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Asia / World Energy Outlook 2011

Growing Uncertainty over International Energy Trends and the Future of Asia

The Institute of Energy Economics, Japan (IEEJ)

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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.

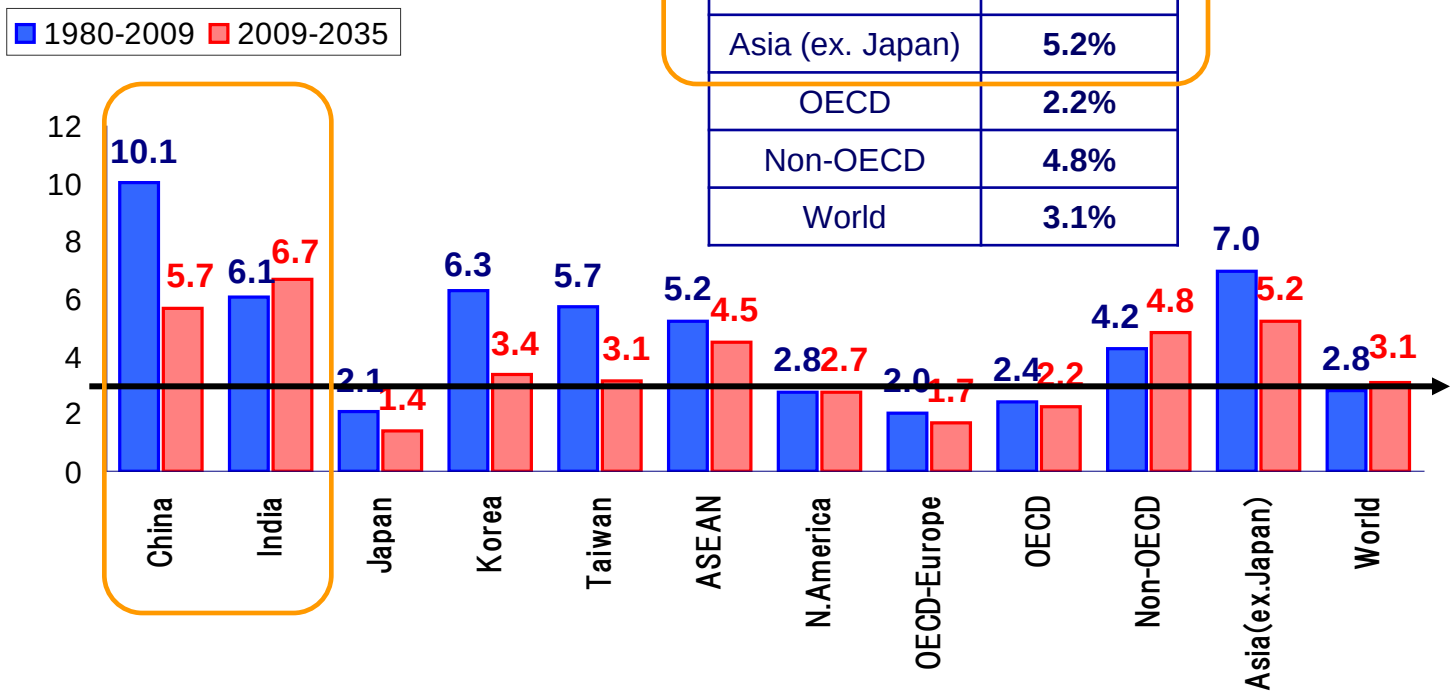
  ■ **Low Nuclear Scenario**

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

Major Assumptions： Gross Domestic Product

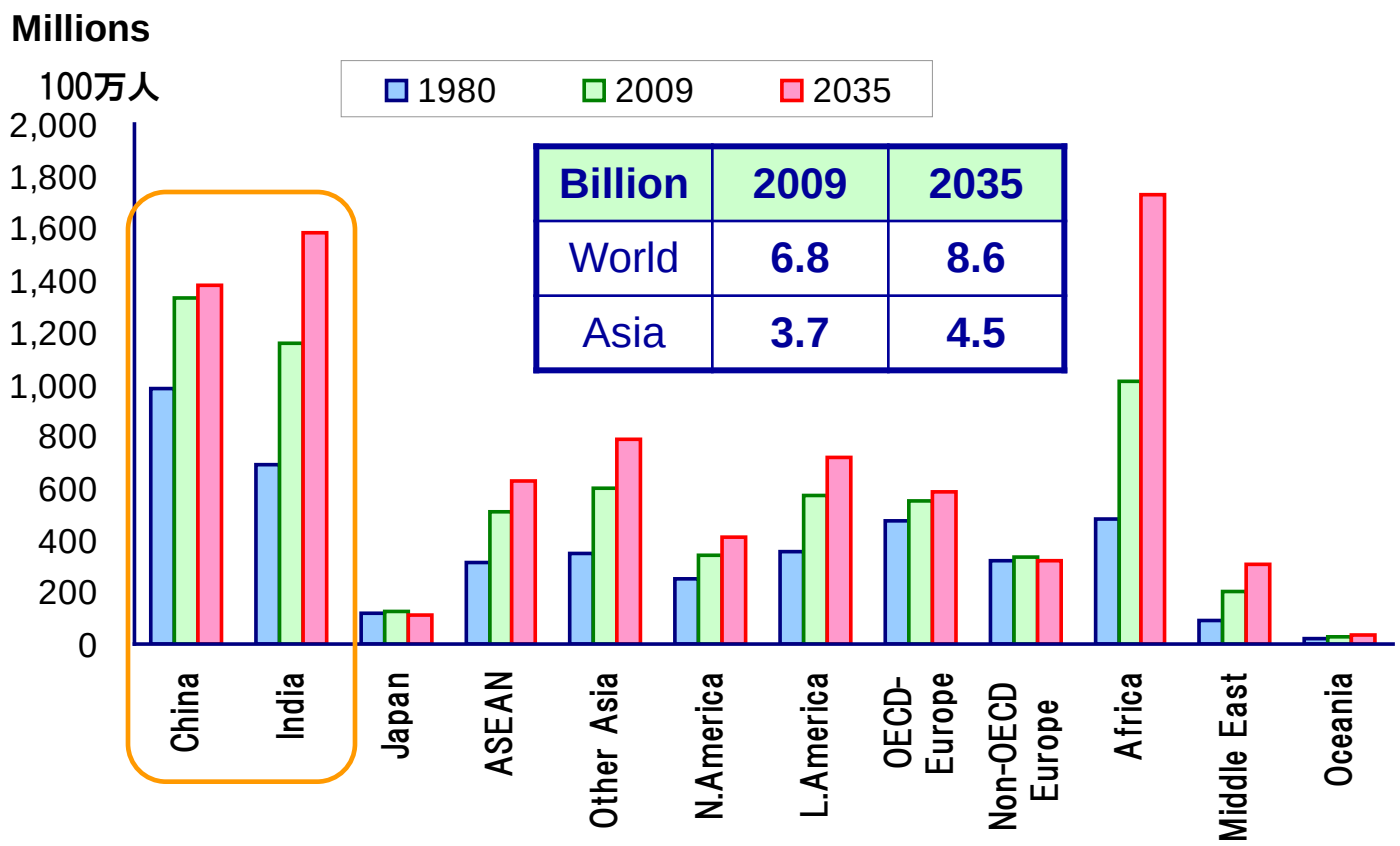
Average Annual Growth Rate (%)

	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

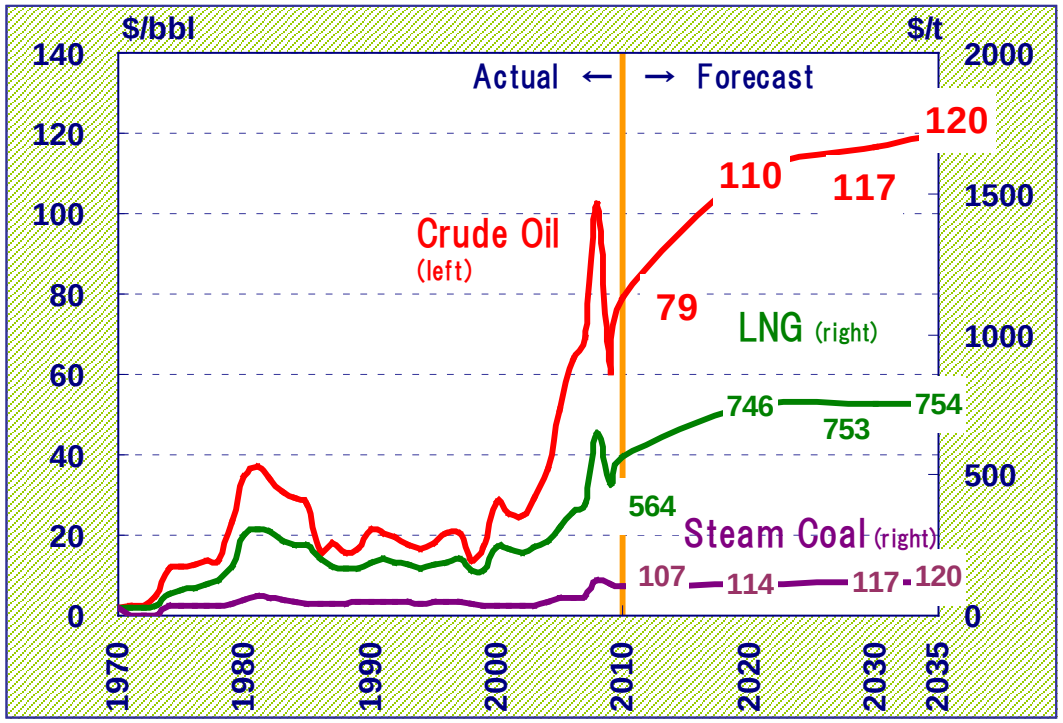
2009
1.33 bil
↓
2035
1.38 bil
(0.05 bil growth)

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).

【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

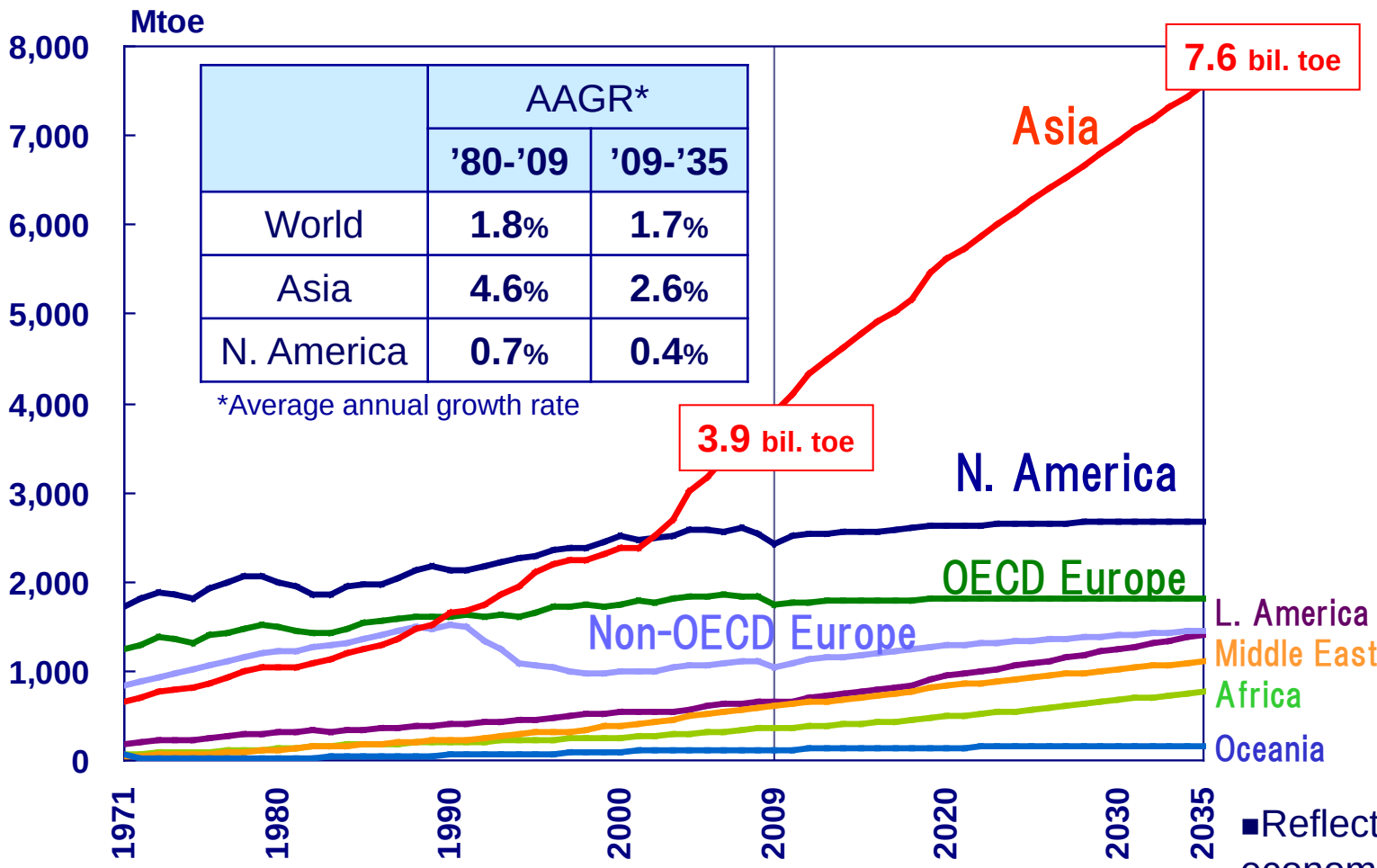
■ After the record spike to $100 per barrel in 2008, crude **oil** prices returned to its earlier path and will continue to increase in the future resulting from the tight balance between demand and supply. Oil demand is projected to increase driven mainly by Asia, while upstream investment may not progress 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.

