

A light gray silhouette of a world map is centered in the background of the slide.

Asia / World Energy Outlook 2013

Reference Material

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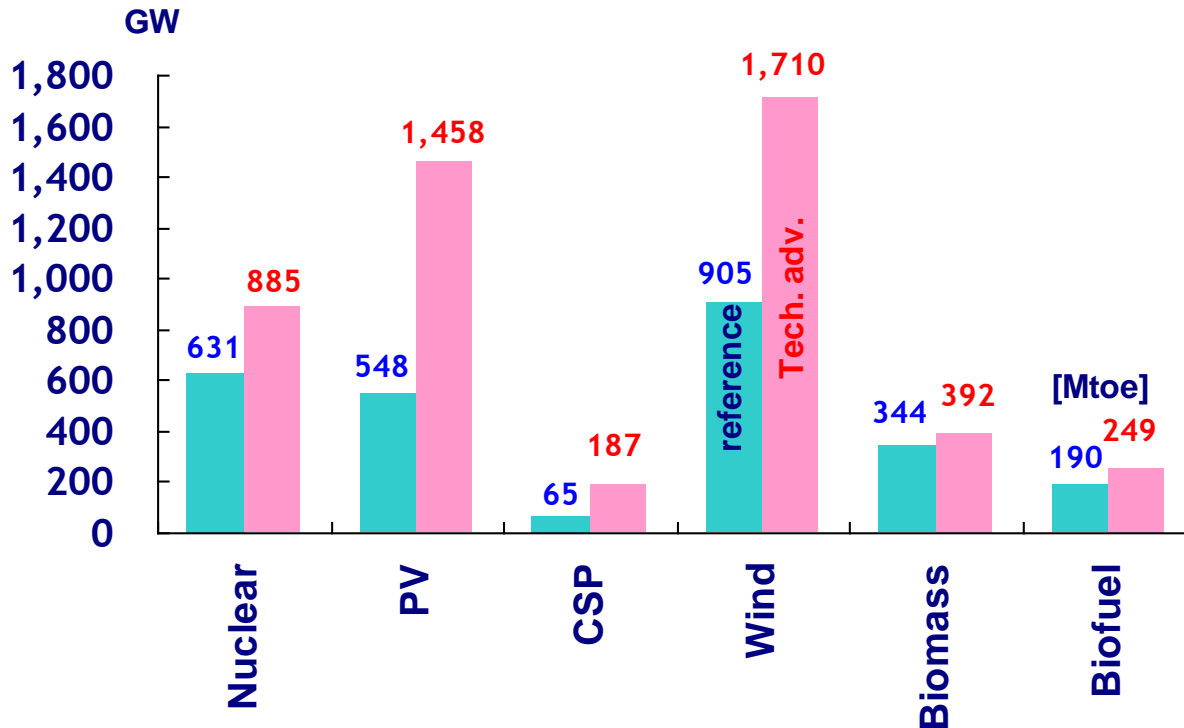
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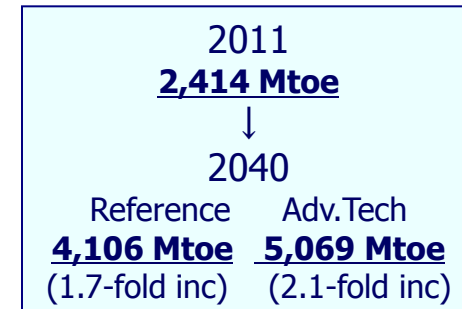
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Assumptions on Adv. Tech. Scenario (World, 2040)

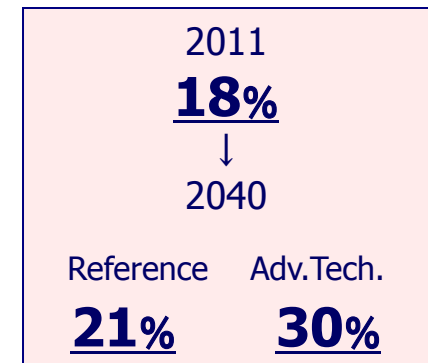


- Further expansion of nuclear and renewables is likely to be realized as global electricity demand grows.
- Biofuel will expand substantially when cellulosic biofuel becomes commercially viable. Cellulosic biofuel does not compete with food production and land use.
- By 2040, the industry, buildings and transport sectors will achieve further savings of 541 Mtoe (14%), 644 Mtoe (14%) and 614 Mtoe (16%) respectively, compared to the reference scenario.
- Average efficiency of fossil fuel-fired power generation will reach 43% by 2040, compared to the reference scenario at 42%.

Non-fossil fuel (Mtoe)



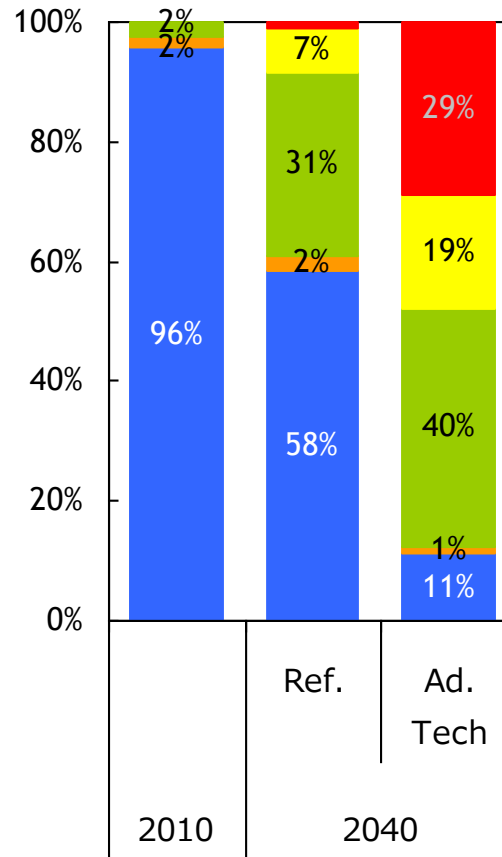
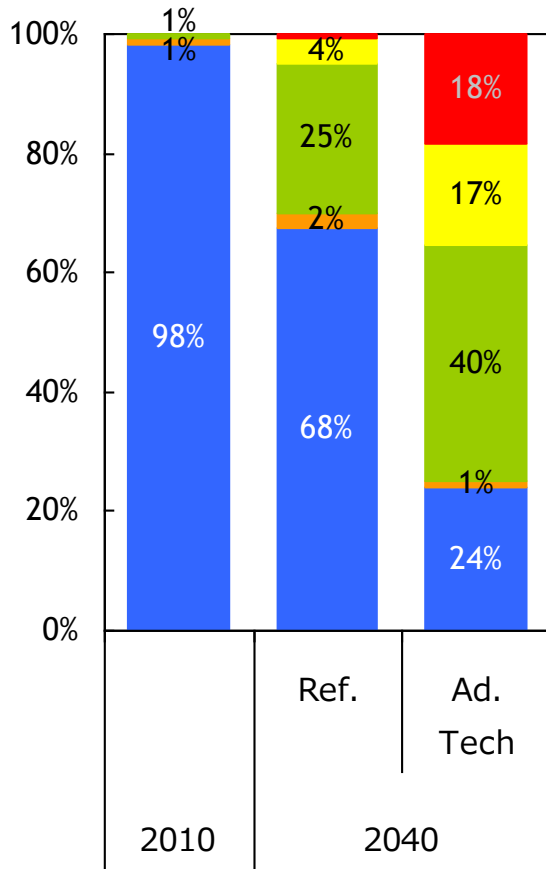
Share of non-fossil fuel



Vehicle Stock and Sales by Type (World)

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

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



- Electric and Fuel Cell Vehicle
- Plug-in Hybrid Vehicle
- Hybrid Vehicle
- Compressed Gas
- ICE (Gasoline, Diesel)

Share of clean energy vehicles in total stocks (2040)

Reference	32 %
Adv. Tech	76 %

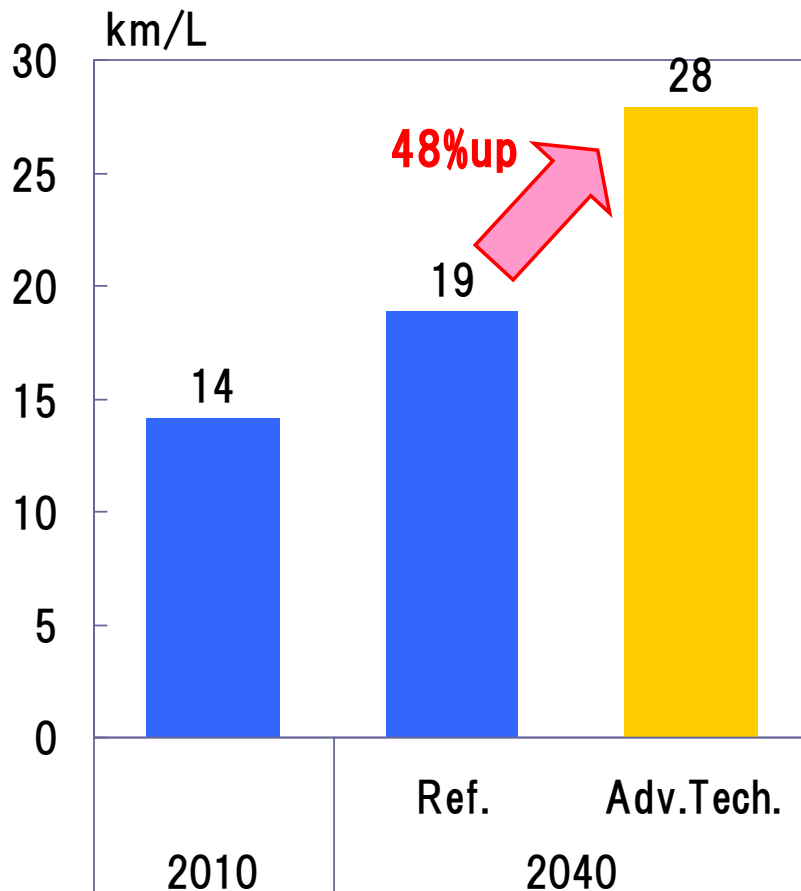
Share of clean energy vehicles in annual sales (2040)

Reference	42 %
Adv. Tech	89 %

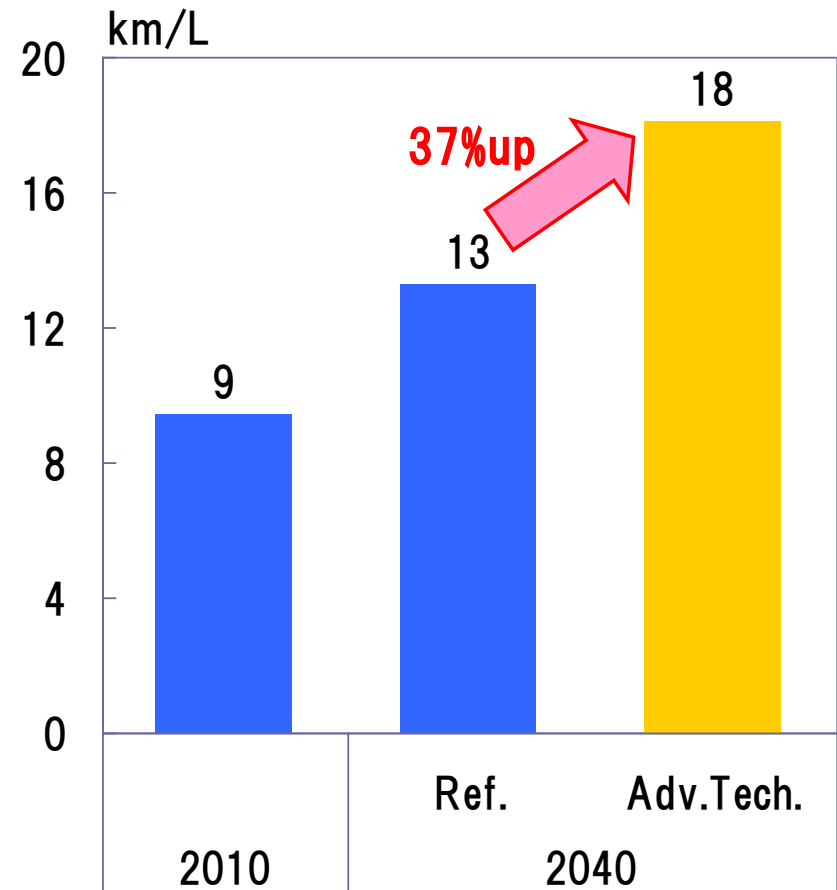
In the Adv. Tech. Scenario, the share of clean energy vehicles will gradually increase and will account for almost 90% of the annual sales by 2040, and comprise three-fourth of the total stock.

Fuel Efficiency of Passenger Vehicles (World)

Fuel Efficiency (Annual sales basis)



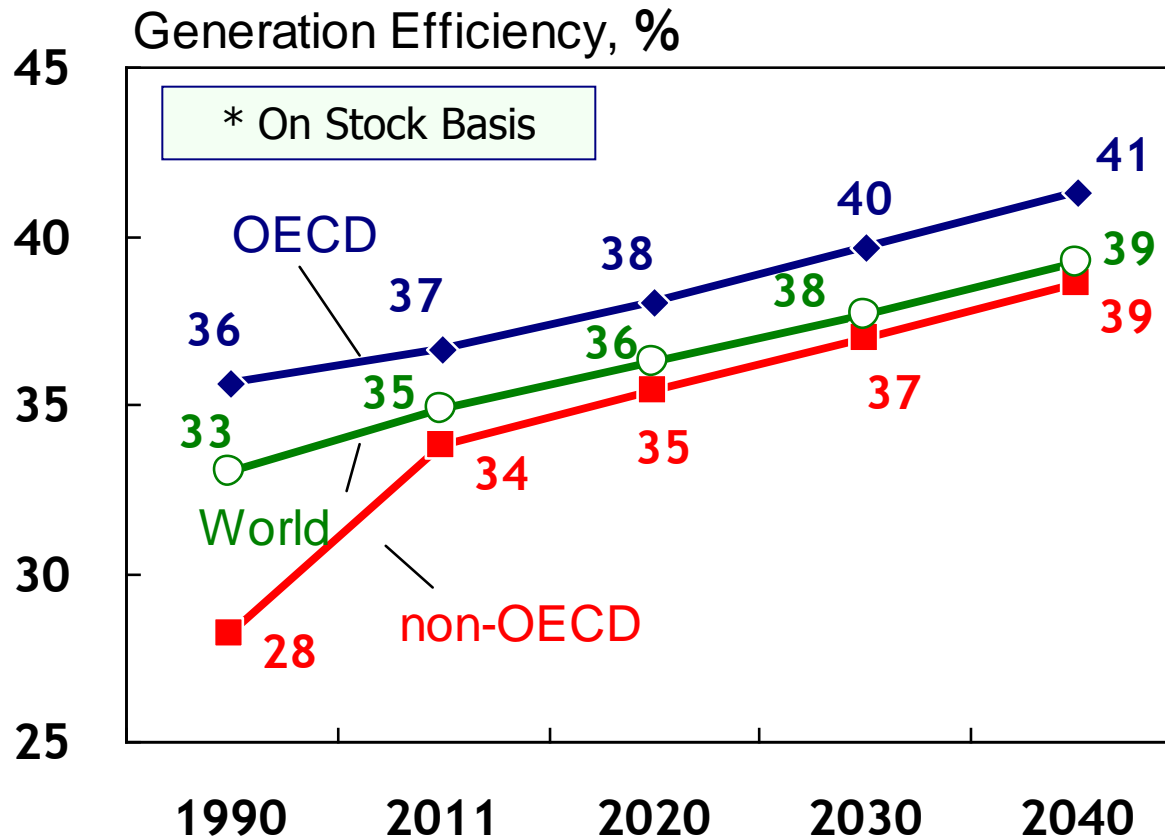
Fuel Efficiency (Stock basis)



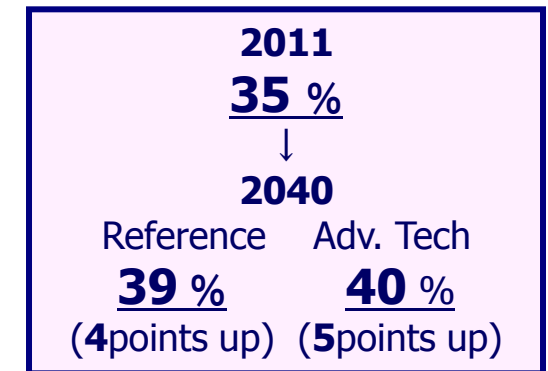
In 2040, the passenger vehicles' fuel efficiency in the Adv. Tech. Scenario will achieve a 48% improvement in comparison with the Reference Scenario. The improvement raises the stock-based fuel efficiency by 37%.

Power Generation Efficiency of Coal-fired Power Plant

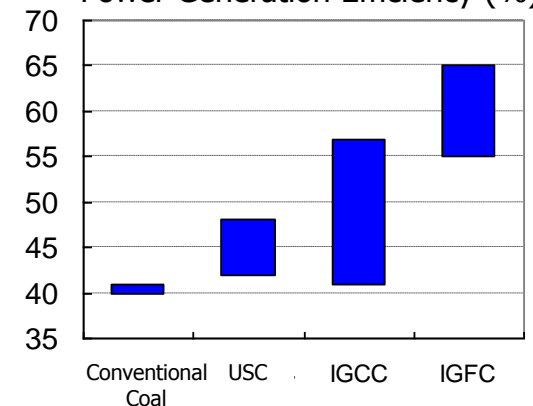
Power Generation Efficiency of Coal-fired Power Plant *(Reference)



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



Advanced Coal-fired Plant Power Generation Efficiency (%)



- In the Reference Scenario, coal-fired generation efficiency will improve from 35% in 2011 to 39% in 2040, which is driven by the gradual introduction of ultra super critical power plants.
- In the Adv. Tech. Scenario, the efficiency will increase by 1% compared to the Reference Scenario.

Energy Outlook in Asia and the World 2010-2040

Primary Energy Demand (Regional Share)

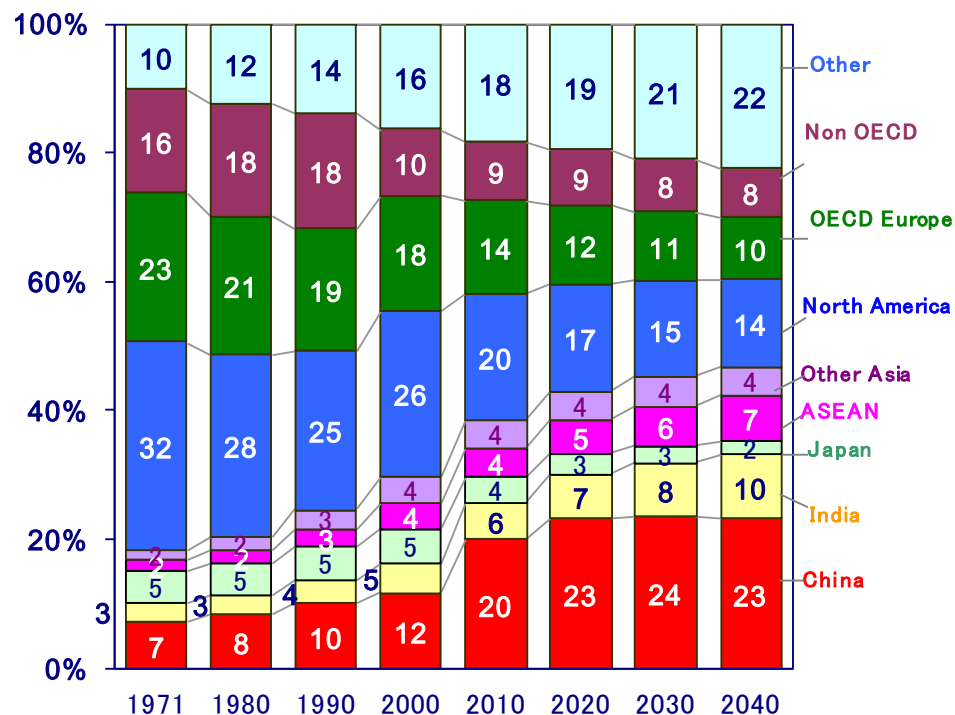
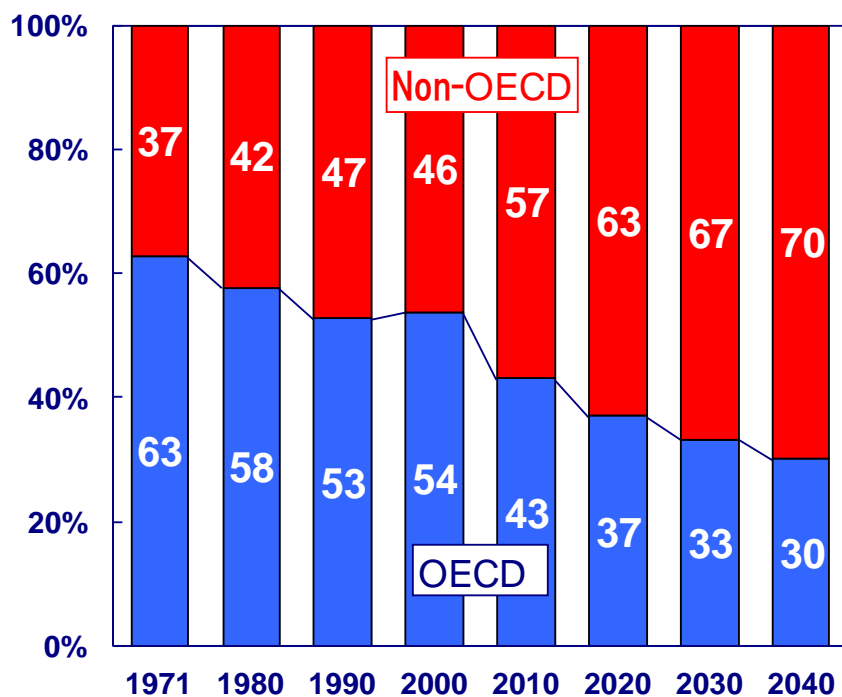
Reference



Share in increase (2011-2040)

China	India	Japan	ASEAN	Other Asia	N. America	OECD Europe
27%	18%	-1%	13%	4%	2%	2%

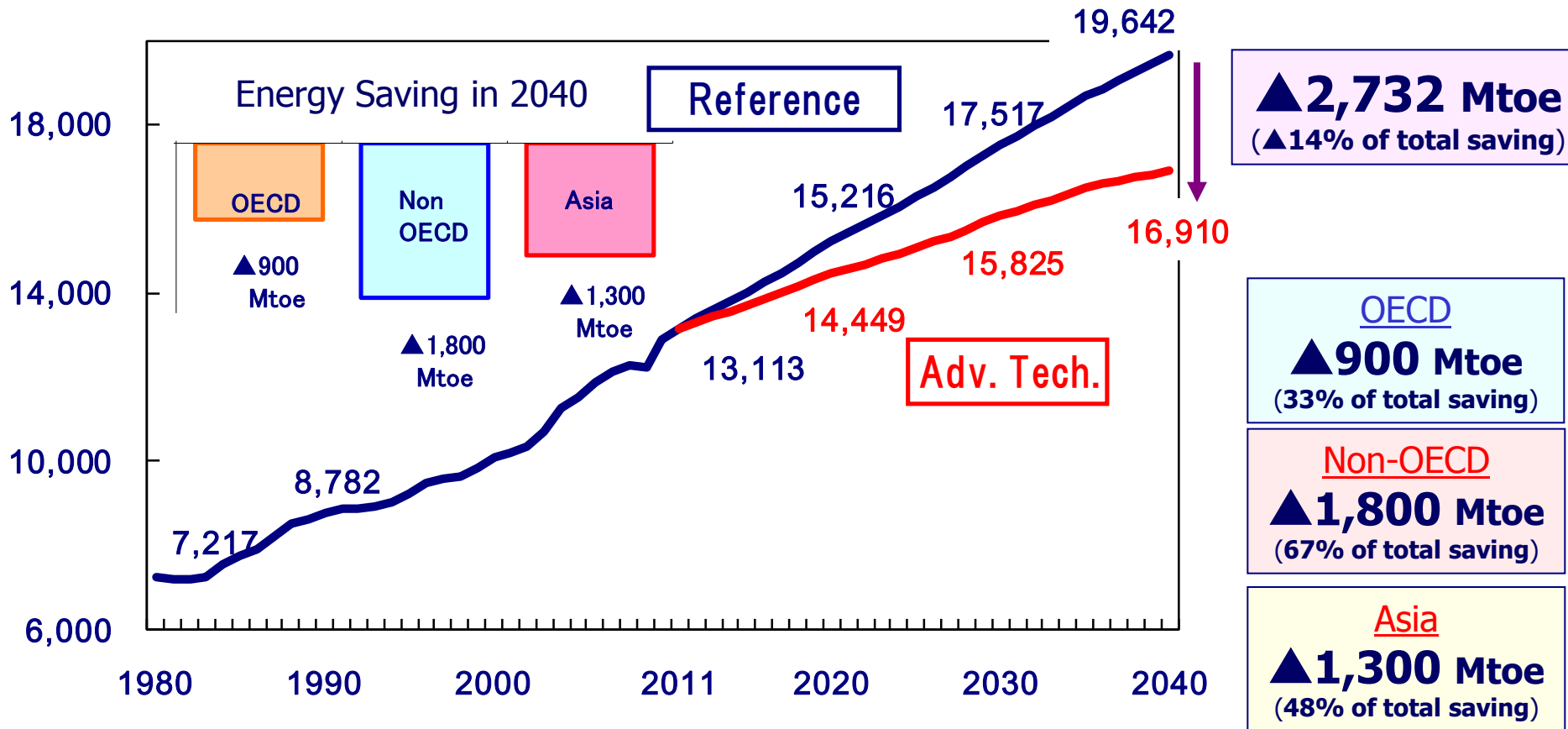
Asia occupies more than 60% of total growth.



