sustain domestic oil production, continued investments are required to explore and develop oil fields in the western part of China and offshore.

Final Energy Demand in China



Note: industrial including non-energy usage.

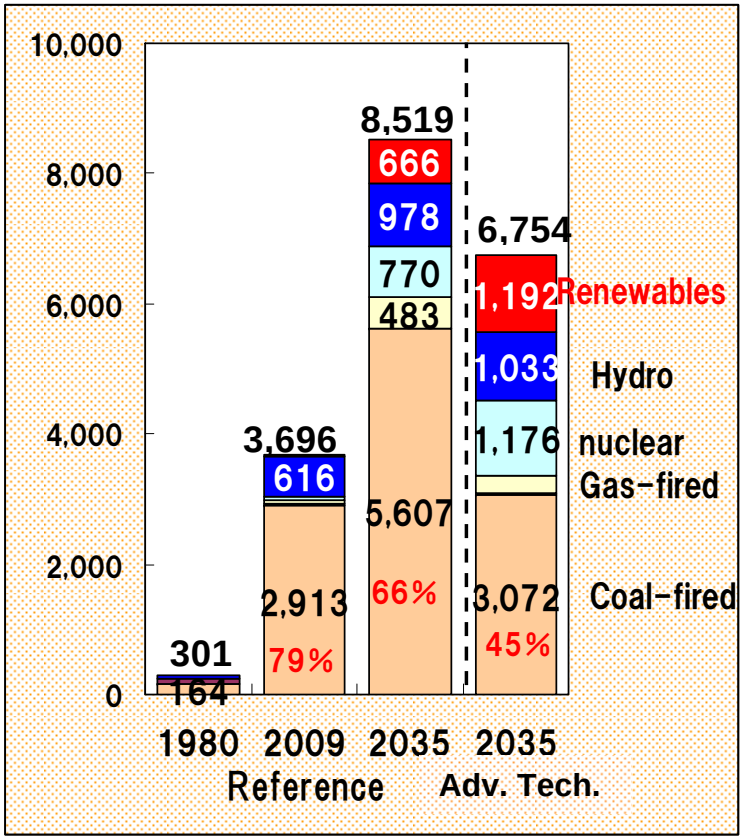
■ Energy demand of heavy industry which has been strong up to now will grow relatively slowly in the future.

■ By contrast, energy demand of the household, buildings, and transport sectors will increase substantially. Although the share of the household and commercial sectors will reach 29% in 2035 (from 22% in 2009) , the per capita energy demand of those sectors will still be lower than the OECD average.

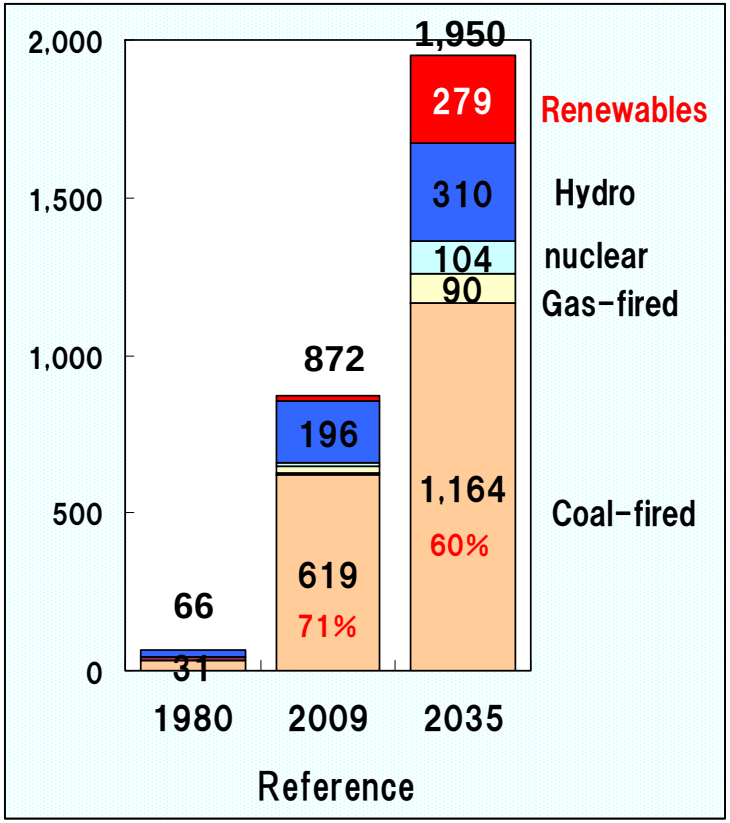
■ In the Tech. adv. Scenario, energy demand of the household, building, and transport sectors is expected to have big potential for reduction.

Power Generation Sector

【Power Generation (TWh)】



【Capacity (GW)】

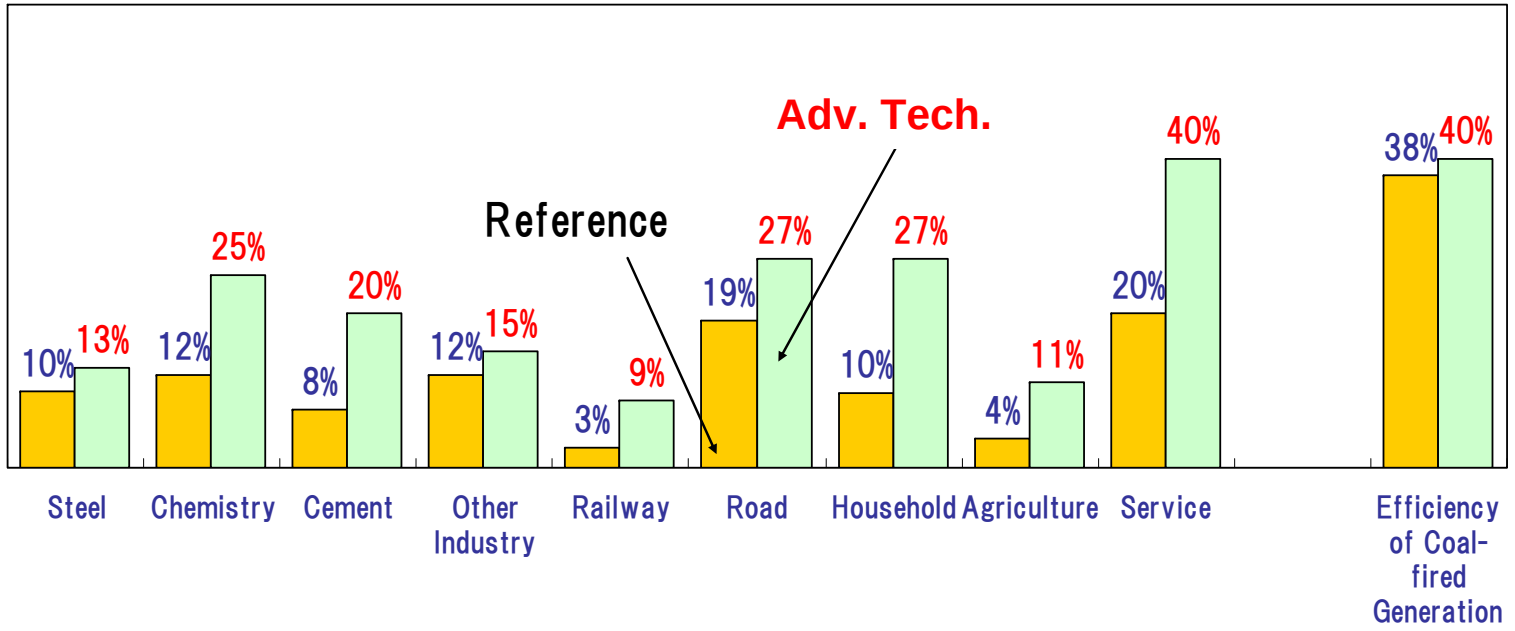


■ Total power generation capacity will increase on average by 41 GW per year, from 870 GW in 2009 to 1,950 GW in 2035,. The share of coal-fired power plant will gradually decline to 60% in 2035, still representing almost half of the world coal-fired power generation capacity.

■ Total power generation will more than double, increasing from 3.7 TWh in 2009 to 8.5TWh in 2035. Power generation from gas-fired, nuclear and renewables will substantially increase, while hydro power will represent moderate growth. . The share of coal-fired will decline from 79% in 2009 to 66% in 2035.

■In the Adv. Tech. Scenario, generation from nuclear, hydro and renewable energy will sharply expand to substitute a further decline in coal-fired generation.

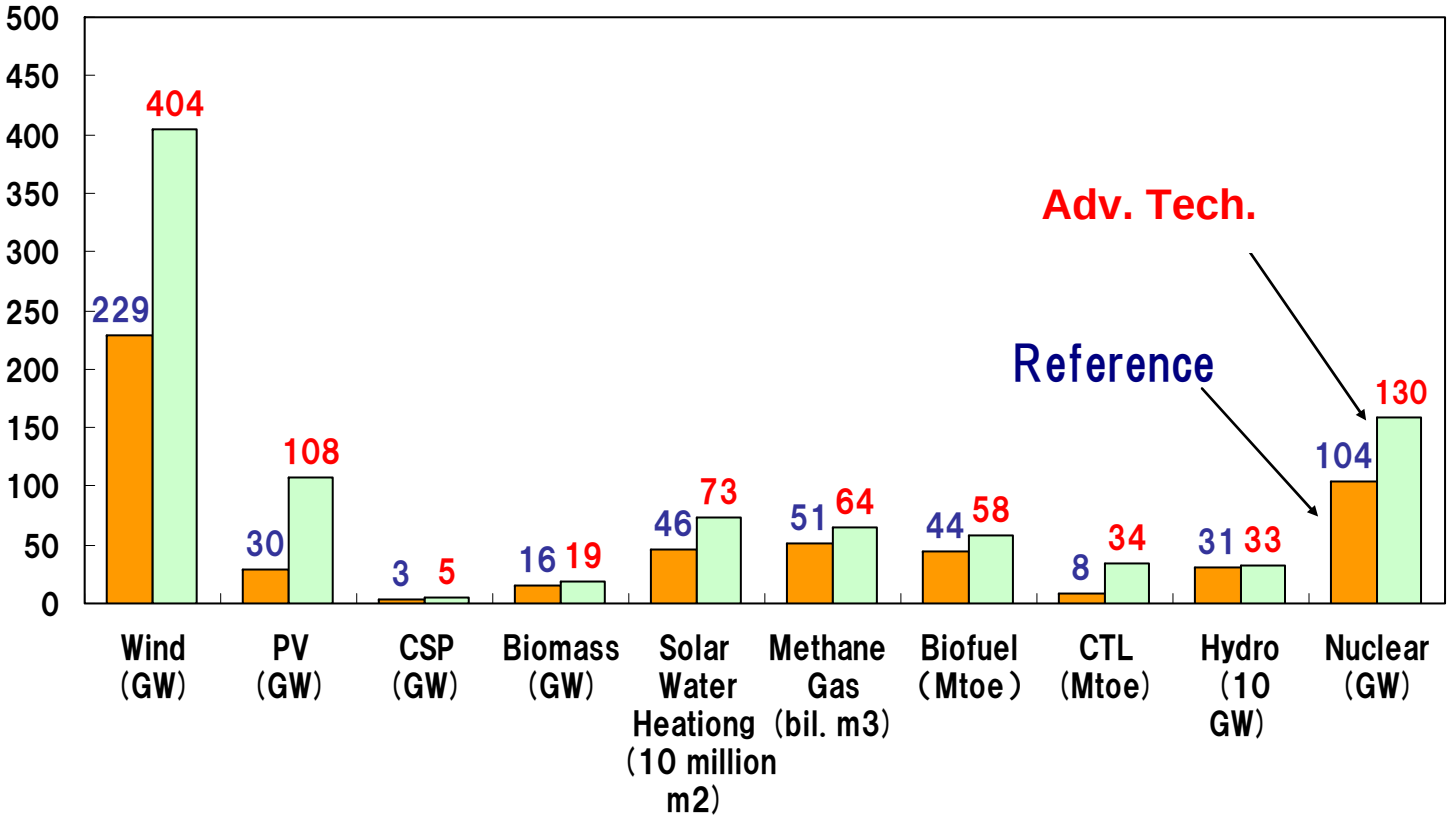
Energy Savings by Sector



Energy saving ratio in 2035 from 2009

■ In the household and building sectors, heating price reform and energy labeling system will play key roles for energy efficiency improvement.
■ The chemical sector may need to introduce large-scale production facilities toward improving production process efficiency in addition to the fuel switching from coal to alternative energy sources.
■ The cement industry would have to increase dry-kiln system (from 70%→nearly 100%) and expand waste heat recovery system.
■ In the power sector, expanding average power generation capacity (60MW→ 350MW) and introduce advanced technology like IGCC will provide considerable savings of coal demand.

Expansion of Non-fossil Fuel in China (2035)



Non-fossil Fuel (2035)

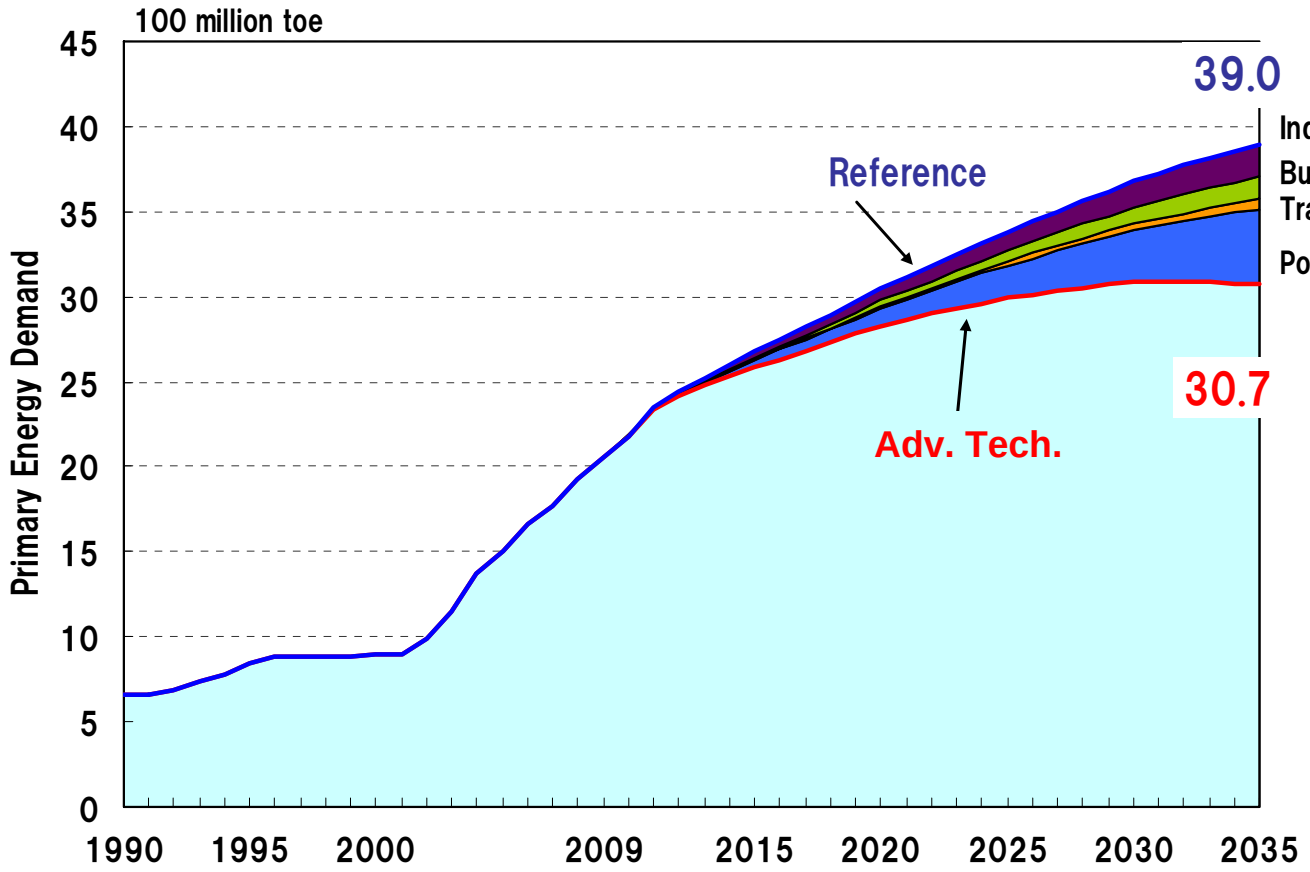
Reference
480 Mtoe
Ratio of TPE
(12%)

Adv. Tech.
680Mtoe
Ratio of TPE
(22%)

■ Hydro expansion will be limited due to resource constraints and environmental considerations.
■ Great expansion of nuclear and wind power is expected to meet considerable electricity demand growth and need for environment protection.
■ Non-fossil fuel will reach 480 Mtoe in 2035, representing 12% of TPED in the Reference Scenario. In the Adv. Tech. Scenario, the share increases to 22% by 2035.

Primary Energy Demand in China

Reference
Adv. Tech.