Primary Energy Demand by Region (World)

Reference



	AAGR*	
	'80-'09	'09-'35
World	1.8%	1.7%
Asia	4.6%	2.6%
N. America	0.7%	0.4%

*Average annual growth rate

World

2009
11.2 bil. toe
↓
2035
17.3 bil. toe
(1.5-fold increase)

Asia

2009
3.9 bil. toe
↓
2035
7.6 bil. toe
(1.9-fold increase)

Share in increase (2009-2035)

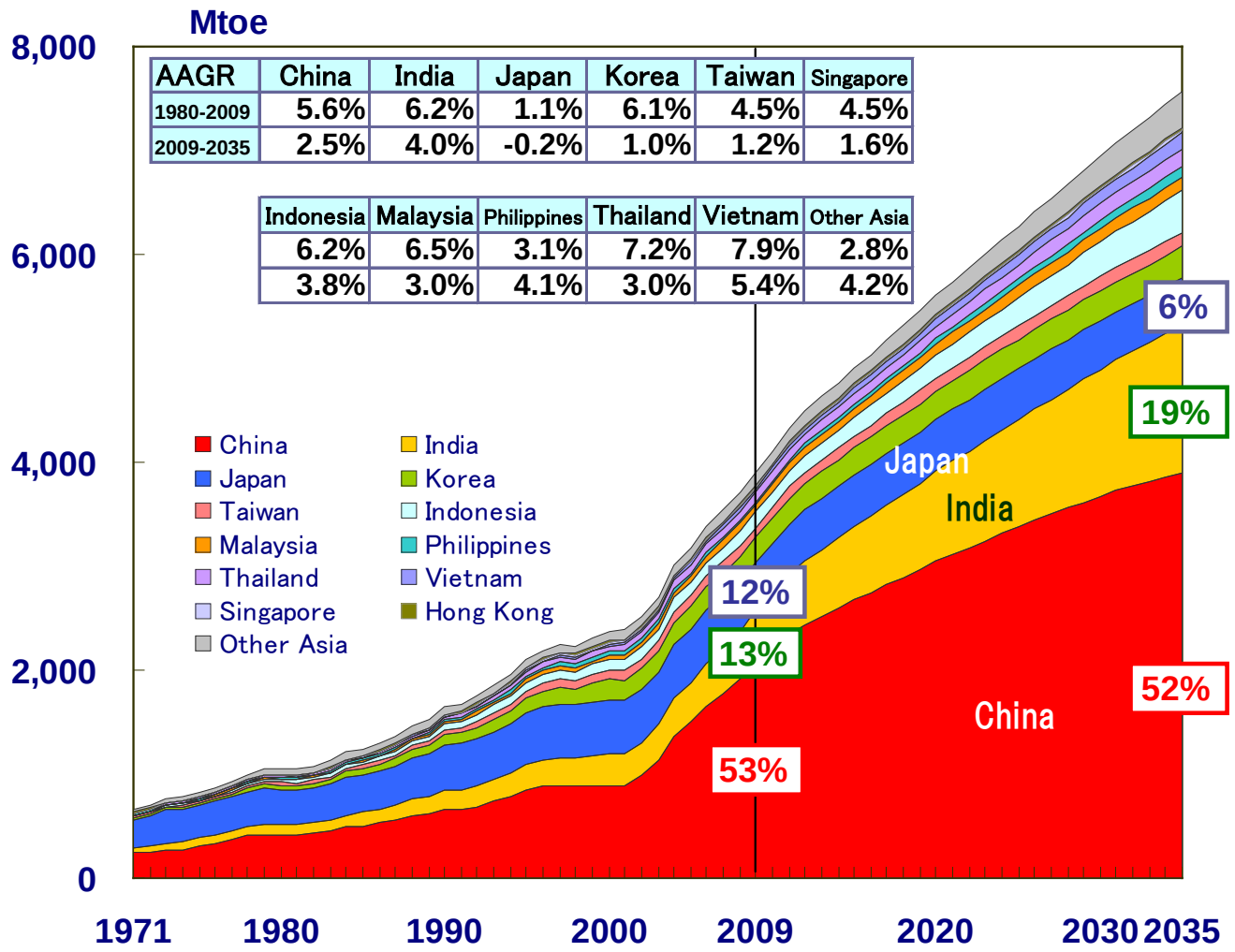
China	India	Japan	ASEAN	Other Asia	N. America	OECD Europe
31%	15%	0%	10%	6%	4%	1%

Asia occupies more than 60% of total growth.

■Reflecting high economic growth, primary energy demand in Asia will double.
(3.9 bil. toe(2009)
→ 7.6 bil. toe(2035))

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

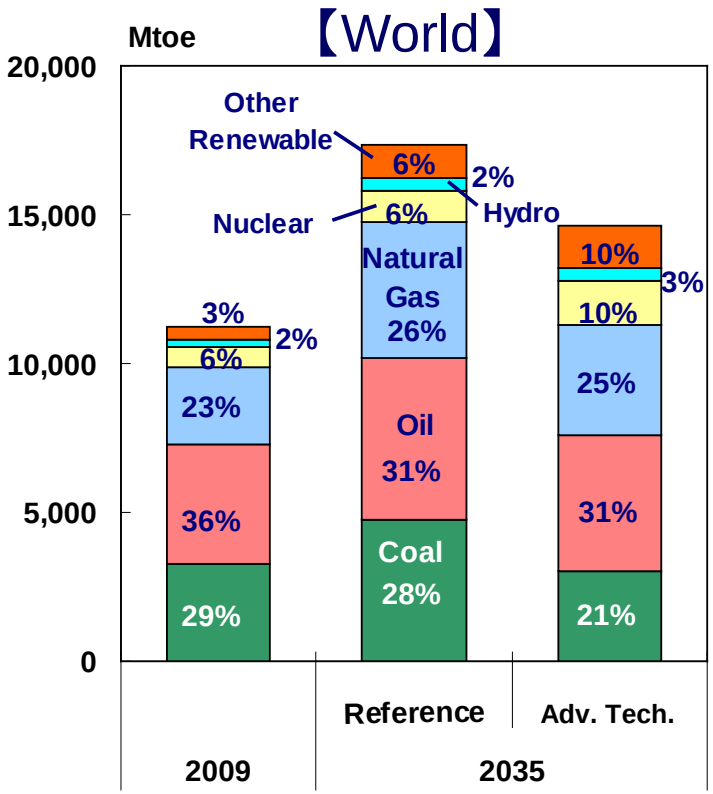
3.9 bil. toe / 1.4 bil. Toe

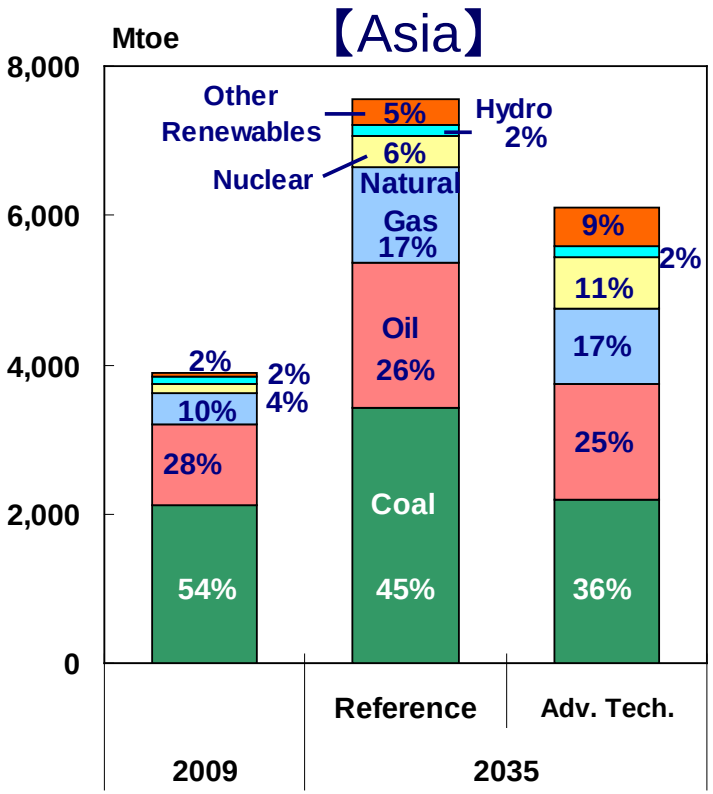
(1.9-fold inc. / 2.8-fold inc.)

- 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 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)

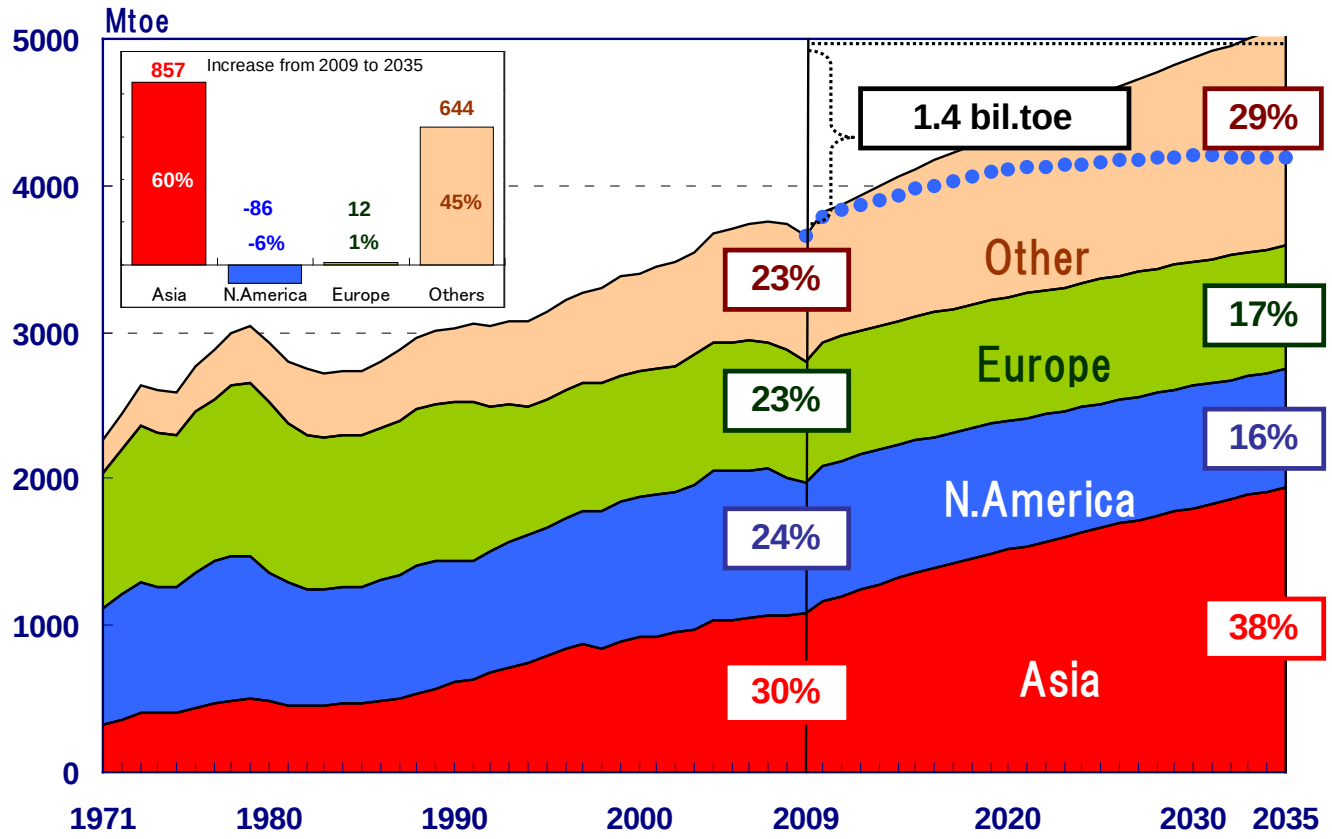
2009
7 %
↓
2035

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.
- Fossil fuel will continue to be the most important fuel in the world and Asia by 2035.
- Fossil fuel keeps its share at 80% even in Adv. Tech. case for both the world and Asia in 2035.

Oil Demand (World)

Solid line: Reference
Dotted line: Adv. Tech.



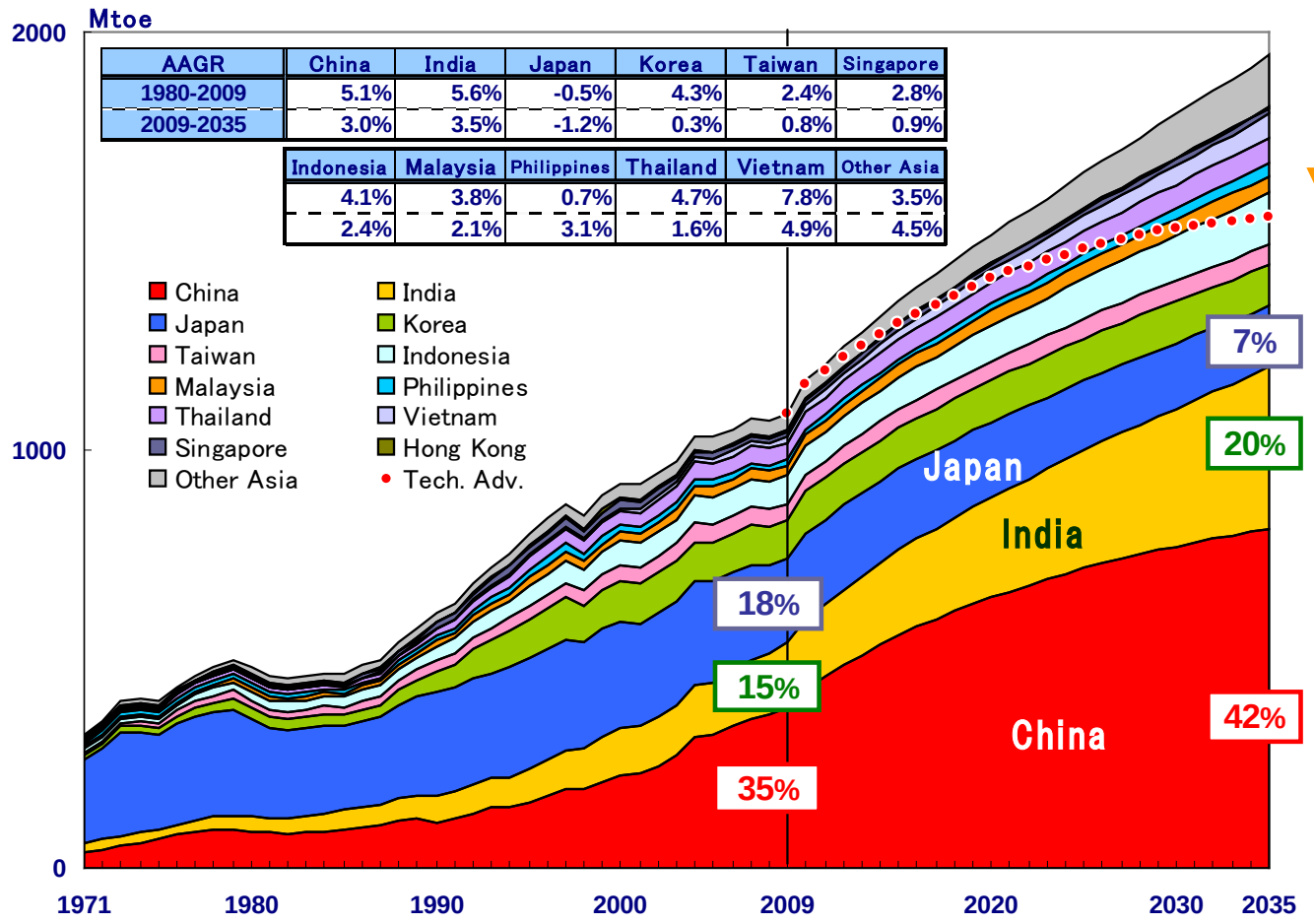
0.90 bil (18%) Saving

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 (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

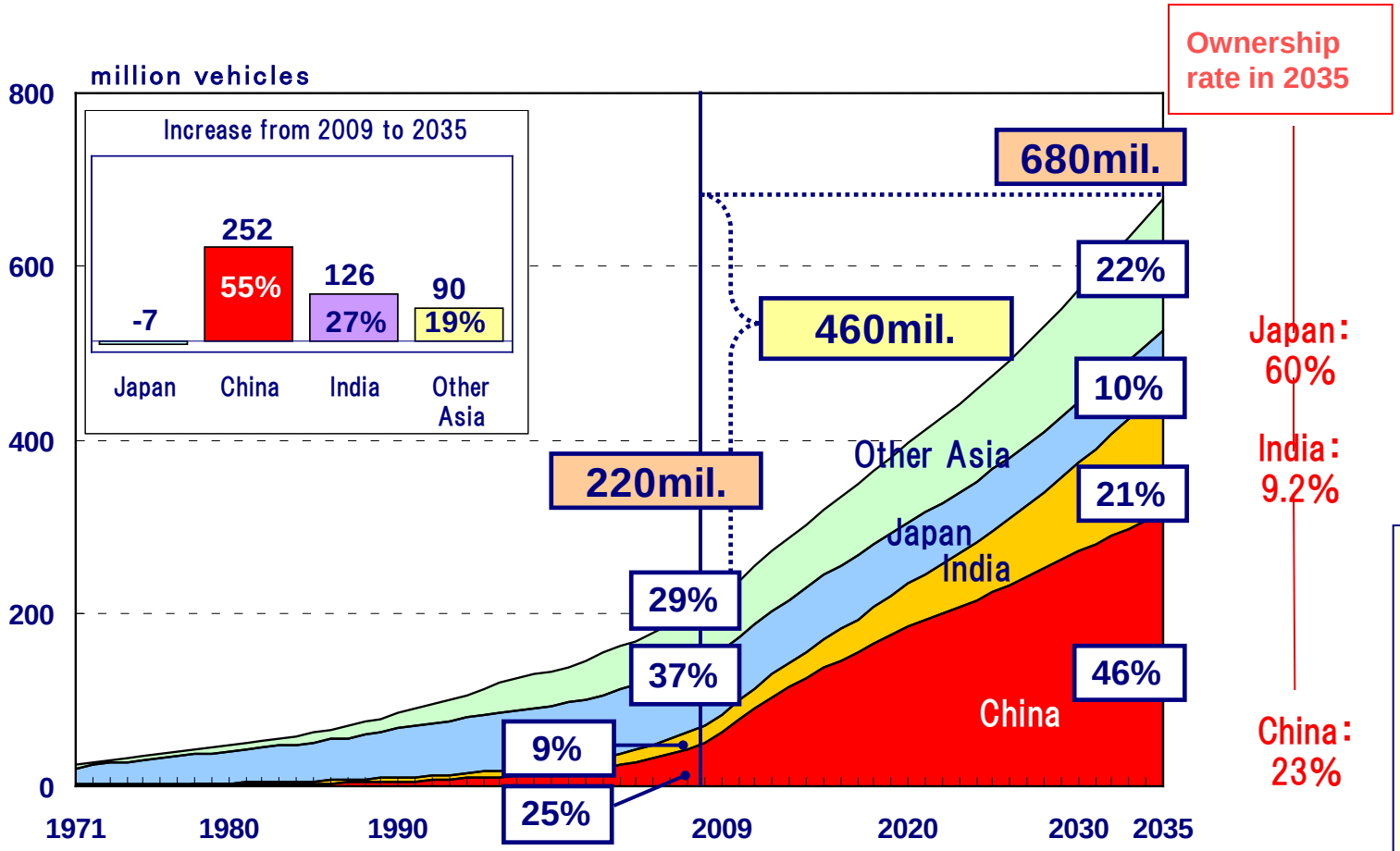
2009
1.09 bil
(22.7 mbd**)**
↓
2035
Reference
1.95 bil **(40.5** mbd**)**
Adv. Tech.
1.56 bil **(32.4** mbd**)**

■ 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 (Asia)

Reference
Adv. Tech.