- 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 38% in 2010 to 46% by 2040.
- The share of China in the world energy demand will increase to 23% by 2040, and India to 10% (a total of 33%). The share of Japan will decline from 4% in 2010 to 2% of world energy demand in 2040.

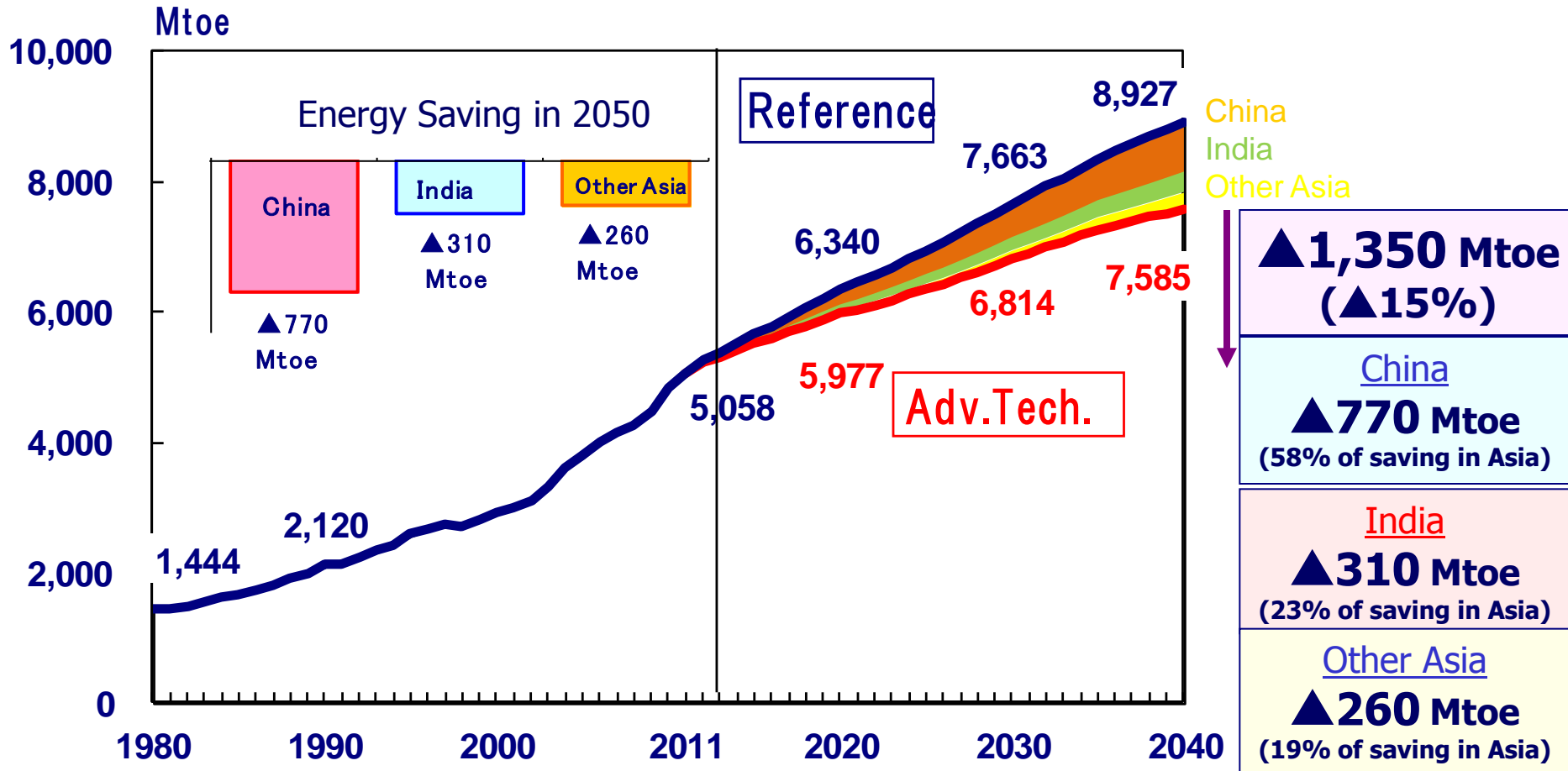
Primary Energy Demand (World)

Reference
Adv. Tech.



- In 2040, total primary energy demand in the Adv. Tech Scenario will be 2,732 Mtoe (about 14%) lower than the Reference Scenario. This saving is more than 5.9 times Japan's total demand in 2011.
- 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.

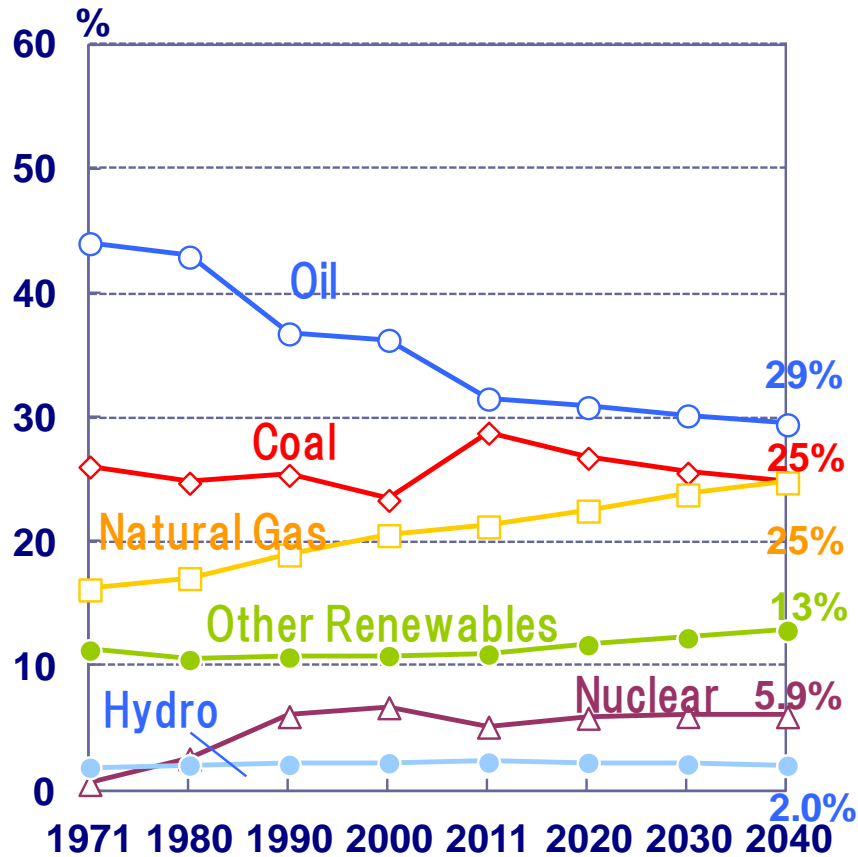
Primary Energy Demand (Asia)

Reference
Adv. Tech.

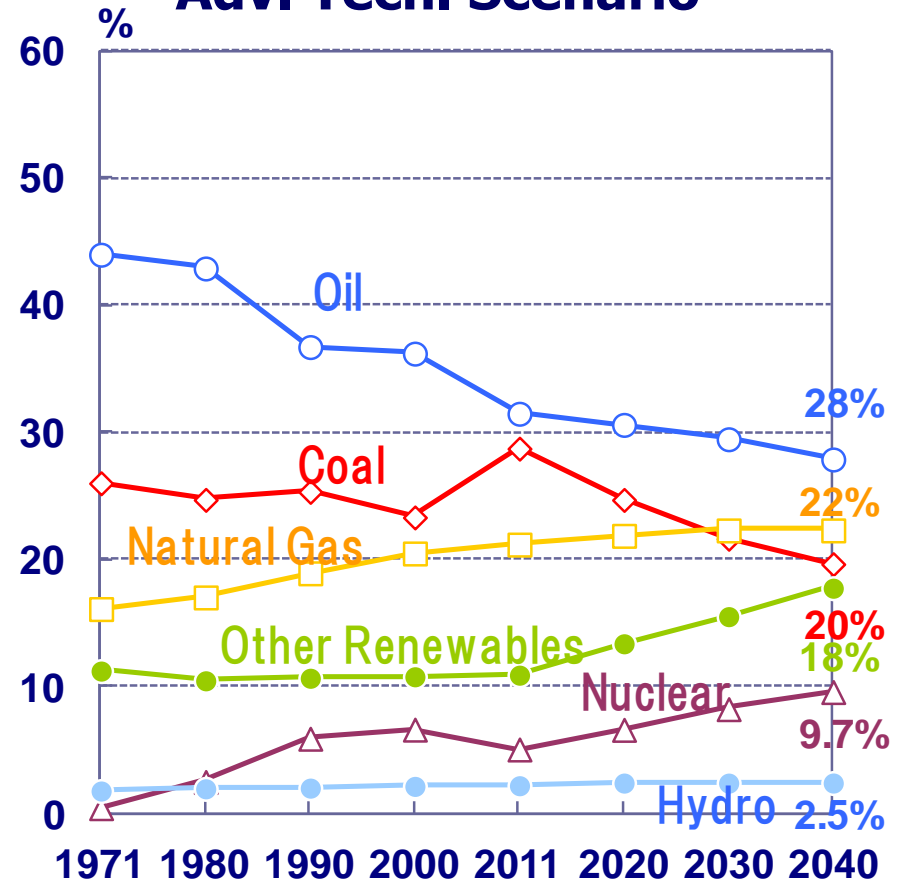
- The potential savings in Asia under the Adv. Tech. Scenario will be 1,350 Mtoe (equivalent to about 2.9 times Japan's current consumption). China and India which represents 80% of the Asian's demand, will have 81% of the saving potential.

Primary Energy Mix (World)

Reference Scenario

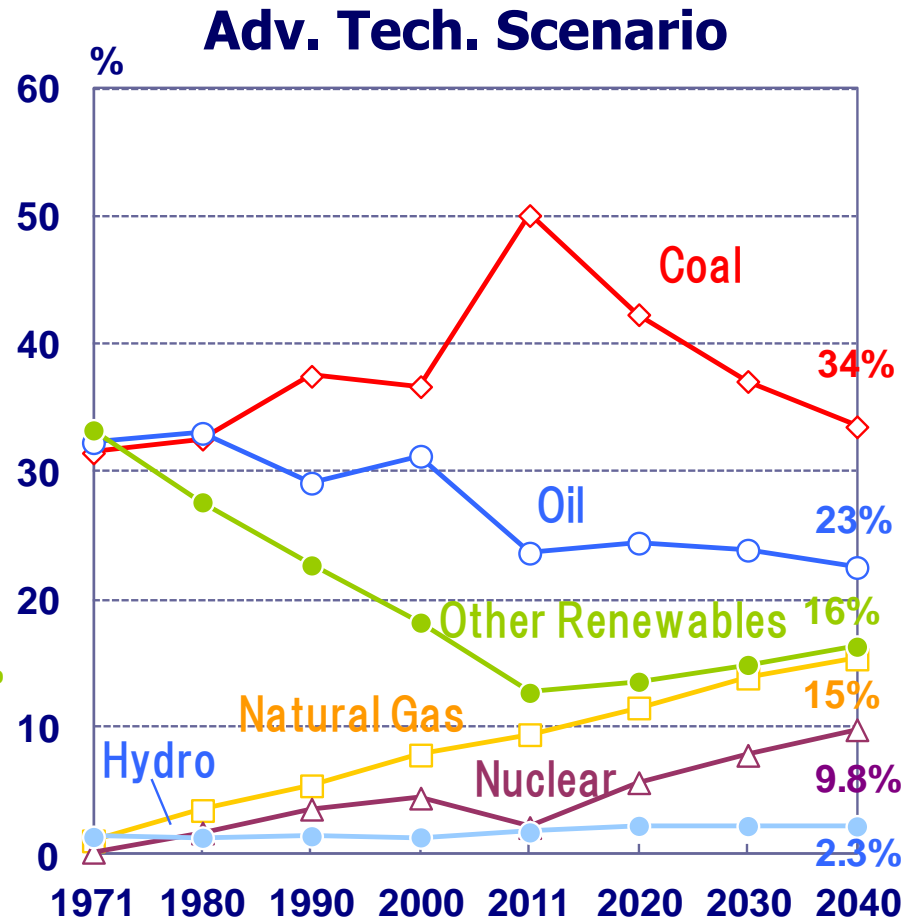
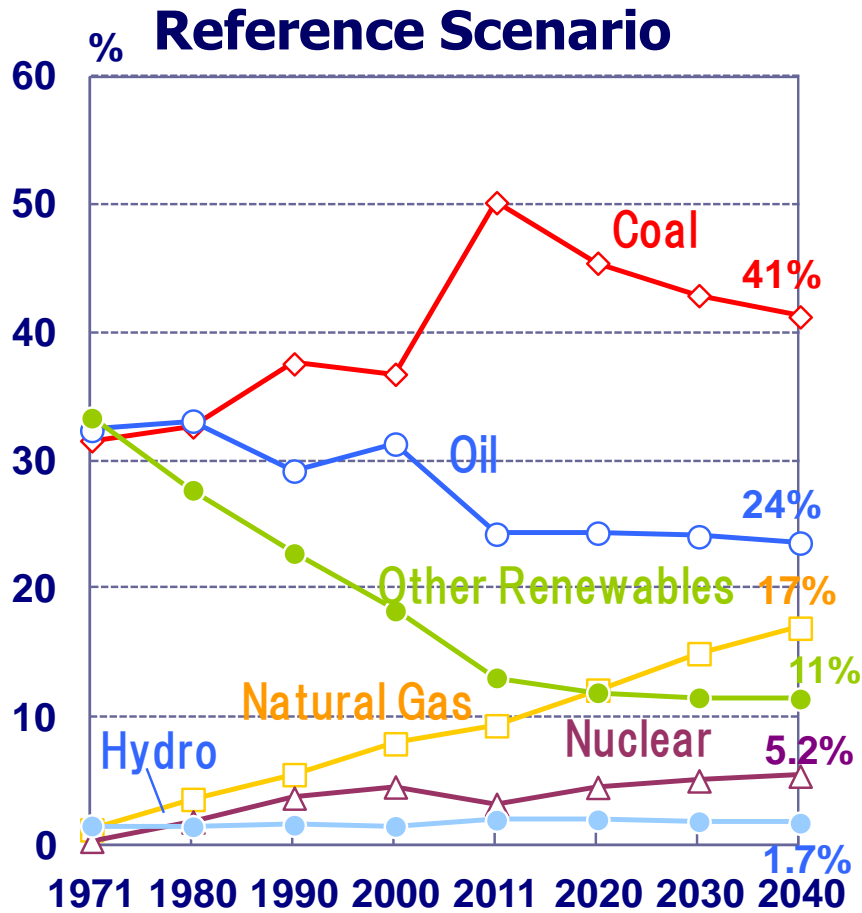


Adv. Tech. Scenario



- In the Reference Scenarios, the oil's share decreases substantially to 29%, 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 2040, maintaining the 70% share.

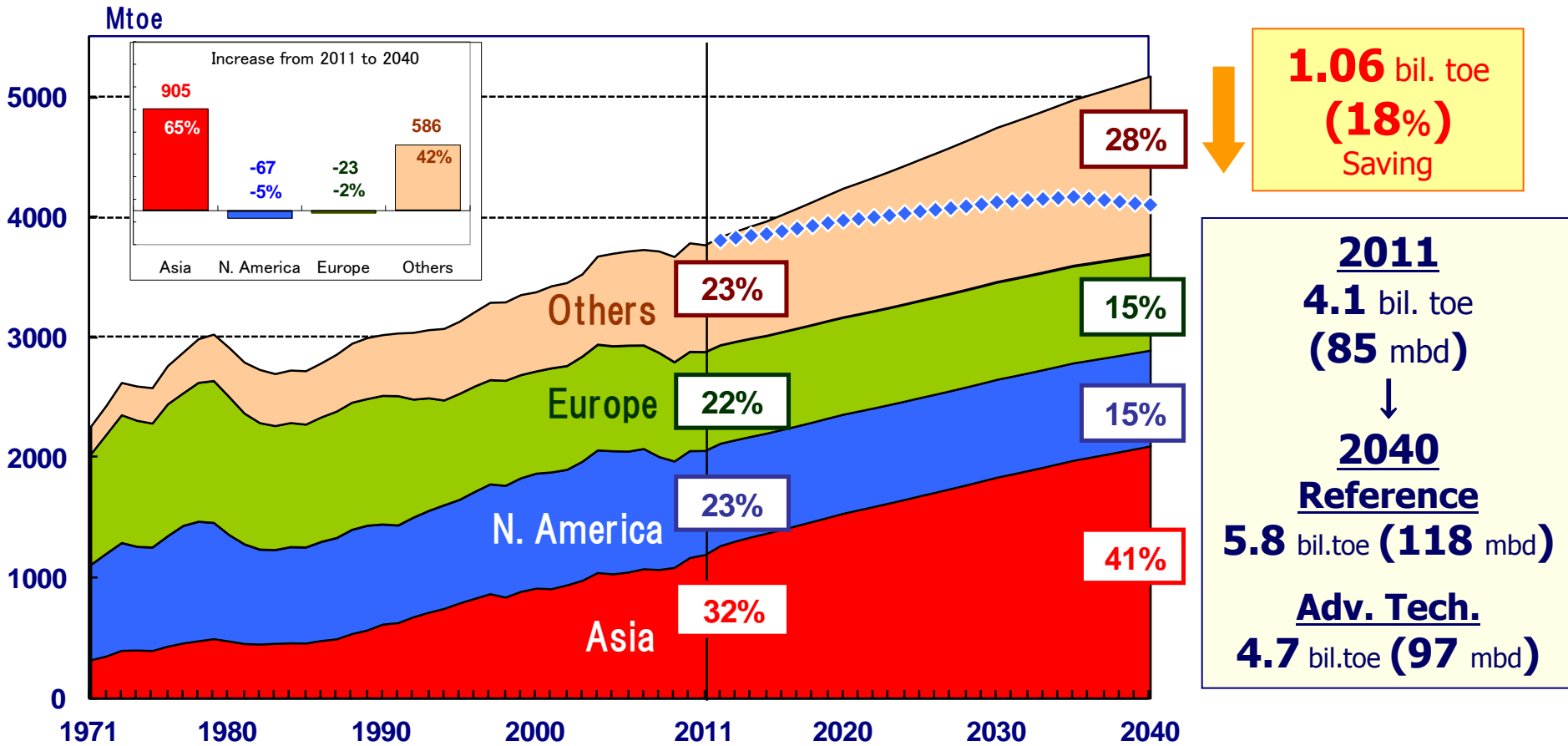
Primary Energy Mix (Asia)



- Coal will keep the biggest share of primary energy demand driven by the electric power demand through 2040. (The coal's share in Asia: 50% (2011) → 41% (2040) in Reference, 34% (2040) 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.