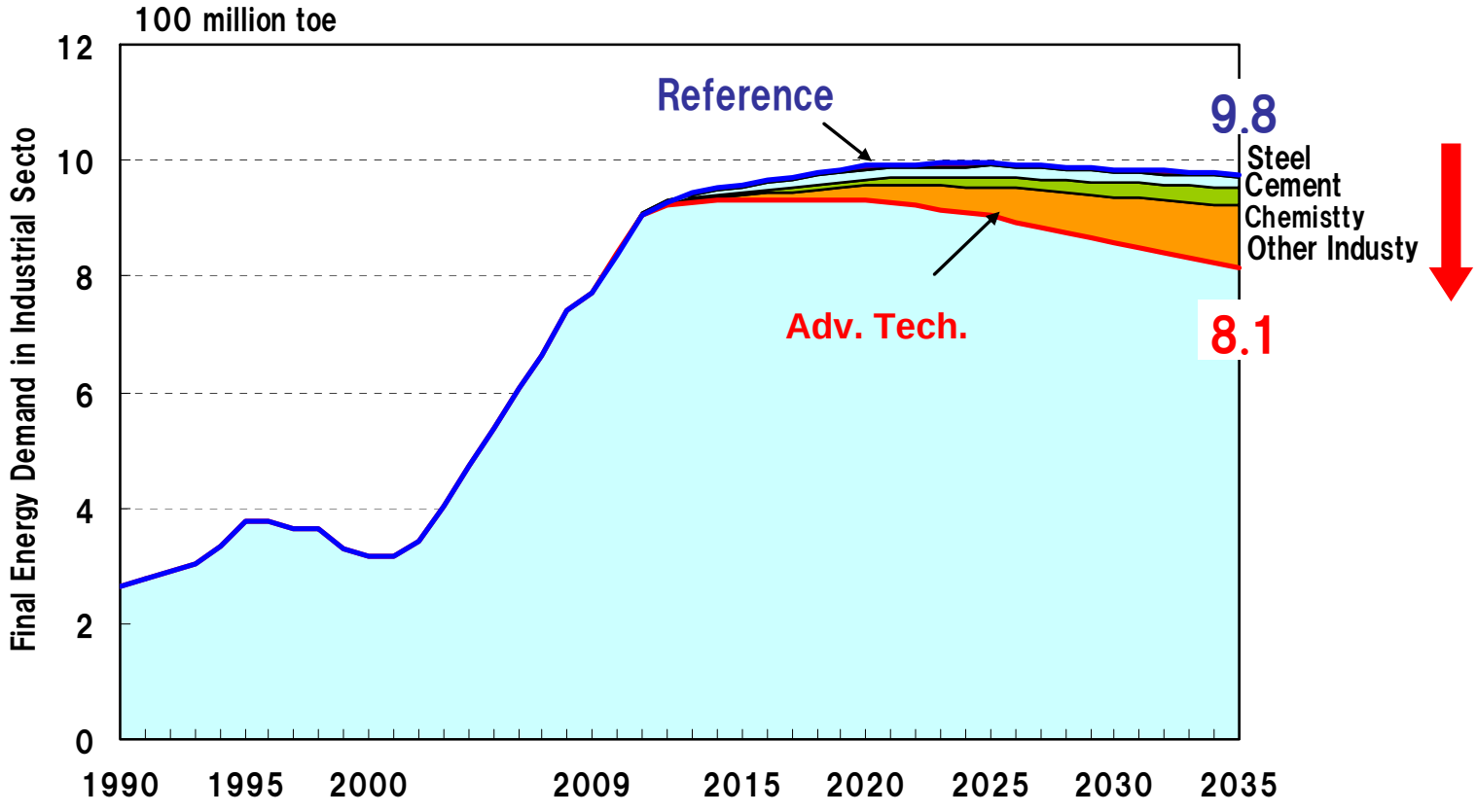
TPE

2035
820 Mtoe
decrease
(21 %down)

■ In the Adv. Tech. Scenario, TPED will be 820 Mtoe lower (or 21%) compared with the Reference Scenario. The power sector provides the largest potential for energy savings.

Final Energy Demand in the Industry Sector

Reference
Adv. Tech.



FED

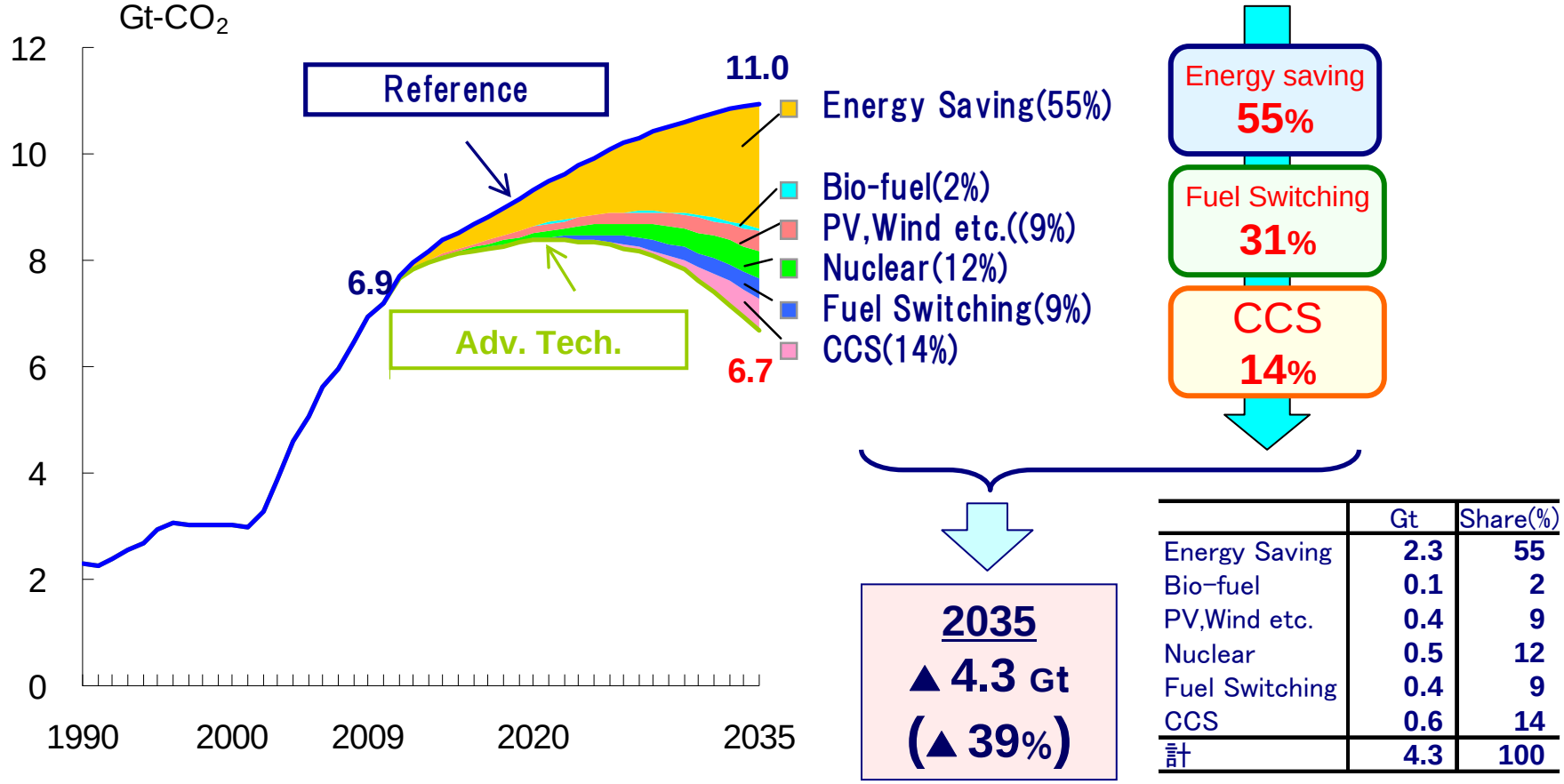
2035
160 Mtoe
decrease
(17 % down**)**

Note: Include energy demand in coke-production process

■ In the Reference Scenario, energy demand of the industry sector will grow moderately at 0.9% per year after 2009, reflecting energy savings and decreasing trend of raw material production.
■In the Adv. Tech. Scenario, final energy demand will decrease by 160 Mtoe (17%).

CO_2 Emissions in China

Reference
Adv. Tech.



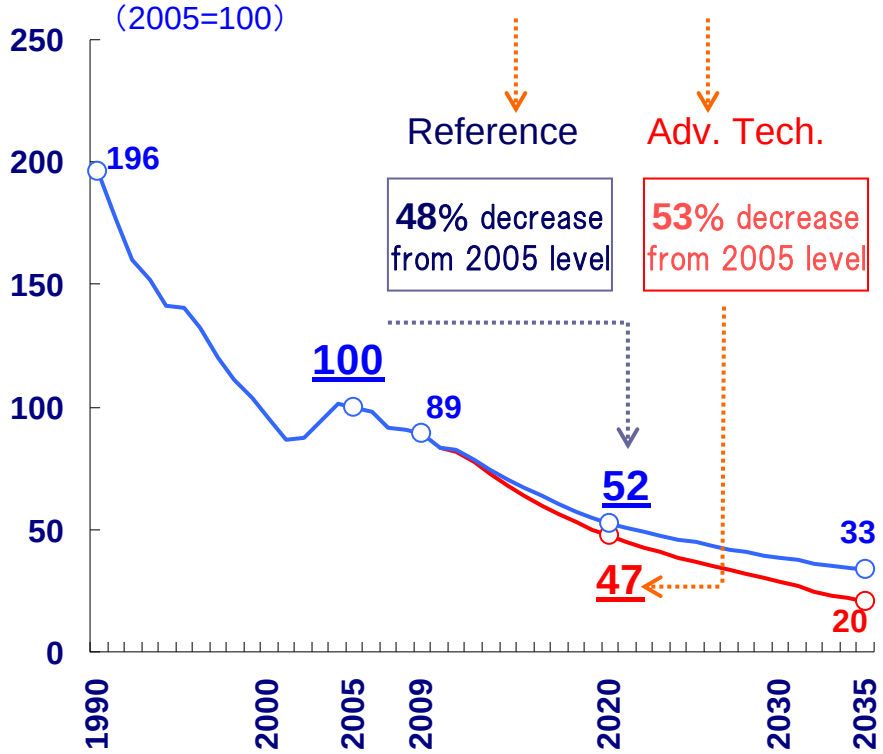
	Gt	Share(%)
Energy Saving	2.3	55
Bio-fuel	0.1	2
PV,Wind etc.	0.4	9
Nuclear	0.5	12
Fuel Switching	0.4	9
CCS	0.6	14
計	4.3	100

■ In the Reference Scenario, CO_2 emissions will increase by 4.0 Gt (up 57%) between 2009 to 2035.
■ In the Adv. Tech. Scenario, CO_2 emissions will be 4.3 Gt (down 39%) lower than the Reference Scenario in 2035.
■ CO_2 emissions will peak around 2025 due to energy saving and fuel switching to non-fossil fuels.

CO_2 Emissions per GDP

Reference
Adv. Tech.

National Target : 40 to 45% reduction by 2020



Decomposition Analysis of CO_2 Emissions

	1990–2005	2005–2020	
		Reference	Tech. adv.
CO2 Emission ΔC	5.4	4.1	3.4
Carbon Intersity Δ(C/E)	▲ 0.2	▲ 0.7	▲ 0.9
Energy Saving Δ(E/Y)	▲ 4.2	▲ 3.6	▲ 4.1
Economic Growth ΔY	10.2	8.7	

$$C = (C/E) * (E/Y) * Y$$

$$\Delta C = \Delta(C/E) + \Delta(E/Y) + \Delta Y$$

Decarbonization / Energy-Saving / Economic-Growth

- In November 25, 2009, the State Council of the Chinese government decided to improve CO_2 intensity (calculated as CO_2 emissions per GDP) by 40%-45% from the 2005 level by 2020.
- The projected CO_2 emissions intensity (per GDP) will substantially improve beyond the official targets. The reduction is 48% in the Reference Scenario and 53% in the Adv. Tech. Scenario.

Energy Demand and Supply in India

Energy and Economic Situation in India

Robust economic growth and consequent energy demand growth

Annual Average Growth Rate (AAGR) from 1990 to 2009

GDP: 6.3%, TPES: 5.6%, Coal: 5.5%, Oil: 5.1%, Gas: 8.4%

Rapid increase in CO_2 emissions and serious local environmental problems

AAGR from 1990 to 2009: 5.5%

Electric power shortage

Energy efficiency improvement

TPES per GDP (2009) (toe per million $ at 2000 value)

India: 590, World: 282, Non-OECD: 547, Japan: 98, China: 700

Rising trend of reliance on imported oil

Dependency on oil import (2009)：76%

Heavy reliance on coal

Share of coal on TPES: 56% (2009)

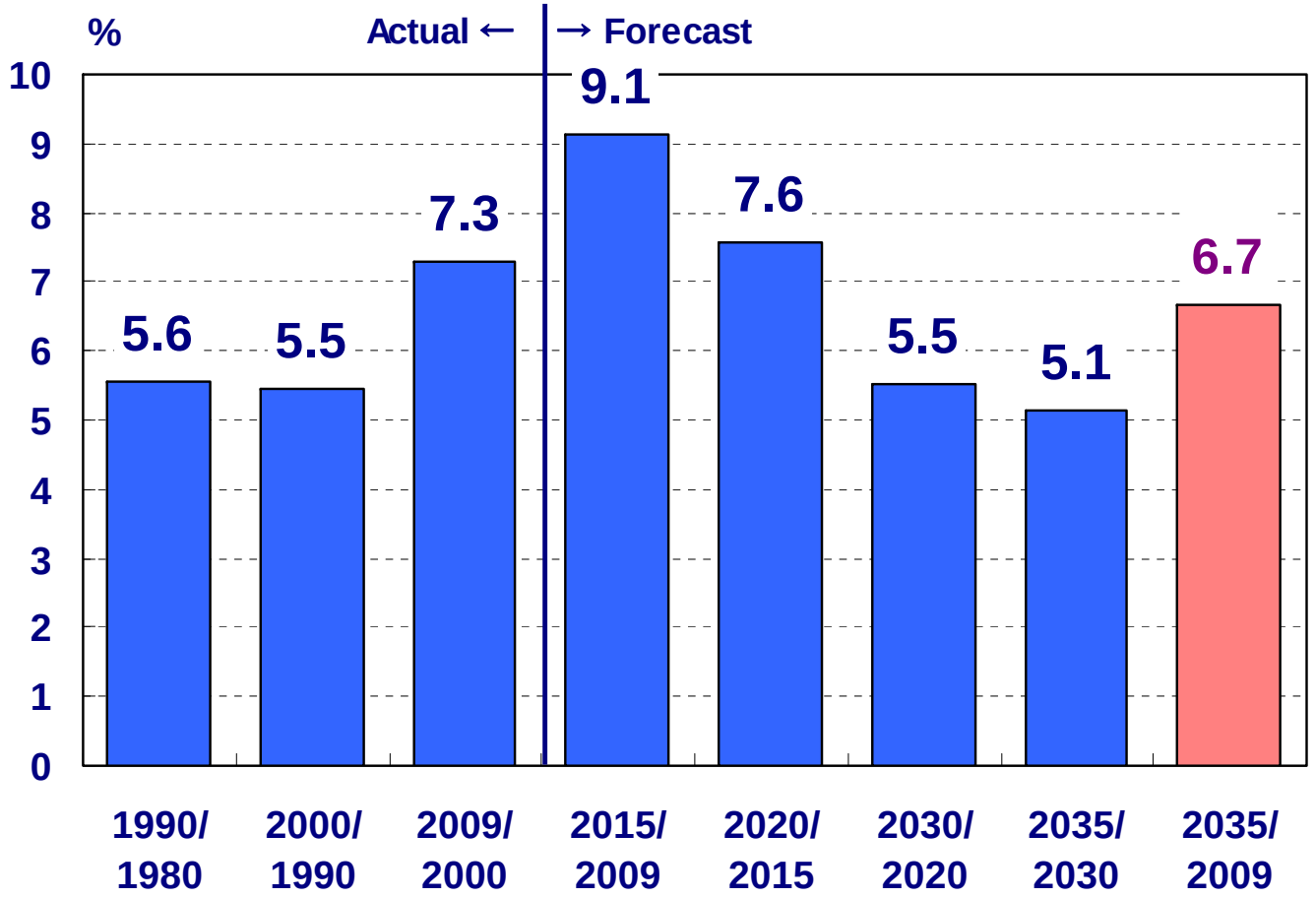
Energy Policy of India

Basic Agenda of Energy Policy on 11th 5 year Plan (2007/08～2011/12)

(1) Encouragement of electric power production and reform of the electricity transmission sector, (2) Expansion of domestic coal production and infrastructure served for coal import, (3) Promotion of exploration and acquiring of foreign equity, (4) Energy sector reform and deregulation, (5) Energy efficiency improvement, (6) R&D, (7) Environmental protection, (8) Comprehensive approach for dealing with energy and environmental issues

GDP Growth

【GDP Growth Rate】



GDP

2009
0.87TUSD
↓
2035
4.63TUSD
(**5.3 folds**)

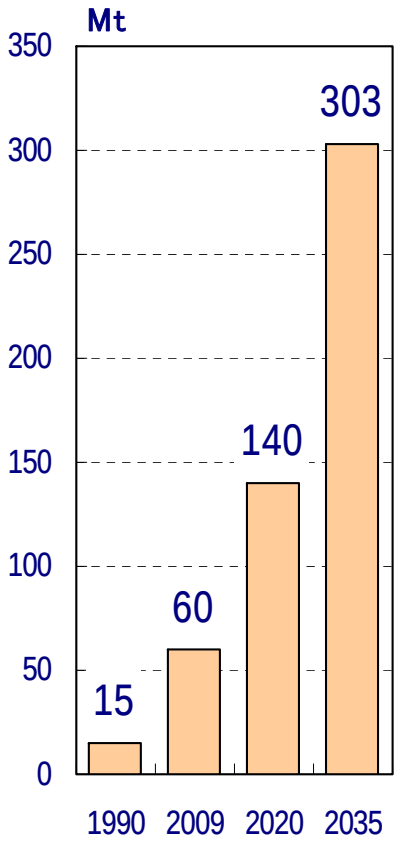
GDP per capita

2009
750USD
↓
2035
2,932USD
(**3.9** folds)

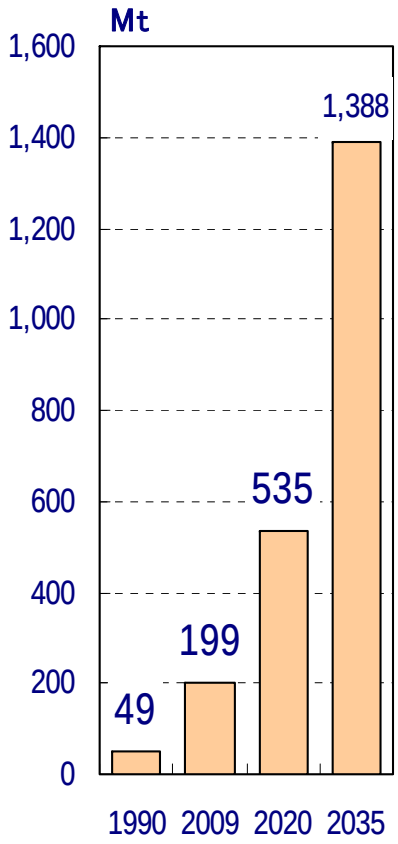
■ GDP will continue to grow robustly due to increase in workforce population, improved quality of labor force, opening up of the market, and growing FDI.
■ Downside factor on GDP growth is the shortage of infrastructure in electric power supply, transportation, port and railway.
■ In 2035, GDP per capita will increase to reach 3,000 USD, one-third of that of China.