China

2009
63 mil.
↓
2035
320 mil.
(5.0-fold inc.)

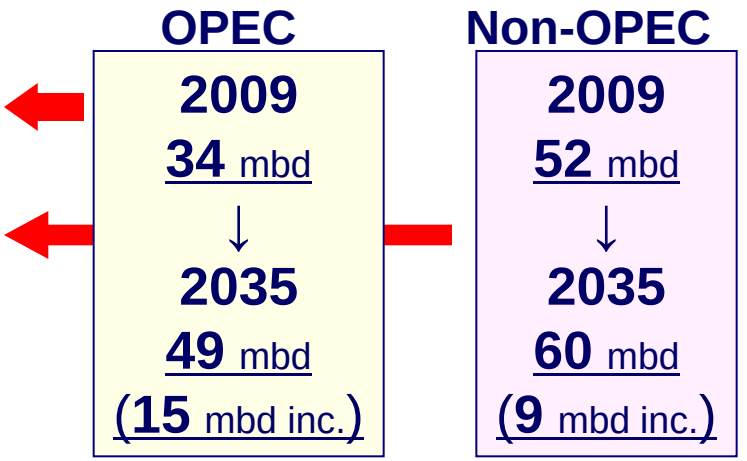
India

2009
19 mil.
↓
2035
150 mil.
(7.0-fold inc.)

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

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	

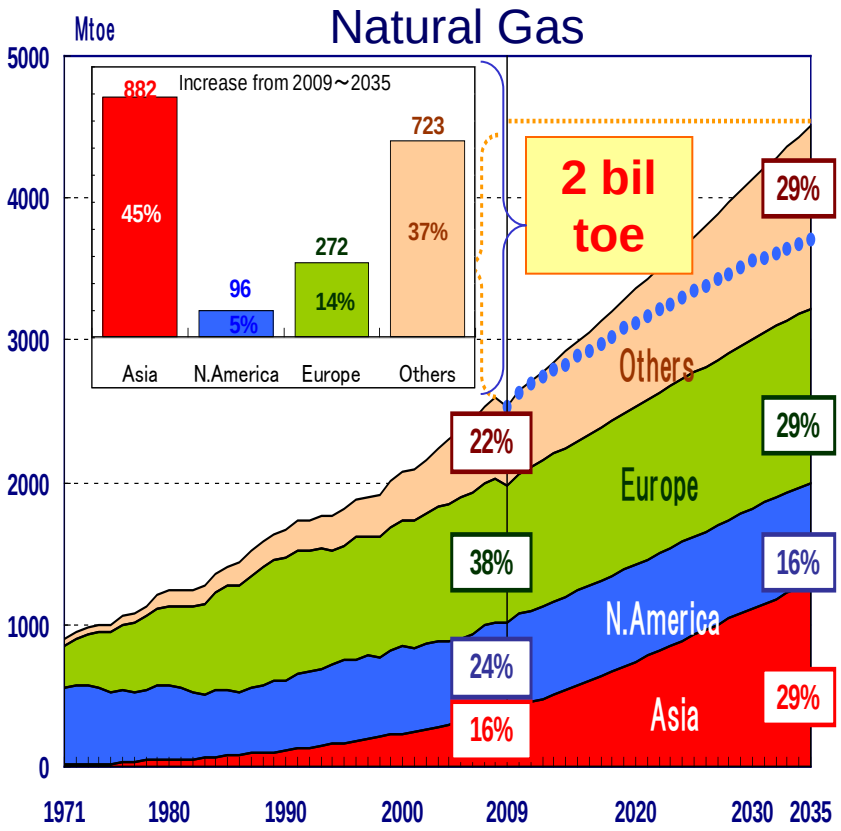


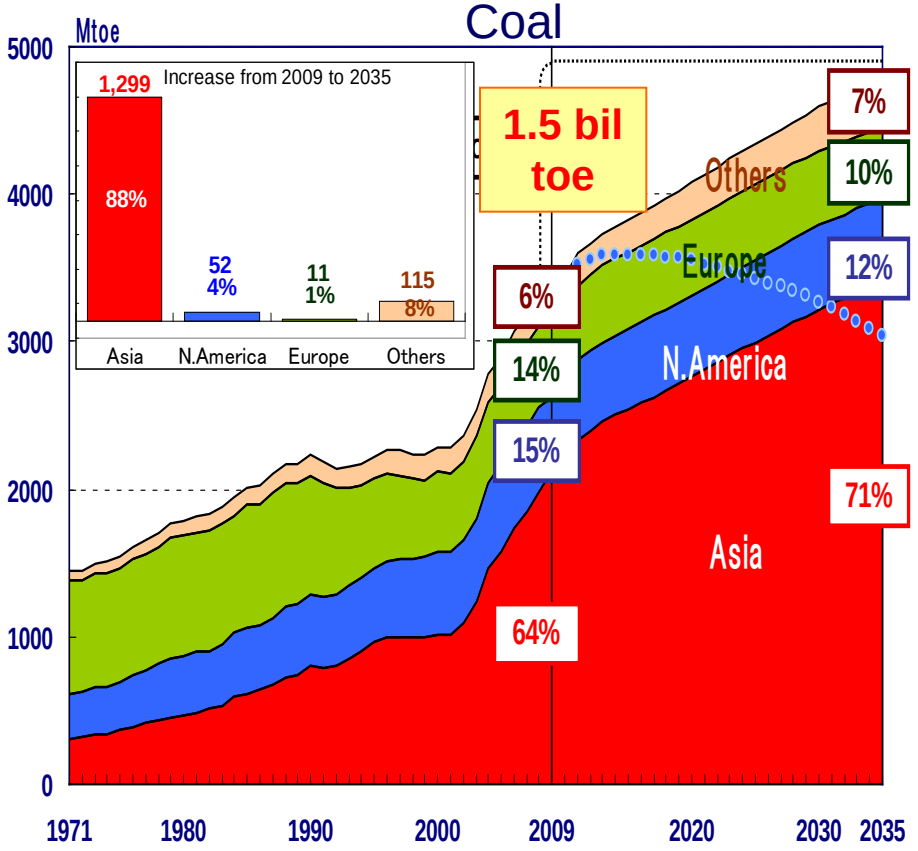
Share in world oil production growth from 2006-2030
OPEC 65% (15mbd)
Non-OPEC 35% (7mbd)

- 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.

Natural Gas and Coal Demand (World)

Reference





2009
2.5 billion toe
↓
2035
Reference
4.5 billion toe

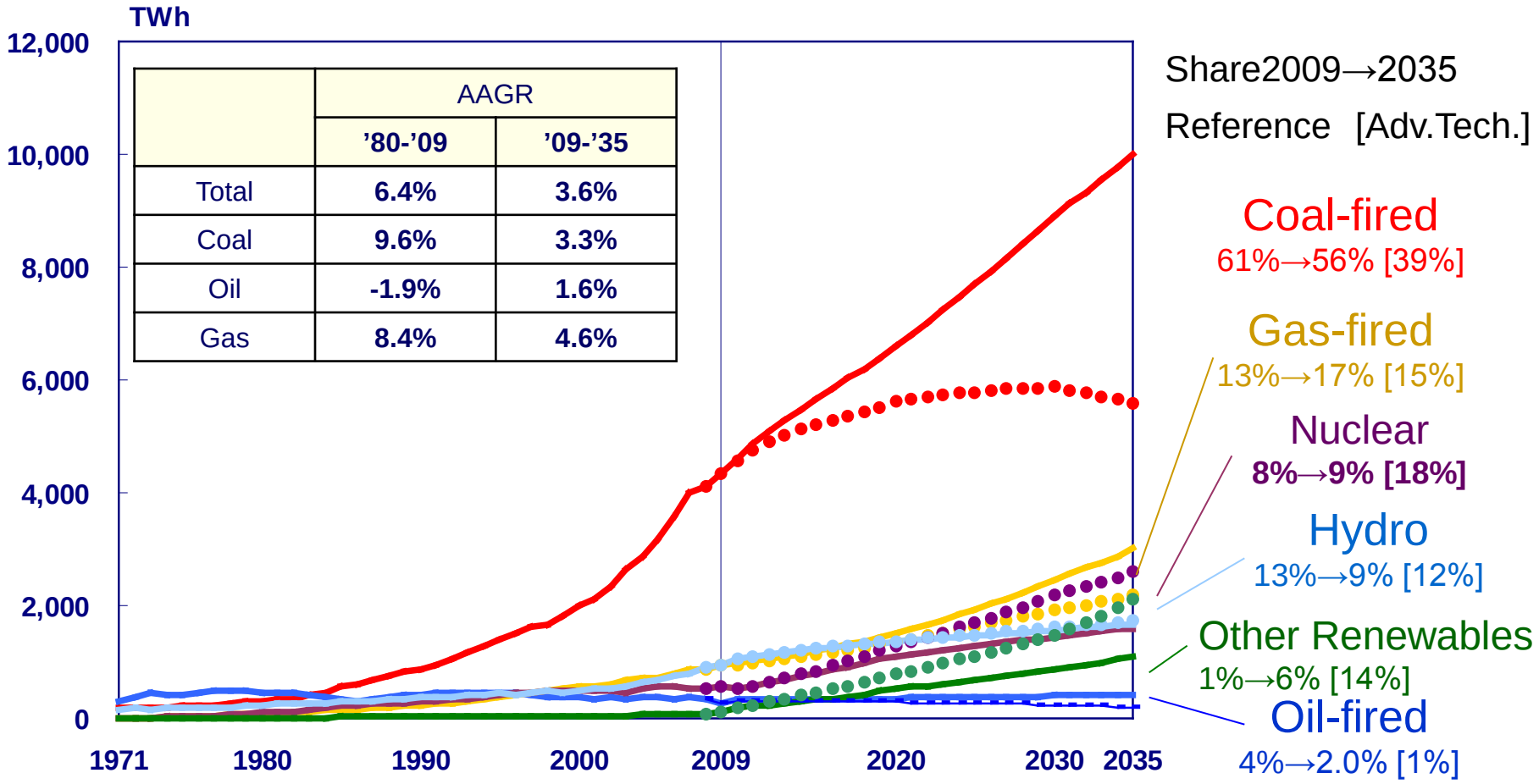
1.9 folds
(1.7 bil. LNG ton)
Increase

2009
3.3 billion toe **(4.7** billion **tce*)**
↓
2035
Reference
4.8 billion **toe** **(6.8** billion **tce*)**

1.5 folds
(2.2 bil. TCE)
Increase

Power Generation Mix by Type (Asia)

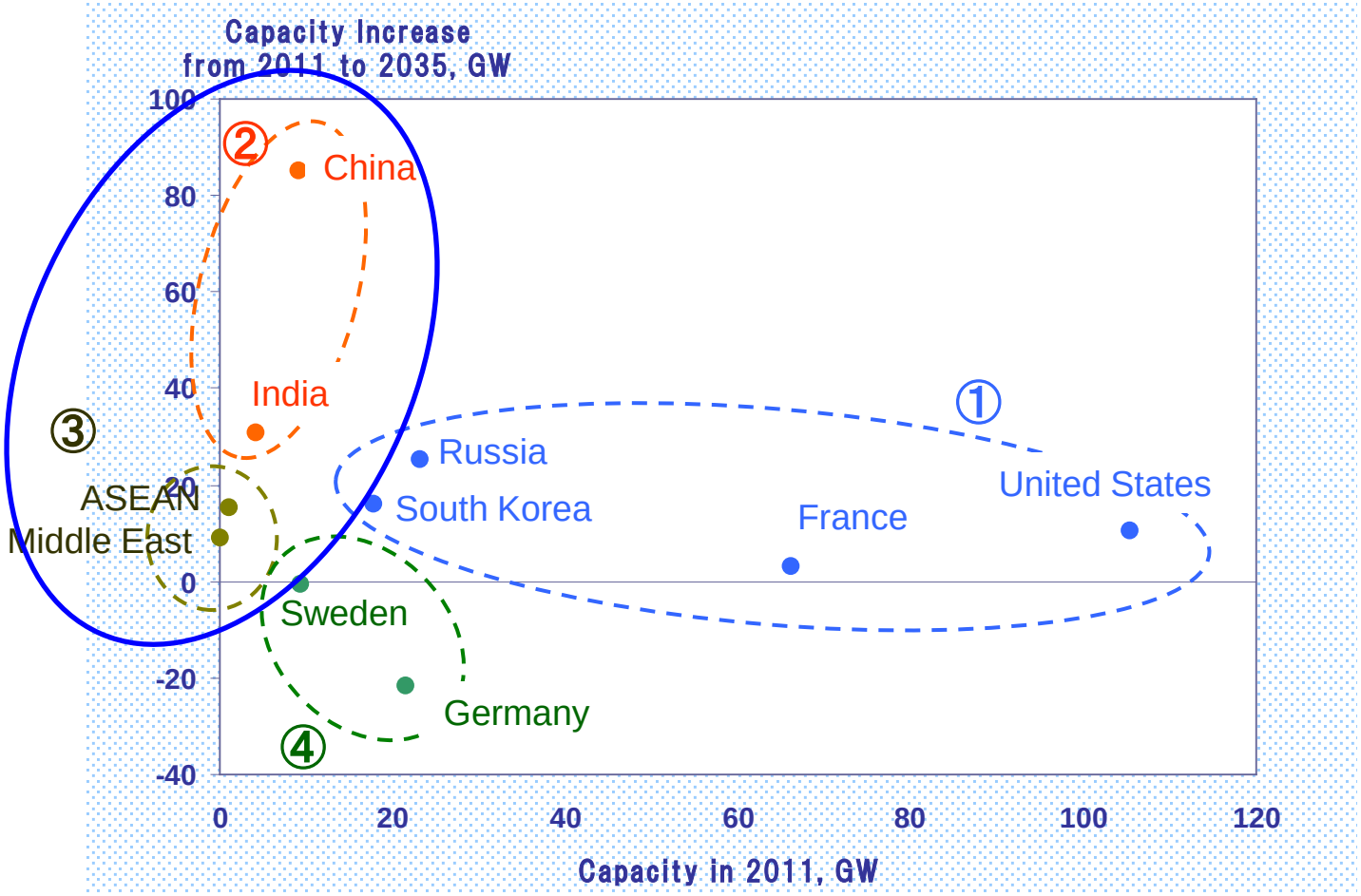
Solid line: Reference
Dotted line: Adv. Tech.