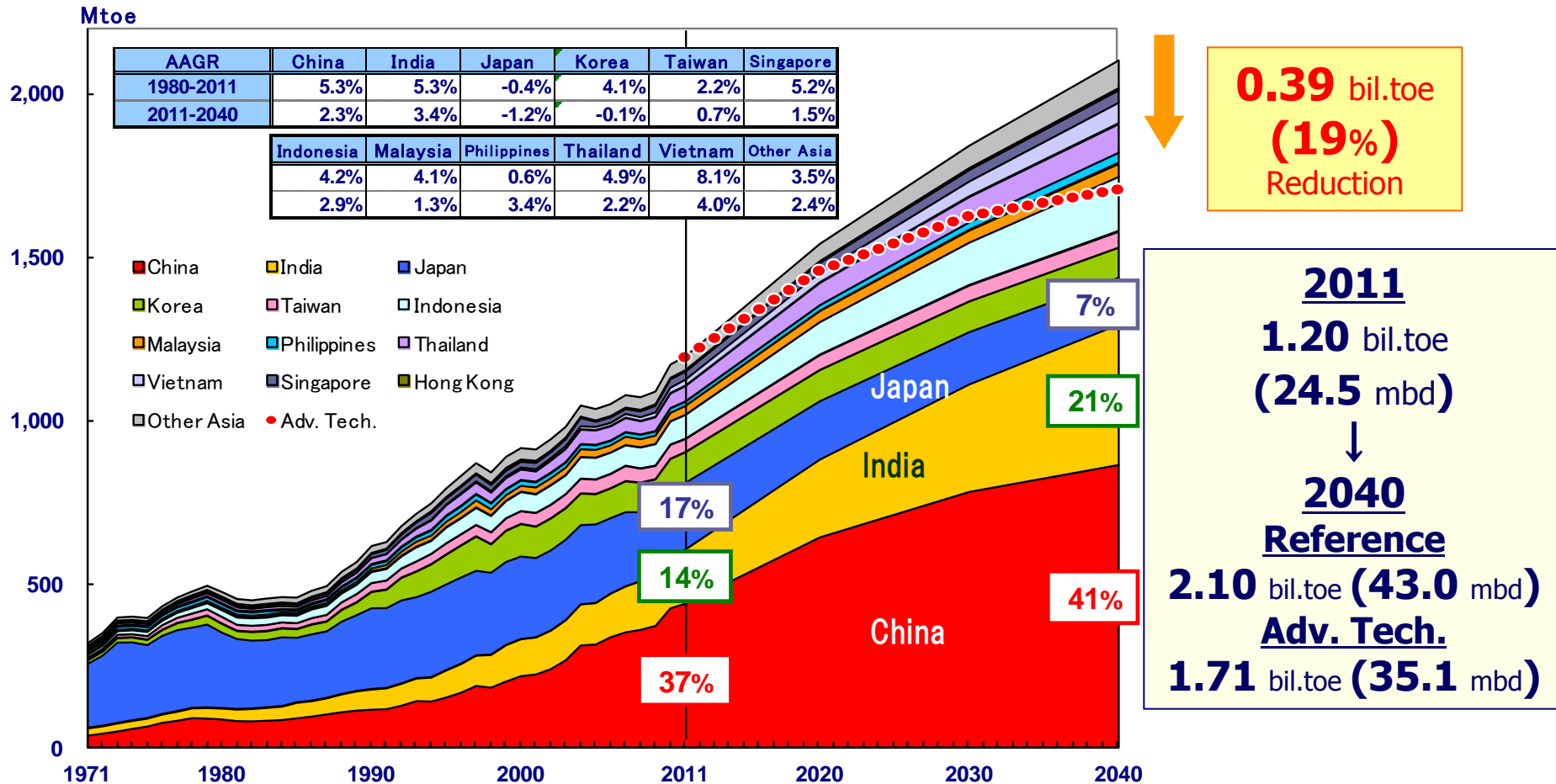
Oil Demand by Region (World)

Solid line: Reference
Dotted line: Adv. Tech.



- The share of Asia in the world oil demand will increase from 32% (2011) to 41% (2040). About 65% of the global oil growth will take place in Asia.
- In the Adv. Tech. the world oil demand will be 0.82 billion ton (15%) lower in 2035 compared with the Reference Scenario.

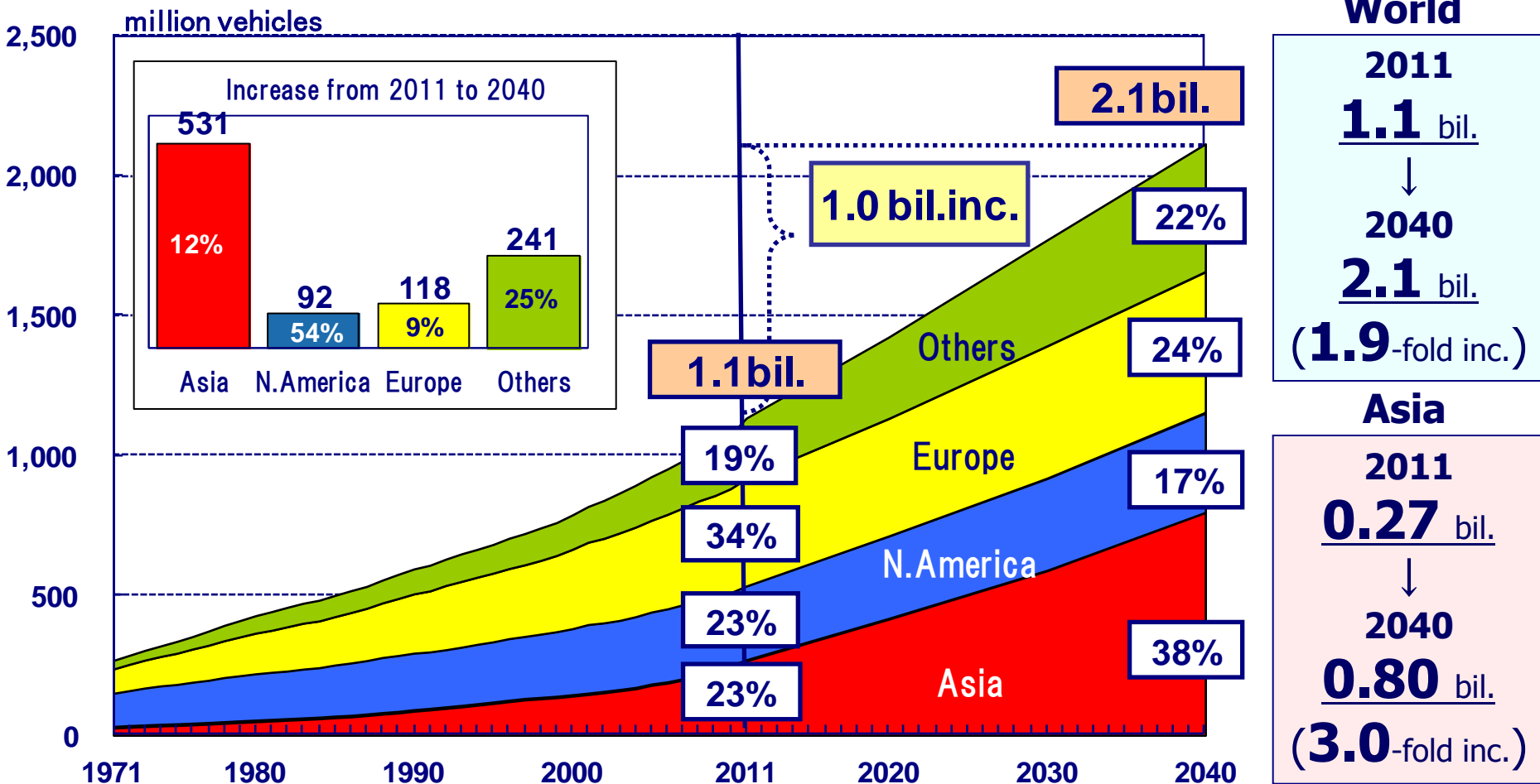
Oil Demand by Region (Asia)



■ Though the vehicles' fuel efficiency may be improved, and clean energy vehicles may expand, oil demand in Asia will expand from 24.5 million B/D in 2011 to 43.0 million B/D in 2040, due mainly to its escalating vehicle ownership. The share of China and India together in Asian oil demand will grow from 51% in 2011 to 62% in 2040.

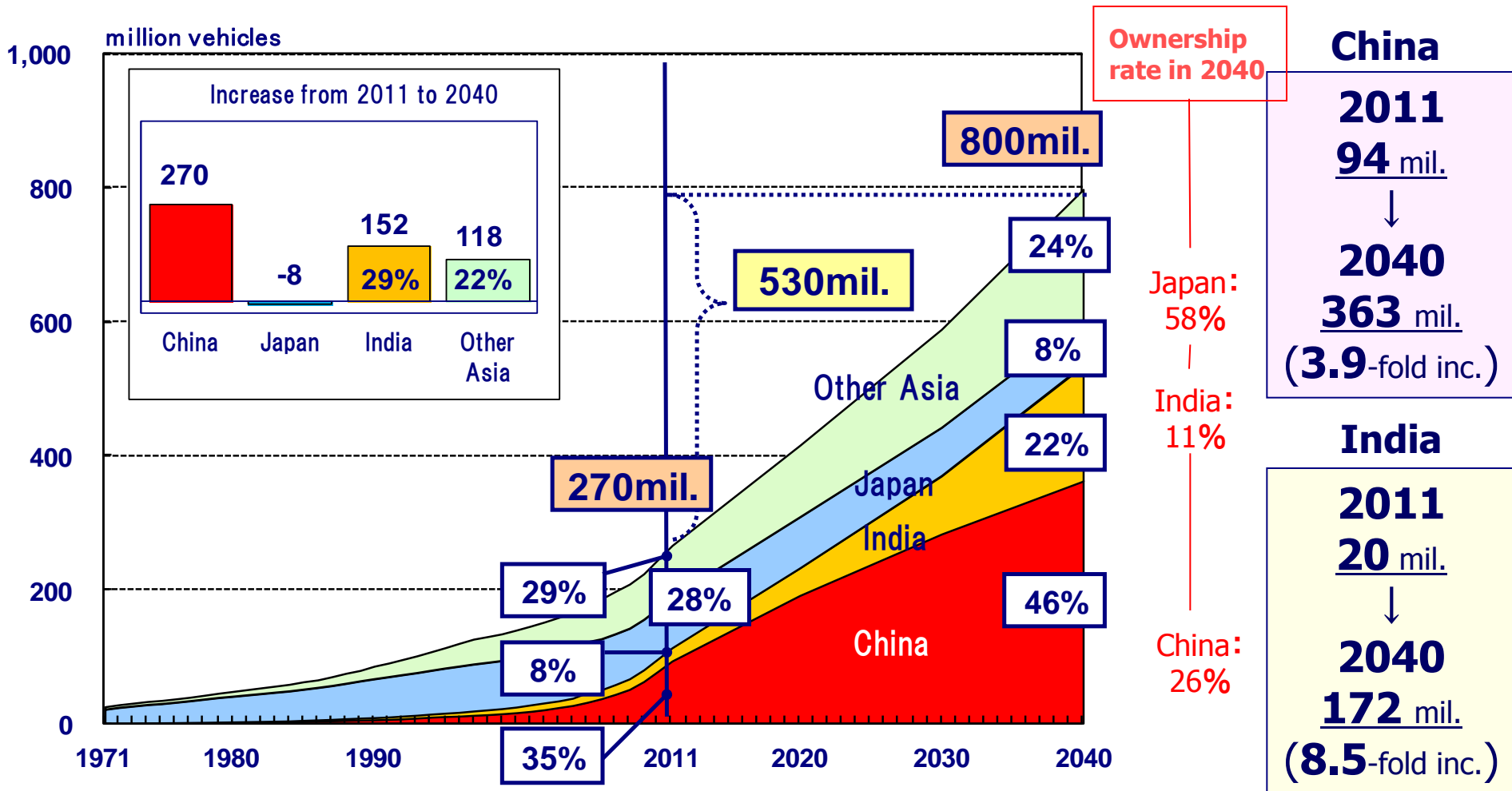
■ Even in the Adv. Tech. Scenario, projected oil demand saving will be equal to 19% of the Reference Scenario in 2040.

The Number of Vehicles (World)



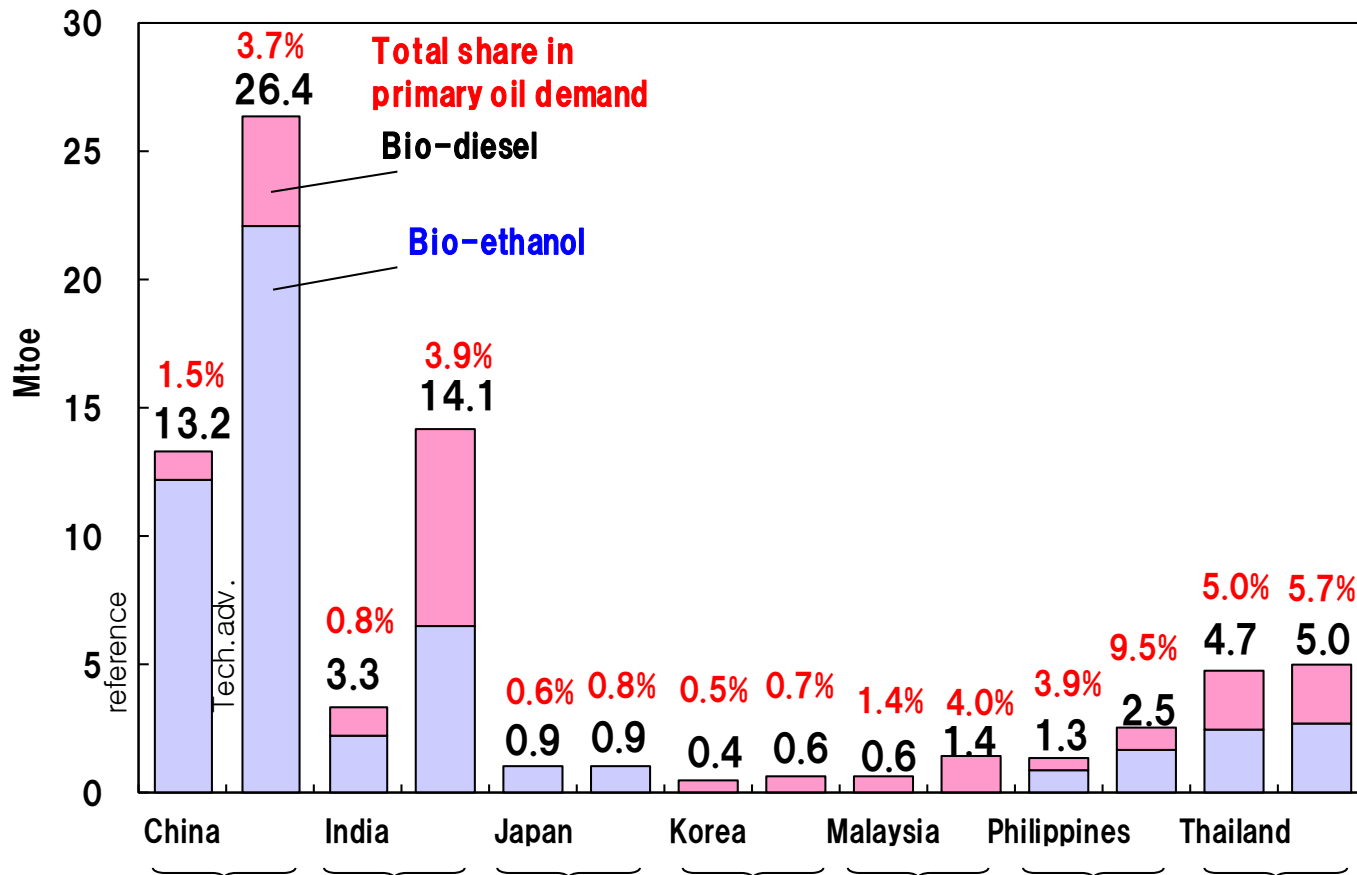
- Approximately 38% of the world vehicle stocks will be concentrated in Asia.
- The share of vehicle stocks in OECD will decline from 63% in 2011 to 43% in 2040. The stock in Non-OECD will surpass that of OECD by 2040.

The Number of Vehicles (Asia)



China vehicle stocks will expand substantially due to an increase in the income level. Number of vehicle stocks in China will increase from 94 million units in 2011 to 363 million units in 2040. India's vehicle stocks will surpass that of Japan around 2027. Number of vehicle stocks in India increase from 20 million units in 2011 to 172 million units in 2040.

Biofuel Outlook in Asia and the World (2040)



World

2011

59 mil. toe



2040

190 mil. toe
(**3.3**-fold inc.)

Asia

2011

2.9 mil. toe



2040

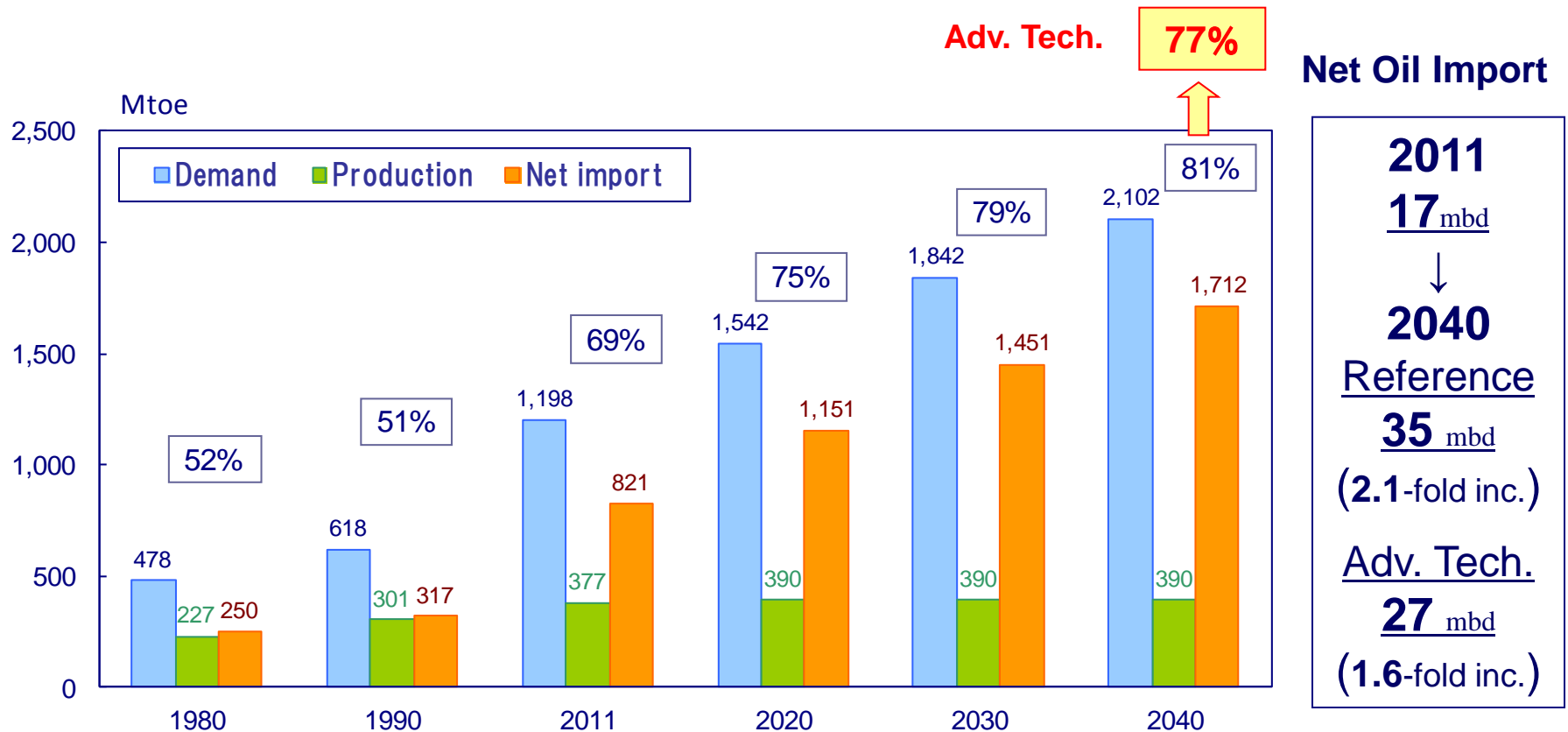
32 mil. toe
(**11**-fold inc.)

■ In the Reference Scenario, the world biofuel demand is expected to reach 190 Mtoe by 2040 mainly driven by the growth in North America, Europe and Latin America. Asia will consume 32 Mtoe of bio-fuel by 2040. The share of bio-fuel in global liquid fuel will amount to 3.3% in 2040.

■ In Asia, ethanol demand will mainly increase in China, India and Japan, while biodiesel will increase in Korea, and Malaysia.

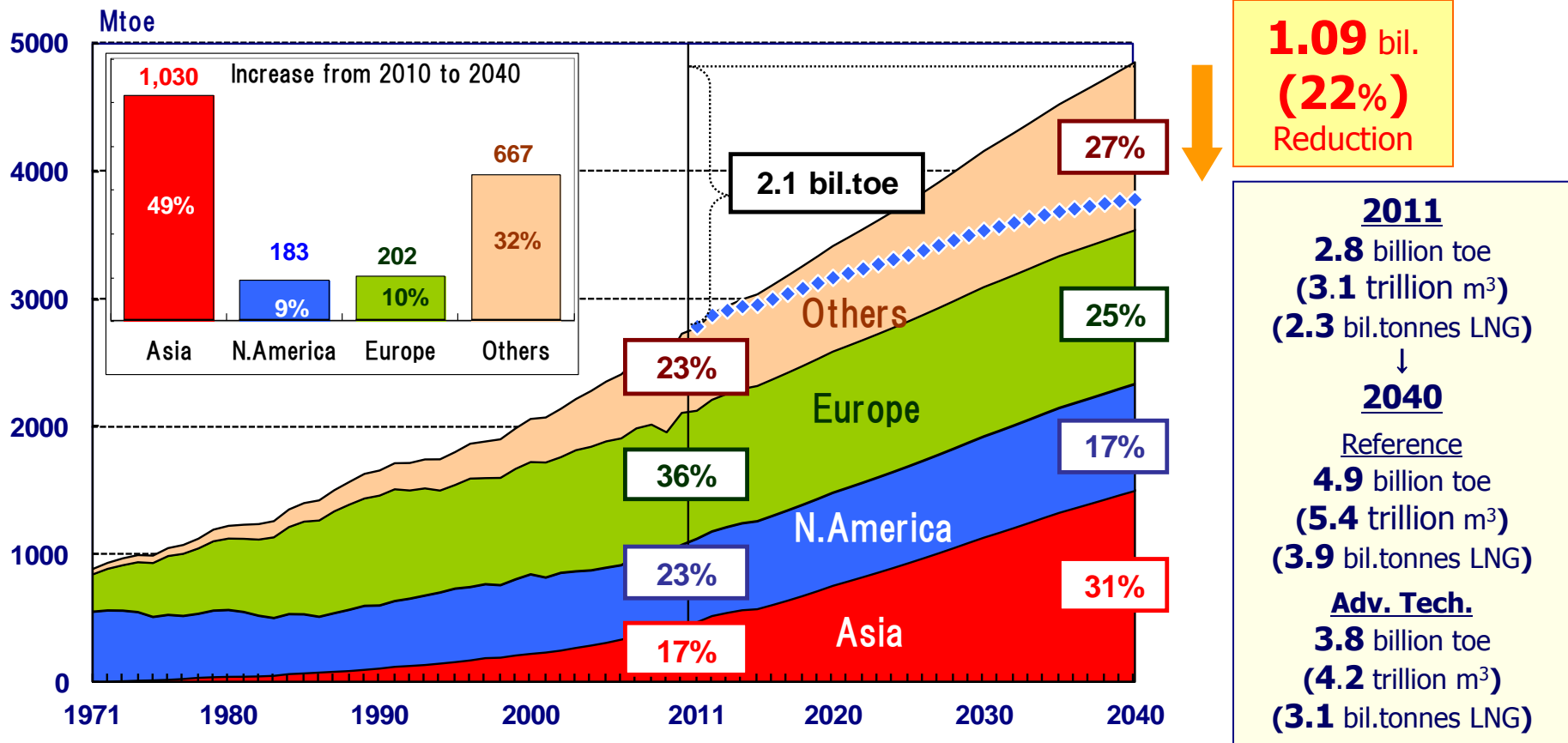
■ In the Adv. Tech. Scenario, the world bio-fuel demand will reach 250 Mtoe 2040, and that of Asia will reach 66 Mtoe.