Production of Raw Material in India

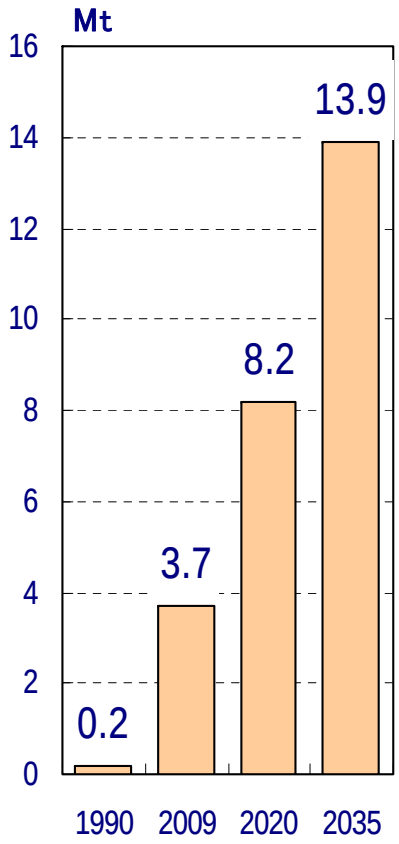
【Crude Steel】



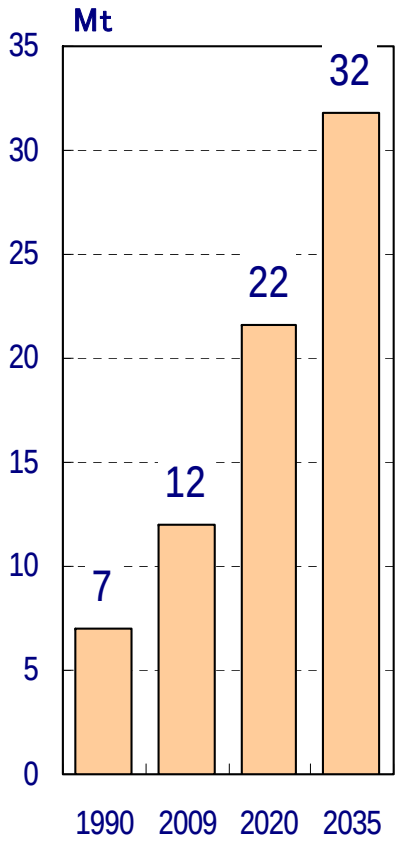
【Cement】



【Ethylene】



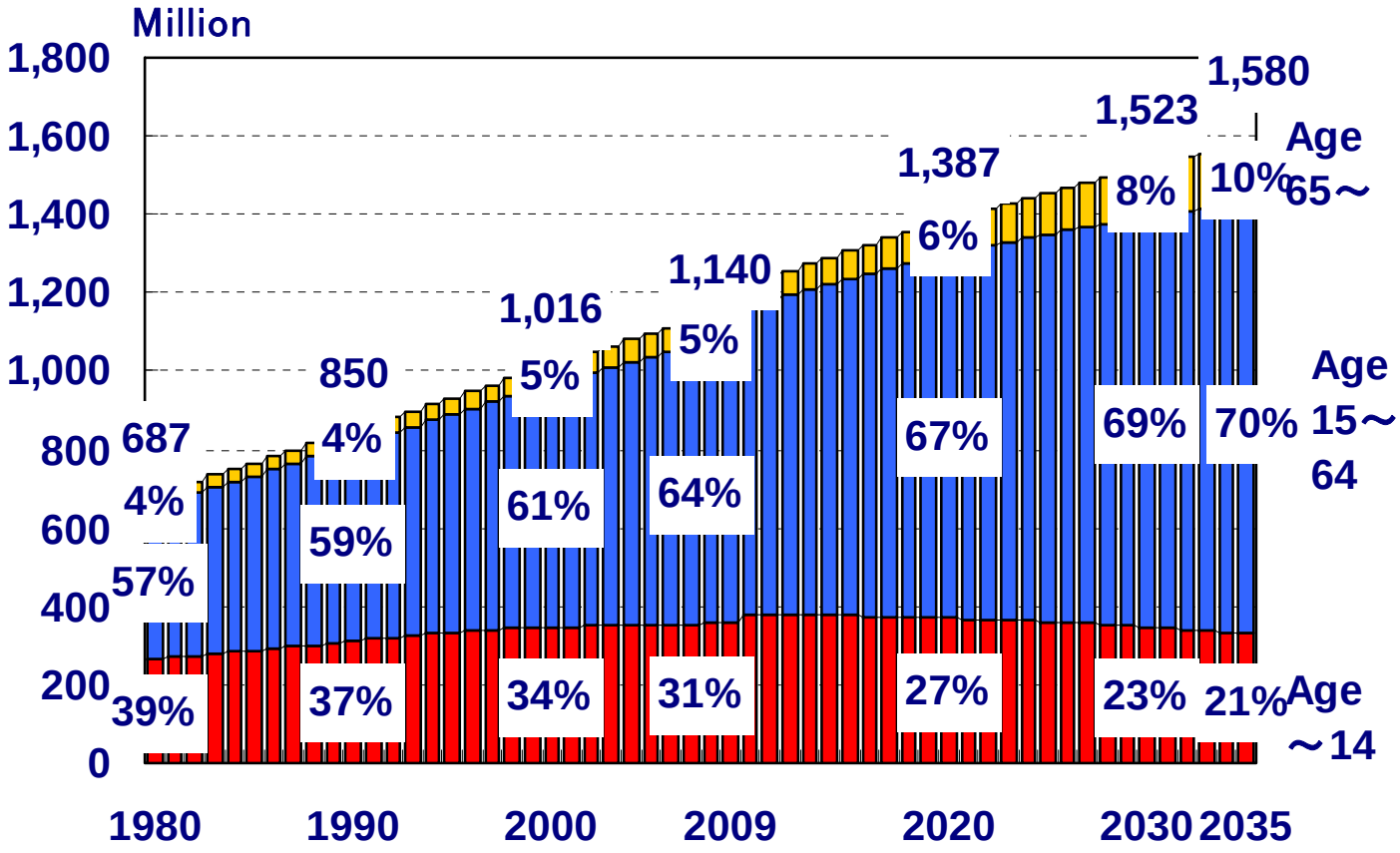
【Nitrogen Fertilizer】



■ Infrastructure development, and expansion of manufacturing industry will result in sharp increases in crude steel, cement and ethylene productions.

■ Nitrogen fertilizer production will grow moderately in accordance with the projected moderate growth of agriculture production.

Population in India



Total Population

2009
1,160 mil.
↓
2035
1,580 mil.
(**1.4** folds)

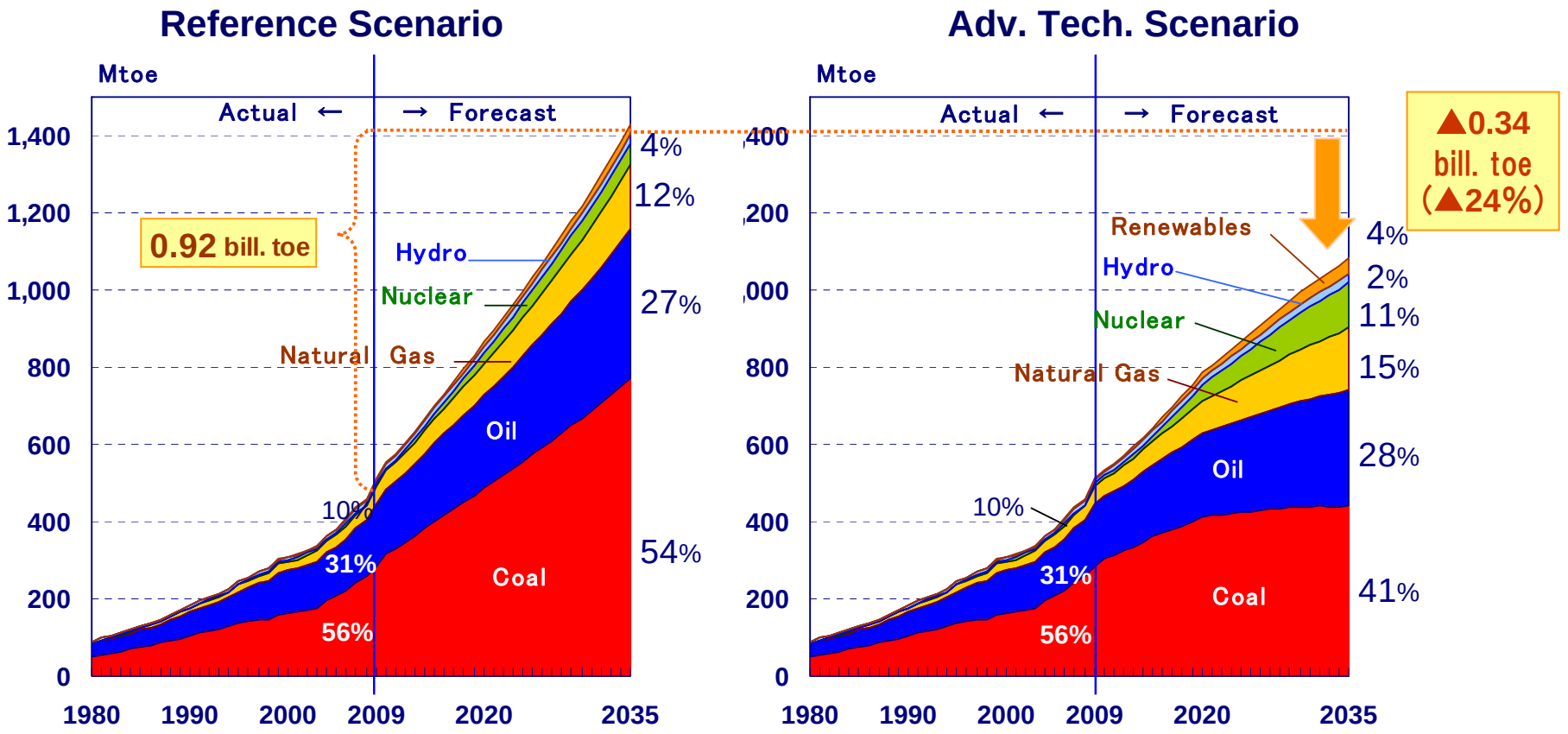
Urbanization Rate

2009
30%
↓
2035
44%
(**14** points up)

- Growing at an annual rate of 1.1%, total population will reach 1.5 billion in 2035 to become the world's most populous country.
- The share of labor force will continue to increase, reaching 70% of the total in 2035.
- The share of urban population will increase to 44% in 2035 from 30% in 2009.

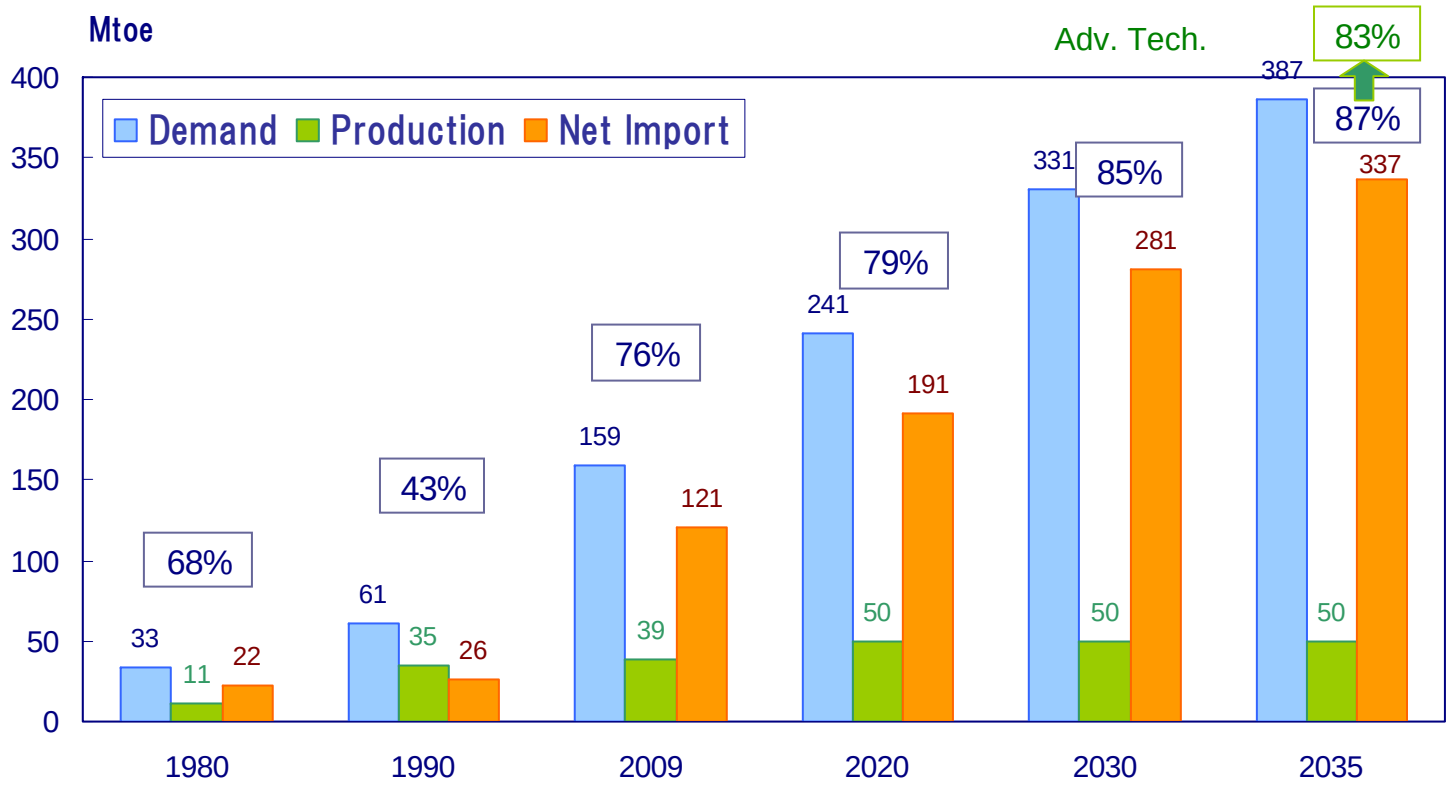
Primary Energy Demand in India

Reference
Adv. Tech.



■ In the Reference Scenario, TPED will increase at annual rate of 4%. 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 55% 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 340 Mtoe lower (24%) in the Adv. Tech. Scenario.

Oil Demand and Supply in India



Net Oil Import

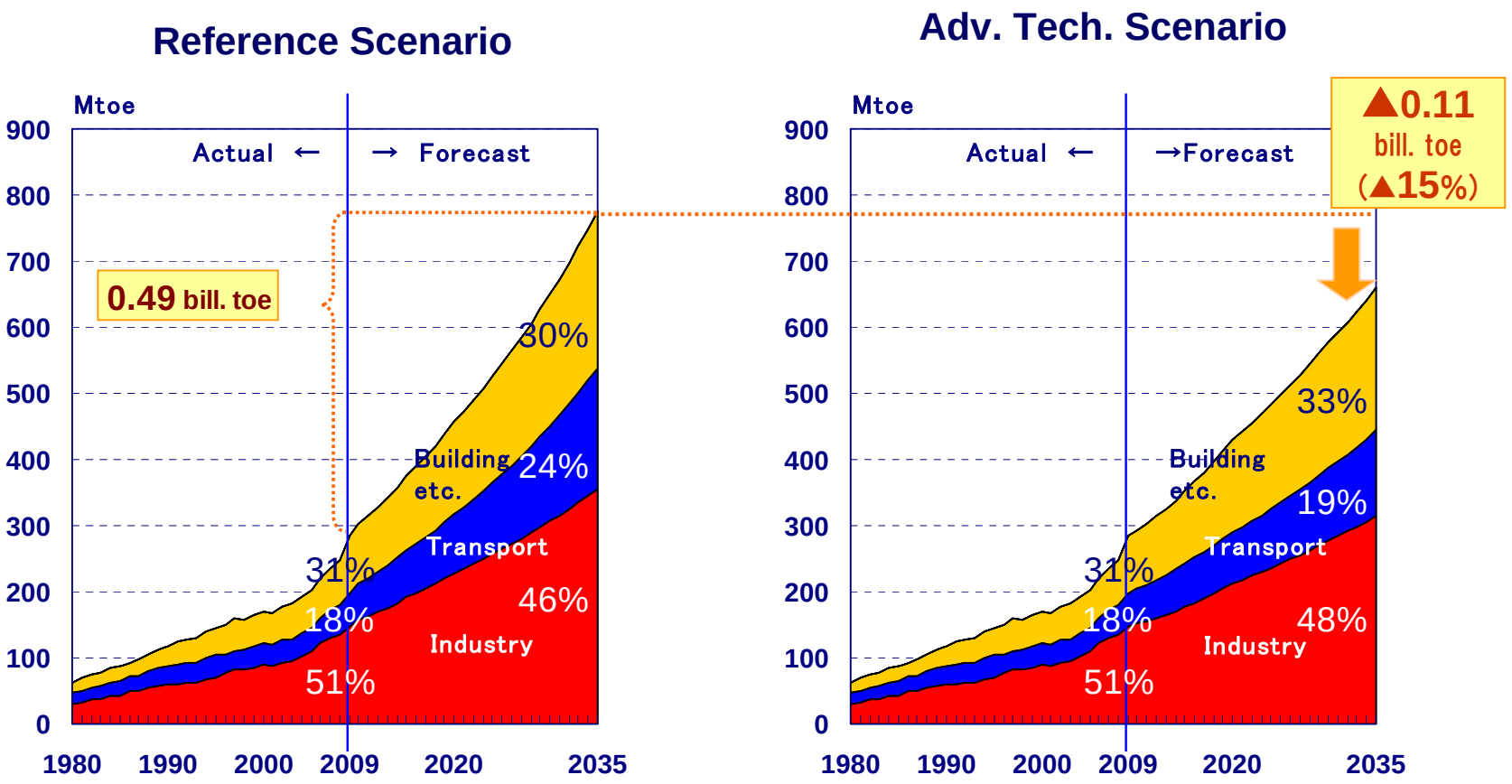
2009
2.4MB/D
↓
2035
Reference
6.8MB/D
(**2.8**folds)

Adv. Tech. Adv.
5.0MB/D
(**2.1**folds)

- Net oil import is projected to expand from 121 million ton (2.4mb/d) in 2009 to 337 million ton (6.8 Mb/d) in 2035. Net oil import ratio will reach 87% in 2035.
- In the Advanced Technologies scenario, net oil import ratio will reach 83% by 2035.