	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.

Nuclear Policies after Fukushima Incident



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

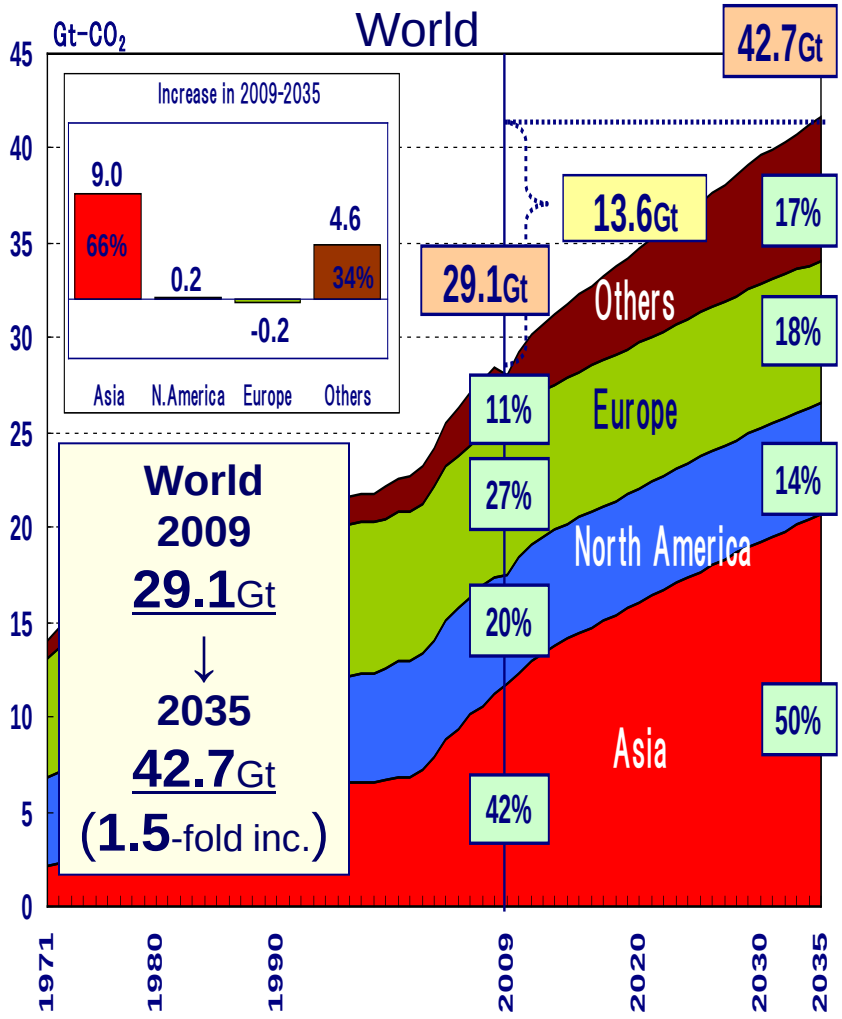
② Emerging Countries (China and India) : No change of massive construction plans

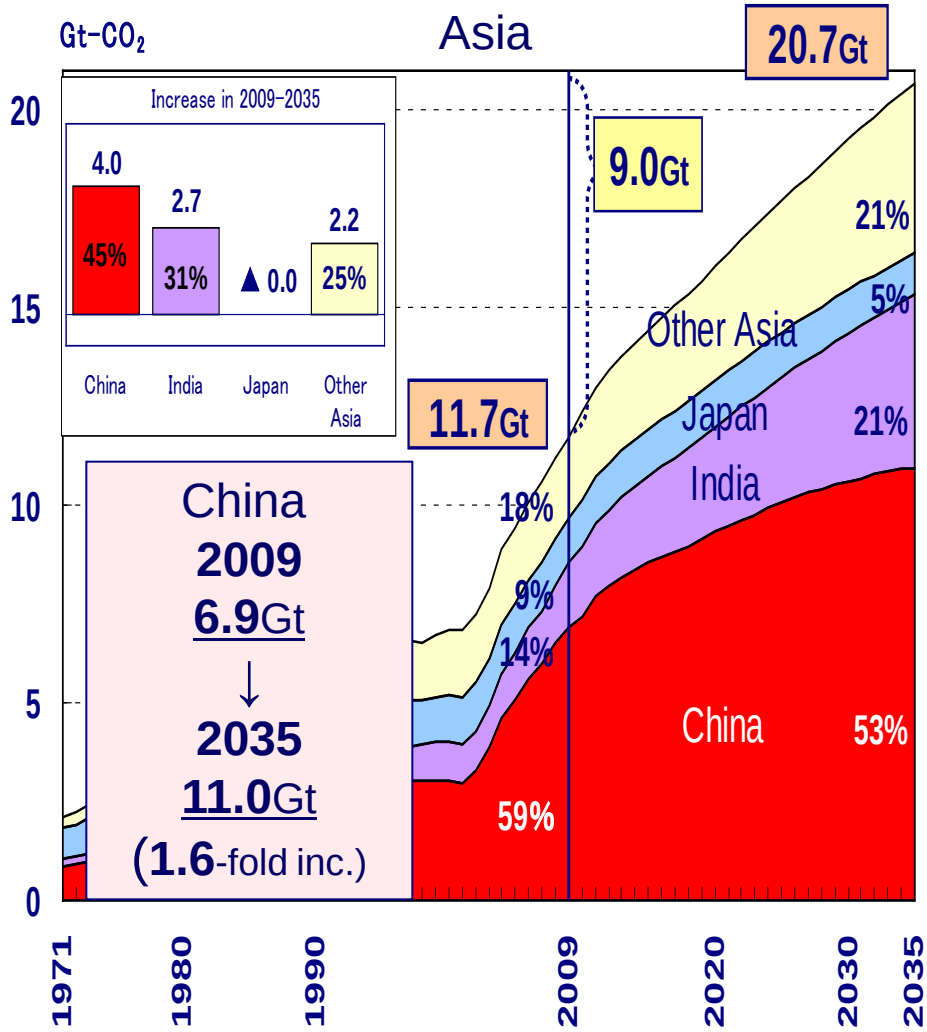
③ Newcomer Countries (ASEAN and Middle East) : Reevaluate the construction plans in some countries

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

CO_2 Emission (World, Asia)

Reference



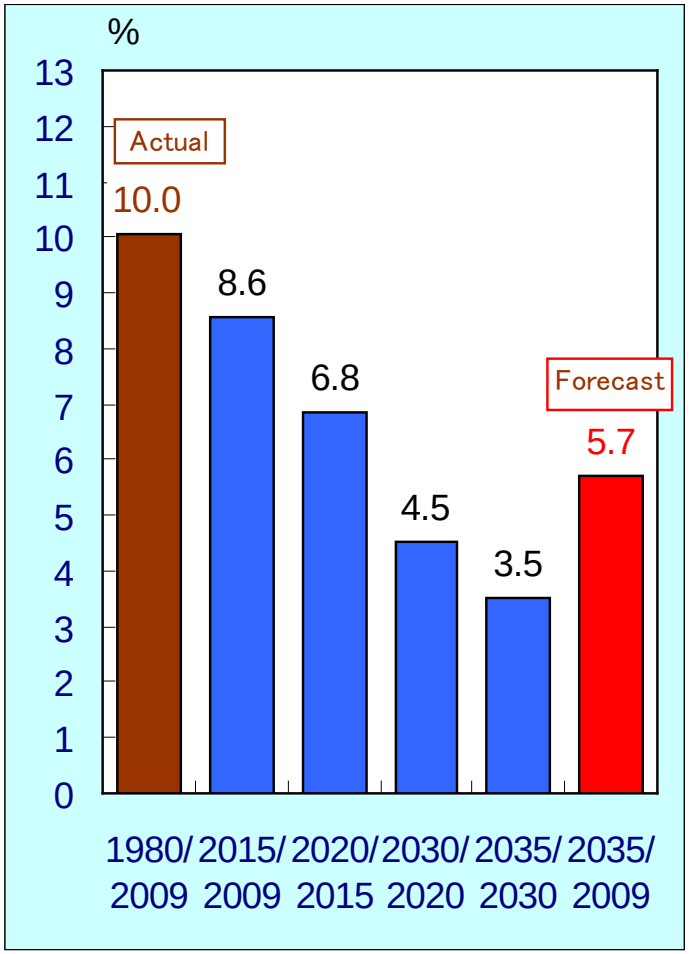


- Asia will account for about 70% of global CO_2 emissions growth through 2035.
- Non-OECD accounts for over 90% of global CO_2 emissions growth through 2035.

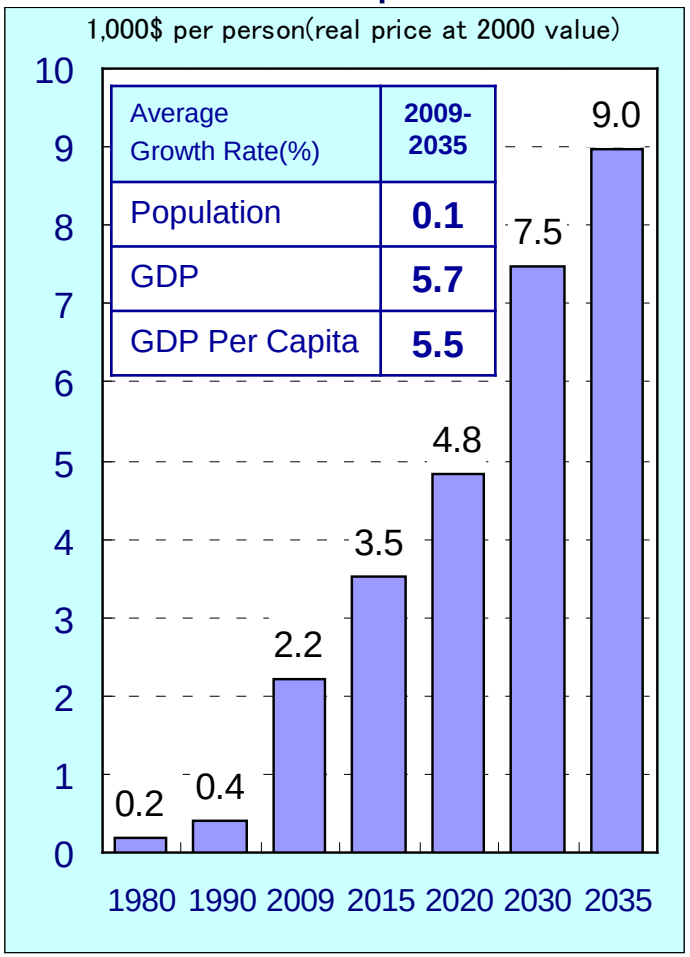
Energy Demand and Supply in China

GDP Growth of China

【 GDP Growth Rate 】



【 GDP Per Capita 】



GDP

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

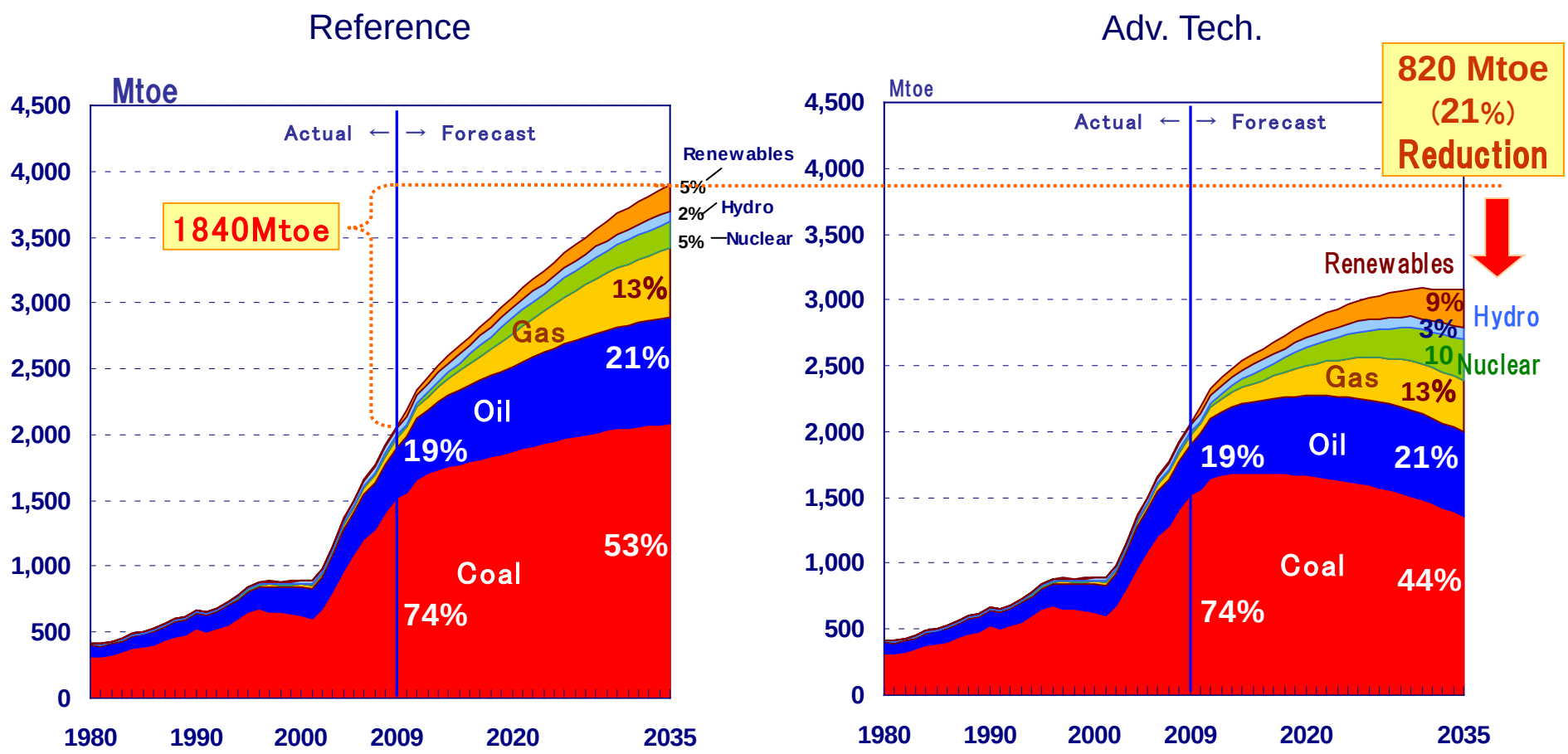
2009
44.0%
↓
2035
64.9%
(20.9points up**)**

■ 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 2005 price) is expected to reach 9 thousand USD in 2035, a four-fold increase from the 2009 level.