Oil Supply and Demand in Asia



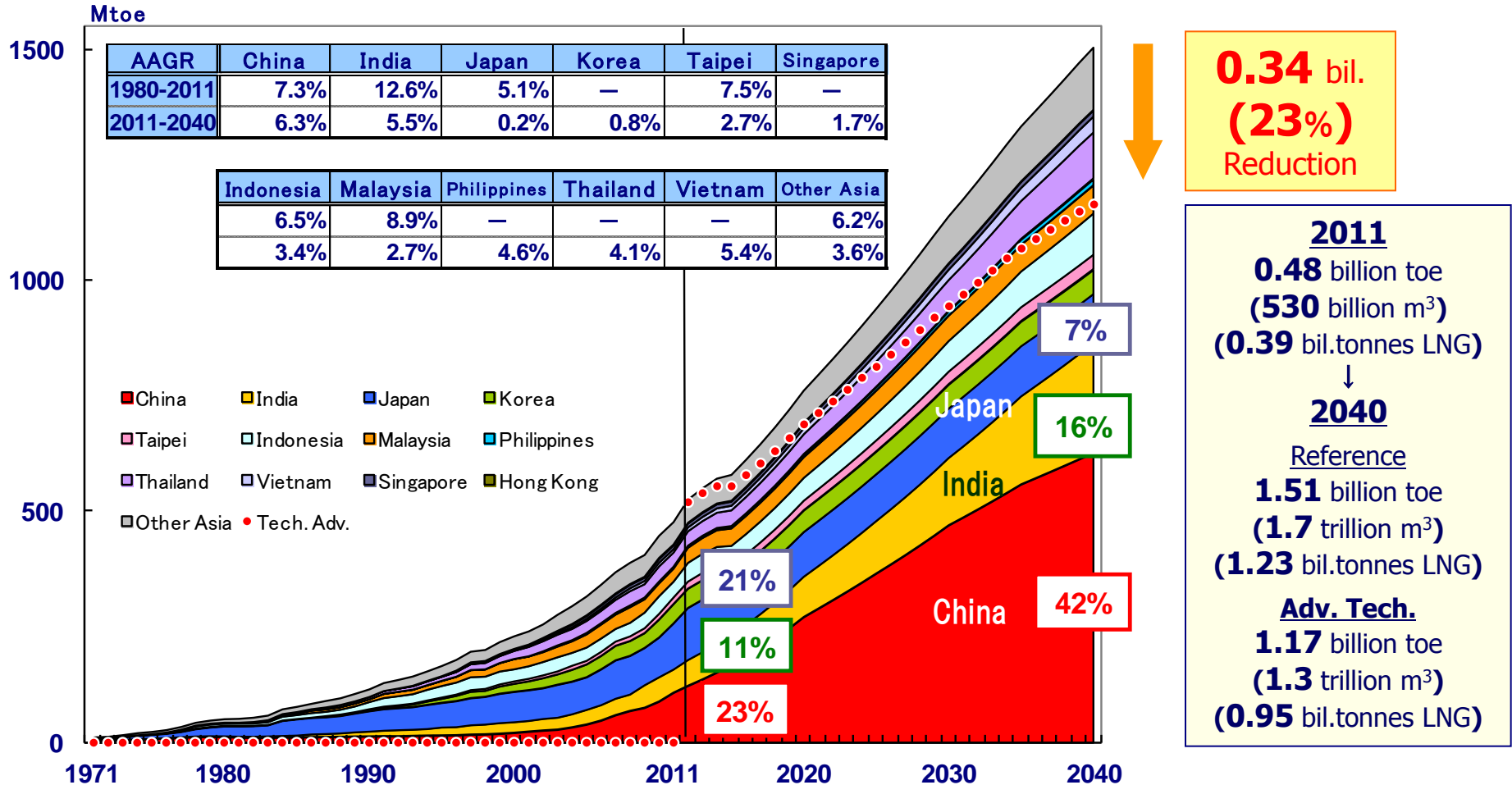
- Net oil import in Asia will expand from 17 mb/d (720 Mtoe) in 2011 to 35 mb/d (1,712 Mtoe) in 2040.
- Oil production in Asia (such as China, India, Indonesia and Malaysia) will marginally increase, not keeping pace with the steady increase in oil demand. Therefore, net oil import ratio will reach 81% in the Reference Scenario, and 77% in the Adv. Tech. Scenario by 2040 (compared with 69% in 2011).

Natural Gas Demand by Region (World)



- The world natural gas demand is expected to increase from 3.1 trillion cubic meters (tcm) in 2011 to 5.4 tcm in 2040, a 1.7-fold increase.
- Non-OECD will account for 82% of the growth in the world natural gas demand from 2011 to 2040,
- In the Adv. Tech. Scenario, natural gas demand will be 1.20 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)

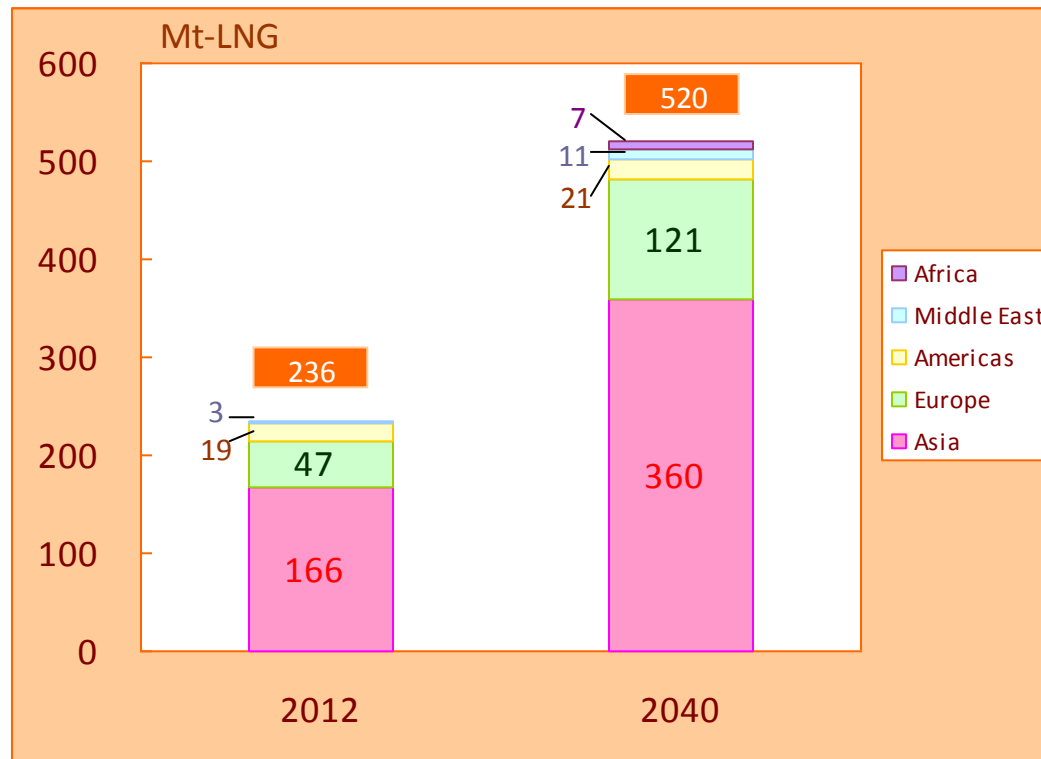


■ Natural gas demand in China will considerably increase (6%/y) due mainly to the increasing demand for power generation and gas use in urban areas. India's natural gas demand will also expand but at a lower pace (6%/y), representing a four-fold increase from 2011 to 2040.

■ In the Adv. Tech. Scenario, the world natural gas demand will be 380 bcm (or 23%) lower than the Reference Scenario by 2040. Despite the gains, natural gas demand will increase at a relatively fast pace of 3.1% per year through 2040.

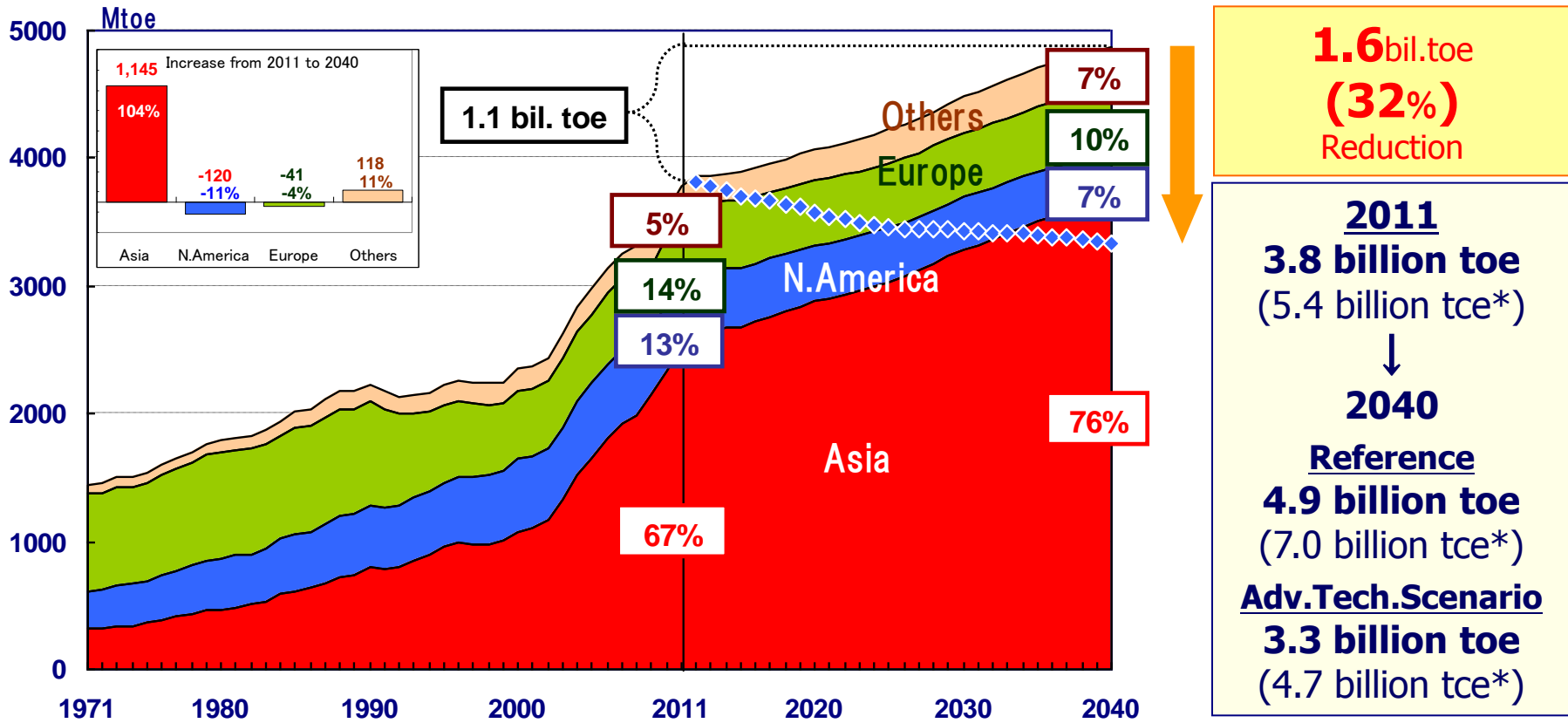
LNG Demand Outlook (World)

Reference



- World LNG demand will expand 121% from 236 million tons in 2012 to 520 million tons in 2040.
- Asia's LNG demand will increase by 193 million tons, accounting for 68% of the world's LNG demand growth through 2040. Growth of LNG in Europe (74 million tons) will account for 14% of the world LNG demand growth, whereas LNG import to north America will increase only slightly in the future.

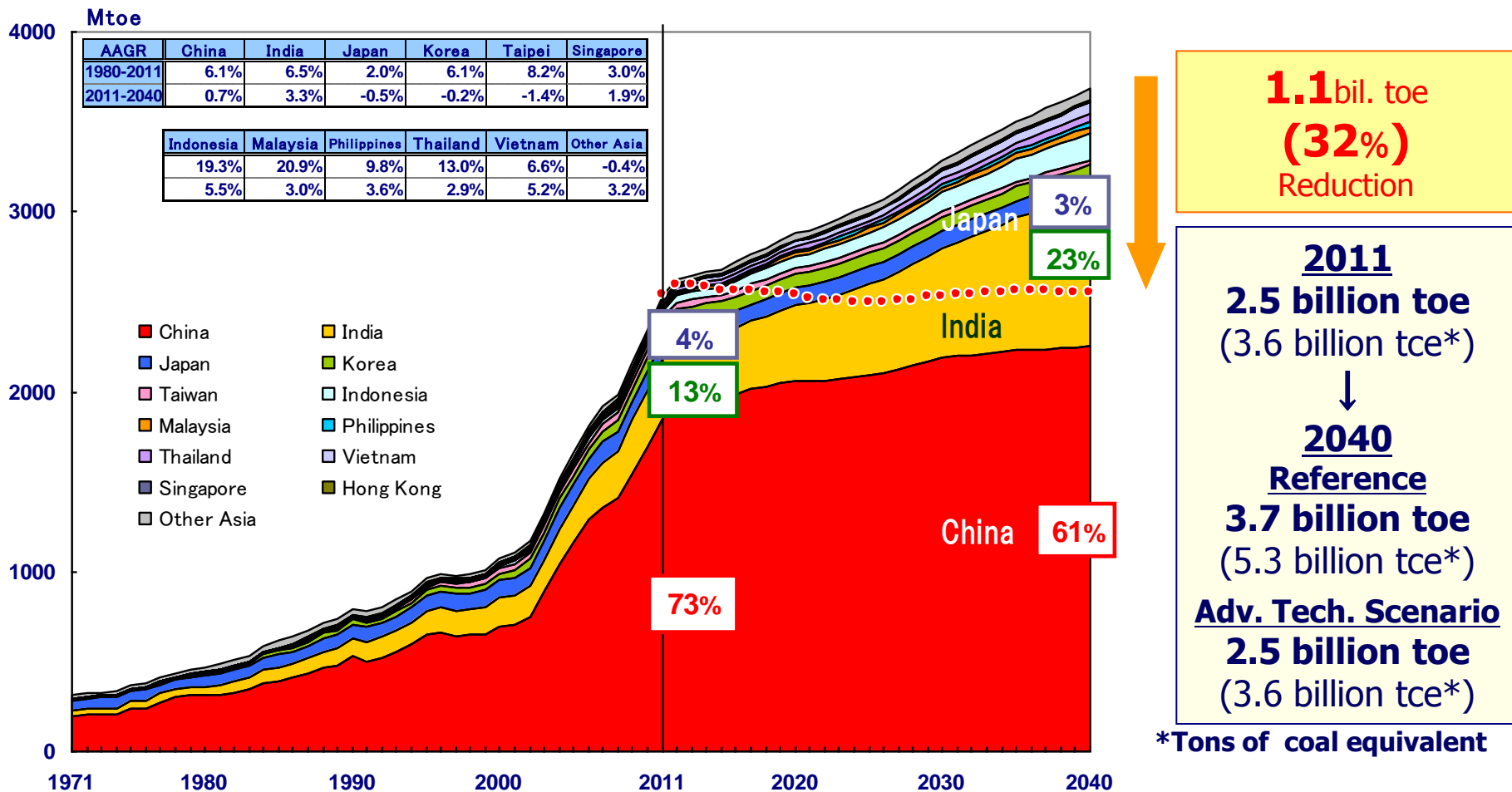
Coal Demand by Region (World)



*Tons of coal equivalent

- Asia will account for about 90% of the world coal demand growth through 2040, and the share of Asia in total coal demand will expand to 76% in 2040 from 67% in 2011.
- In the Adv. Tech. Scenario, the world coal demand in 2040 will be 1.6 billion toe (or 32%) lower compared with the Reference Scenario.

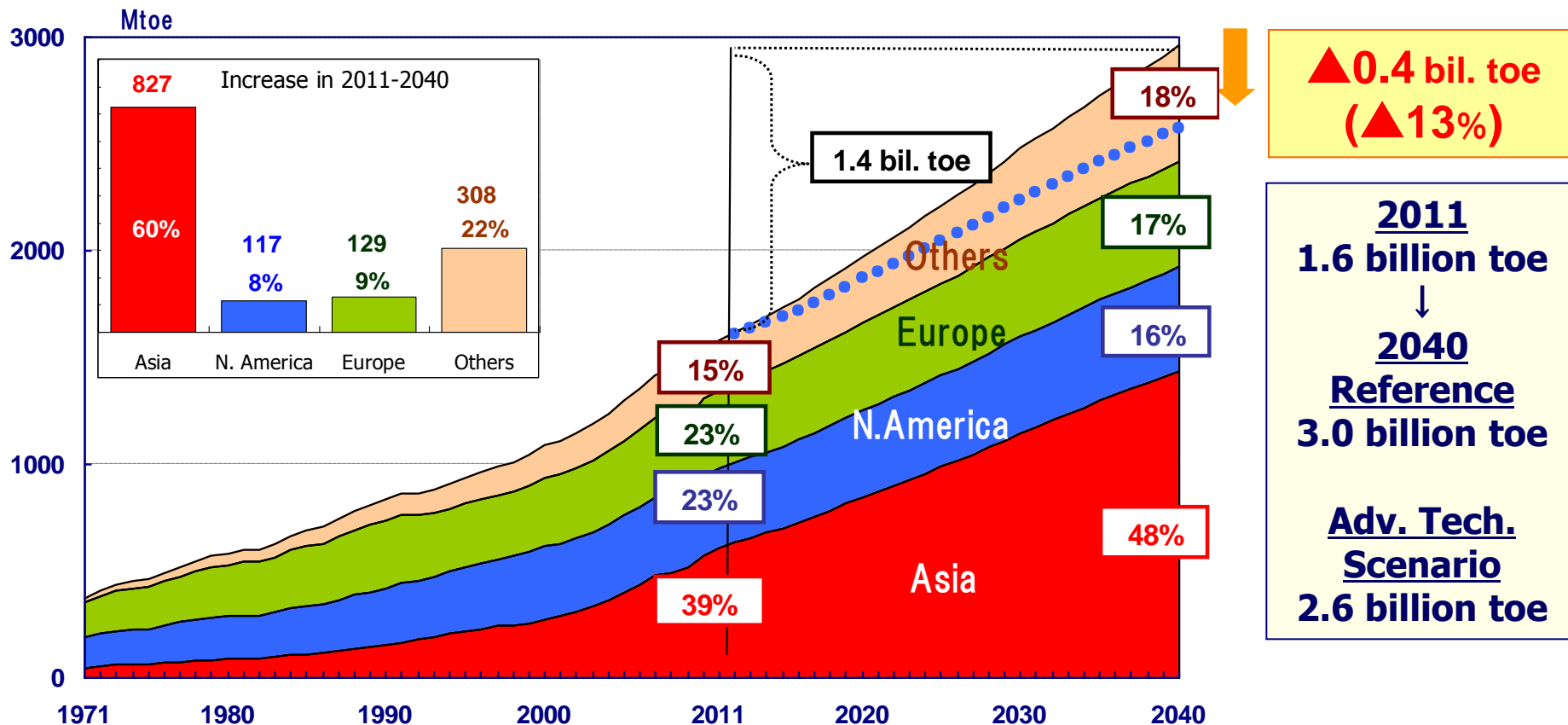
Coal Demand by Country (Asia)



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

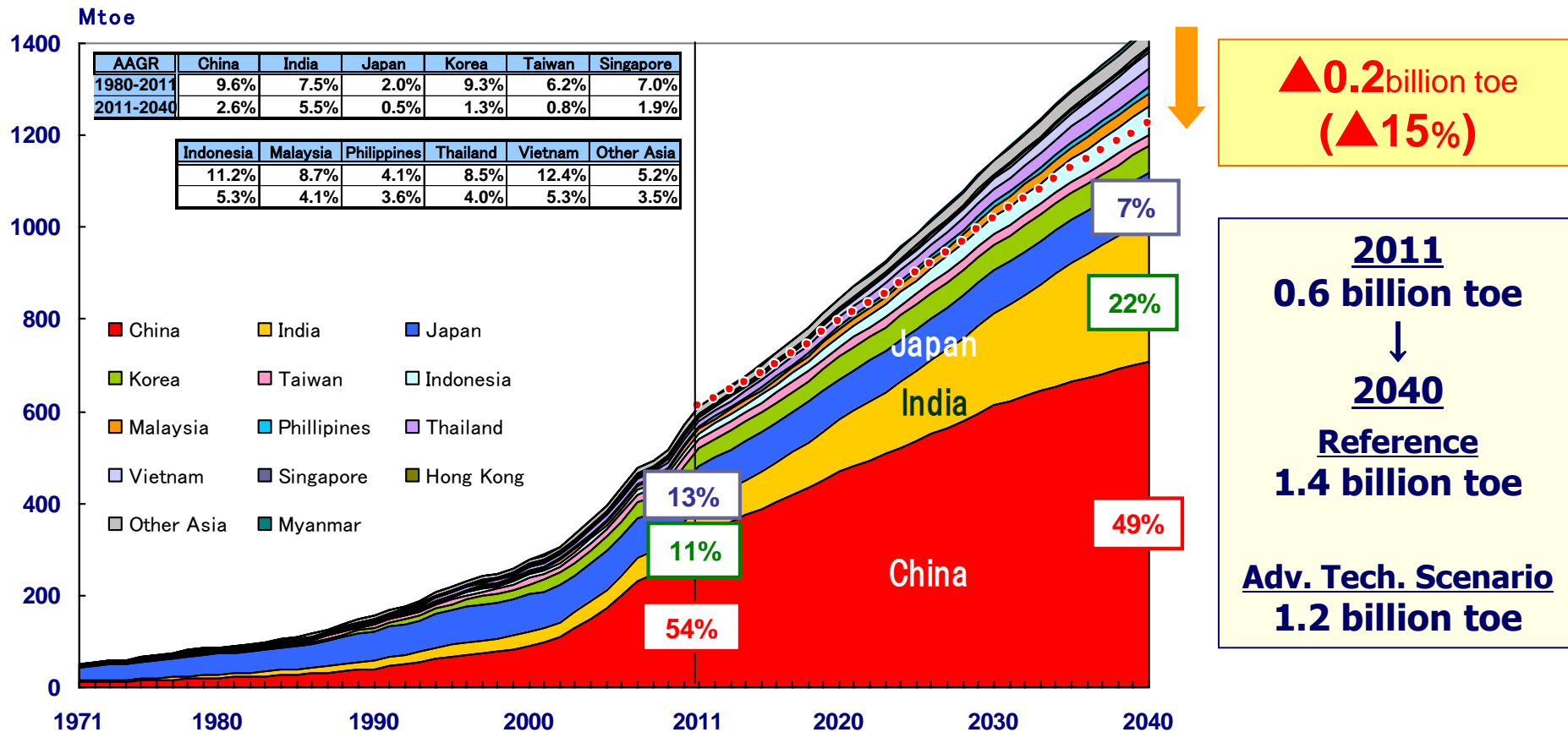
■ In the Adv. Tech. Scenario, Asian coal demand in 2040 will be 1.1 billion toe (or 32%) lower due to shift natural gas and enhancement of power generation efficiency compared with the Reference Scenario.