Final Energy Demand in India

Reference
Adv. Tech.

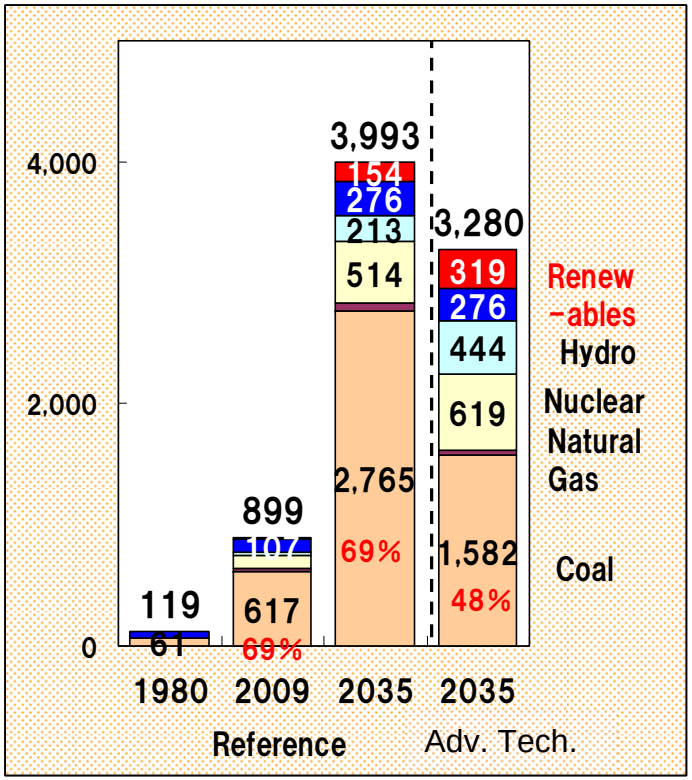


(The industry sector includes non-energy use)

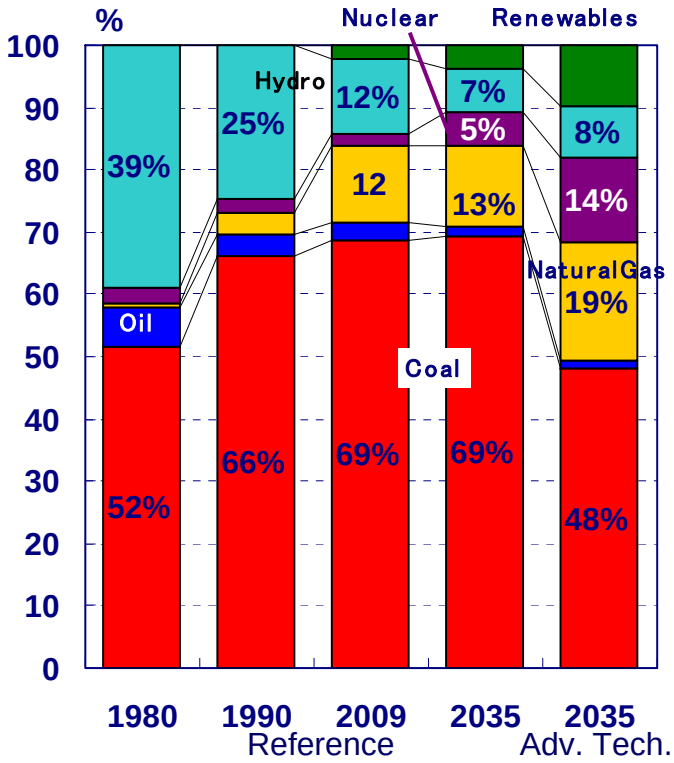
■ Industry will increase rapidly due to industrialization and production increases from the heavy industry.
■ Electricity demand grows at an annual rate of 5.8%. Per capita electricity demand will increase to 1,911kWh in 2035 (20% of that of Japan in 2009).
■ In the Adv. Tech. Scenario, energy demand will be 110 Mtoe lower (15%) in 2035 compared with the Reference Scenario.

Power Generation Mix in India

【Power Generation】



【Power Generation Mix】

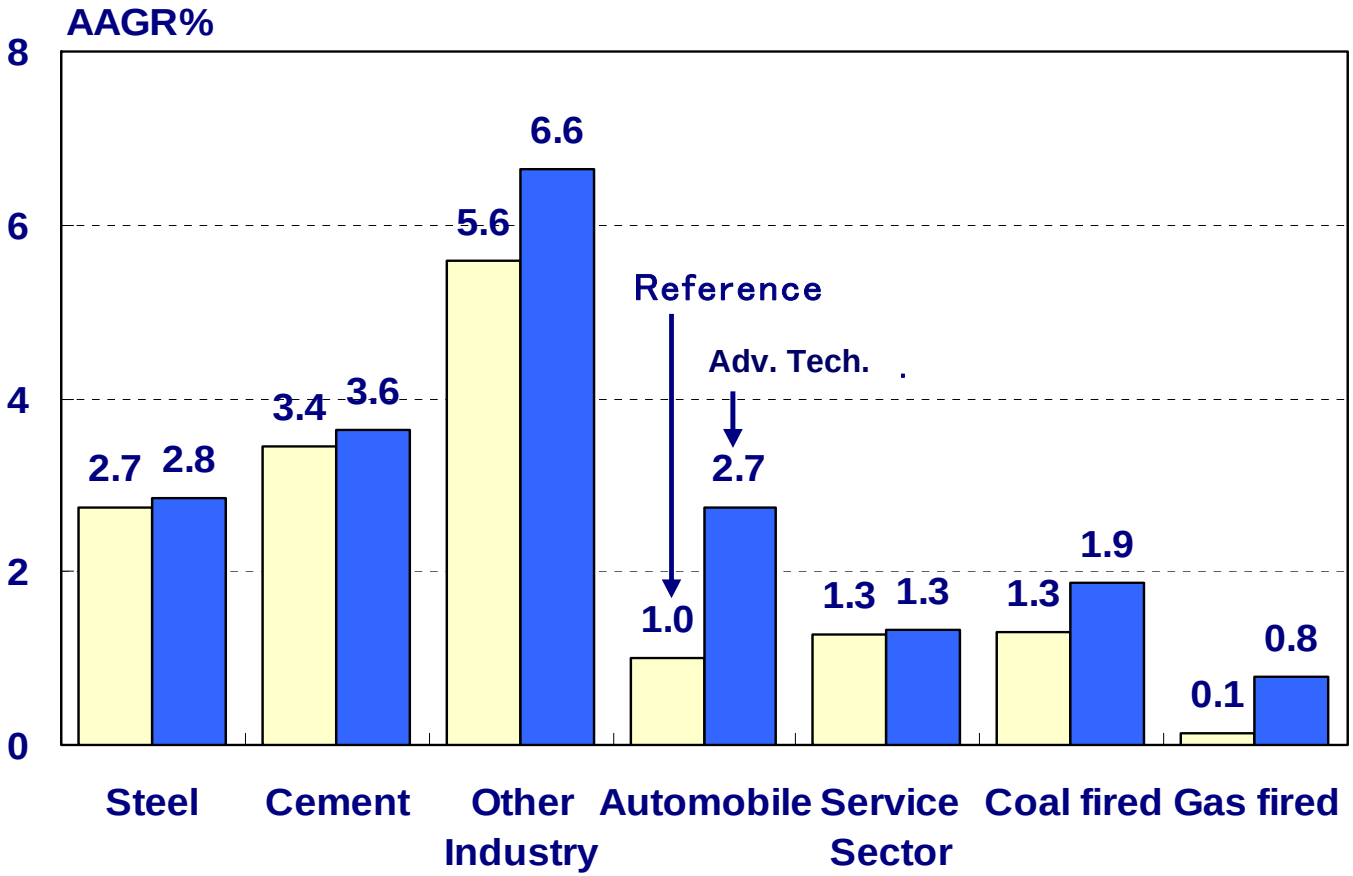


■Coal-fired power will continue to account for the largest share. The generation efficiency will improve led by the government's Ultra Mega Power Project to introduce several 4GW-class super critical coal-fired power plants.

■On the other hand, the share of natural gas and nuclear will gradually expand and power generation mix will become more diversified.

■Capacity of nuclear will increase from 4.1 GW in 2009 to 30 GW in 2030 (an 7.2-fold increase).

Energy Efficiency Improvement by Sector

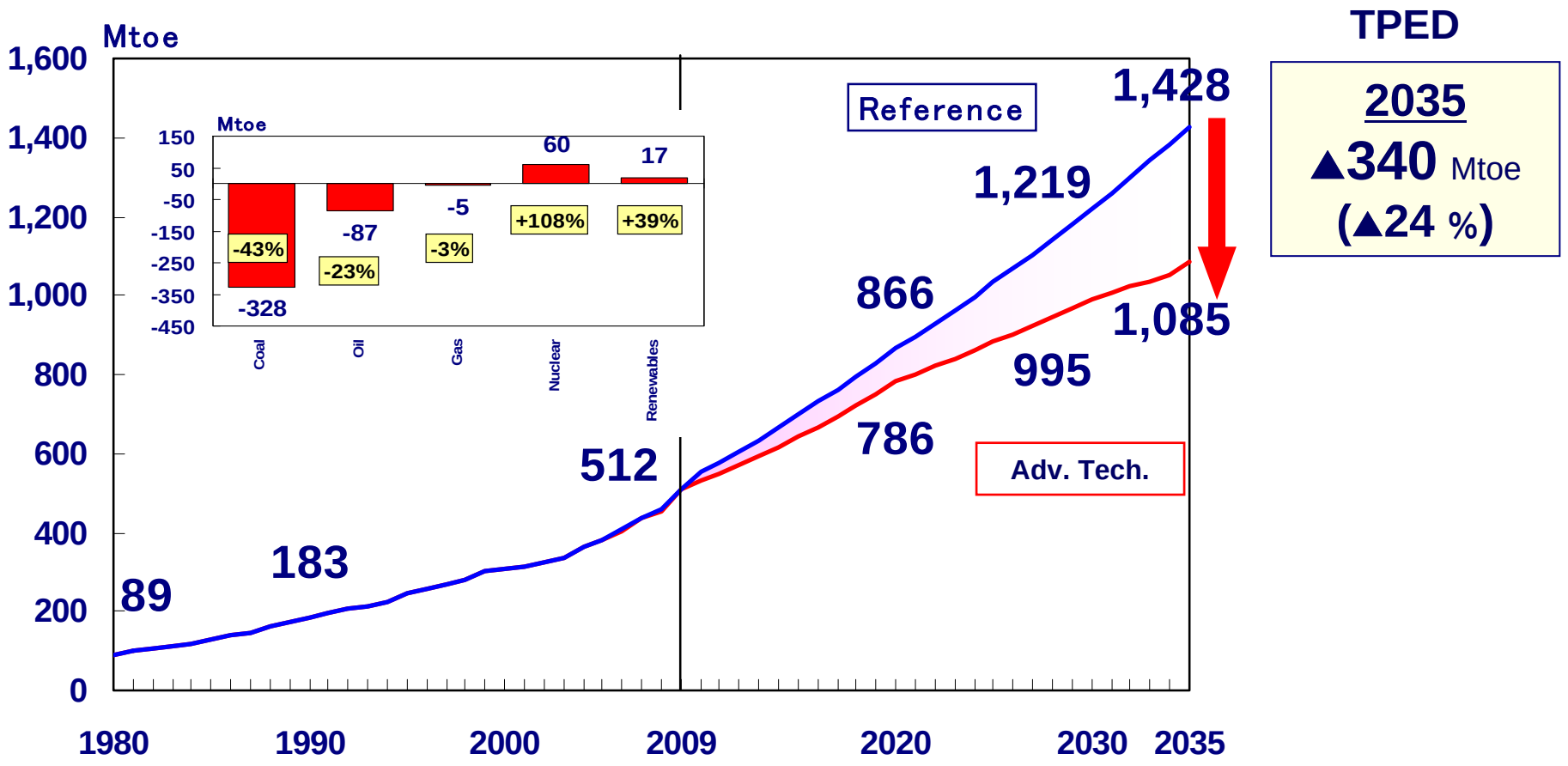


■ Newly built factories in India will introduce production systems, with high energy efficiency levels, comparable to international standards. This will be realized with the uptake of various technologies, including pulverized coal injection and blast furnace gas, new type kilns, highly efficient furnaces, motors, and boilers.

■ Policies and measures need to be introduced to promote purchase of energy efficient products for the household customers.

Primary Energy Demand in India

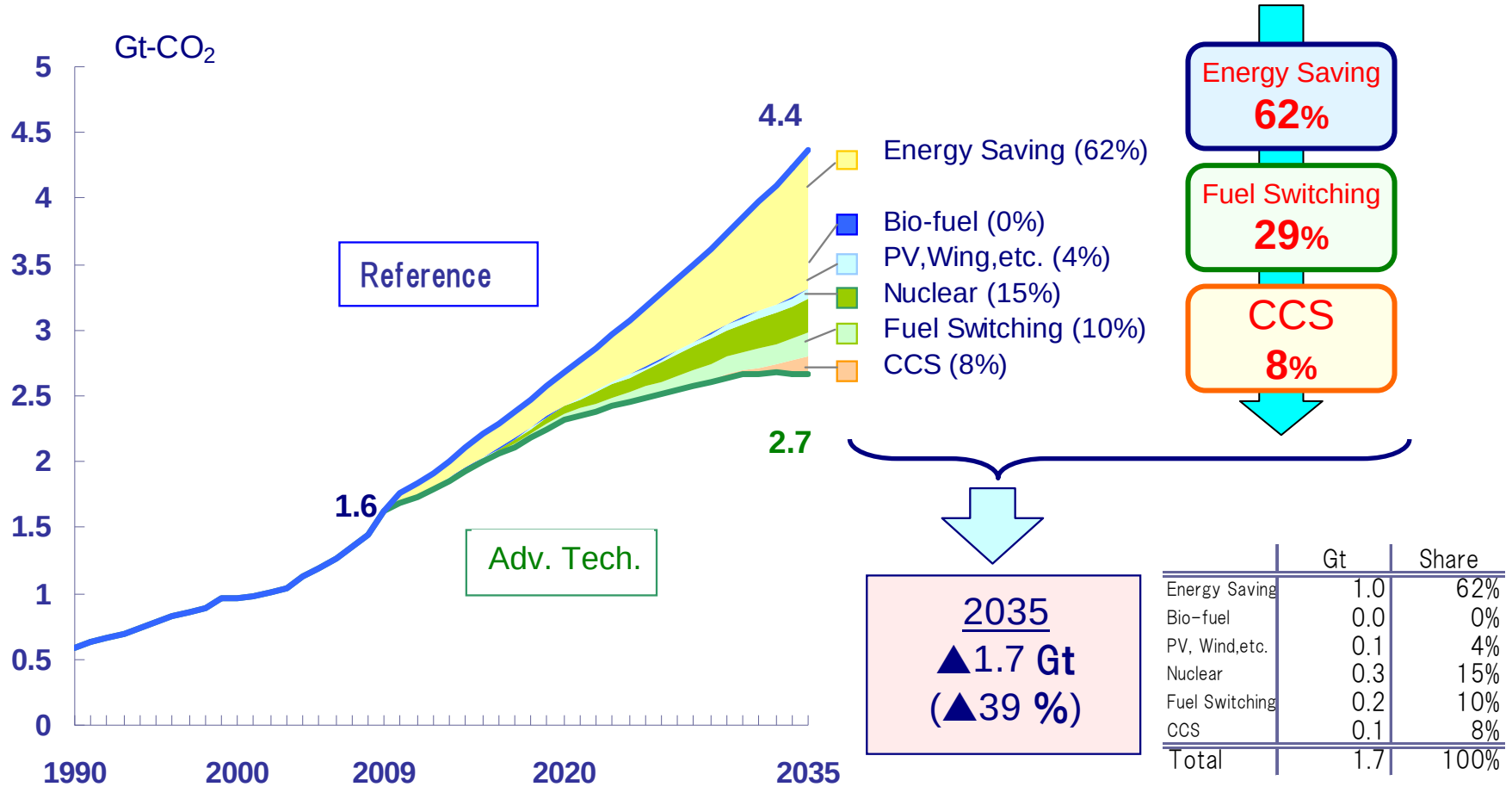
Reference
Adv. Tech.



- In the Adv. Tech. Scenario, India's primary energy demand will be 340 Mtoe lower in 2035 compared with the Reference Scenario.
- Substantial reduction in coal demand at 330 Mtoe is expected due to the introduction of clean coal technology.

CO_2 Emissions Reduction in India

Reference
Adv. Tech.