Primary Energy Demand in China

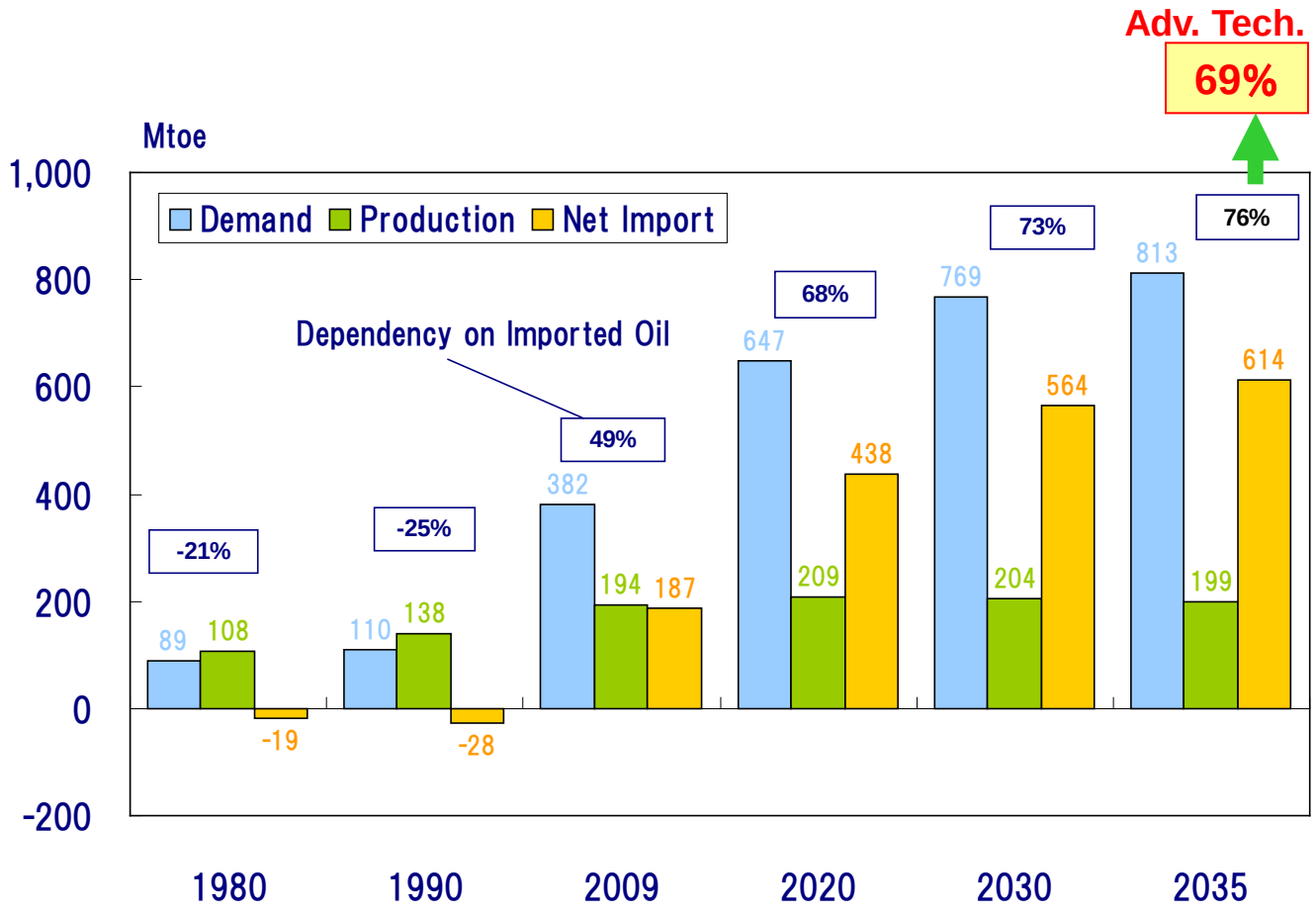
Reference
Tech. Adv.



■ 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



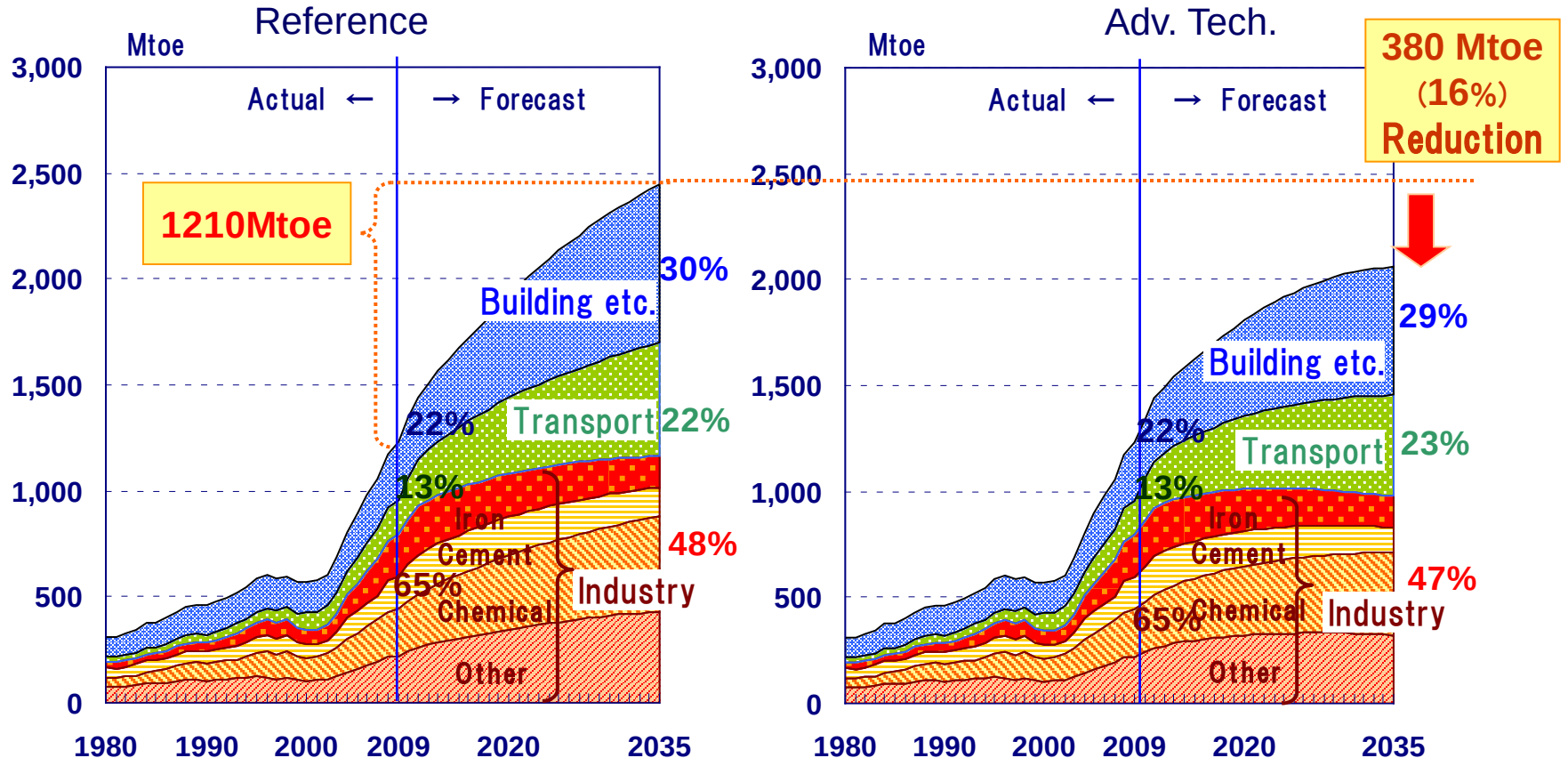
Net Oil Import

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

Adv.Tech.
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.

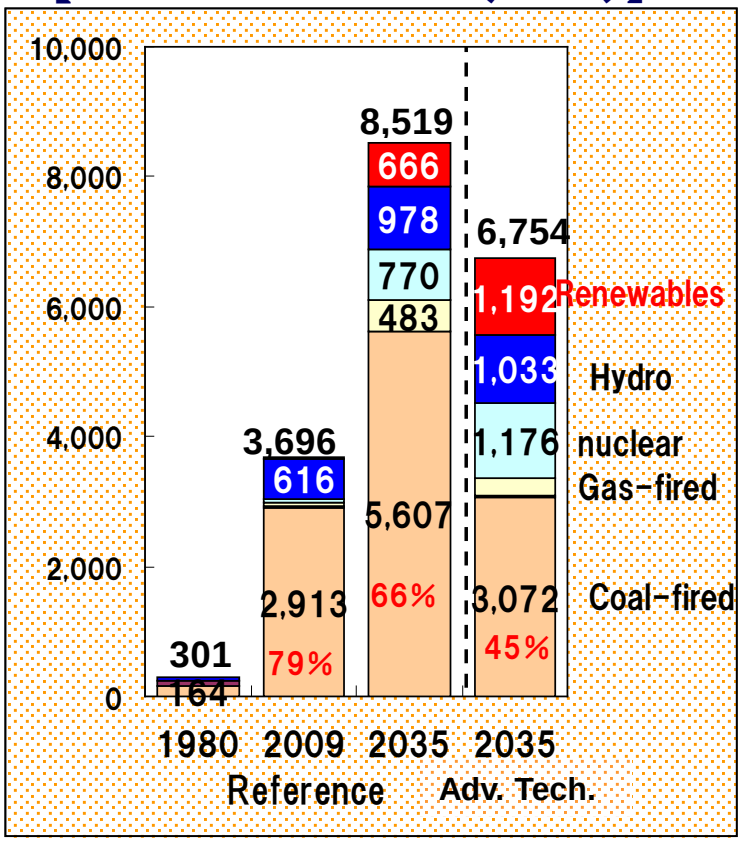
■ Energy demand of heavy industry which has been strong up to now will grow relatively slowly in the future.

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

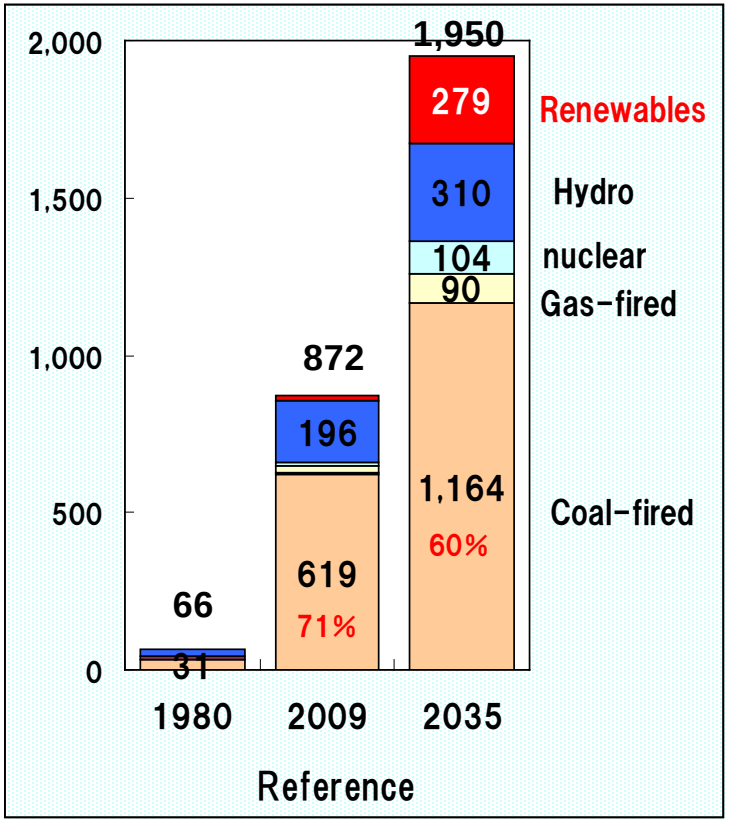
■ In the Tech. adv. Scenario, energy demand of the household, building, and transport sectors is expected to have big potential for reduction.

Power Generation Sector

【Power Generation (TWh)】



【Capacity (GW)】



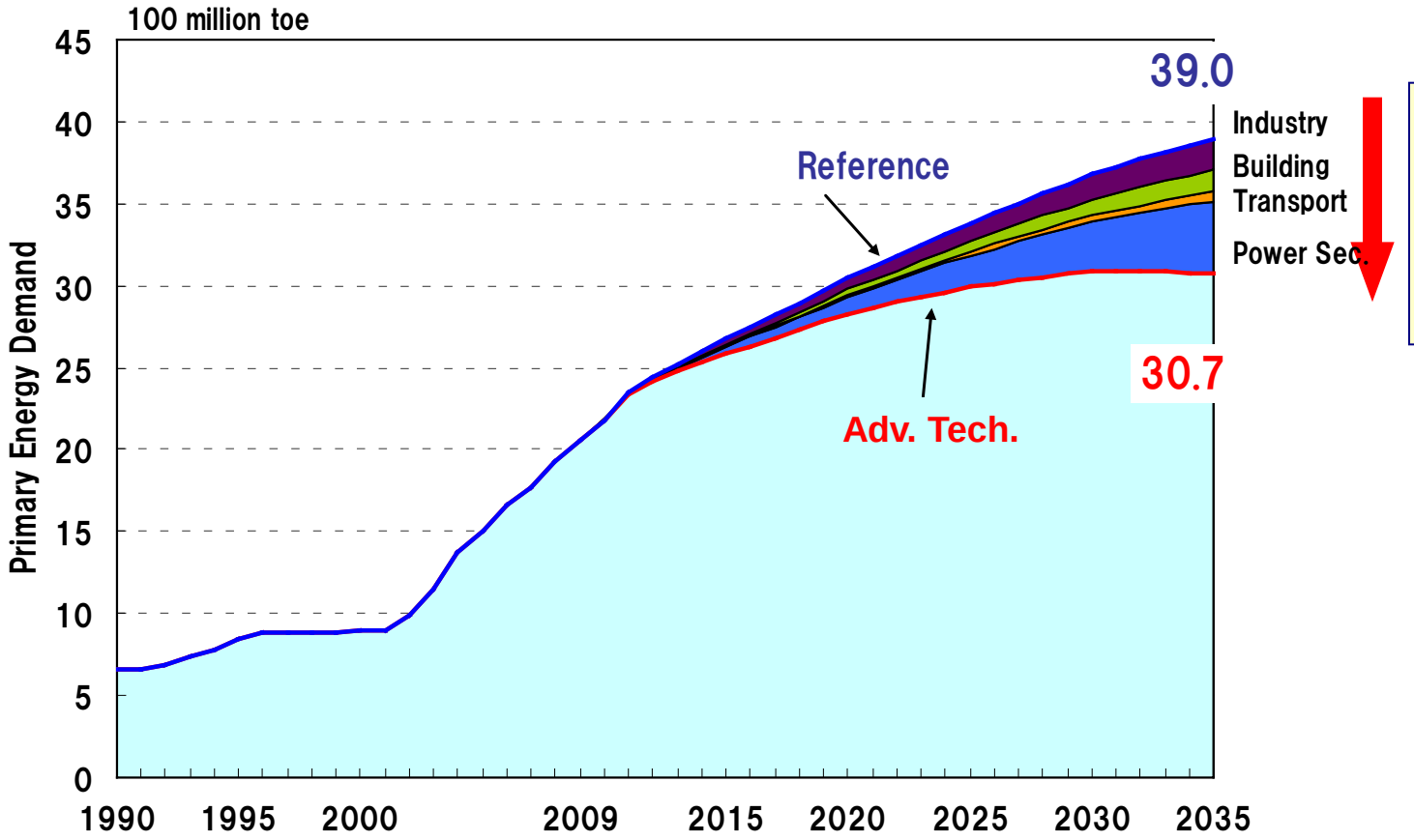
■ Total power generation capacity will increase on average by 41 GW per year, from 870 GW in 2009 to 1,950 GW in 2035,. The share of coal-fired power plant will gradually decline to 60% in 2035, still representing almost half of the world coal-fired power generation capacity.

■ 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.

Primary Energy Demand in China

Reference
Adv. Tech.