Electricity Demand by Region (World)



- Asia will account for 60% of the world electricity demand growth through 2040, and the share of Asia in total electricity demand will expand to almost 50%.
- In the Adv. Tech. Scenario, the world electricity demand in 2040 will be 0.39 billion toe (or 13%) lower compared with the Reference Scenario.

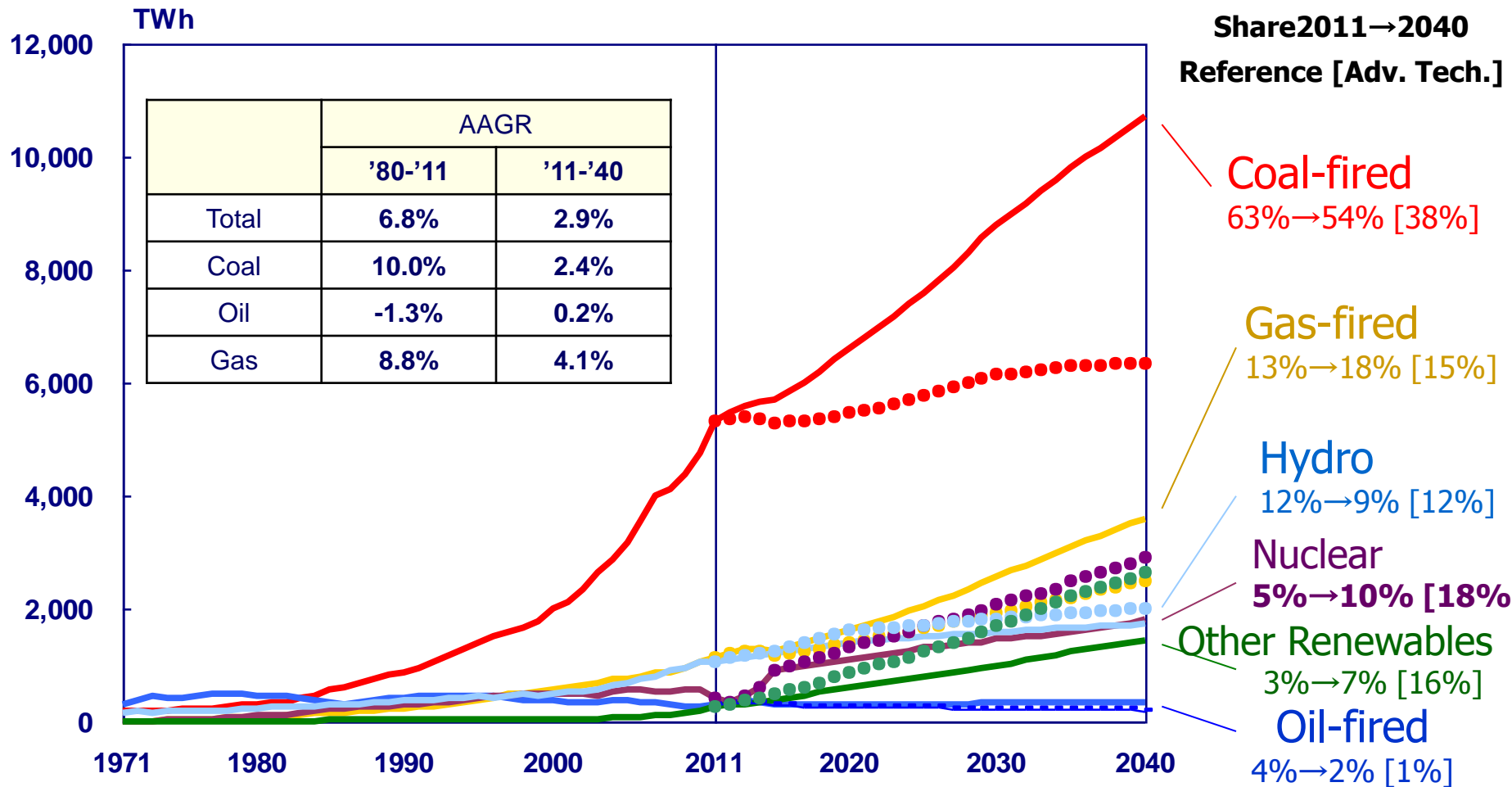
Electricity Demand by Country (Asia)



- Electricity demand in Asia will increase rapidly driven by the improvement of living standards. Electricity demand in China will expand 213% by 2040, and India will expand 476% during the same period.
- Through 2040, electricity demand will increase at a faster rate than final energy demand (Reference Scenario at 3.0%, and Adv. Tech. Scenario at 2.4% per year).

Power Generation Mix by Source (Asia)

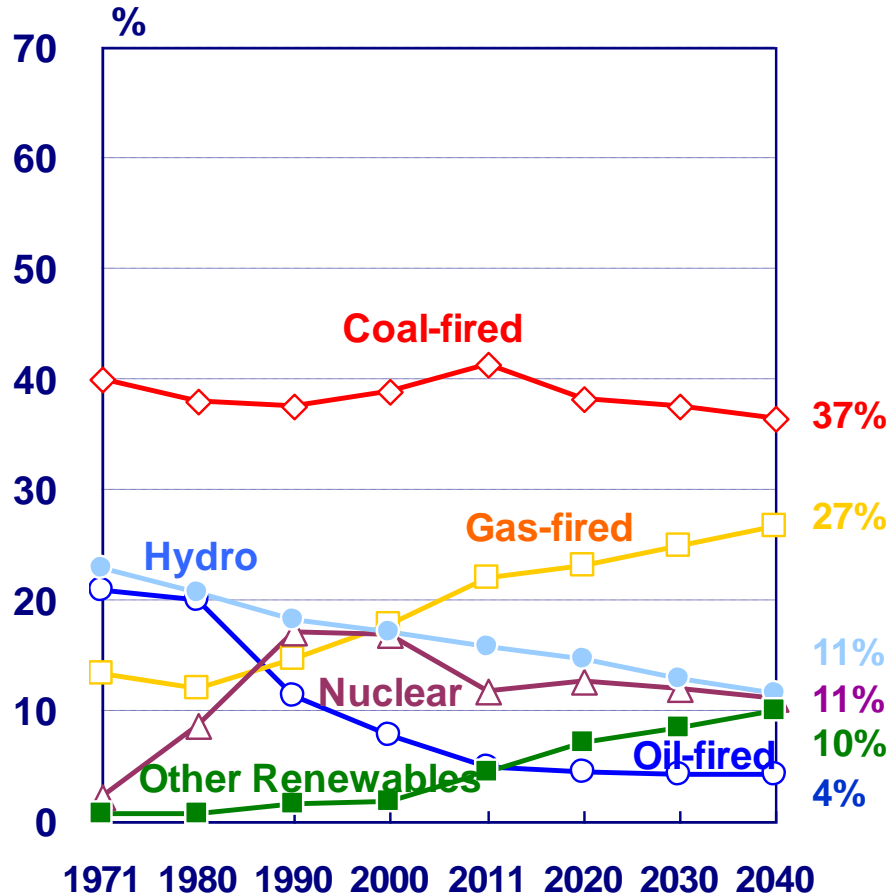
Solid line: Reference
Dotted line: Adv. Tech.



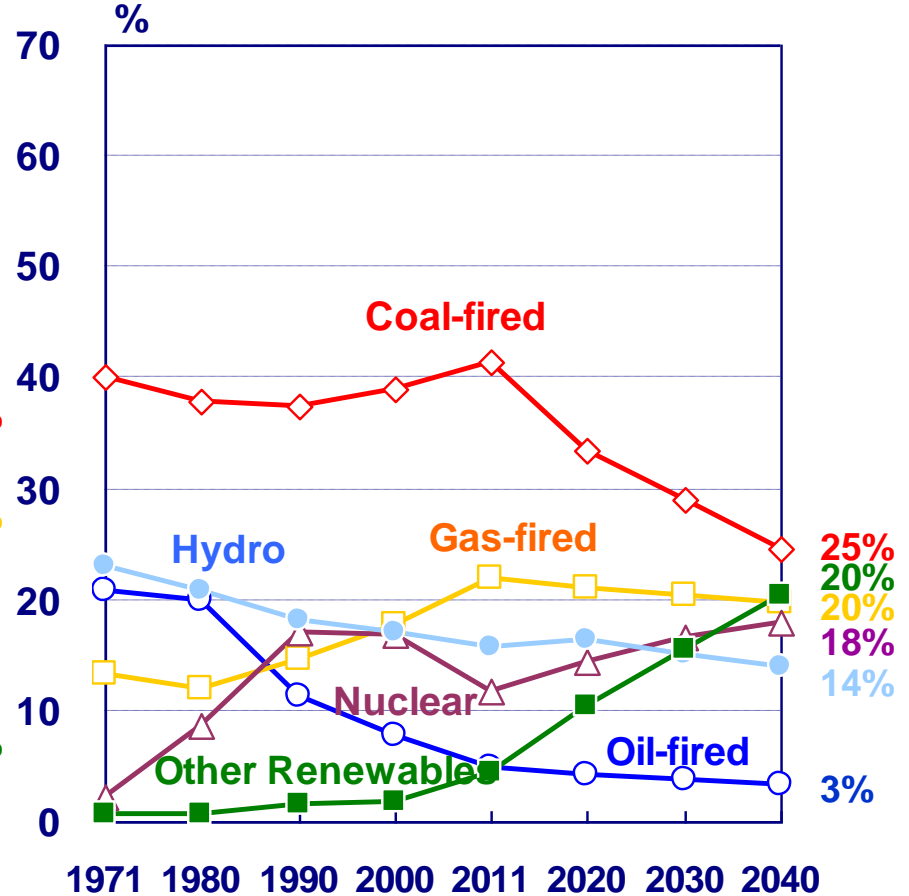
- The Asia's share of coal in the generation mix will remain higher than 50%, reflecting resources availability.
- The share of natural gas will increase from 13% in 2011 to 18% in 2040. The share of nuclear power generation will remain 10% in 2040.
- In the Adv. Tech. Scenario, the share of coal will decline from 63% in 2011 to 54% in 2040. Clean coal technology (CCT) is expected to play an important role in addressing global warming issues.

Power Generation Mix by Source (World)

Reference Scenario



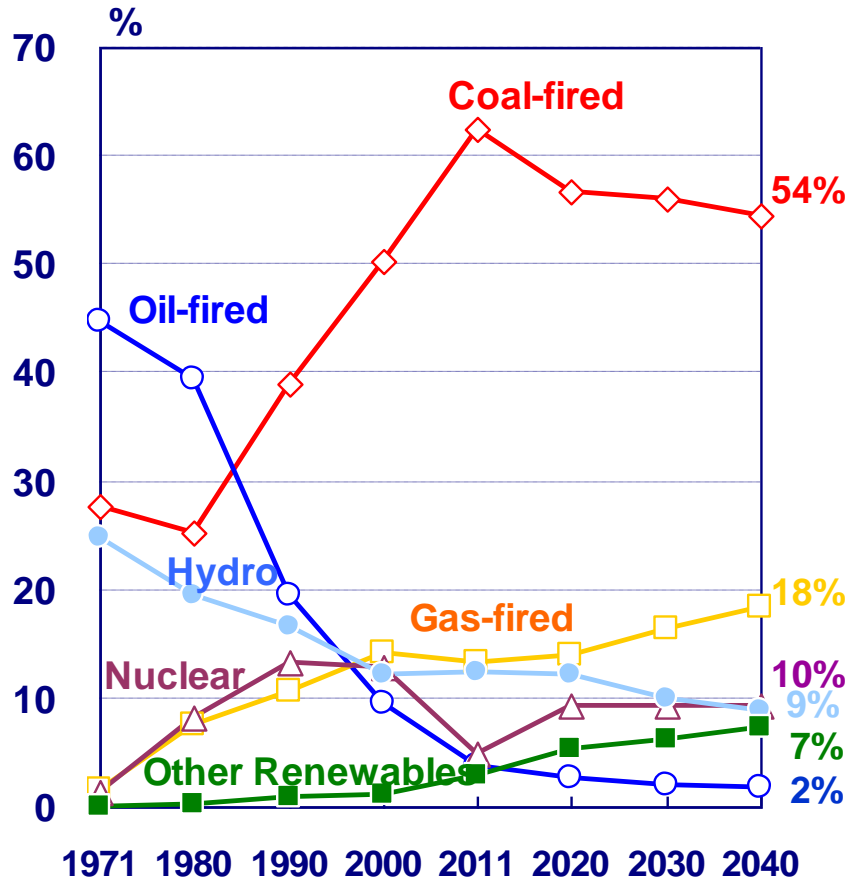
Adv. Tech. Scenario



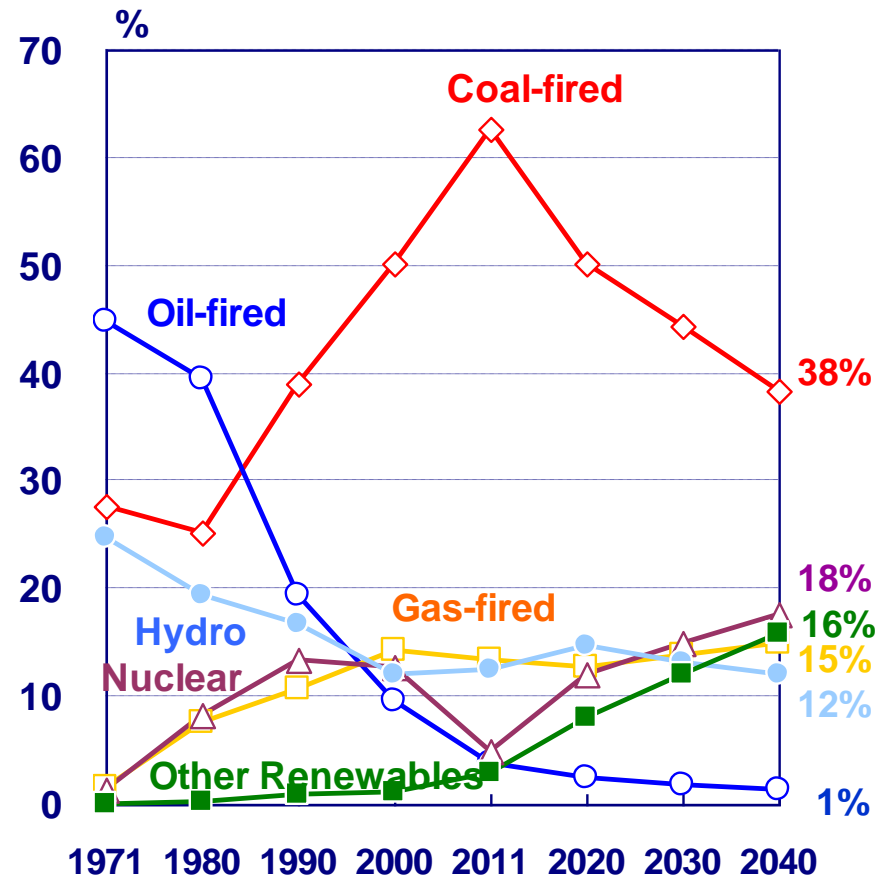
- Coal-fired generation will maintain the biggest share in the power generation mix by 2040.
- In the Adv. Tech. Scenario, the share of coal-fired generation will decrease substantially, while that of renewable energy and nuclear will increase.

Power Generation Mix by Source (Asia)

Reference Scenario



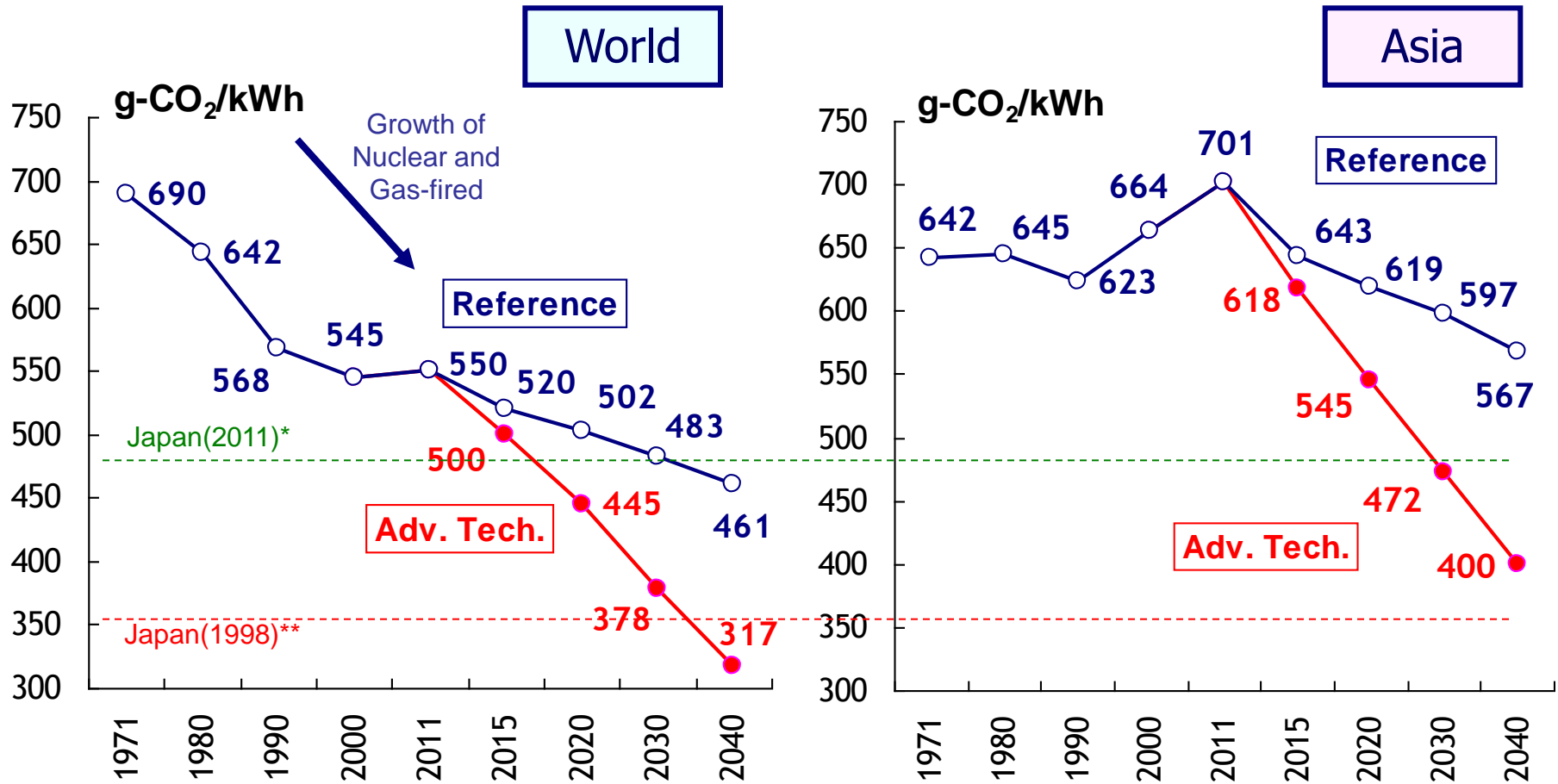
Adv. Tech. Scenario



■ In Asia, the highest share of coal-fired generation will remain to 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.