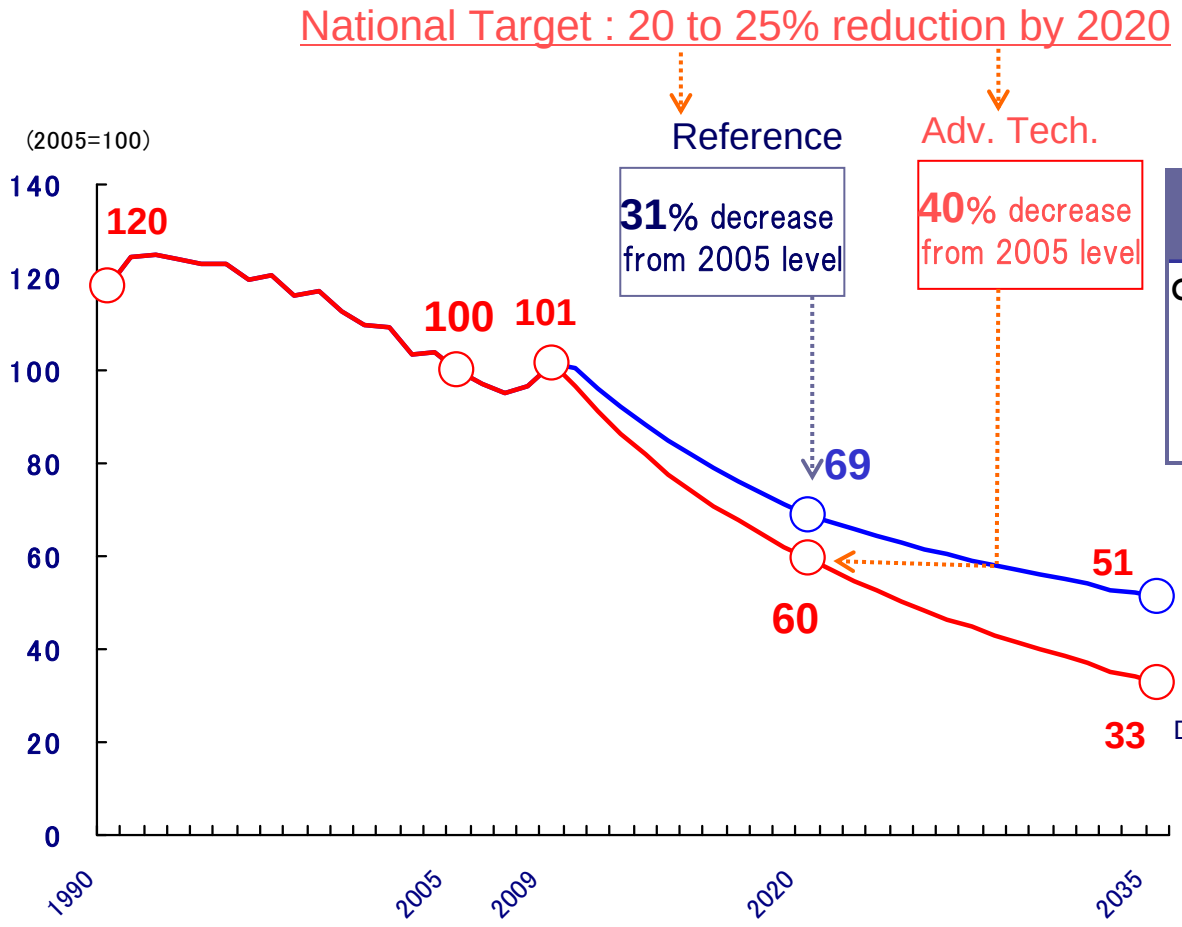


	Gt	Share
Energy Saving	1.0	62%
Bio-fuel	0.0	0%
PV, Wind,etc.	0.1	4%
Nuclear	0.3	15%
Fuel Switching	0.2	10%
CCS	0.1	8%
Total	1.7	100%

- In the Reference Scenario, CO_2 emission will increase by 2.7 Gt (169%) in 2035 from 2009.
- In the Adv. Tech. Scenario, CO_2 emissions will be 1.7 Gt (39%) lower from the Reference Scenario.

CO_2 Emissions per GDP

Reference
Adv. Tech.



Decomposition Analysis of CO_2 Emissions

		1990-2005	2005-2020 Reference	2005-2020 Tech. Adv.
CO2Emissions	ΔC	4.8	5.5	4.5
Carbon Intensity	Δ(C/E)	▲ 0.2	▲ 0.1	▲ 0.4
Energy Saving	Δ(E/Y)	▲ 0.9	▲ 2.4	▲ 3.0
Economic Growt	ΔY	6.0	8.2	8.2

$C = (C/E) * (E/Y) * Y$

$\Delta C = \Delta(C/E) + \Delta(E/Y) + \Delta Y$

Decarbonization / Energy-Saving/ Economic-Growth

- India announced to improve its CO_2 intensity (calculated as CO_2 emissions per GDP) by 20 to 25% from 2005 level by 2020.
- The improvement in CO_2 emissions per GDP in 2020 will exceed those targets reaching 31% in the Reference Scenario and 40% in the Adv. Tech. Scenario.

Beyond 2035;
Asia/World Energy Outlook through 2050

GDP, Population and Energy Price

	2009	2035	2050
GDP (2000 real price)	**40** tril. $ (AAGR in 1990-2009：2.6%)	**87** tril. $ (AAGR in 2009-2035：3.1%)	**116** tril. $ (AAGR in 2035-2050：1.9%) (AAGR in 2009-2050：2.7%)
Population	**6.8** bil.	**8.6** bil. (1.8 bil. increase from 2009)	**9.3** bil. (2.5 bil. increase from 2009)
GDP per Capita	**6** thousand $	**10** thousand $	**13** thousand $
Oil Price (On a Japanese CIF basis、2010 real price)	**(2010)** **79 $/bbl**	**120 $/bbl** (Nominal price：197 $/bbl)	**125 $/bbl** (Nominal price：276 $/bbl)

- Global GDP will grow annually at 2.7% from 2009 to 2050.
- World total population will expand from 6.8 bil. in 2009 to 9.3 bil. in 2050.
- Crude oil price (on a Japanese CIF basis、2010 real price) is assumed to increase from 79$/bbl in 2010 to 125 $/bbl in 2050.

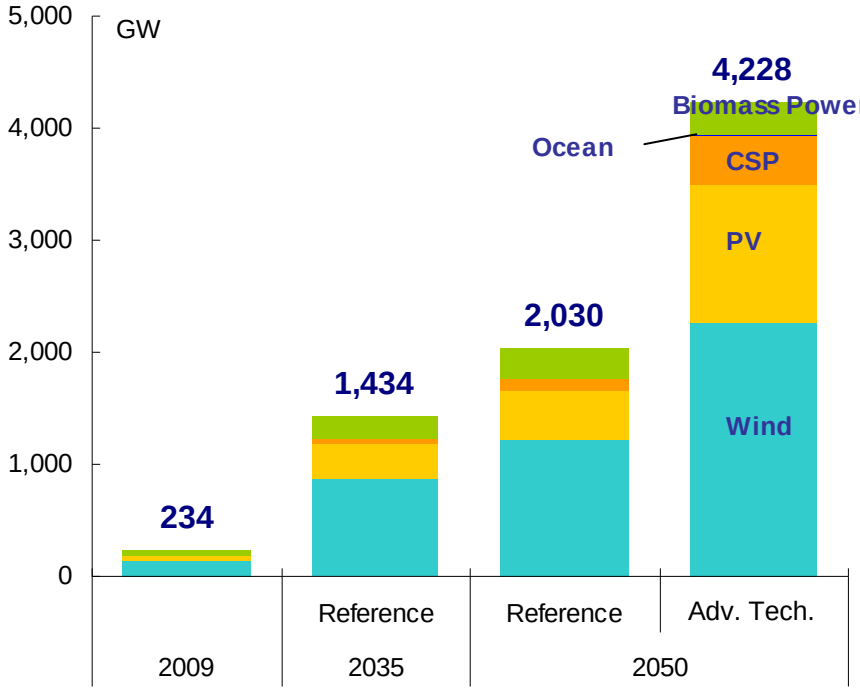
Assumed Energy and Environmental Technologies

	2009	2035		2050	
	Actual	Reference	Adv. Tech.	Reference	Adv. Tech.
Nuclear	390 GW	574 GW	814 GW	725 GW	1,140 GW
Conversion Efficiency	Coal:34% Gas:40%	Coal: 39% Gas: 45%	Coal: 42% Gas: 47%	Coal: 41% Gas: 46%	Coal: 45% Gas: 50%
Photovoltaic	23 GW	289 GW	612 GW	448 GW	1,239 GW
CSP	0.6 GW	58 GW	113 GW	103 GW	426 GW
Wind	148 GW	881 GW	1,411 GW	1,211 GW	2,266 GW
Biomass Power Gen.	62 GW	200 GW	223 GW	255 GW	274 GW
Biofuel	43 Mtoe	287 Mtoe	350 Mtoe	473 Mtoe	540 Mtoe
CCS	-	0	2.6 bil. Ton	0	10.1 bil. Ton
Adv. Vehicle in Annual Sales PHEV EV/FCV	-	5% 0%	22% 16%	11% 2%	30% 31%
Average Fuel Efficiency of new vehicle sales	(2010) 14 km/L	18 km/L	25 km/L	20 km/L	30 km/L

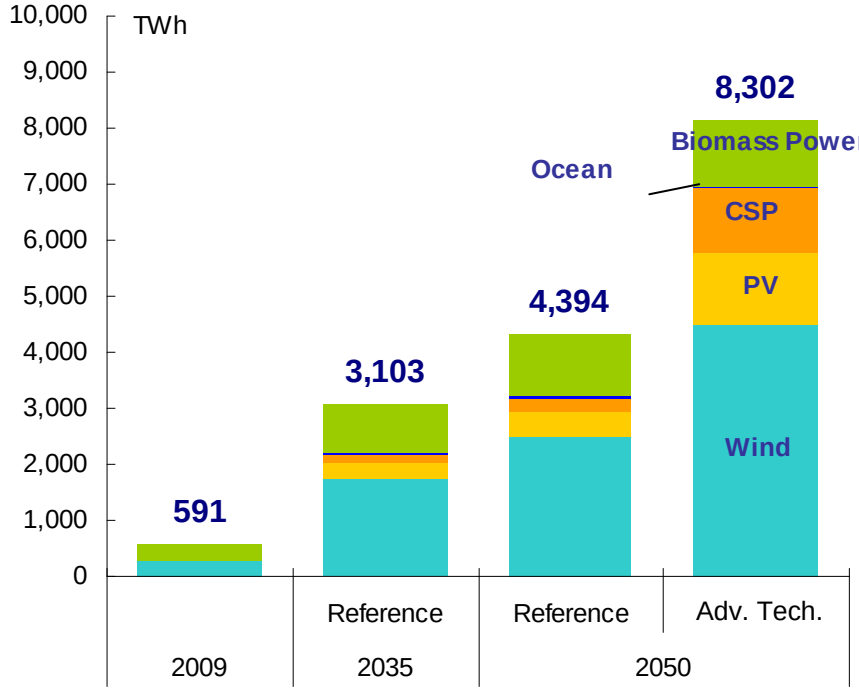
CSP: Concentrated Solar Power, **CCS**: Carbon Capture and Storage, **PHEV**: Plug-in Hybrid Electric Vehicle, **EV**: Electric Vehicle, and **FCV**: Fuel Cell Vehicle

Renewable Power Generation (World)

Electric Power Capacity



Electric Power Generation

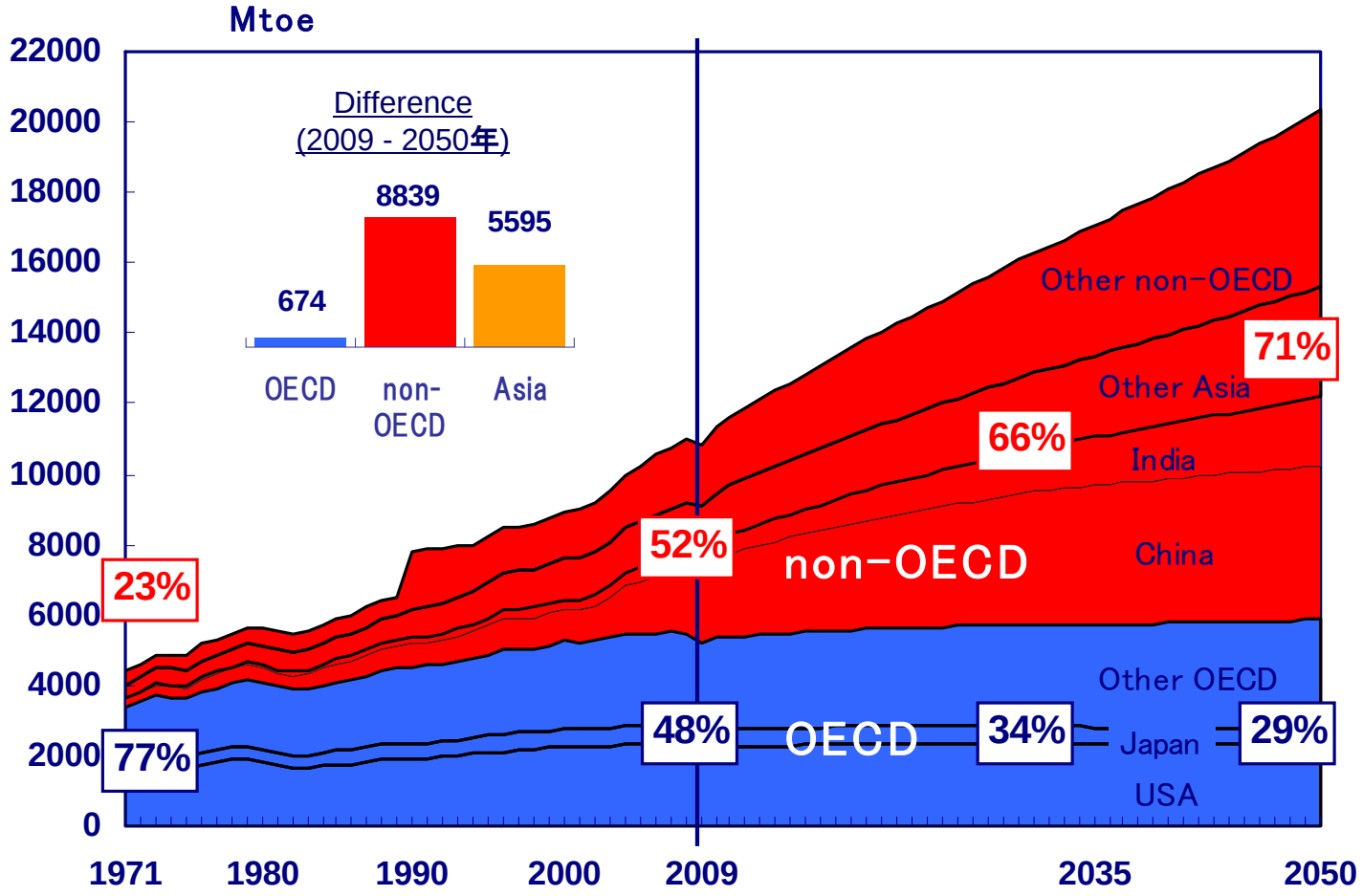


■ In the Adv. Tech. Scenario, by 2050, renewable power generation capacity, excluding hydro, will expand 14 times as much as that of 2009.

■ Wind power capacity in 2050 will exhibit a 15-fold increase compared with that in 2009; PV capacity, 53-fold increase; CSP capacity, 1330-fold increase; ocean energy capacity, 100-fold increase; biomass capacity, 4-fold increase.

Primary Energy Demand (World)

Reference

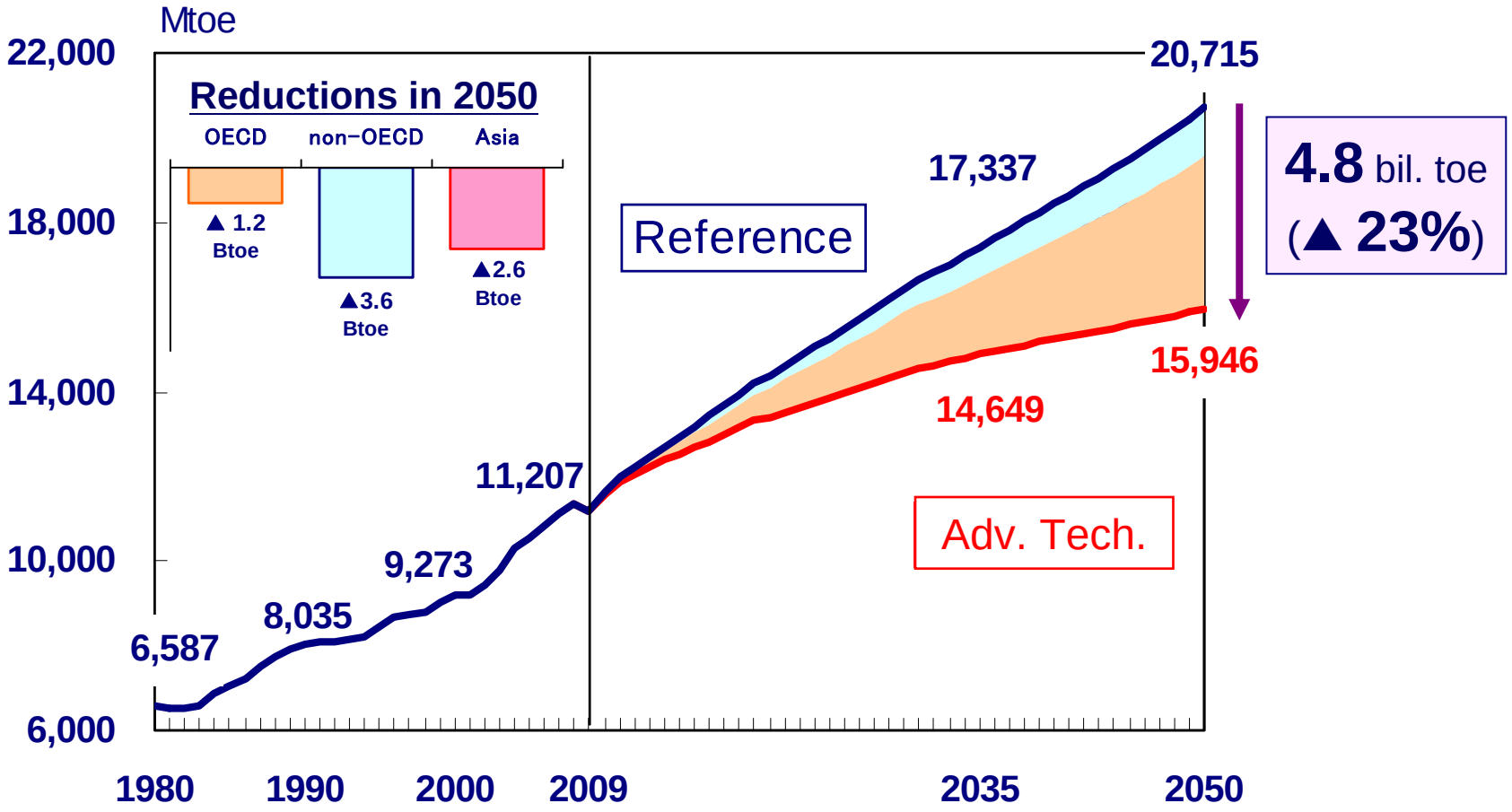


■ World primary energy demand will increase from 10.9 Btoe in 2009 to 20.4 Btoe in 2050, showing a 1.9-fold increase from 2009.