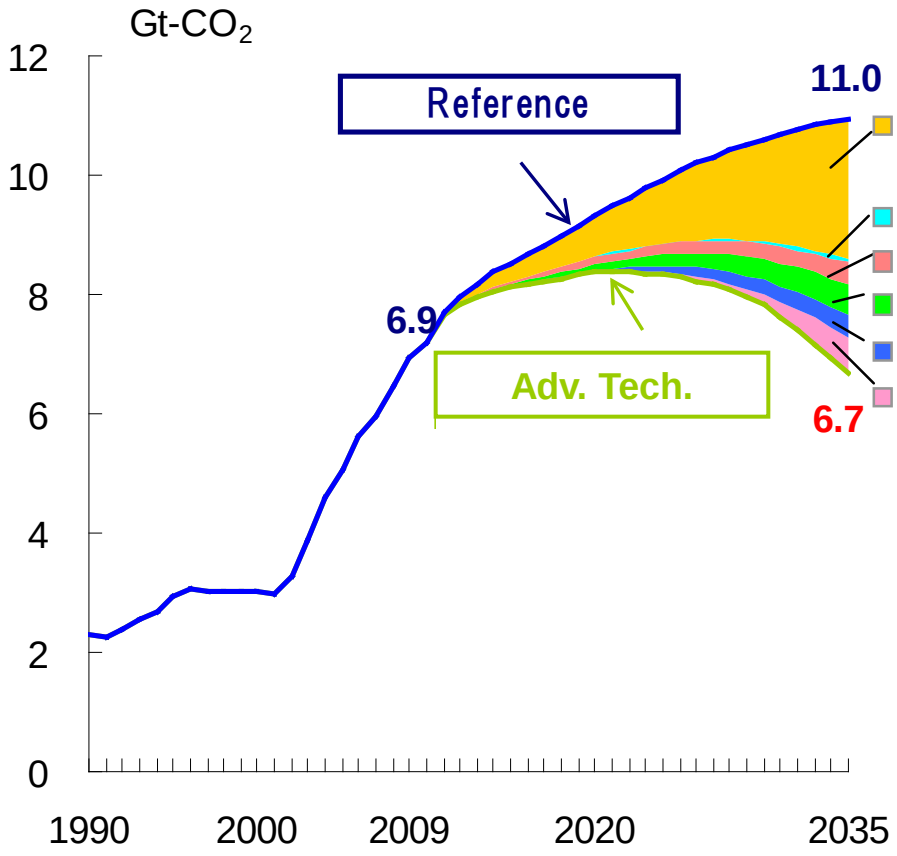
TPE

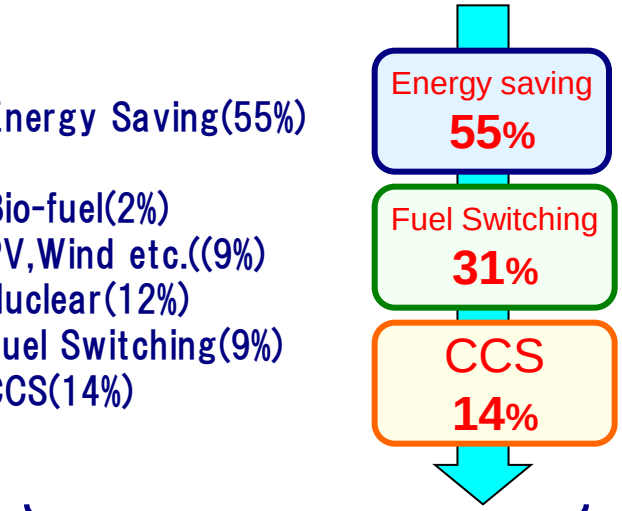
2035
822 Mtoe
decrease
(21 %down)

■ 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.

CO_2 Emissions in China

Reference
Adv. Tech.





2035
▲4.3 Gt
(▲39%)

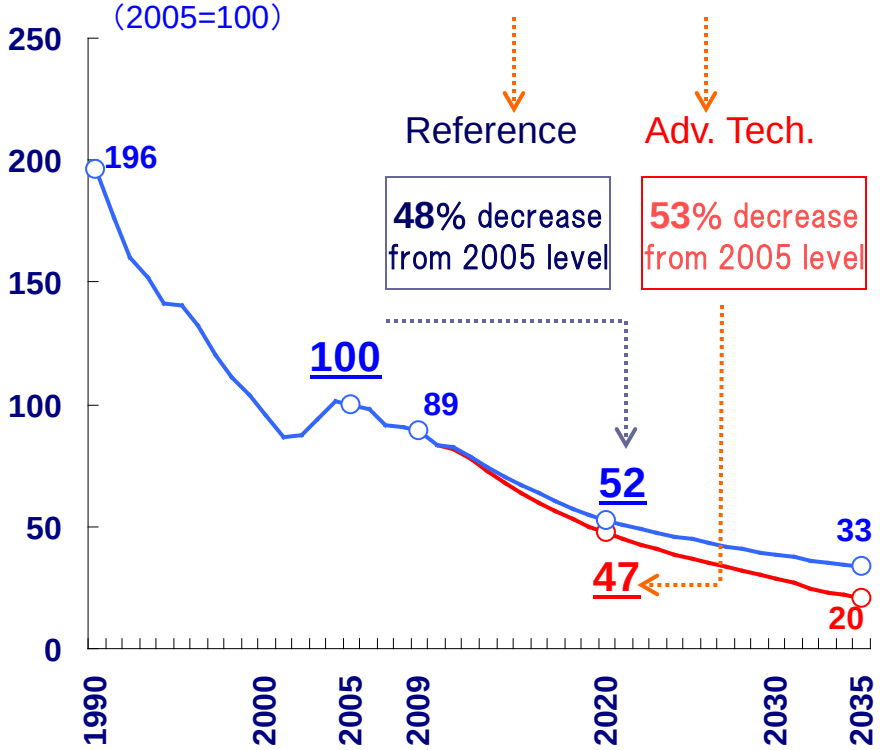
	Gt	Share(%)
Energy Saving	2.3	55
Bio-fuel	0.1	2
PV,Wind etc.	0.4	9
Nuclear	0.5	12
Fuel Switching	0.4	9
CCS	0.6	14
計	4.3	100

- In the Reference Scenario, CO_2 emissions will increase by 4.0 Gt (up 57%) by 2035.
- In the Adv. Tech. Scenario, CO_2 emissions will be 4.3 Gt (down 39%) lower than the Reference 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	

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

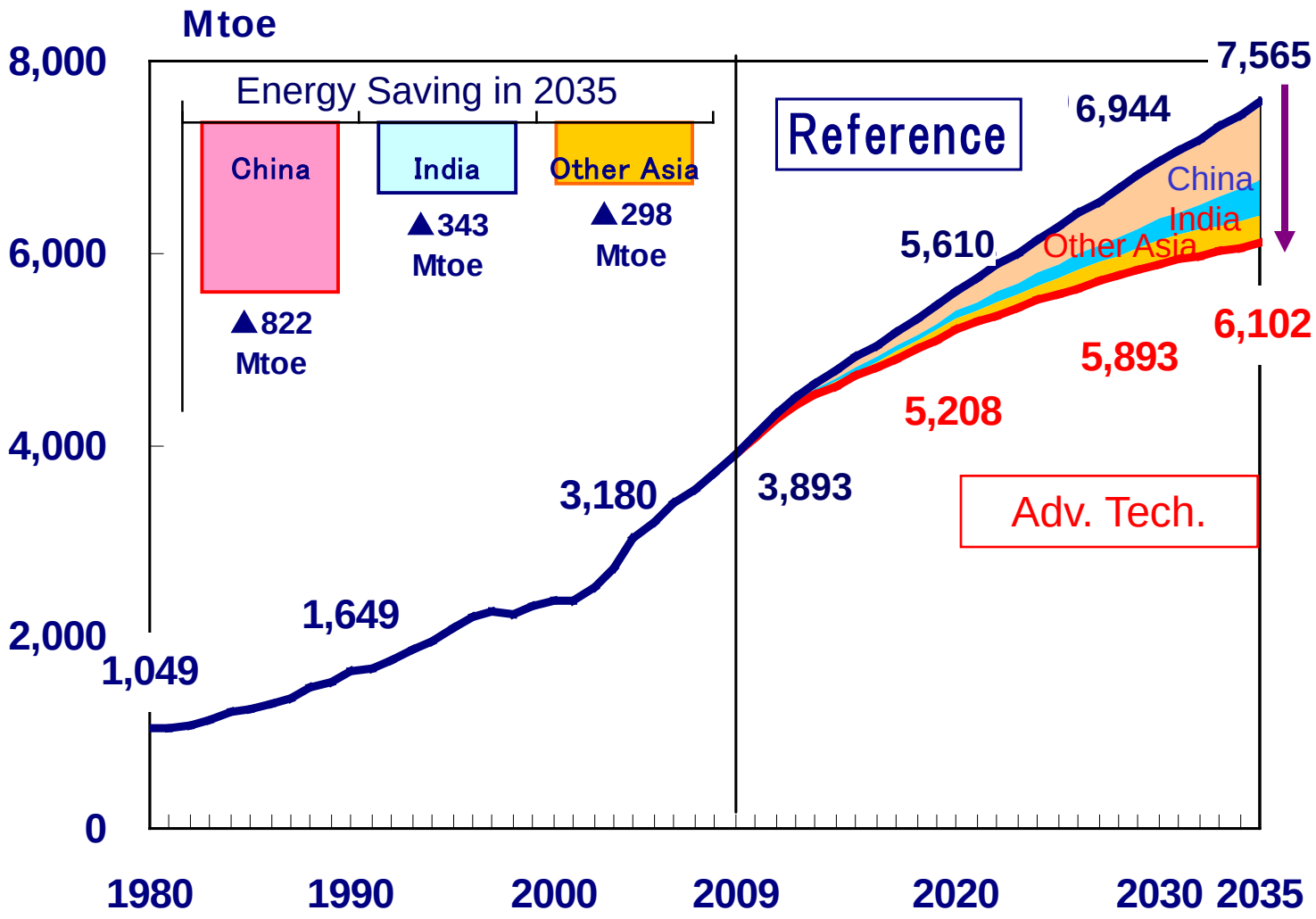
$$\Delta C = \Delta(C/E) + \Delta(E/Y) + \Delta Y$$

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.

Primary Energy Demand (Asia)

Reference
Adv. Tech.



▲1,463 Mtoe (▲19%)

China
▲822 Mtoe
(56% of saving in Asia)

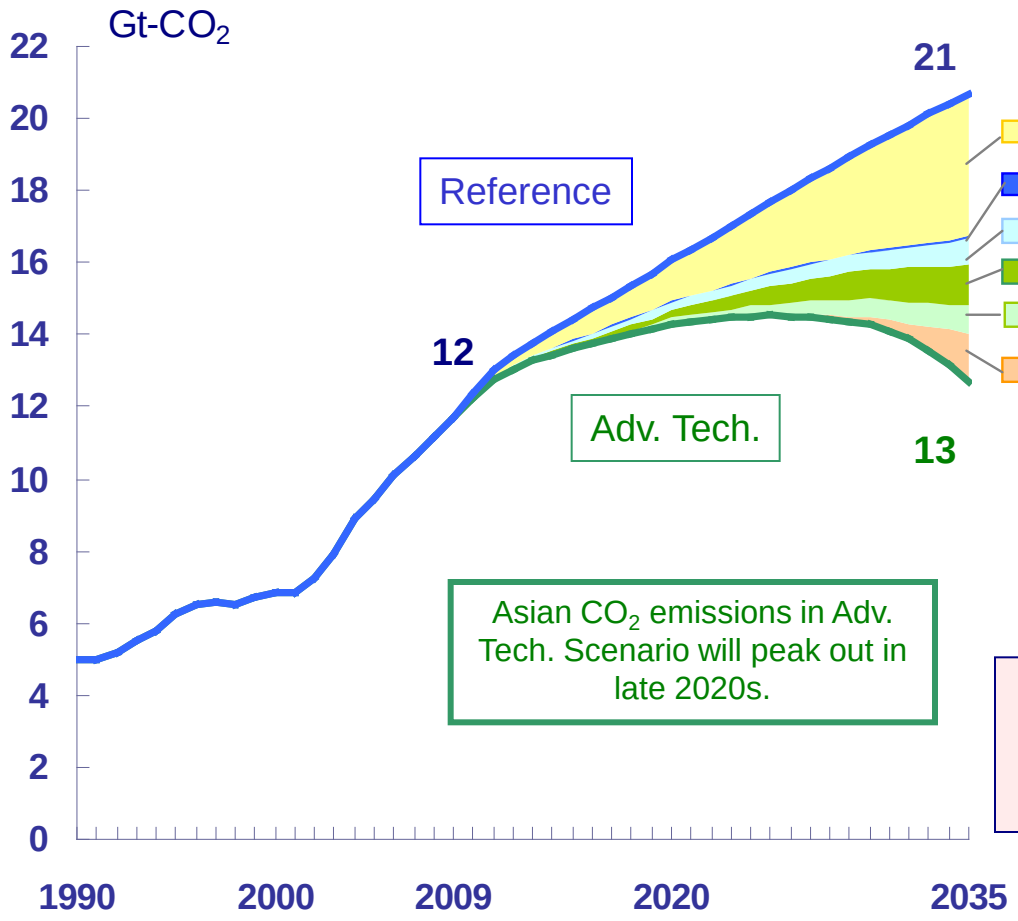
India
▲343 Mtoe
(23% of saving in Asia)

Other Asia
▲298 Mtoe
(20% of saving in Asia)

■ 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.

CO_2 Emissions Reduction by Technology (Asia)

Reference
Adv. Tech.



Energy Saving (50%)
Biofuel (1%)
Wind, Solar, etc. (8%)
Nuclear (14%)
Fuel Switching (9%)
CCS (17%)

Energy Saving **50%**
Fuel Switching **33%**
CCS **17%**

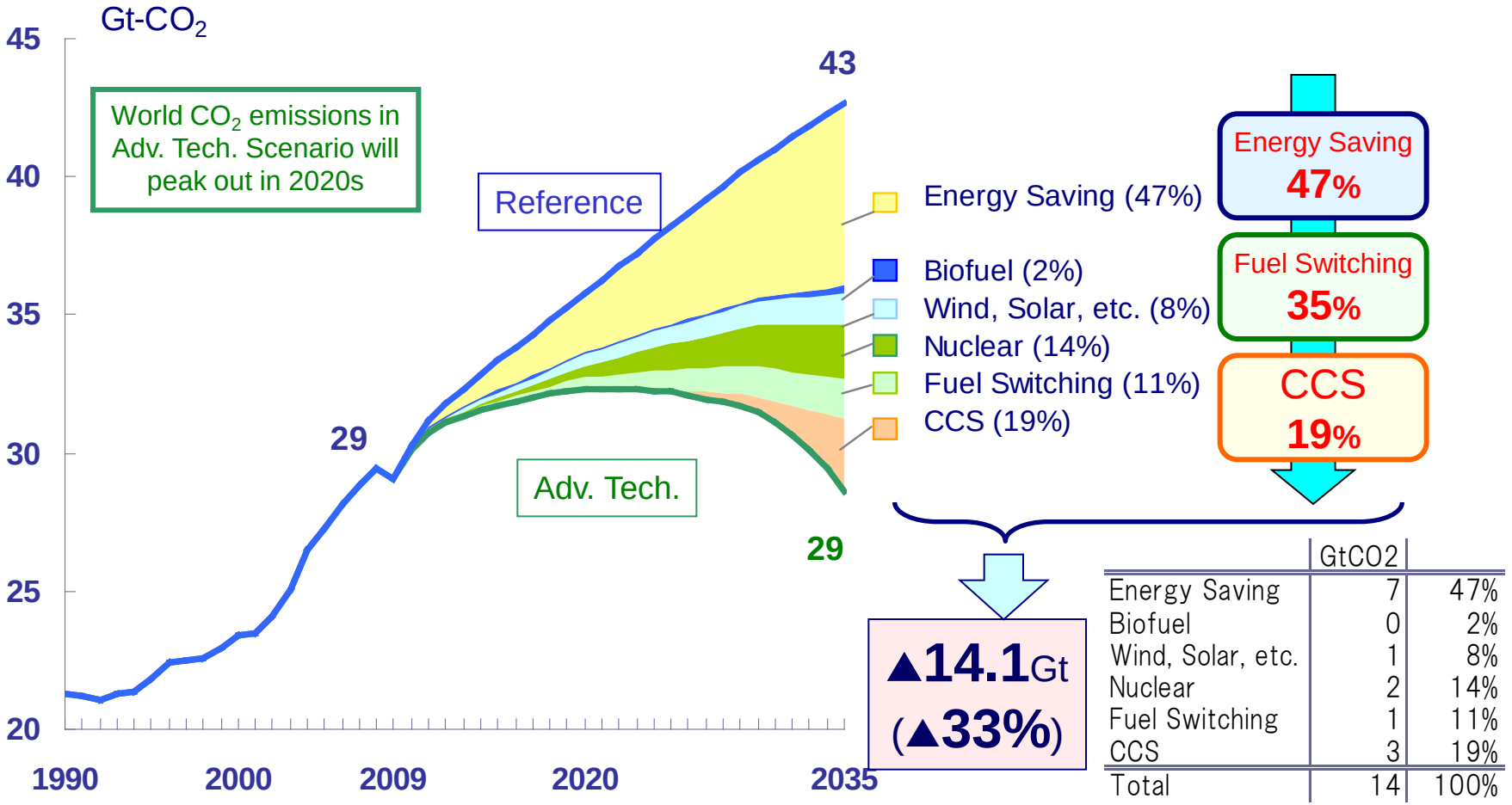
▲8.0Gt (▲39%)

	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 (World)

Reference
Adv. Tech.