Carbon Intensity of Electricity (CO₂ Emissions per kWh)

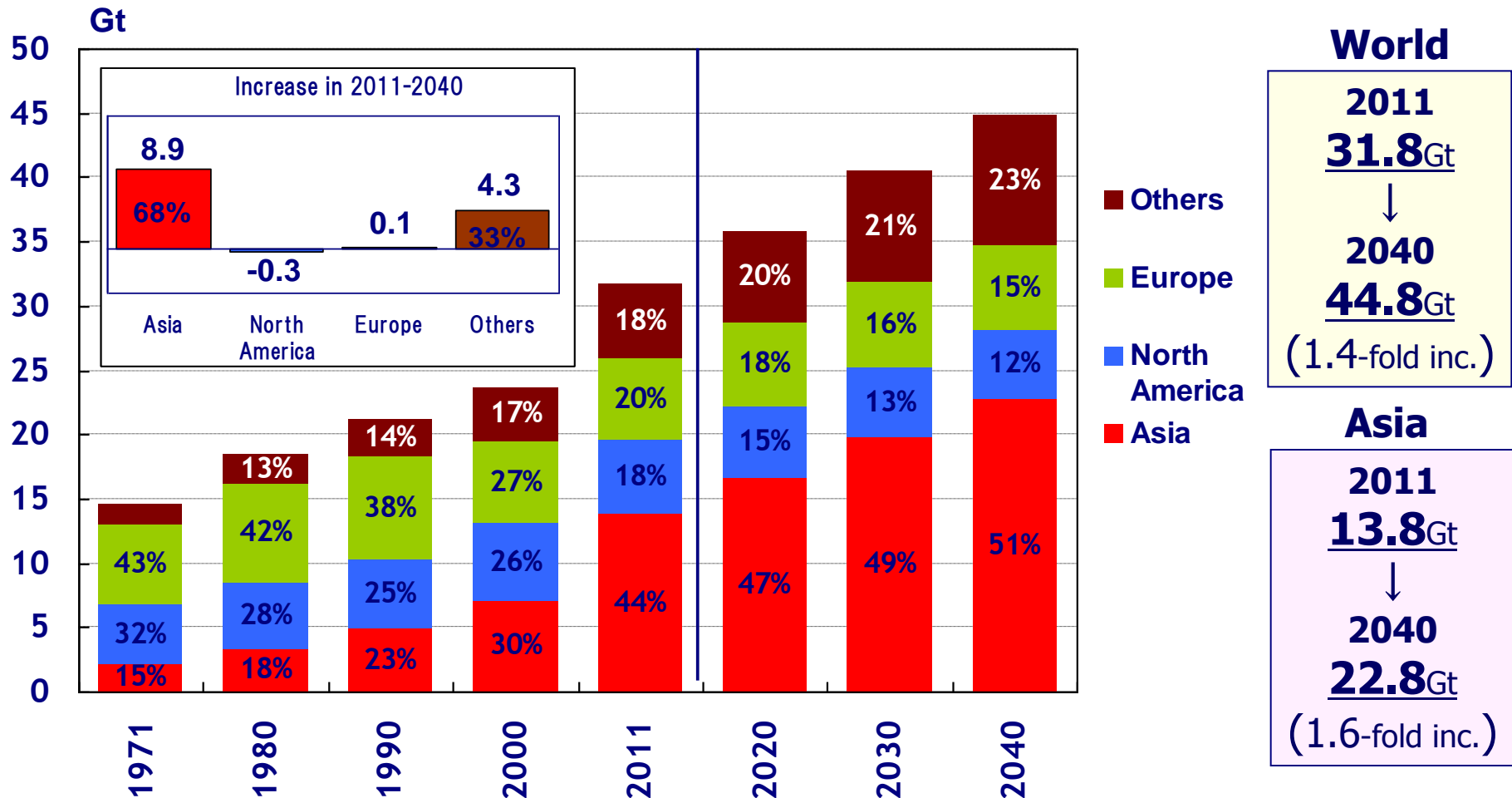


*480g-CO₂/kWh **350g-CO₂/kWh

- The average CO₂ 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 CO₂ emissions per kWh in the world in 2040 will be 42% less than the 2011 level. In Asia, the reduction will reach 43%.

CO₂ Emission by Region (World)

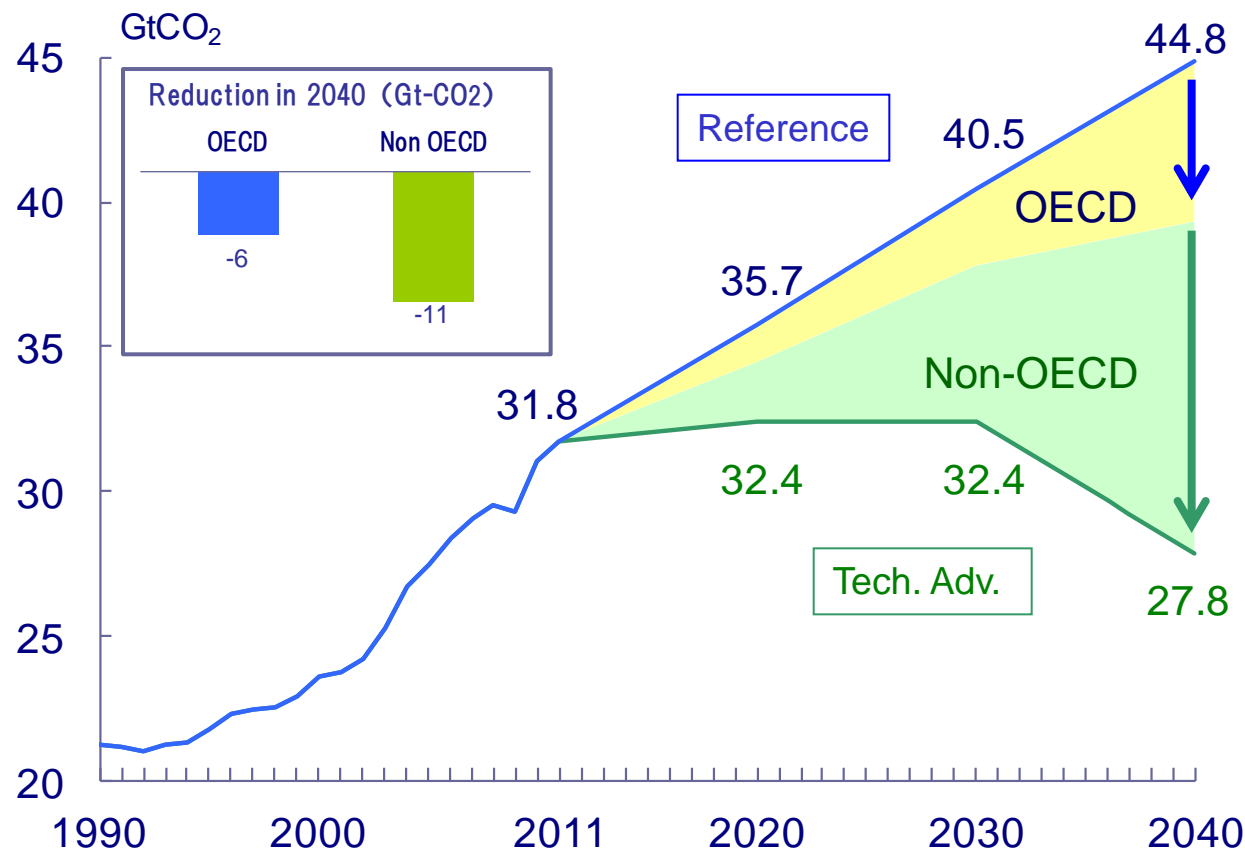
Reference



■ CO₂ emissions in the world reach 44.8Gt in 2040 from 31.8Gt in 2011.

■ Asia alone will account for about 70% of the increase in global CO₂ emissions through 2040. The share of North America and Europe will decrease from 38% in 2011 to 29% in 2040.

CO₂ Emissions Reduction by Region (World)

Reference
Adv. Tech.

Total **17.0** Gt
(38% reduce)

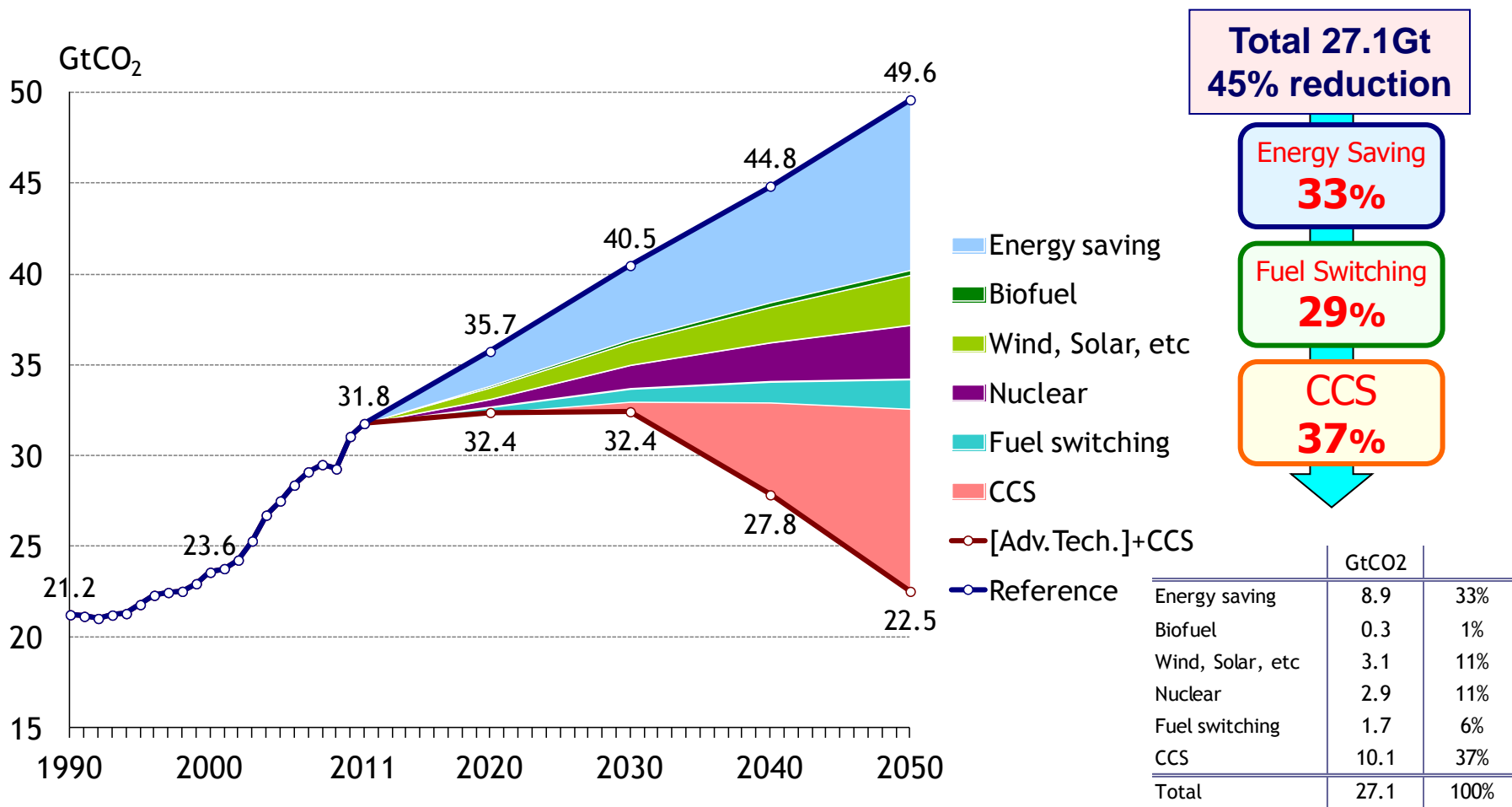
5.5 Gt
(32% of total)

11.5 Gt
(68% of total)

- In 2040, Non-OECD's CO₂ emissions reduction (between the Reference and the Adv. Tech. Scenario) is estimated to reach 11.5 Gt, more than twice that of OECD at 5.5 Gt.
- Technology transfer and swift deployment of advanced technology in Asia is indispensable in order to address global warming issues.

CO₂ Emissions Reduction by Technology (World)

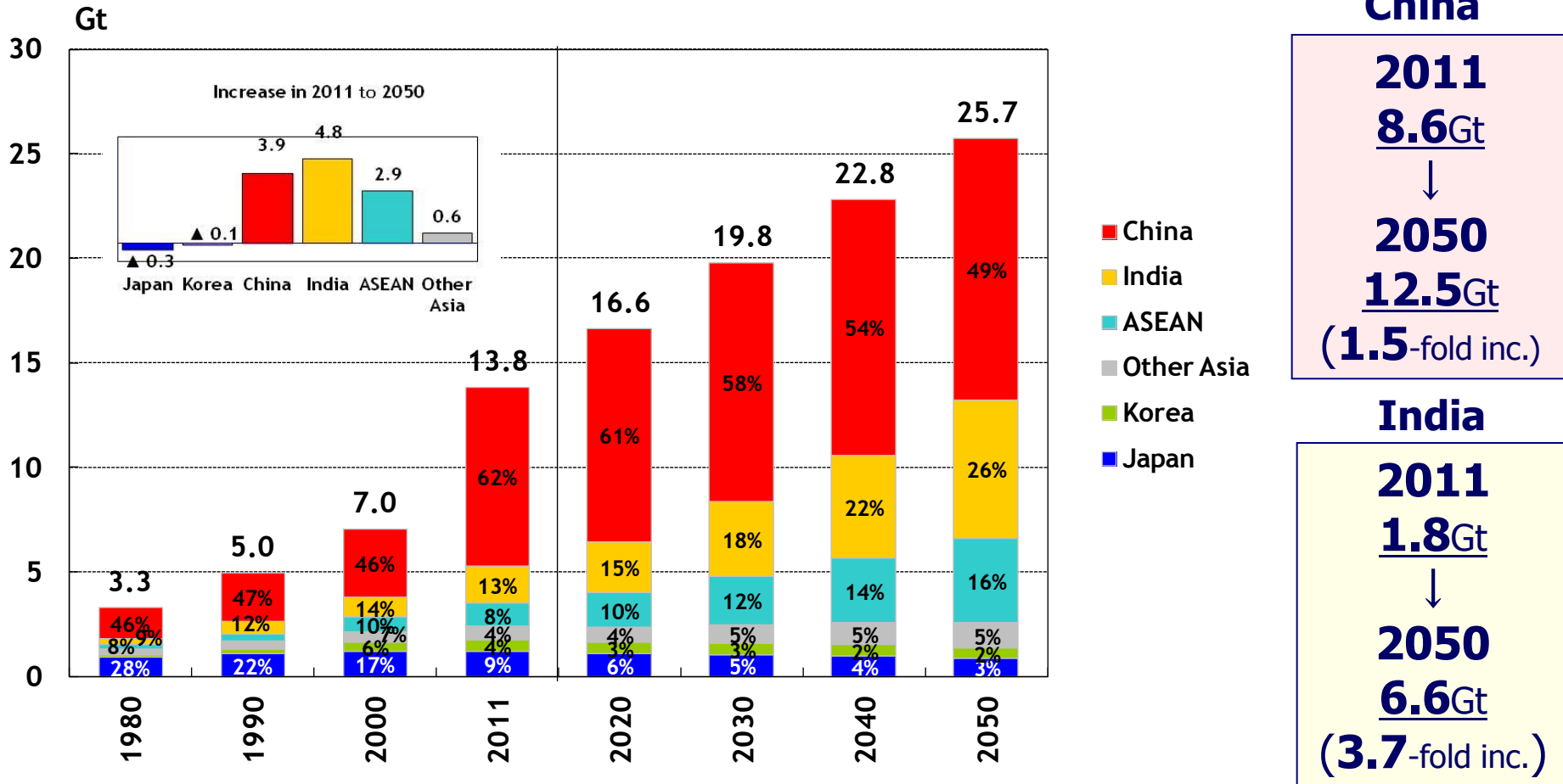
Reference
[Adv. Tech.]+CCS



■ In the Adv. Tech. Scenario, the global CO₂ emissions will be reduced by various technological options, including energy saving, enhancement of power generation efficiency, renewables, nuclear, and CCS altogether contribute to massive CO₂ emissions reduction.

CO₂ Emission by Region (Asia)

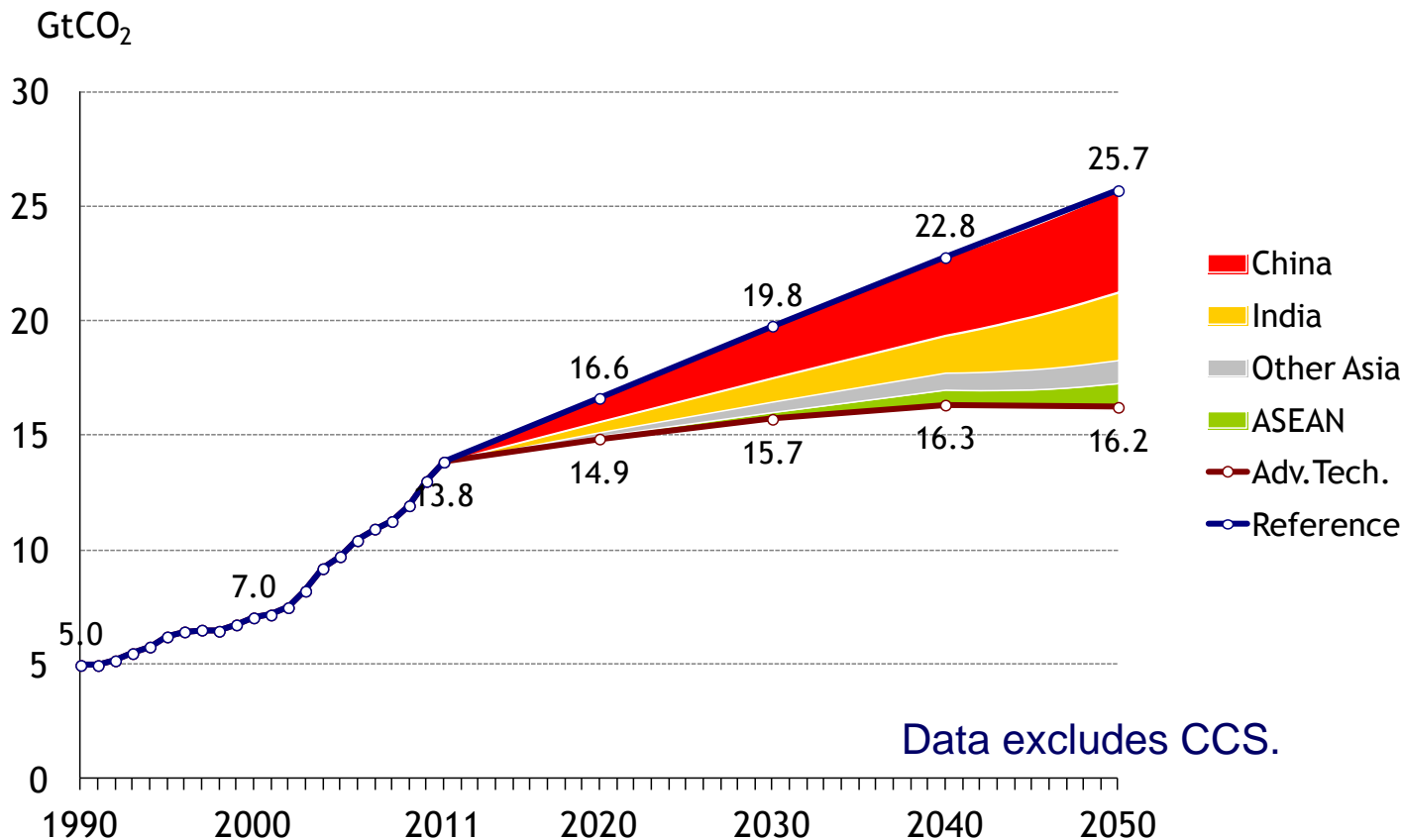
Reference



■ CO₂ 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 70%. Japan's major loss of share is taken up by "Other Asian"

■ Increase in Asia will account for about 70% of the world CO₂ emissions growth through 2050. The development of clean coal technology will play a large role to reduce CO₂ emissions in Asia.

CO₂ Reduction by Region (Asia)



Total **9.5 Gt**
(37% reduction)

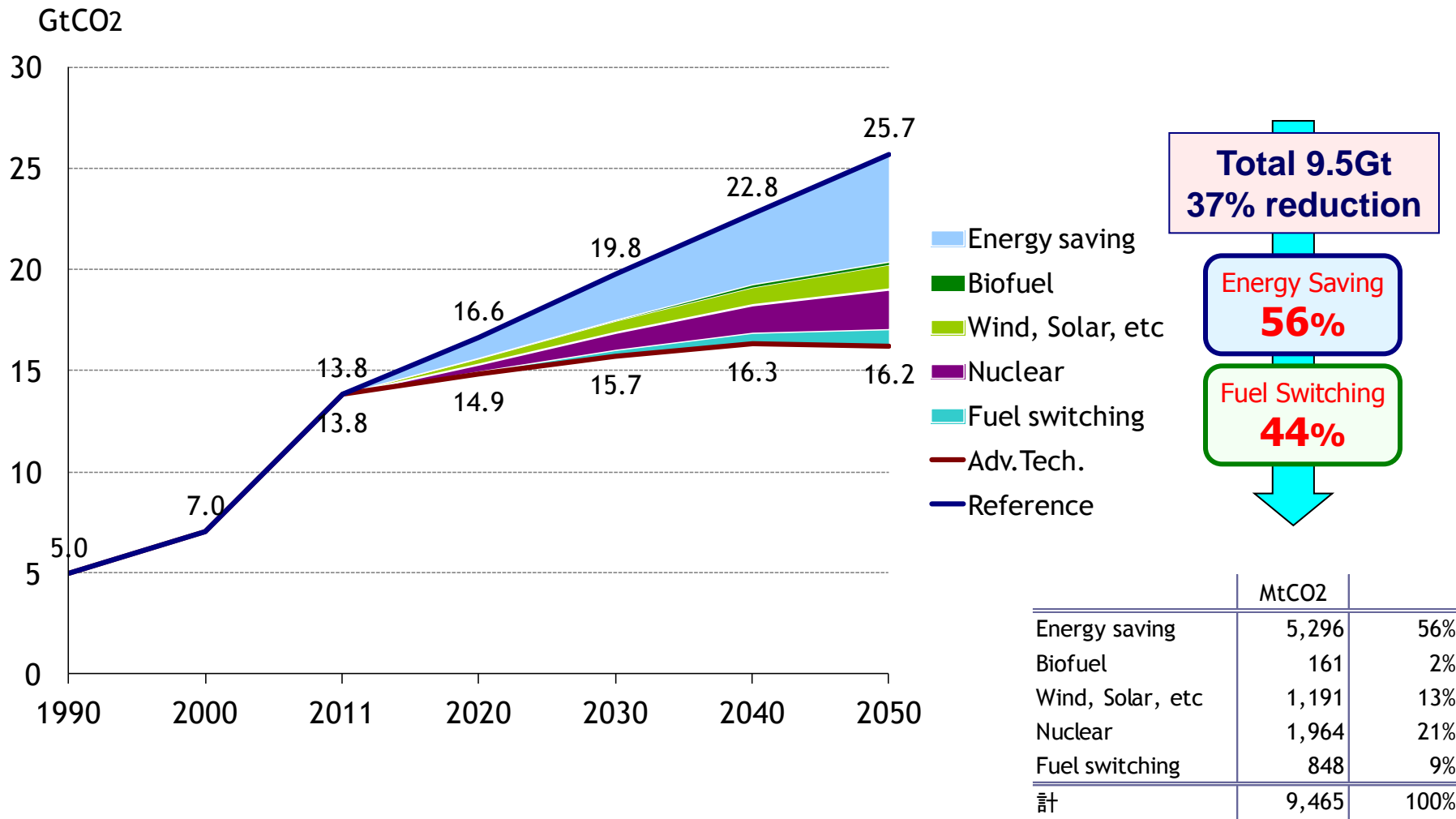
China
4.4 Gt
(47% of total)

India
3.0 Gt
(31% of total)

Other Asia
1.0 Gt
(11% of total)

- In the Adv. Tech. Scenario, 9.5Gt of CO₂ emissions in Asia will be reduced in 2050.
- China and India have great potential to reduce CO₂ emissions. China's CO₂ emissions reduction will account for 47% of Asia's reduction in 2050. India and ASEAN countries will account for the remaining 42%.