■ The primary energy demand by Non-OECD countries will account for approximately 70 % of the world primary energy demand.

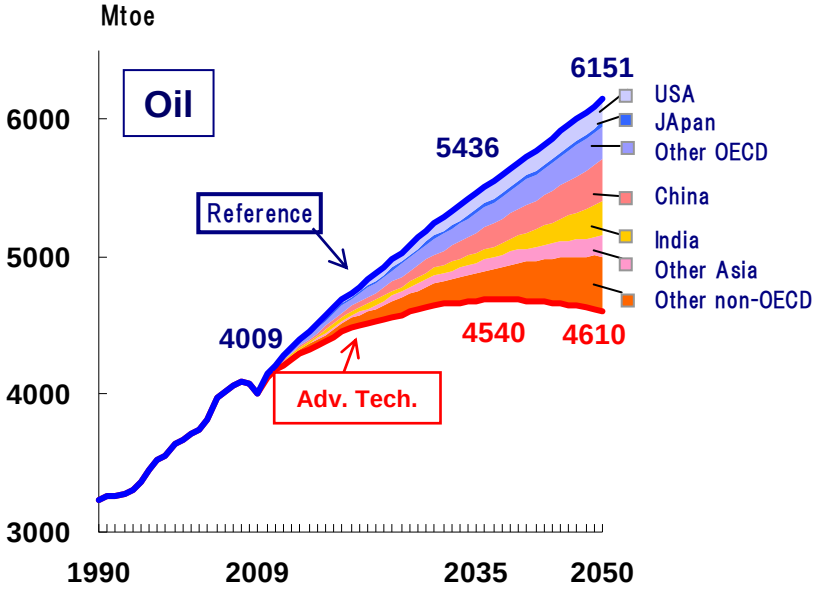
Primary Energy Demand (World)

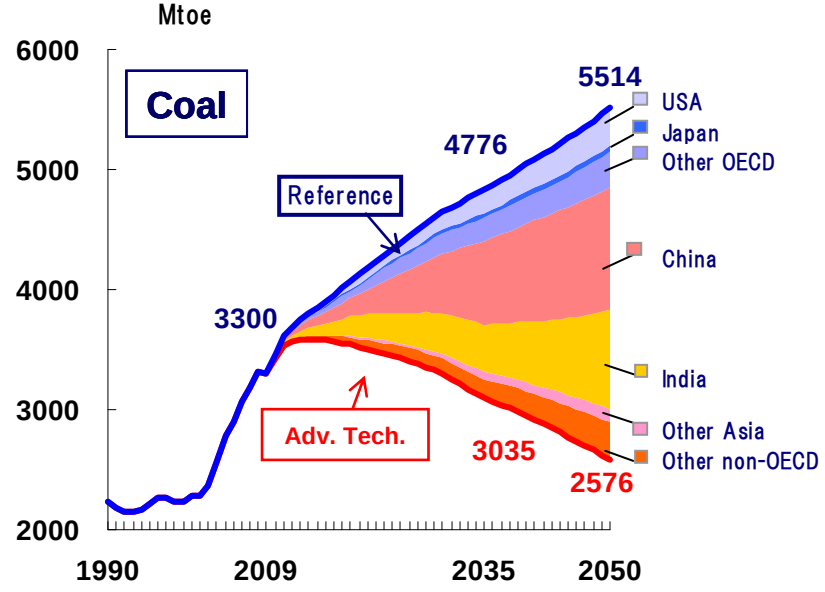
Reference
Adv. Tech.

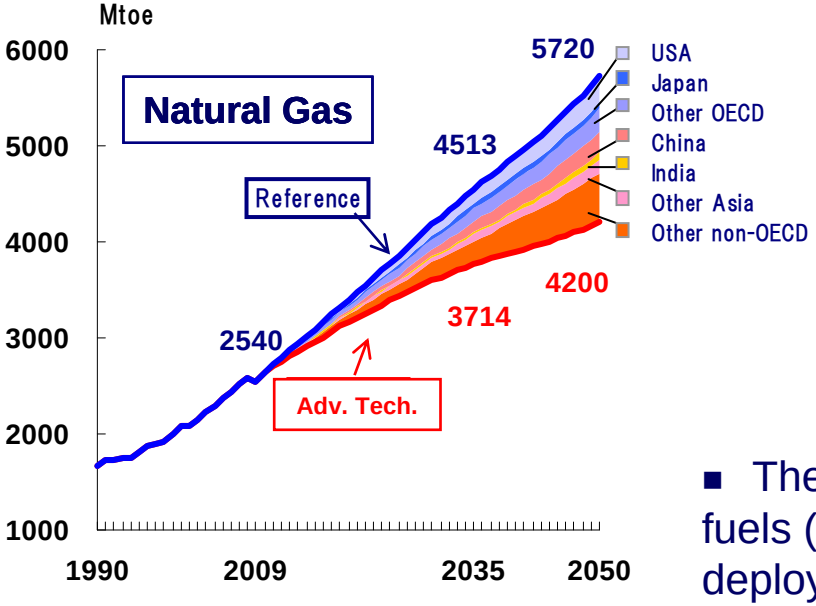


■ The world primary energy demand will peak out around 2050 in the Adv.Tech. Scenario.
■ In 2050, world primary energy demand in the Adv.Tech. Scenario will be decreased by 4.8 Btoe in comparison with the Reference Scenario. The demand by OECD and non-OECD will be decreased by 1.2 Btoe and 3.6 Btoe, respectively. The demand by non-OECD and Asian countries will be largely decreased because of diffusing innovative technologies.

Fossil Fuel Demand







Reduction in 2050 (Regional Breakdown)

(Oil)

	Mtoe	Share
USA	168	11%
Japan	33	2%
Other OECD	242	16%
China	296	19%
India	257	17%
Other Asia	151	10%
Other non-OECD	394	26%
OECD	442	29%
non-OECD	1,099	71%
Developing Asia	705	46%
World	1,541	100%

(Coal)

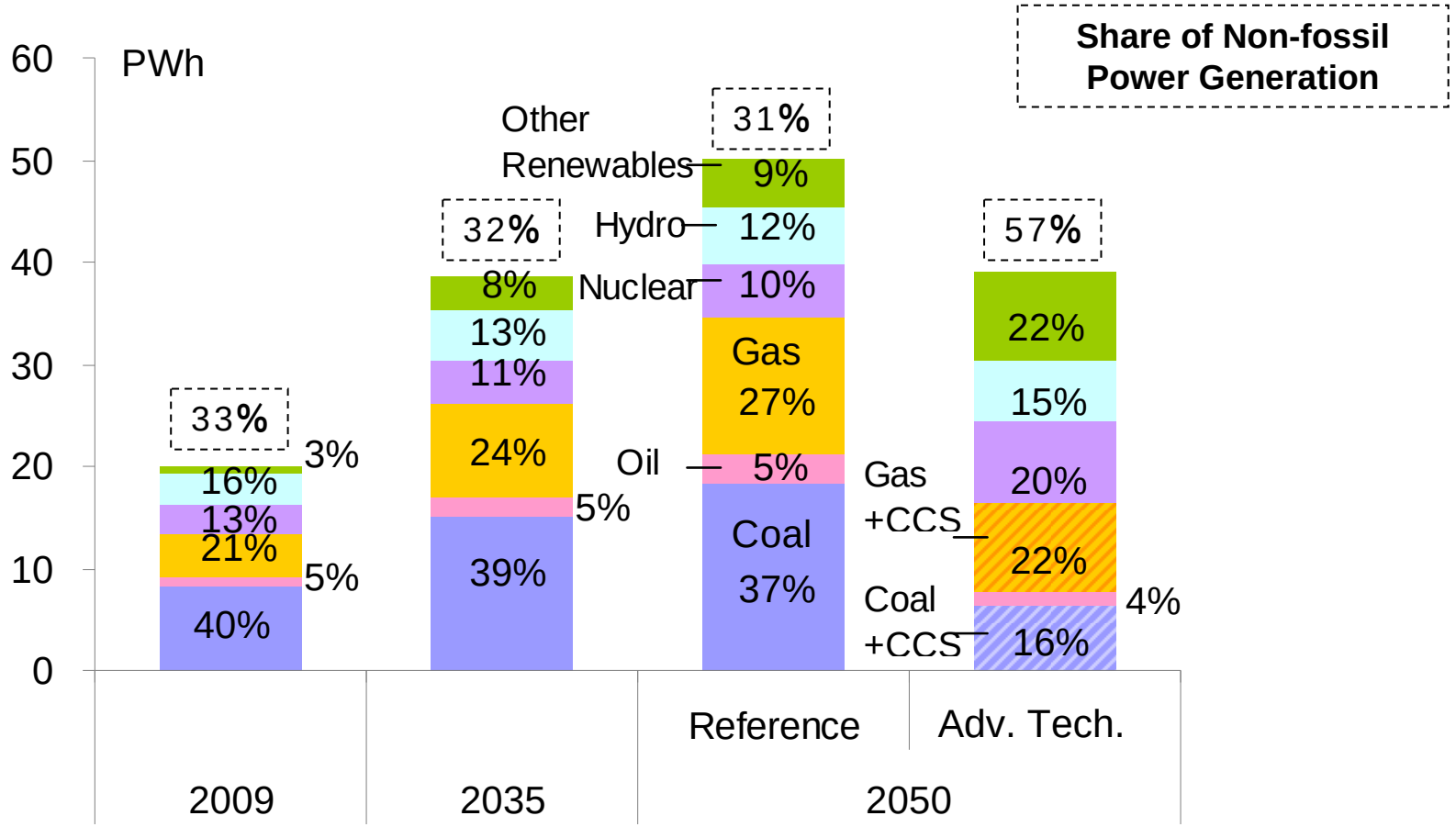
	Mtoe	Share
USA	316	11%
Japan	56	2%
Other OECD	287	10%
China	1,021	35%
India	829	28%
Other Asia	114	4%
Other non-OECD	316	11%
OECD	659	22%
non-OECD	2,280	78%
Developing Asia	1,964	67%
World	2,938	100%

(Natural Gas)

	Mtoe	Share
USA	271	18%
Japan	63	4%
Other OECD	238	16%
China	211	14%
India	81	5%
Other Asia	142	9%
Other non-OECD	514	34%
OECD	572	38%
non-OECD	948	62%
Developing Asia	434	29%
World	1,520	100%

- The highly efficient technologies consuming fossil fuels (such as clean coal technologies) need to be deployed in order to largely decrease the fossil fuel consumption

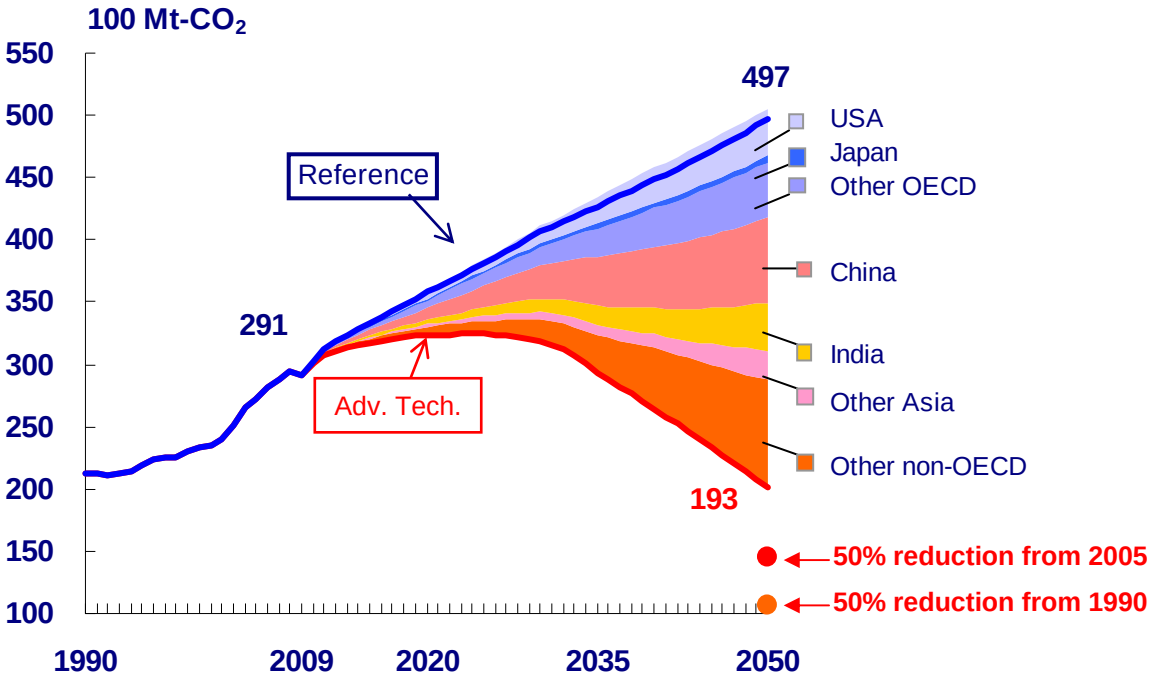
Power Generation Mix (World)



■ In the Reference Scenario, the world power generation will grow from 20 PWh in 2009 to 50 PWh in 2050. In the Adv. Tech. scenario, the power generation in 2050 will reach 39 PWh – lower than the Reference Scenario due to energy conservation.

■ The share of non-fossil power generation (including renewable and nuclear) will account for 31% in Reference and 57% in Adv.Tech. Scenario by 2050.

CO_2 Emissions Reduction Potential by Region (World)

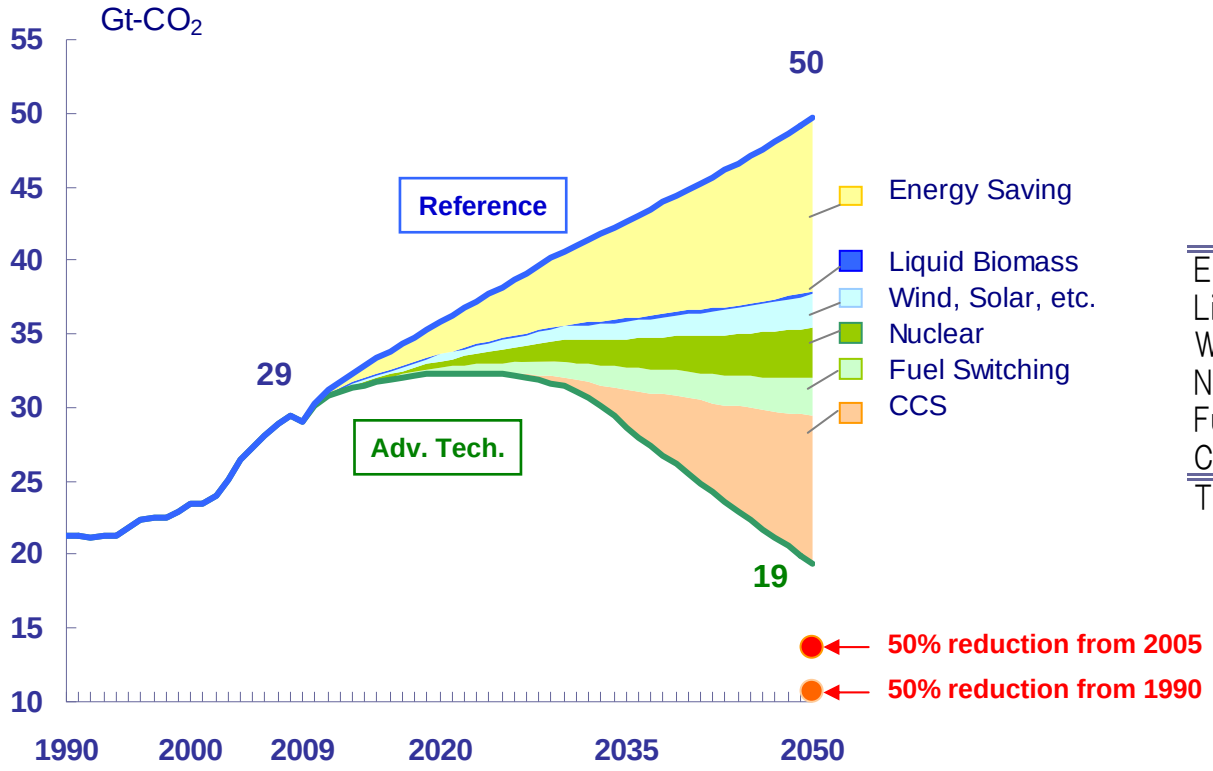


CO_2 emissions reduction in 2050

	100 Mt	
USA	38	13%
Japan	5	2%
Other OECD	45	15%
China	68	22%
India	38	13%
Other Asia	24	8%
Other non-OECD	86	28%
OECD	88	29%
non-OECD	216	71%
Developing Asia	130	43%
World	304	100%

■ Non-OECD will account for 71% of the world CO_2 emissions reduction potential in 2050. This suggests that reinforcement of energy and environmental measures in developing countries would be important toward the global efforts to CO_2 emissions reduction.