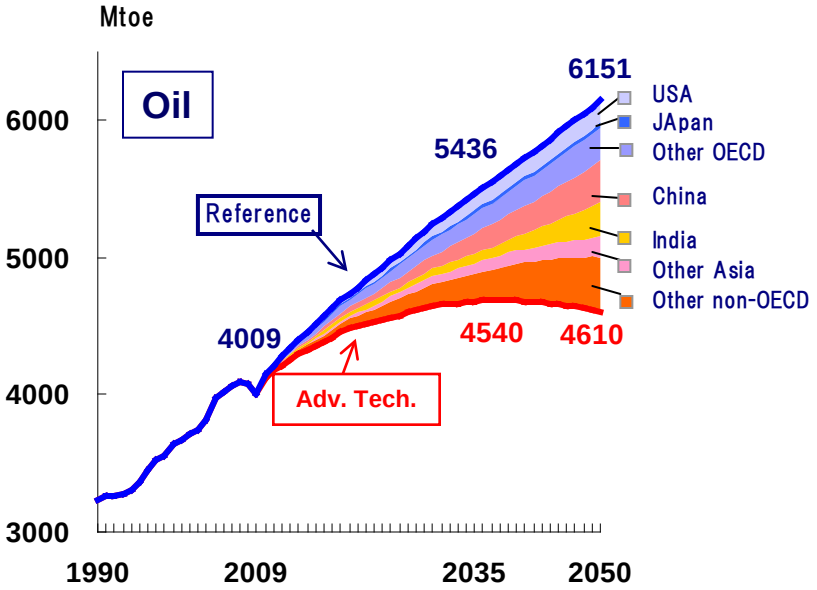
	GtCO2	
Energy Saving	7	47%
Biofuel	0	2%
Wind, Solar, etc.	1	8%
Nuclear	2	14%
Fuel Switching	1	11%
CCS	3	19%
Total	14	100%

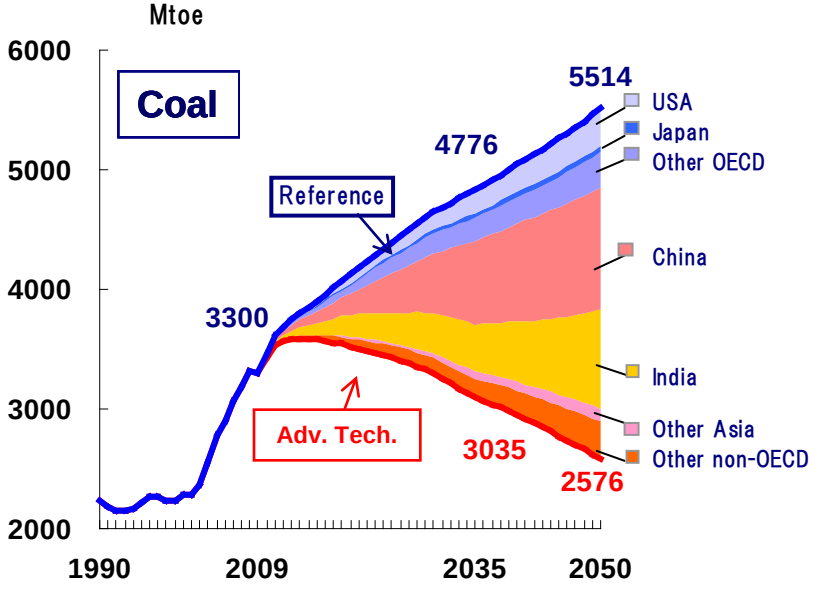
■ In the Adv. Tech. Scenario, between 2005 and 2020 the world CO_2 emissions will increase by 5.1 Gt-CO_2 (or 19% up from the 2005 level), while the CO_2 emissions will reach its peak during 2020s with the introduction of advanced energy and environmental technologies.

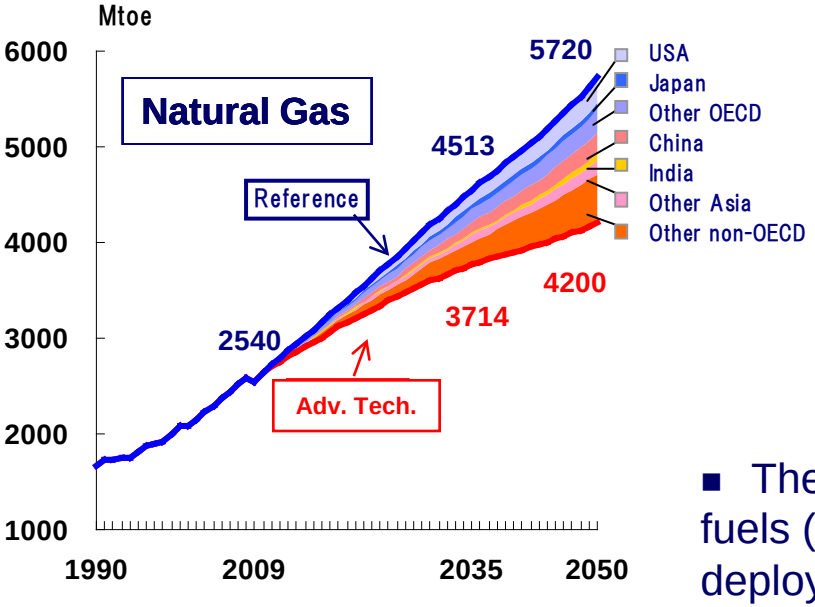
■ Various technological options, including energy saving, enhancement of power generation efficiency, renewables, nuclear, and CCS altogether contribute to massive CO_2 emissions reduction.

Fossil Fuel Demand (2050)

Reference
Adv. Tech.







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%

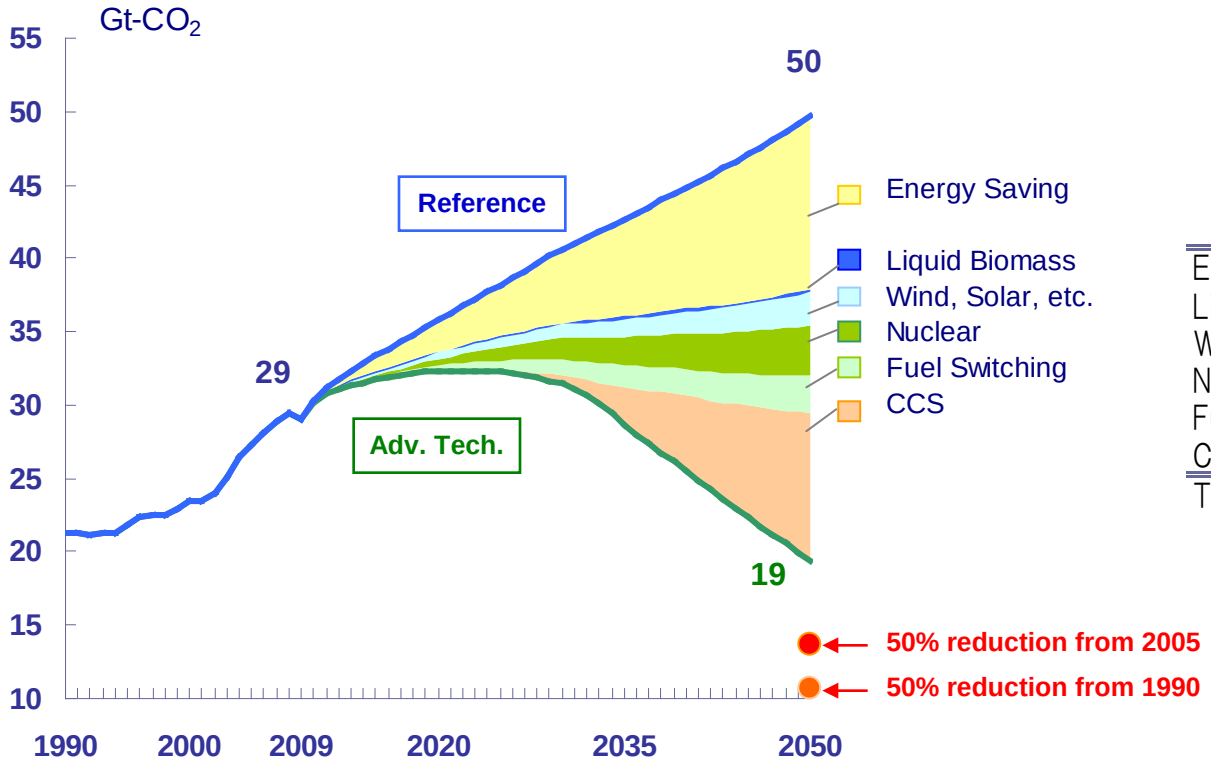
(Natural Gas)

	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

CO_2 Emissions Reduction Potential by Technology (World) 2050

Reference
Adv. Tech.



	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 CO2 reduction in 2050. Fuel switching and CCS will substantially mitigate global emissions as well.
■ In order to halving world CO2 emissions, further political and technological measures are required, such as progressive R&D, and development of low-carbon-emitting cities.

In Summary

- Surging energy demand, assurance of stable energy supply and response to global warming ("3E's and Safety" challenges) will require increased efforts from a long-term perspective in a comprehensive manner.

- All available measures will be required, including promotion of :
  - ✓ "enhanced **energy conservation**" (demand side)
  - ✓ "cleaner use of **fossil fuels**" (supply side)
  - ✓ "lower-cost **renewable** energy" (supply side)
  - ✓ "safer **nuclear** technology" (supply side)

- Halving the world's CO2 emissions by 2050 cannot be achieved by promoting currently considered technologies in "advanced technologies scenario" including nuclear (in the absence of nuclear, even harder).

- Development and dissemination of new innovative technologies (i.e. fundamental breakthroughs and large-scale dissemination of new technologies for **nuclear power**, **renewable energy**, **CCS +U** and other **energy conservation** technologies) are additionally required.

- Increasing importance of global & regional cooperation promotion in the area of "Energy and Environment" for Asia

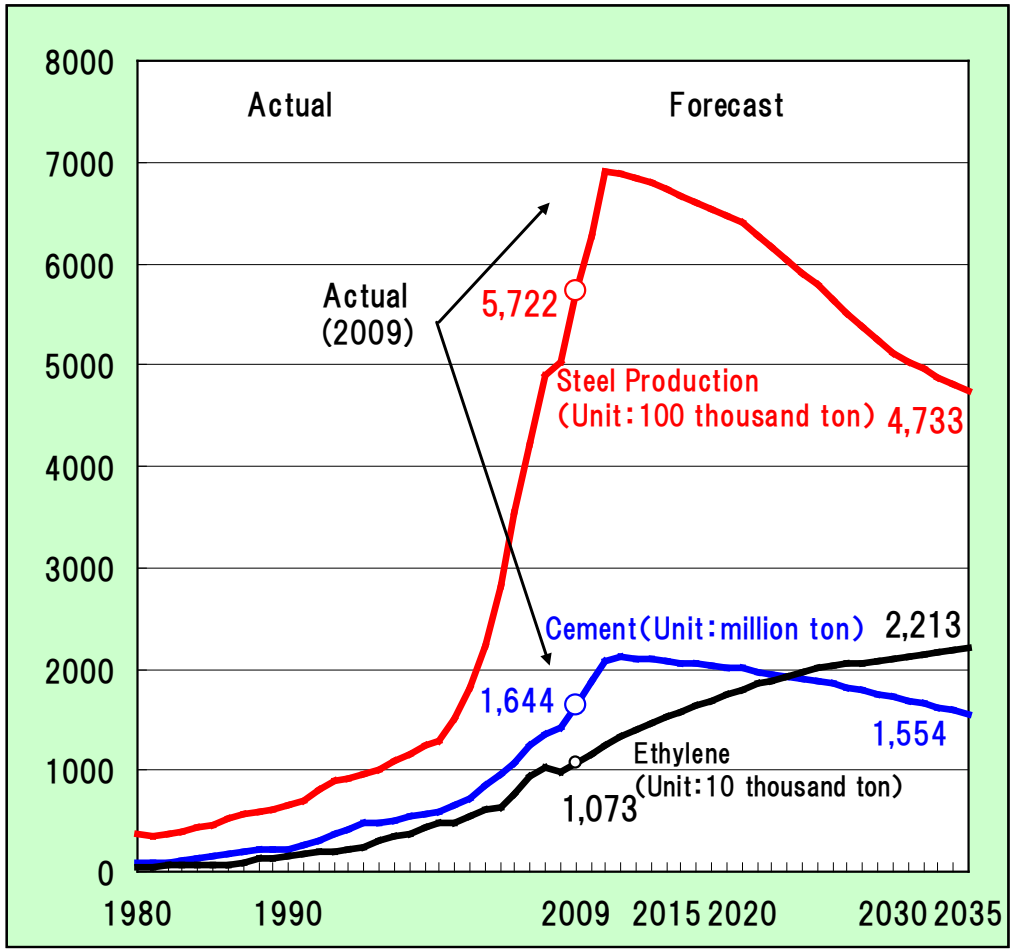
Thank very much for your attention!

Coming Soon in English!