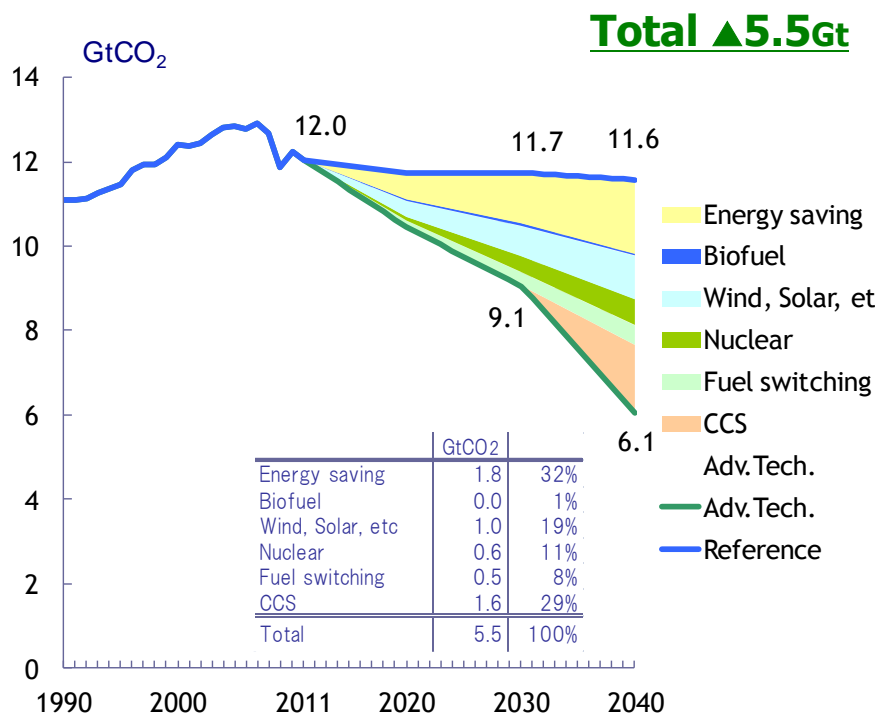
CO₂ Emissions Reduction by Technology (Asia)



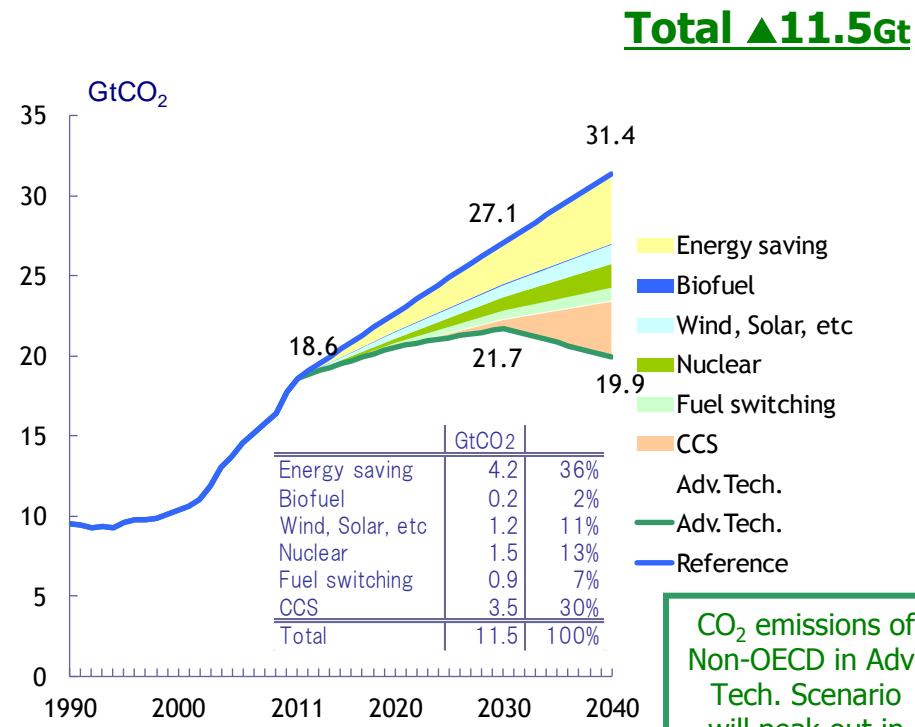
■ Aggressive development and deployment of advanced technologies in Asia enables to considerably reduce CO₂ emissions and realize its peak by 2040s.

CO₂ Emissions Reduction by Technology (OECD, and Non-OECD)

OECD



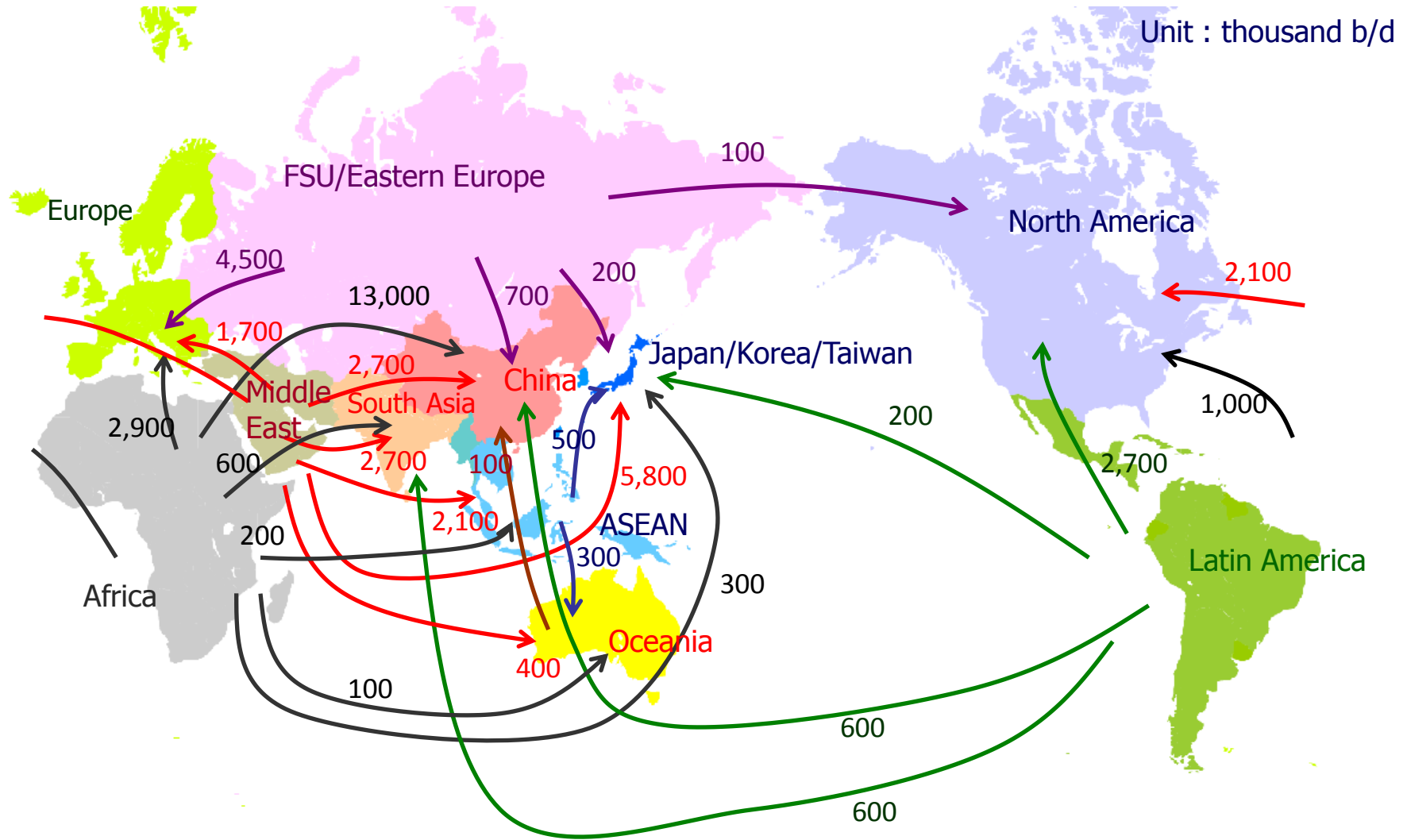
Non-OECD



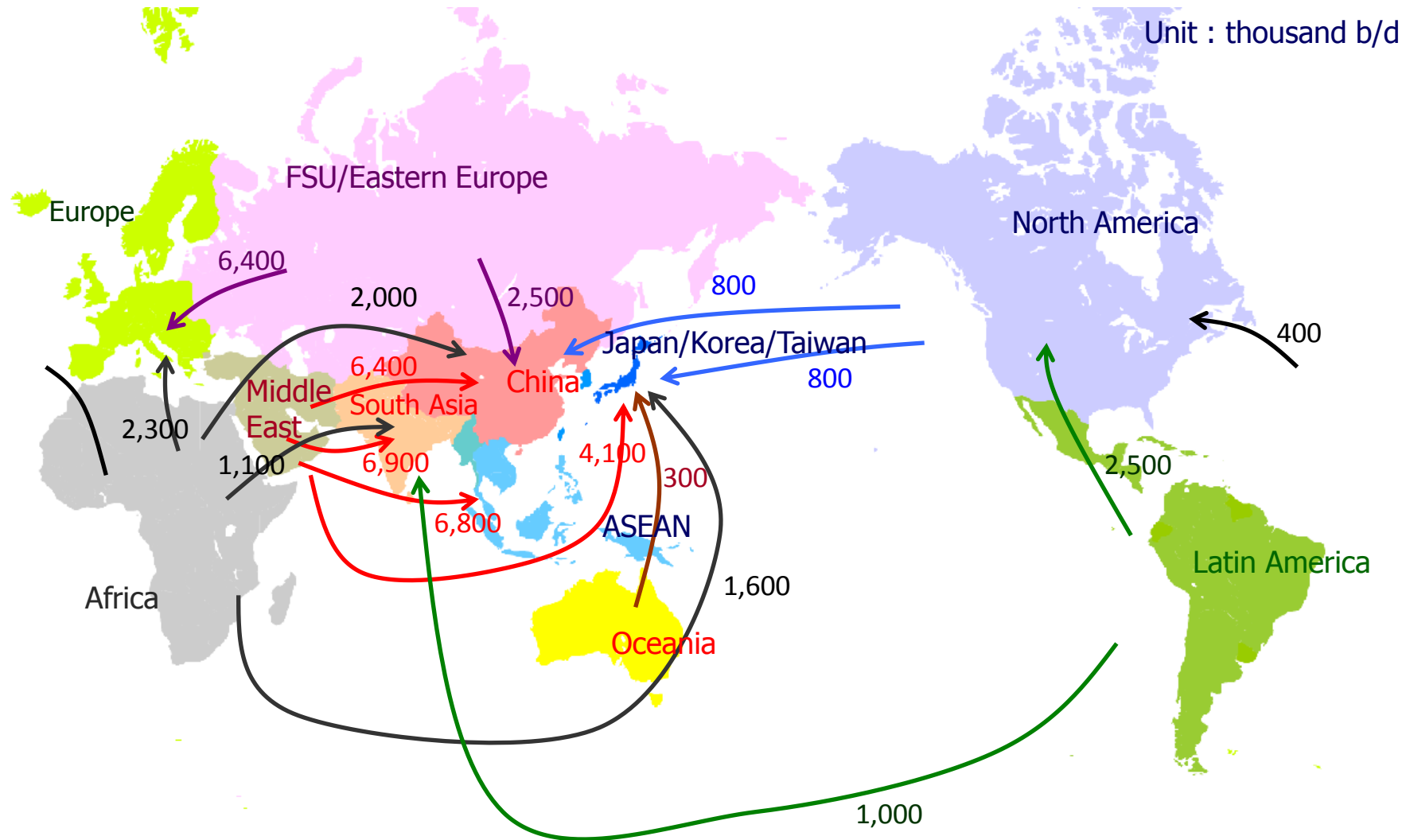
CO₂ emissions of Non-OECD in Adv. Tech. Scenario will peak out in 2030s.

- Various technologies are needed to reduce CO₂ emissions. In OECD, energy saving will be responsible for the largest share at 32% (or 1.8 Gt). It is followed by nuclear at 11% (or 0.6 Gt), renewable energy at 20% (or 1.0 Gt), fuel switching at 8% (or 0.5 Gt), and CCS at 29% (1.6 Gt).
- In Non-OECD, energy saving will be responsible for more than half of the 11.5 Gt reduction. Supportive measures concerning technology transfer and the establishment of efficiency standards are important to realize those CO₂ emissions reduction while further enhancing energy security.

Major Crude Oil Trade Flows (2012)

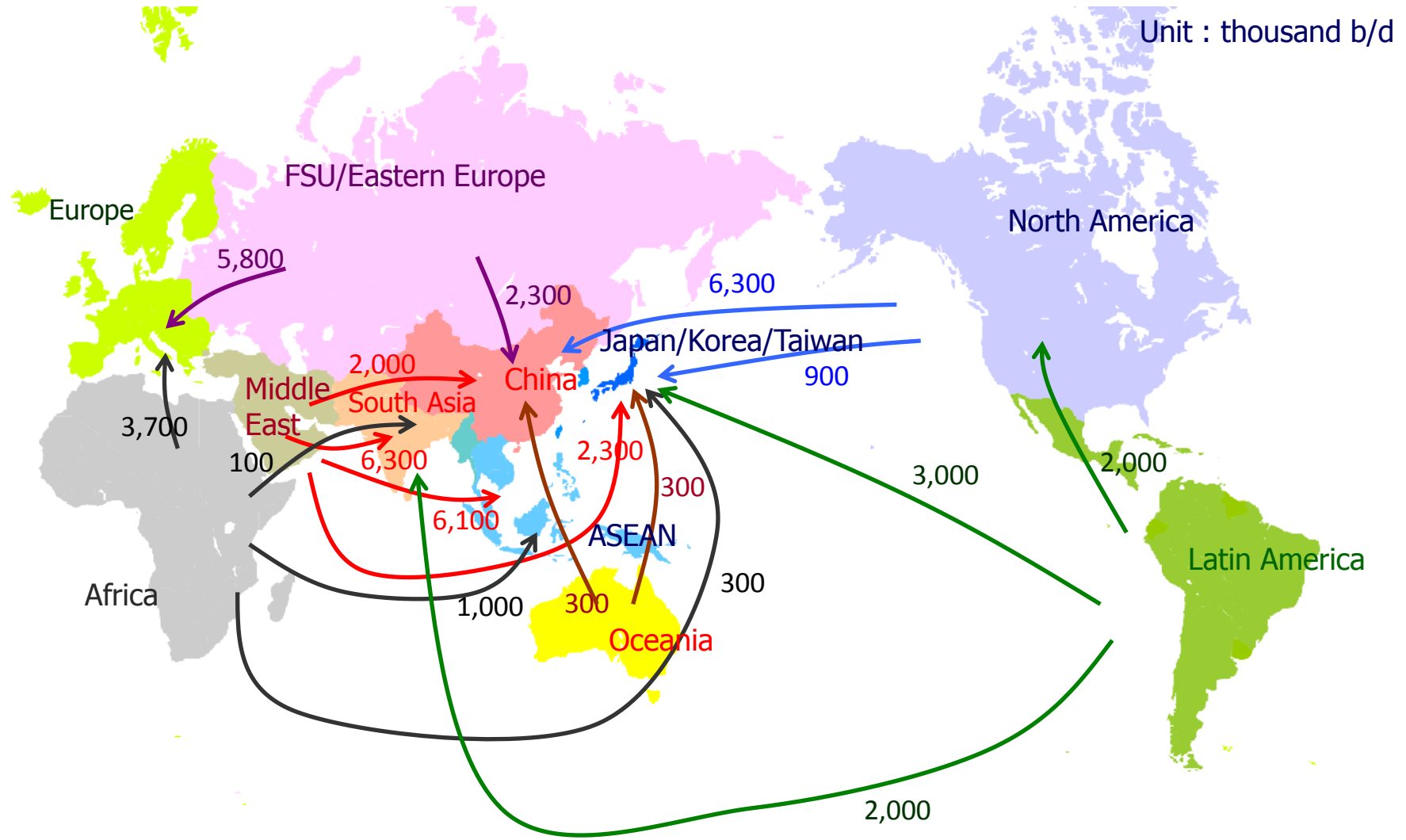


Major Crude Oil Trade Flows (2040: Reference Scenario)



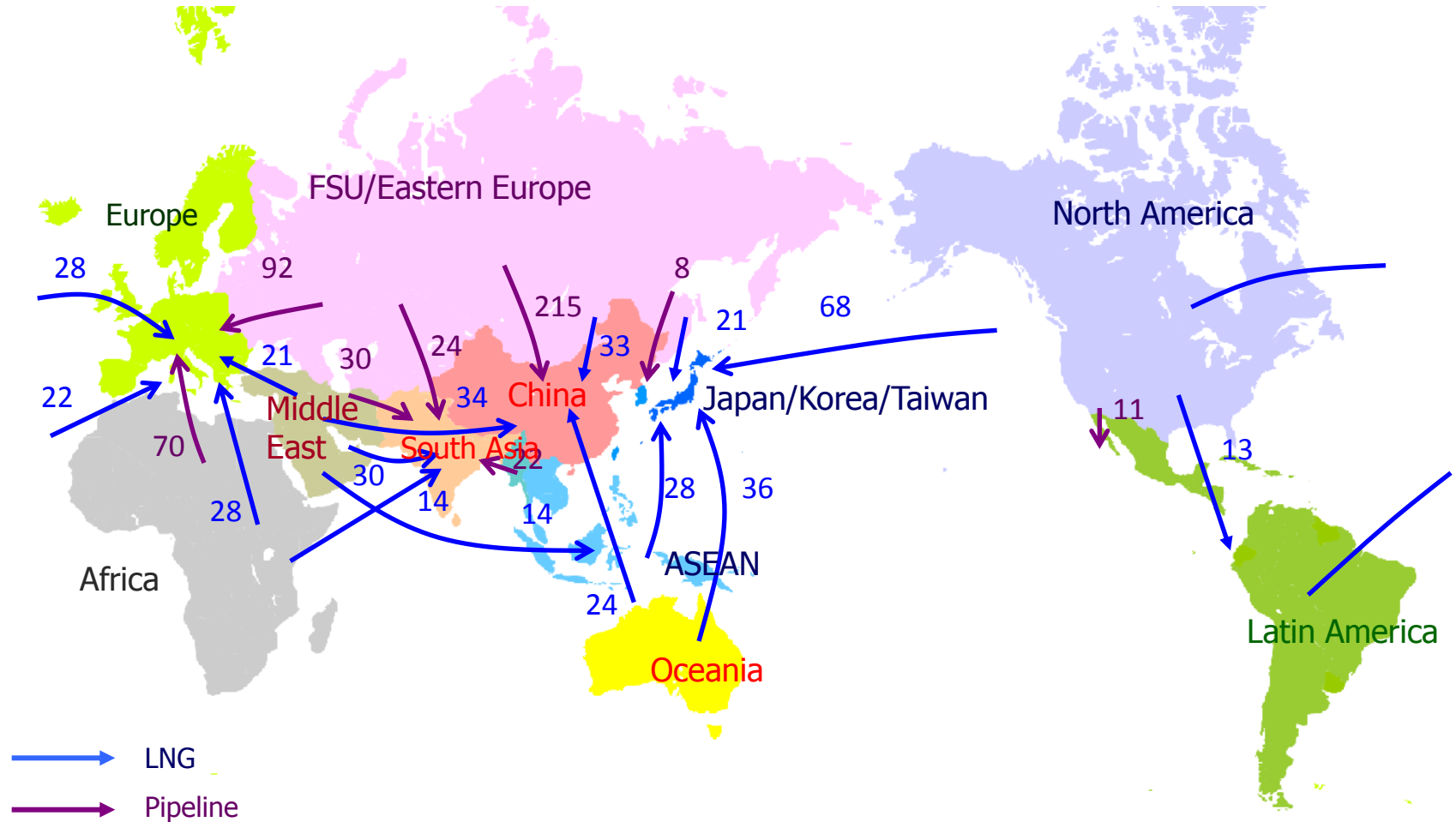
- In 2040, an export flow from North America to Asia will have been established. Crude oil imports into China will total 12 Mb/d. Its imports from various regions including the Middle East, Africa, the Former Soviet Union and North America will increase.