CO_2 Emissions Reduction Potential by Technology (World)

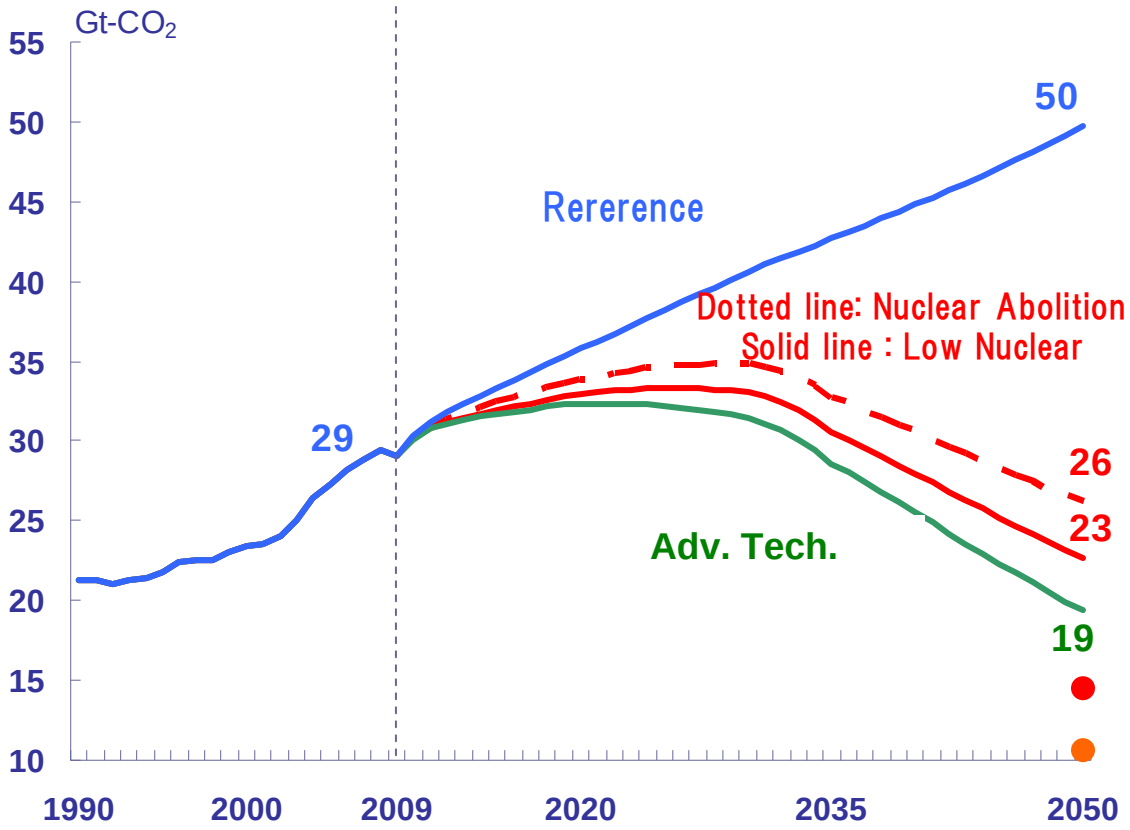


	Gt	
Energy Saving	12	39%
Liquid Biomass	0.2	1%
Wind, Solar, etc.	2	8%
Nuclear	3	11%
Fuel Switching	3	8%
CCS	10	33%
Total	30	100%

■ Energy saving technology principally contributes to the world CO_2 reduction in 2050. Fuel switching and CCS will substantially mitigate global emissions as well.

■ In order to halving world CO_2 emissions, further political and technological measures are required, such as progressive R&D, and development of low-carbon-emitting cities.

CO_2 Emissions in the low nuclear scenario (World)



World CO_2 emission in 2050

	from 1990	from 2005
Adv. Tech.	-9%	-29%
Low Nuclear	+7%	-17%
Nuclear Abolition	+23%	-4%

■ In the Low Nuclear Scenario (replaced by fossil-fuel fired), CO_2 emission in 2050 will become larger than that in the Adv. Tech. Scenario by 4Gt(18%).

Implications

■ Impact of the incident at Fukushima Daiichi Nuclear Power Station

The Great East Japan Earthquake and the succeeding incident at Fukushima Daiichi Nuclear Power Station have heightened concerns over the safety of nuclear power generation around the world. As a result, a number of countries' energy policies were affected in various ways.

Some countries are moving to abolish or scale back nuclear power generation or significantly cut back on plans to build nuclear power stations. On the other hand, those countries that have been aggressively promoting nuclear power are expected to maintain and expand nuclear power generation in the medium to long term from the perspective of overcoming the "3E's" challenges ("Energy security", "Environment" and "Economy").

Therefore, it is essential to better ensure the "Safety" of nuclear power generation. It is important for technologically developed countries, including Japan, to make active contributions to the establishment of a global nuclear safety control system.

On the other hand, it will also be an important challenge to secure alternative power sources to make up for delays and cutbacks in nuclear power development plans.

■Surging energy demand, assurance of stable energy supply and response to global warming

The world's primary energy consumption will continue to increase in the future. In particular, Asia will lead the growth in the world's primary energy demand, with demand in China and India growing especially sharply. In line with the energy demand growth, many energy-consuming countries will become more dependent on imports for their energy supply, and this may intensify the competition to secure energy resources.

Given the expectations of fossil fuels demand growth, ensuring stable energy supply will become an increasingly important challenge for all major countries. At the same time, climate change is an important worldwide issue that may affect sustainable global growth. Therefore, in order to overcome the "3E's and S" challenges, it is important to make increased efforts from a long-term perspective in a comprehensive manner.

As there is no panacea for resolving those challenges, it is essential to take all available measures, including promotion of "enhanced energy conservation" on the demand side and "safer nuclear technology," "cleaner use of fossil fuels" and "lower-cost renewable energy" on the supply side. The following three measures are particularly important:

(1) Energy conservation

Of the CO_2 reduction potential, which represents the difference between the CO_2 emissions under the reference and advanced technologies scenarios, energy conservation (improvement in energy use efficiency on both supply and demand sides) accounts for 47%. The ratio of energy conservation is particularly high in regions where steep demand growth is expected, such as Asia and the Middle East, and hopes pinned on energy conservation are all the higher in those regions. Thus, energy conservation is the most effective means to reduce CO_2 emissions, so progress in energy conservation will have a significant impact on global energy security and climate change mitigation.

(2) Effective use of fossil fuels

Fossil fuels will continue to account for most of the world's primary energy consumption. Therefore, making clean and highly efficient use of and ensuring stable supply of fossil fuels will continue to be critical challenges in the long-term. To deal with global warming in the long-term, it will also be important to accelerate the development of technologies for CCS plus U (carbon capture, storage, and effective use).

(3) Expansion of the use of renewable energy

Likewise, in light of the need for energy security and measures to deal with global warming, the importance of renewable energy is certain to grow. Therefore, it is an urgent challenge to strengthen policy, research and development and infrastructure development activities, including the reduction of the cost of renewable energy and the implementation of measures to resolve supply instability (measures to deal with problems related to power grids), so as to promote the dissemination of renewable energy.

■ Outlook through 2050

Under the technologically advanced scenario, the world's CO_2 emissions in 2050 will be 29% lower compared with 2005. In other words, in order to achieve the goal of halving the world's CO_2 emissions by 2050, it will be necessary not only to introduce technologies that are currently expected to be put into practice but also develop and disseminate new innovative technologies. In order to achieve technological innovation, it will be necessary to enable fundamental breakthroughs and large-scale dissemination of new technologies by making further research and development investments in the fields of nuclear power generation, renewable energy, CCS and other energy conservation technologies.

Implications for Japan

For Japan, which is poorly endowed with energy resources, ensuring energy security is a particularly important challenge. It will be necessary to take an action from the perspective of procuring fossil fuels amid the intensifying competition to secure resources while promoting the introduction of renewable energy. It will also be important to consider making efforts to ensure energy security in the medium to long term through international cooperation, particularly partnership with Asian countries in energy infrastructure development.

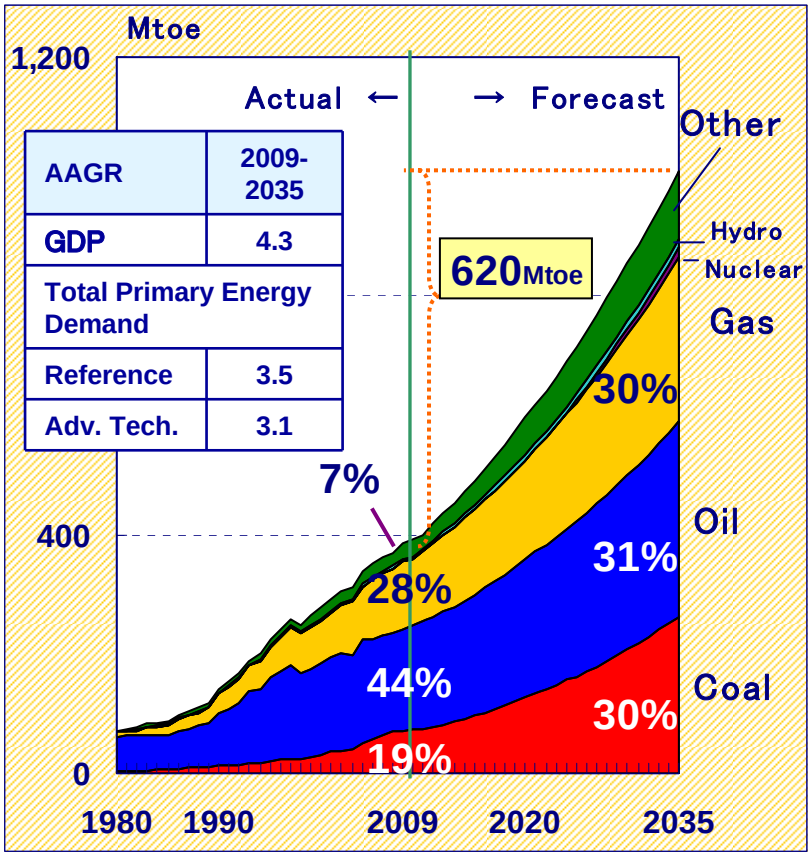
Moreover, as nuclear power generation will be expanded mainly in Asia, it will be important for Japan to make active contributions to ensuring the security of nuclear power on a global level based on the lesson of the Fukushima accident through the formulation of international standards of safety regulation, transfer of safety technologies and personnel training.

All things considered, Japan, which has technological and institutional advantages, has a very great role to play in this respect. In particular, Japan is competitive in energy-saving and environmental conservation technologies, which play the central role in overcoming the “3E’s and S” challenges. Further development and utilization of those technologies should be a key option of the Japan’s growth strategy and international energy strategy. In the future, it will be important for Japan to utilize these advanced technologies to step up efforts to overcome the “3E’s and S” challenges simultaneously and accomplish sustainable economic growth as a leading technology-oriented nation.

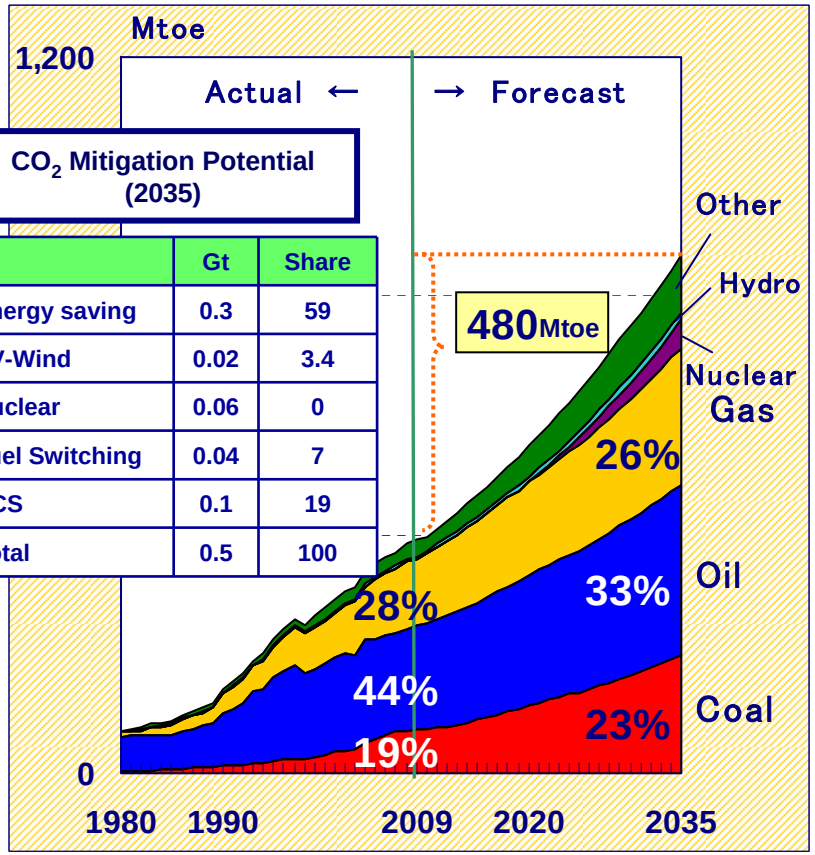
＜Reference Material＞

Primary Energy Demand (ASEAN)

【Reference Scenario】



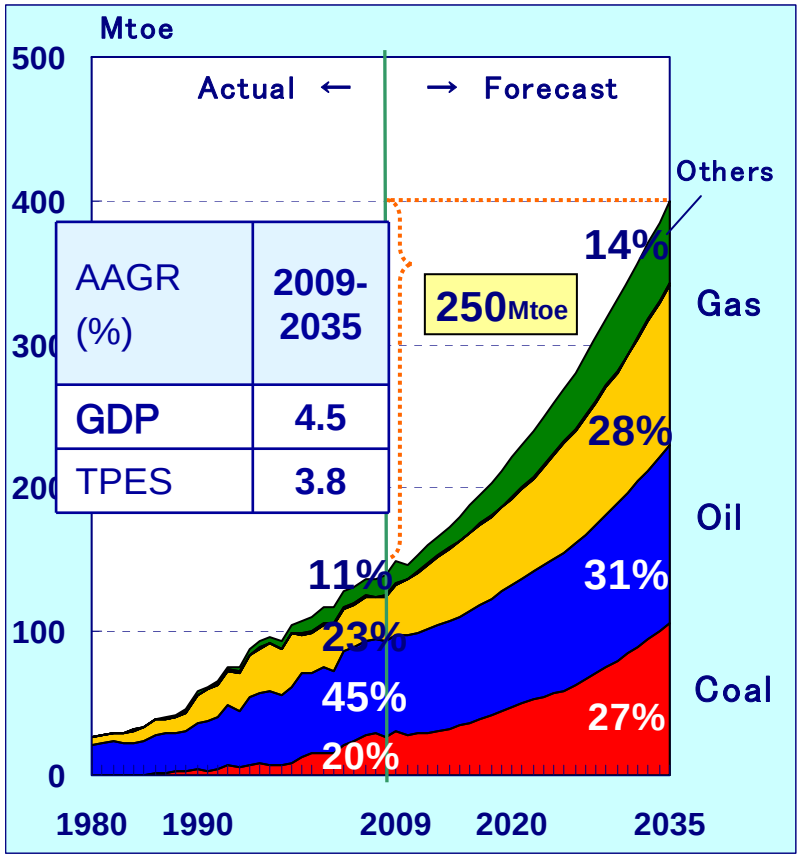
【Adv. Tech. Scenario】



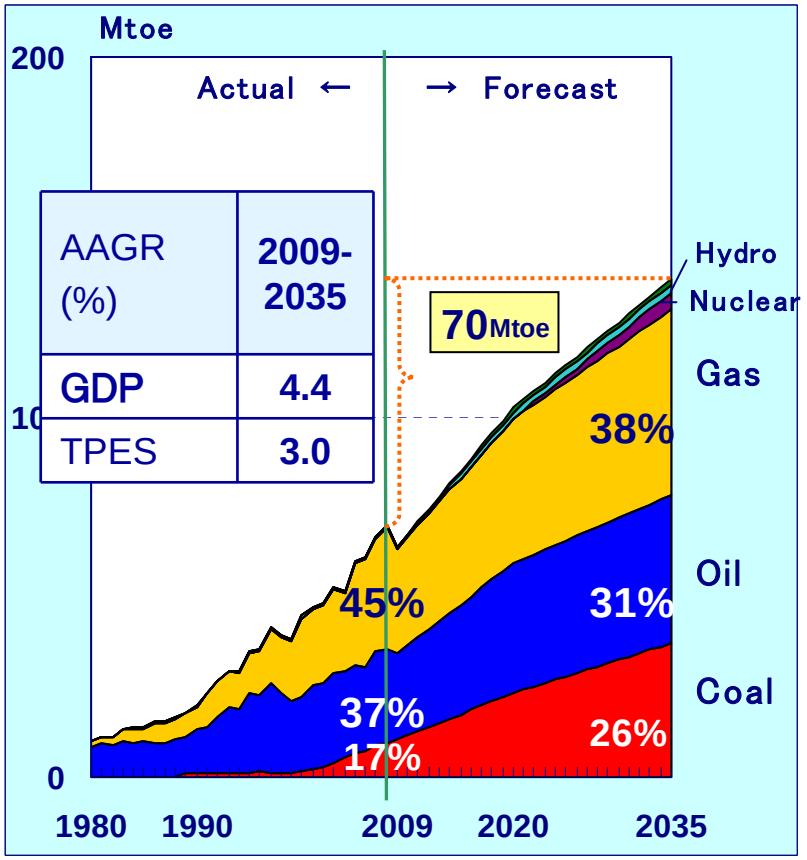
ASEAN countries have achieved economic growth reflecting on abundant labor force and exporting manufacturing product to international market. These factors have led to increase its energy demand. Electricity demand, in particular, represents fast growth and a couple of nuclear power plants is projected to be installed for securing electricity supply.