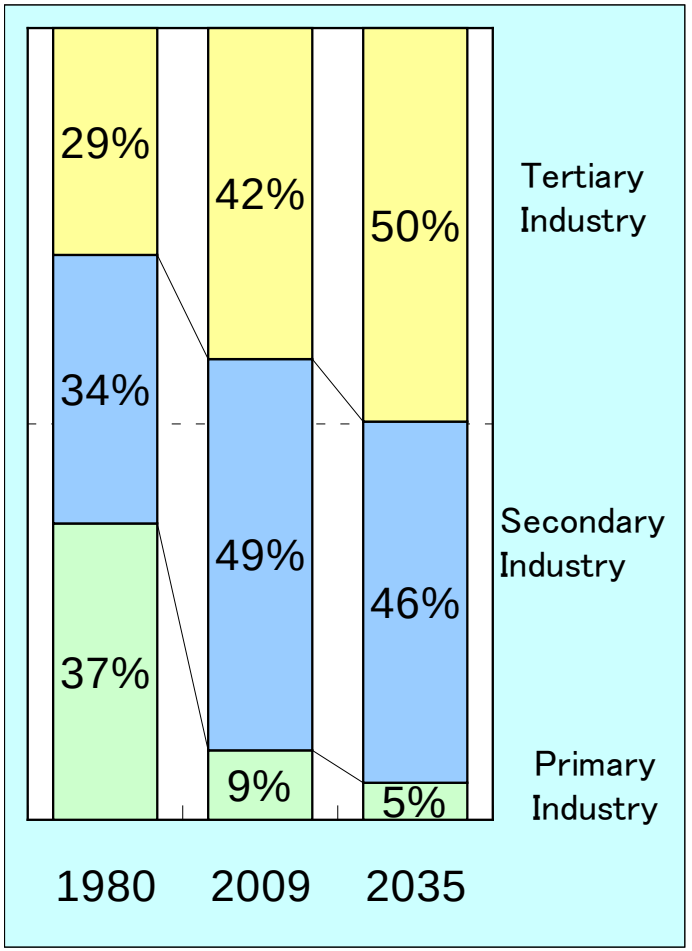
Asia / World Energy Outlook 2011

Raw Material Production and Industrial Structure in China

【 Raw Material Production 】



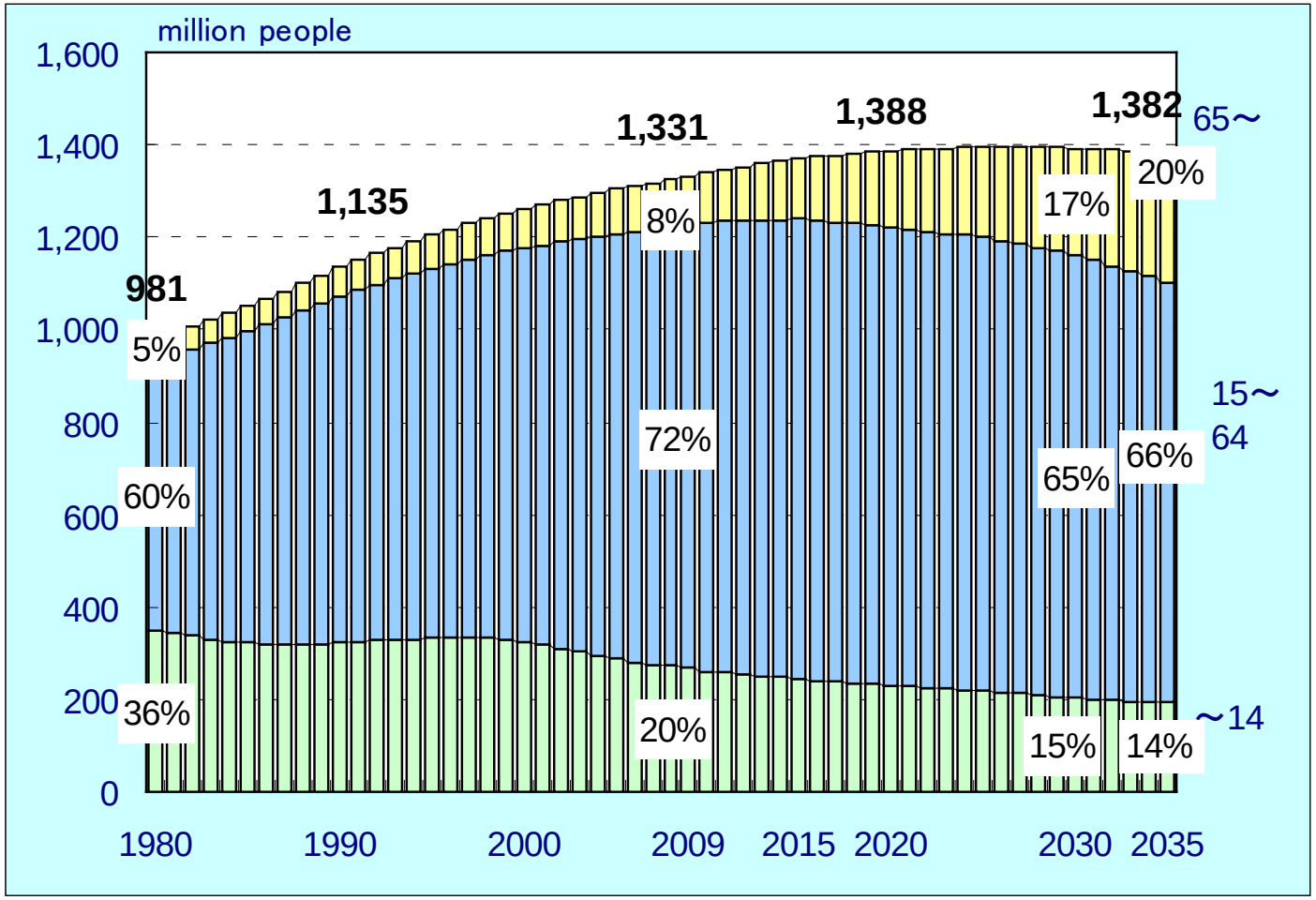
【 Industrial Structure 】



■ 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.

■ Heavy industry is likely to decrease while the weight of secondary industry will remain at the same level by 2035.

Population in China



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

Total Population (Million)

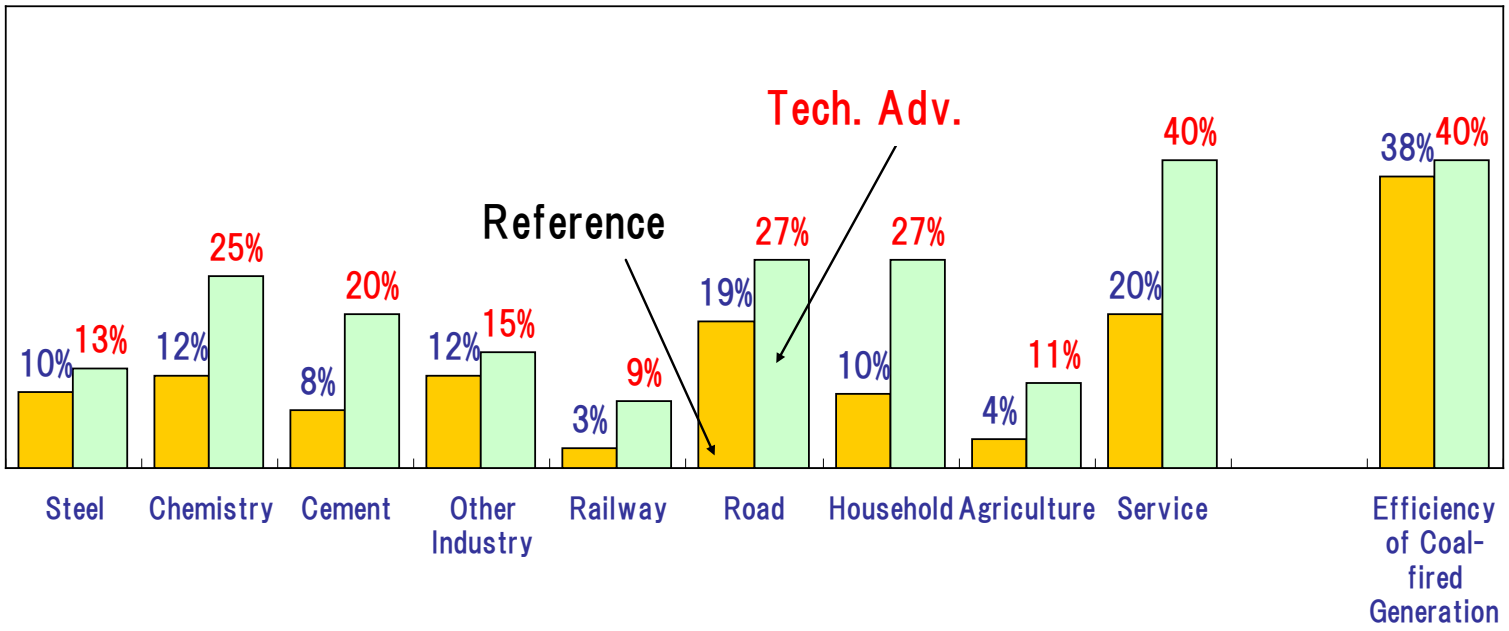
2009
1,330
↓
2035
1,380
(**1.04** times)

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 and 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.

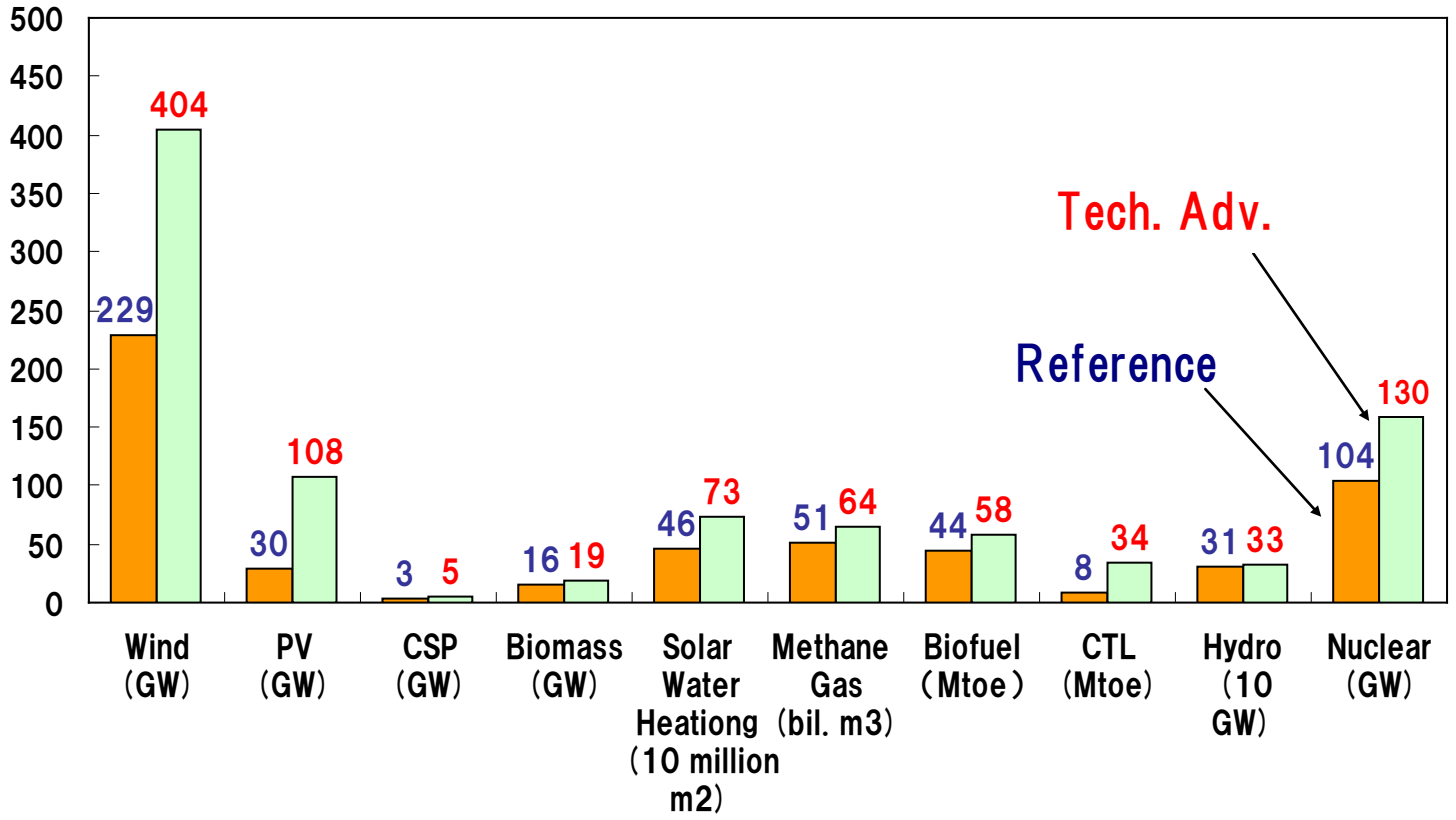
Energy Savings by Sector



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.

Non-fossil Fuel Outlook in China (2035)



Non-fossil Fuel (2035)

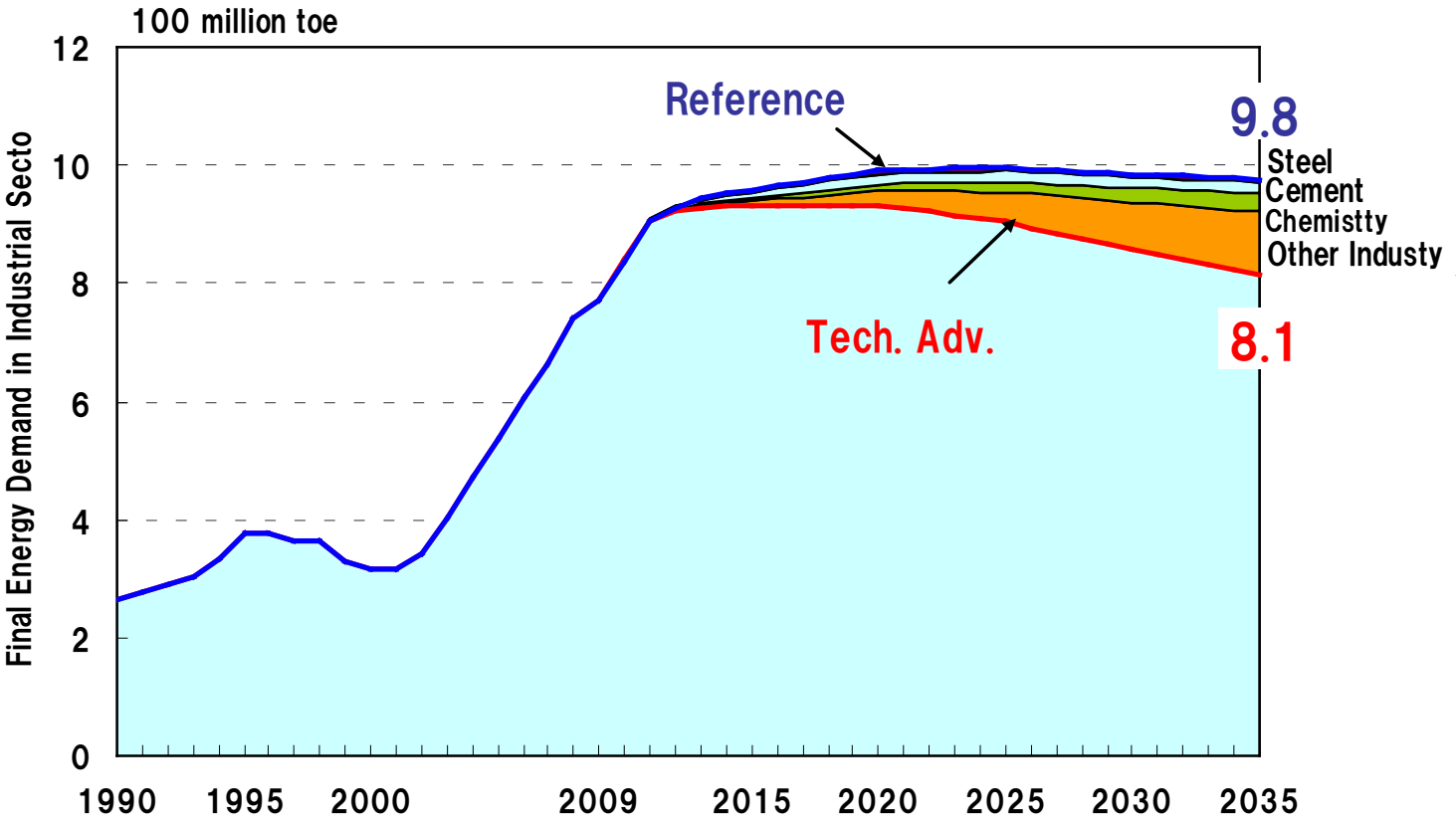
Reference
480 Mtoe
Ratio of TPE
(12%)

Tech. Adv
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 Tech. Adv. Scenario, the share of non-fossil fuel will represent a higher share at 22% by 2035.

Final Energy Demand in the Industry Sector

Reference
Tech. Adv.



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 on energy saving and decreasing trend of raw material production.
■In the Tech. Adv. Scenario, final energy demand will decrease by 160 Mtoe (17%) in the industry sector compared with Reference Scenario in 2035.

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.

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