Primary Energy Demand (Indonesia, and Malaysia)

【Indonesia】 (Reference)



【Malaysia】 (Reference)

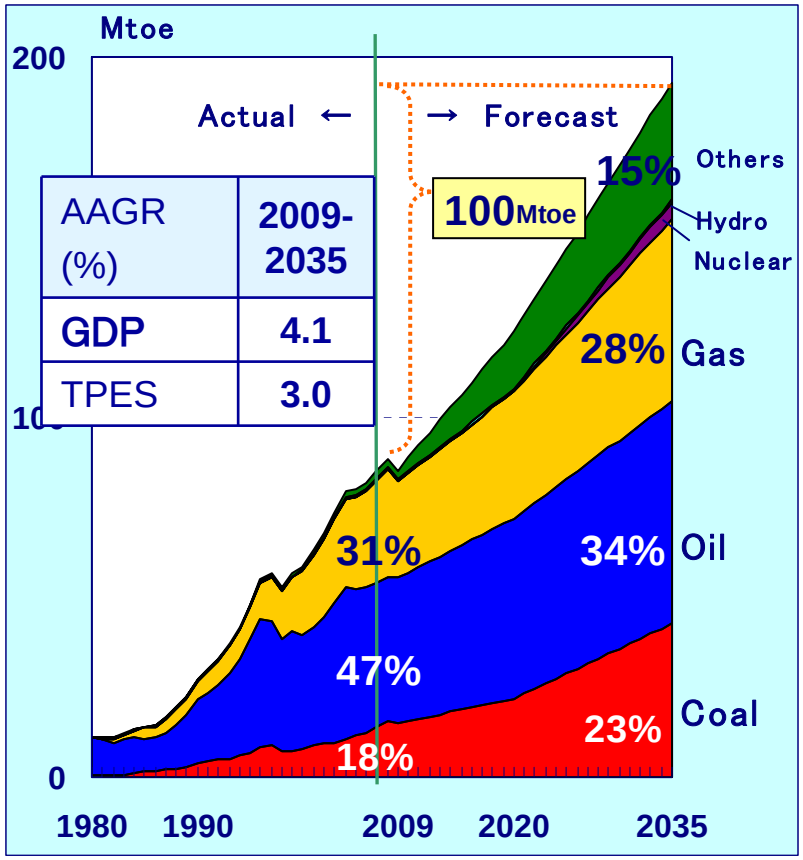


Indonesia: Major target of energy policy is composed of securing energy supply, exporting domestic energy resources at high value, managing domestic energy reserves, and providing affordable energy to low-income people.

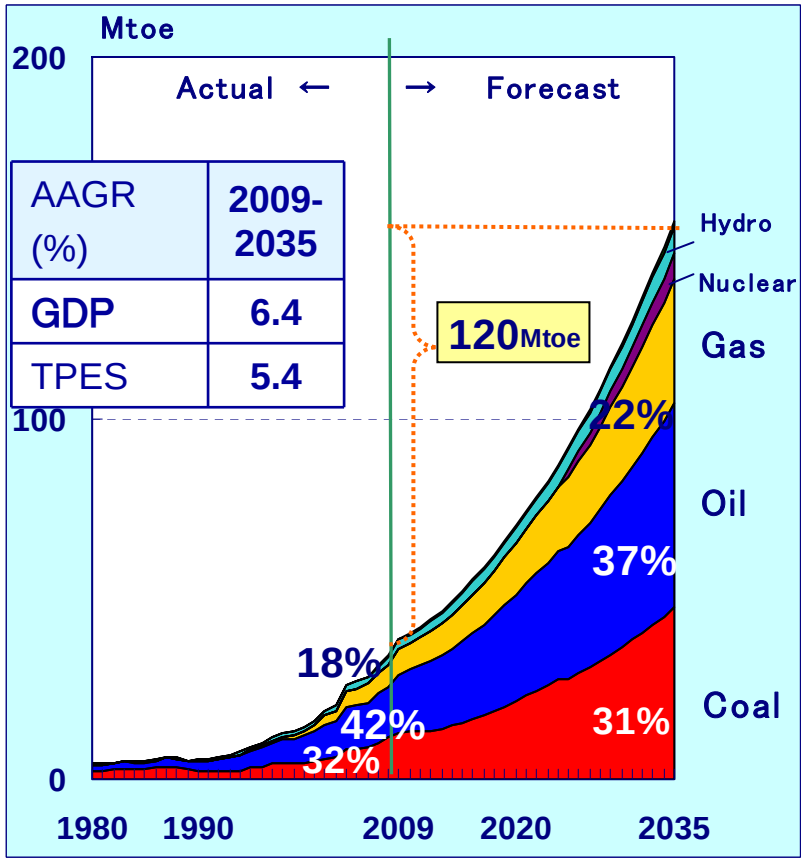
Malaysia: Political priority is emphasized on ensuring affordable energy supply and sustainable economic growth. Basic target is fuel diversification, energy efficiency and environmental protection.

Primary Energy Demand (Thailand, and Vietnam)

【Thailand】 (Reference)



【Vietnam】 (Reference)

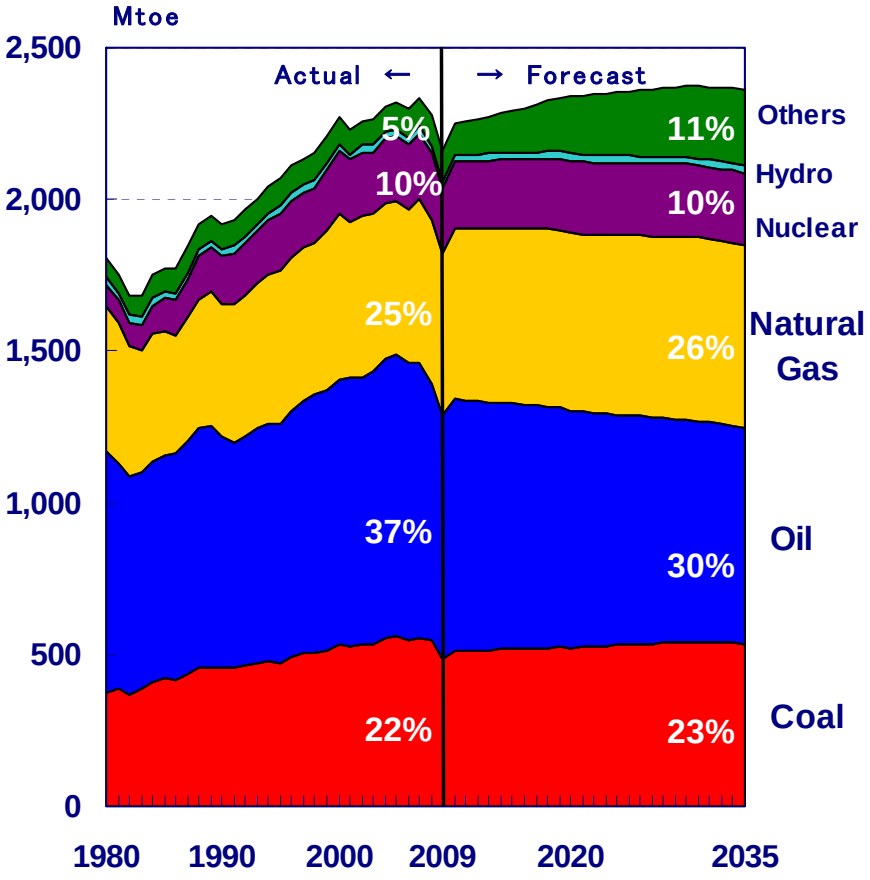


Thailand: Energy policy emphasis is placed on energy supply security, appropriate energy price, alternative fuel, energy efficiency, and environmental protection. The government focuses on the CDM project.

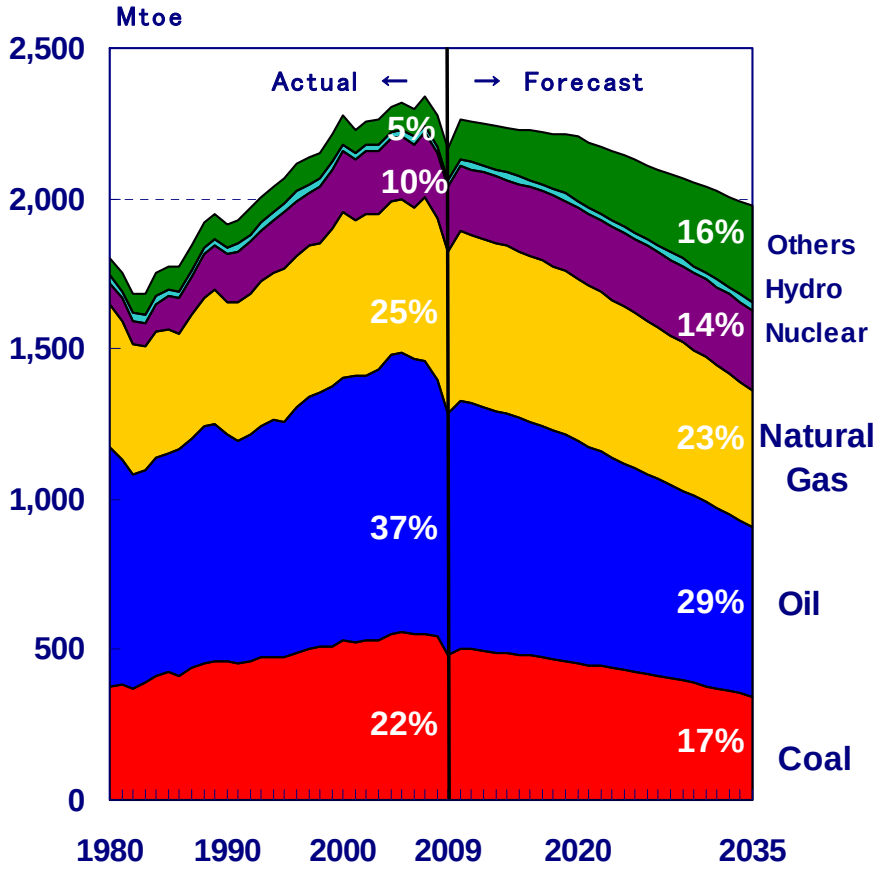
Vietnam: The government aims to promote foreign investment in the upstream sector in order to ramp up domestic oil production, and increase oil export for expanding foreign currency revenues.

Primary Energy Demand in the U.S.

【Reference】



【Adv. Tech.】

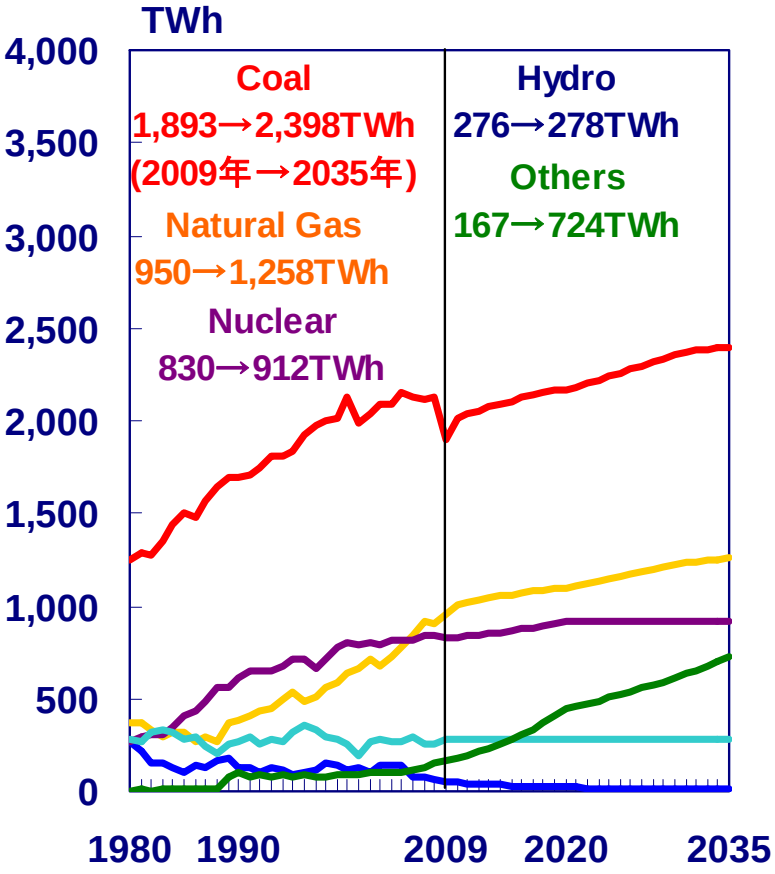


■ Oil demand will decrease due to the vehicles fuel efficiency improvement and deployment of bio-fuel. Oil demand will decline from 16.2 mb/d in 2009 to 14.3 mb/d in Reference and 11.4 mb/d in Adv. Tech. by 2035.

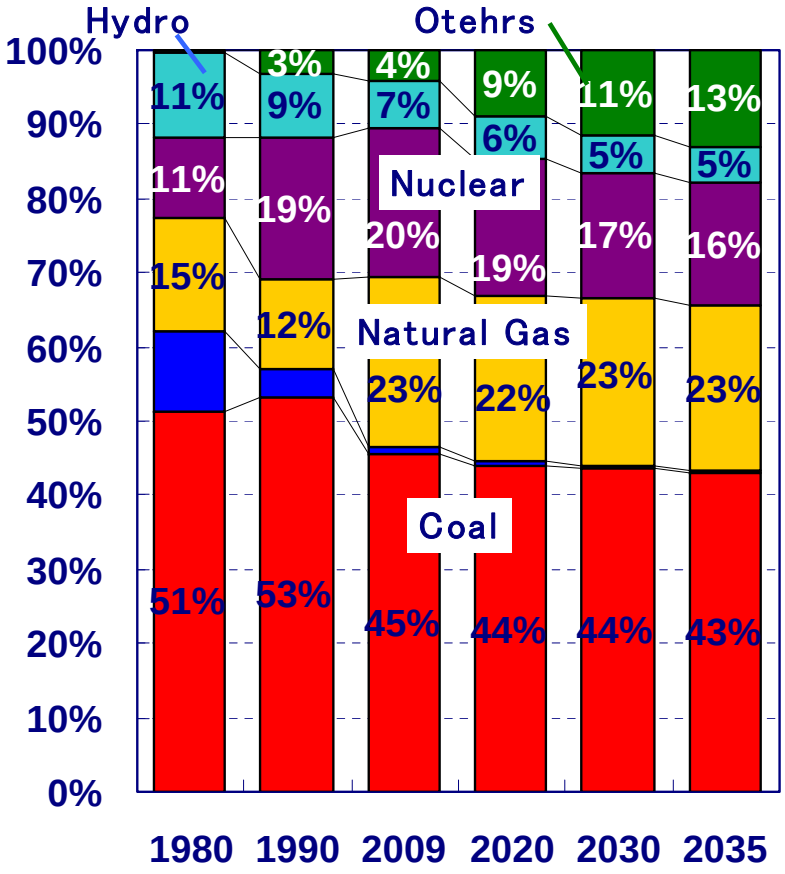
■ Renewables, particularly wind and bio-fuel, will considerably increase.

Power Generation Mix in the U.S.

【Power Generation】 (Reference)



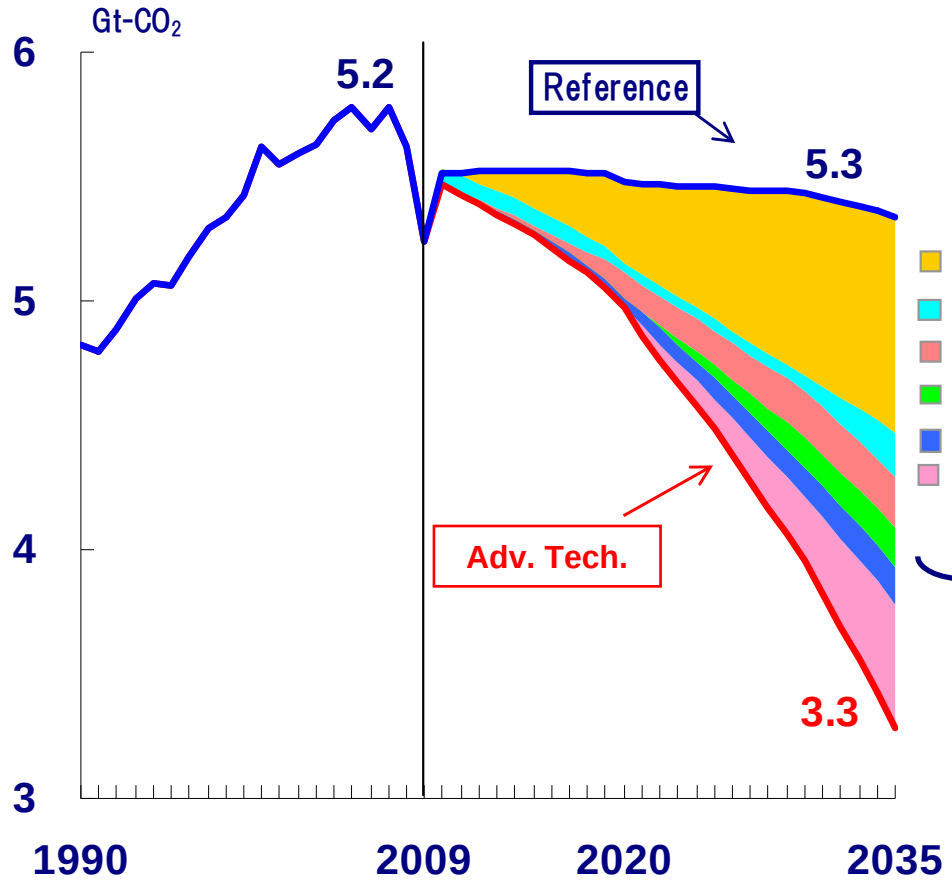
【Power Generation Mix】 (Reference)



■Coal-fired generation will remain in a base source of electricity. And natural gas-fired generation will increase continuously due to shale gas developments.

■The share of renewable, particularly solar and wind, will increase from 4% in 2009 to13% in 2035.

CO_2 Emissions Reduction in the U.S.



Energy Saving(42%)
Bio-fuel(9%)
PV,Wind etc.(10%)
Nuclear(8%)
Fuel Switching(7%)
CCS(24%)

Energy Saving 42%

Fuel Switching 34%

CCS 24%

2035
2.0 billion-tonnes
(38 %)

	Gt	Share
Energy Saving	0.9	42
Bio-fuel	0.2	9
PV, Wind etc.	0.2	10
Nuclear	0.2	8
Fuel Switching	0.1	7
CCS	0.5	24
Total	2.0	100

■CO_2 emissions in the Adv. Tech. Scenario will be 2.0 billion toe lower compared with the Reference Scenario.

■The CO_2 emissions in U.S. building sector is likely to grow continuously, suggesting that measures need to be implemented to improve energy efficiency and utilize low-carbon emission power generation technologies.

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