Major Crude Oil Trade Flows (2040: Enhanced Development Scenario)



Major Natural Gas Trade Flows (2040: Reference Scenario)

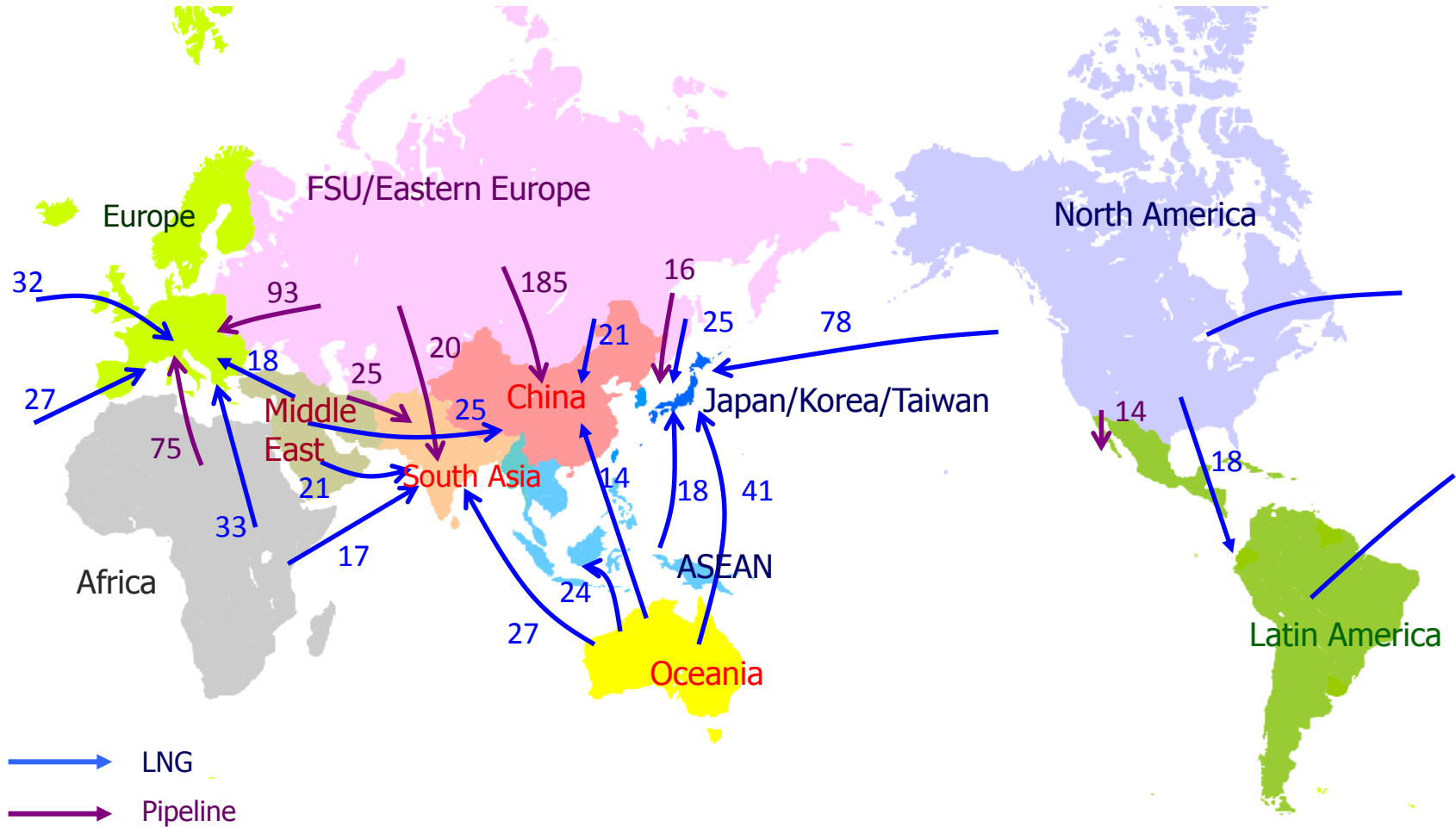
Unit : Bcm



- Exports from North America, the Former Soviet Union and Australia will expand, centering on those to Asia. Particularly, large export flows from North America will be established.

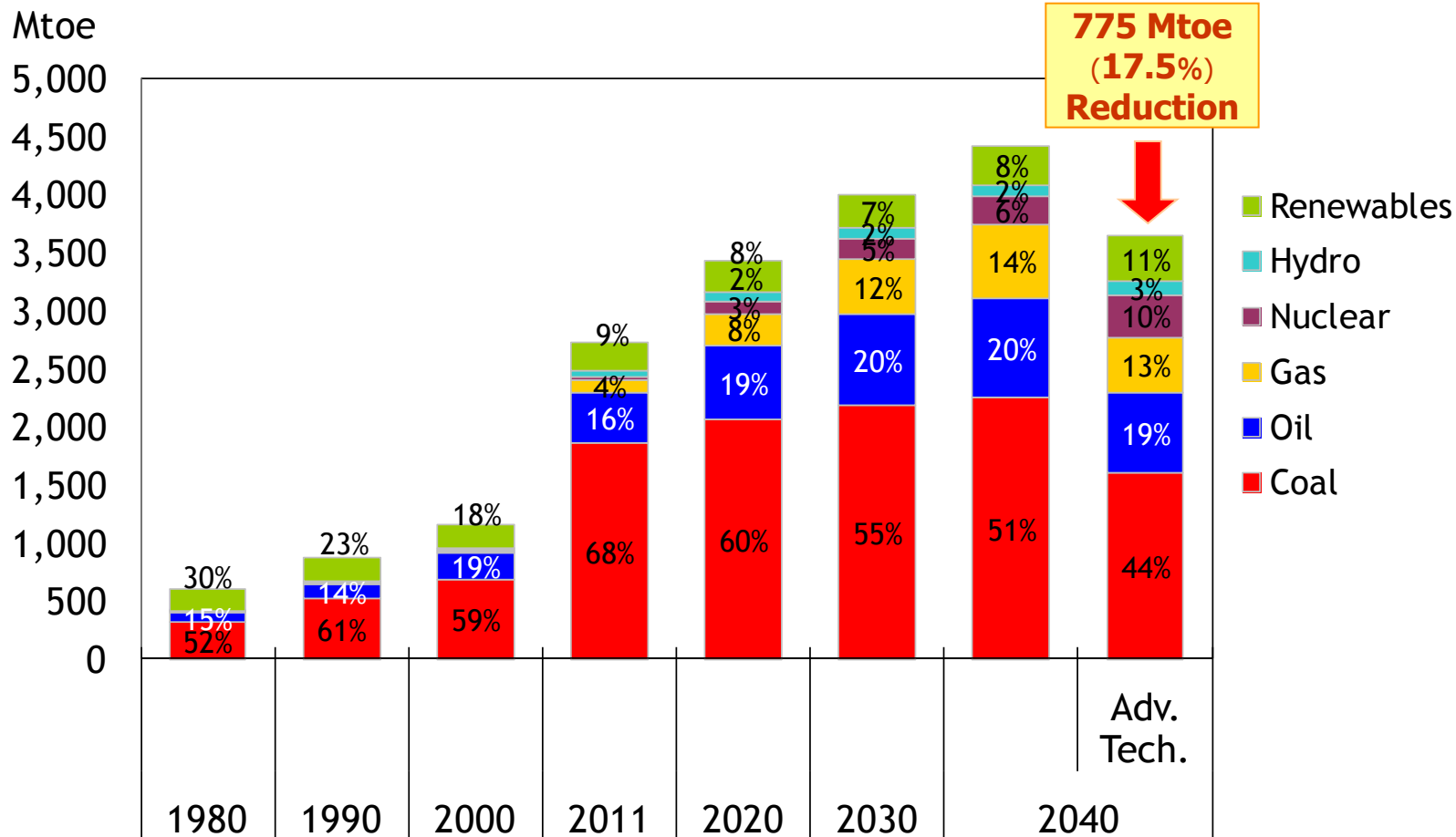
Major Natural Gas Trade Flows (2040: Enhanced Development Scenario)

Unit : Bcm



Energy Demand and Supply in China

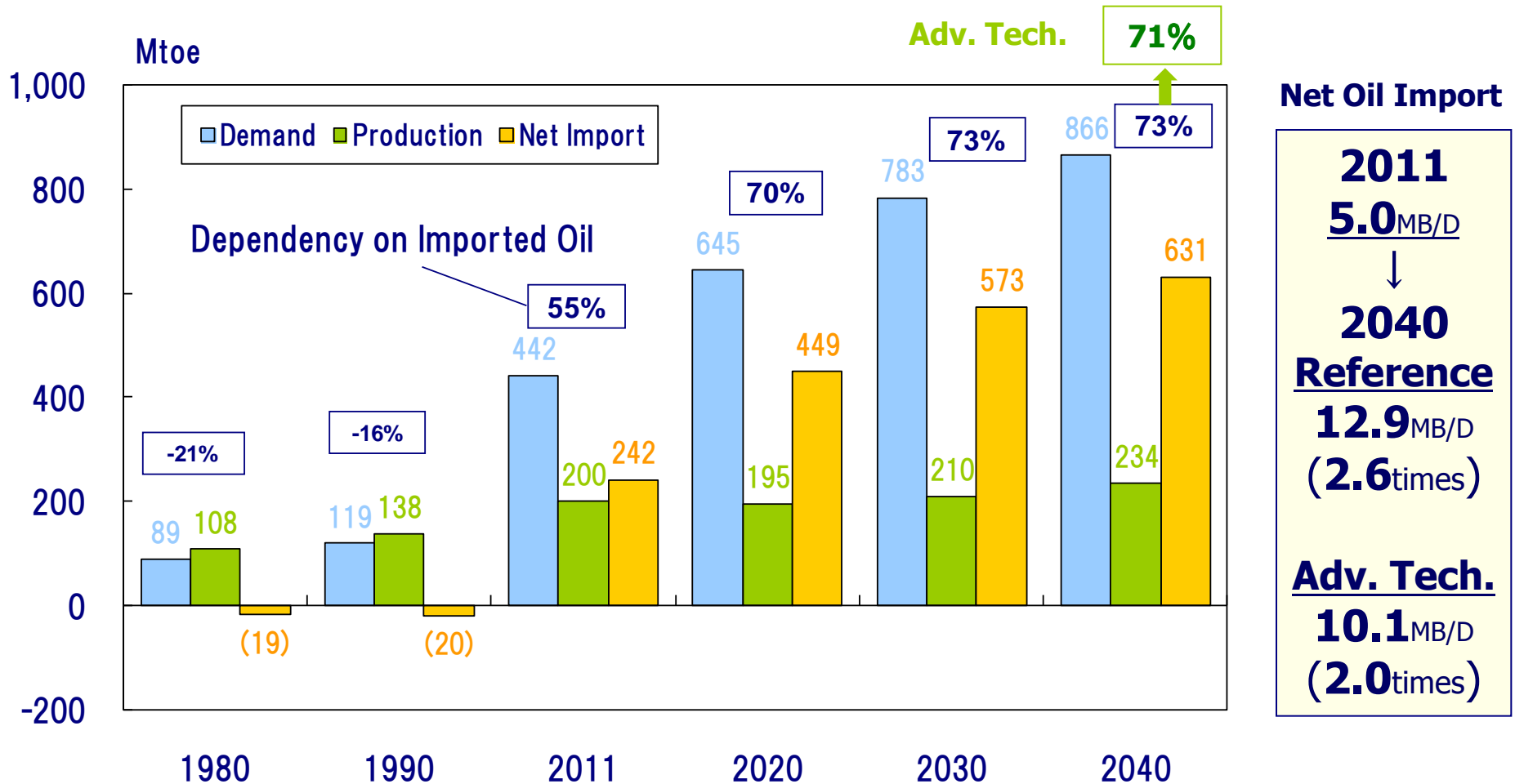
Primary Energy Demand in China

Reference
Adv. Tech.

■ TPED will increase at an annual rate of 1.7% 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.

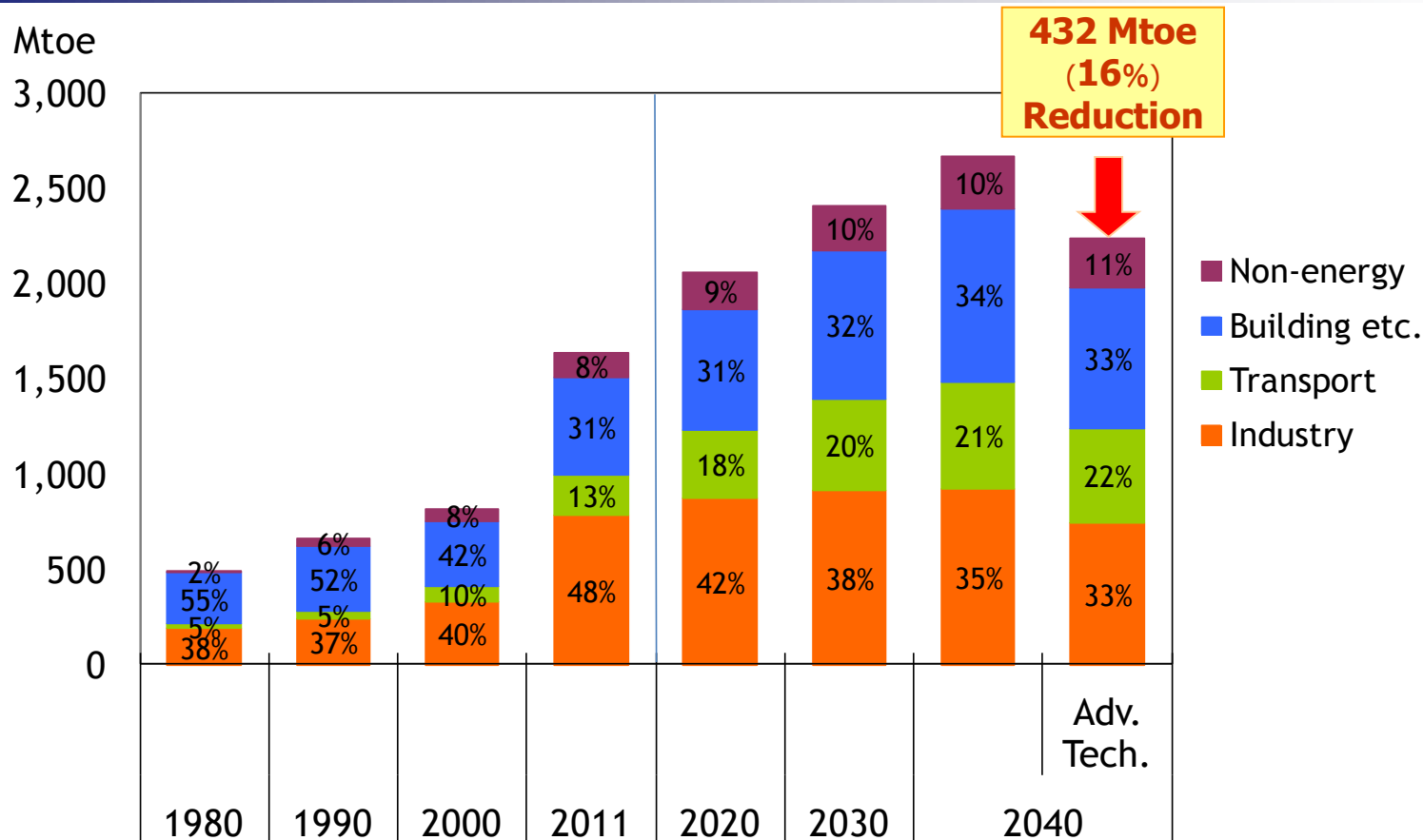
■ In the Adv. Tech. Scenario, coal demand will decrease, especially in power generation, accounting for 775 Mtoe (17.5% down) reduction compared with Reference Scenario in 2040.

Oil Demand and Supply in China



- Net oil import is projected to expand from 242 million ton (5.0mb/d) in 2011 to 631million ton (12.9 mb/d) in 2040. As a result, net oil import ratio will reach 73% in 2040 from 55% in 2011.
- In the Adv. Tech. Scenario, oil demand will grow at a relatively slow rate, but net oil import ratio will still increase to 71% in 2040.
- 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.

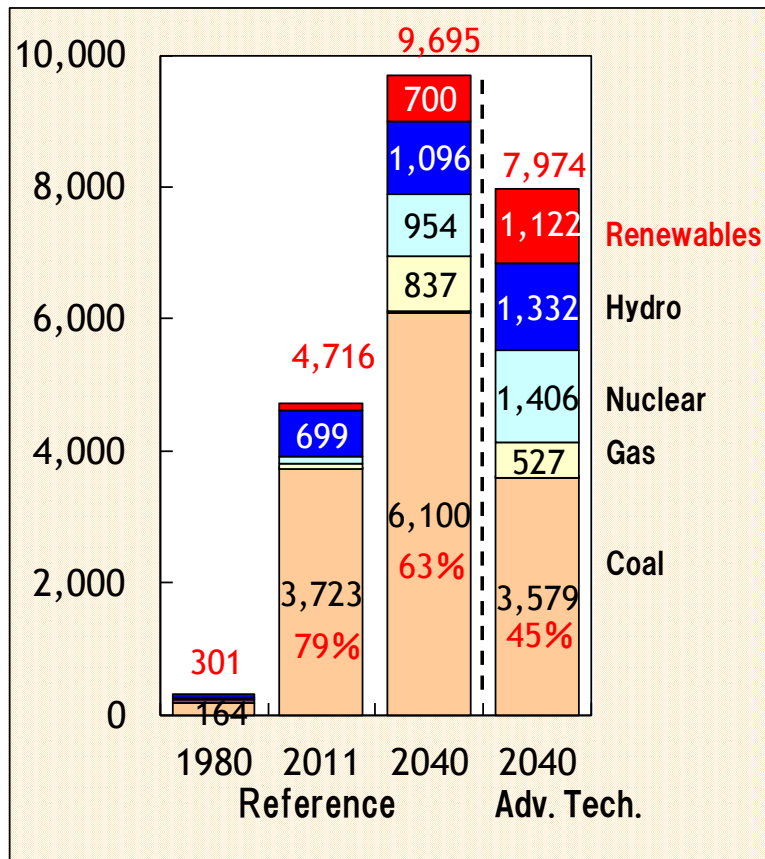
Final Energy Demand in China



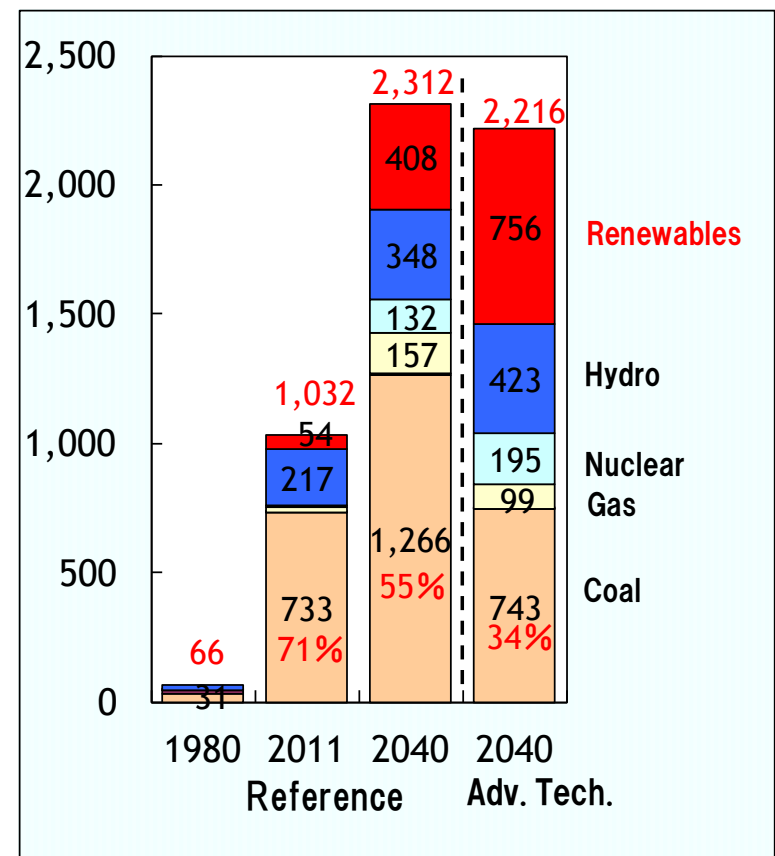
- Energy demand of heavy industry which has been strong up to now will grow relatively slowly in the future.
- By contrast, energy demand of the household, buildings, and transport sectors will increase substantially. Although the share of the household and commercial sectors will reach 34% in 2040 (from 31% in 2011), 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)】

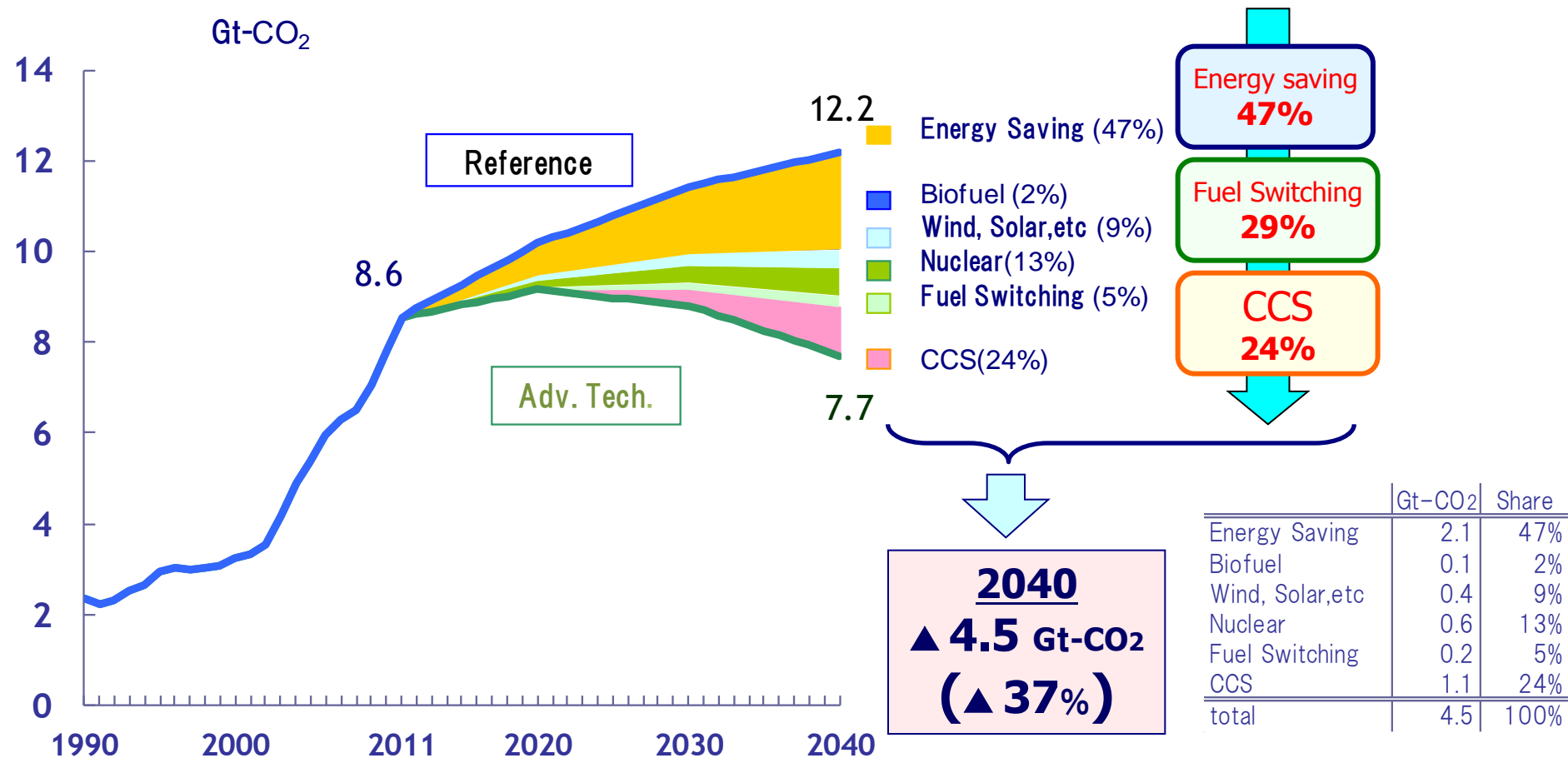


【Capacity (GW)】



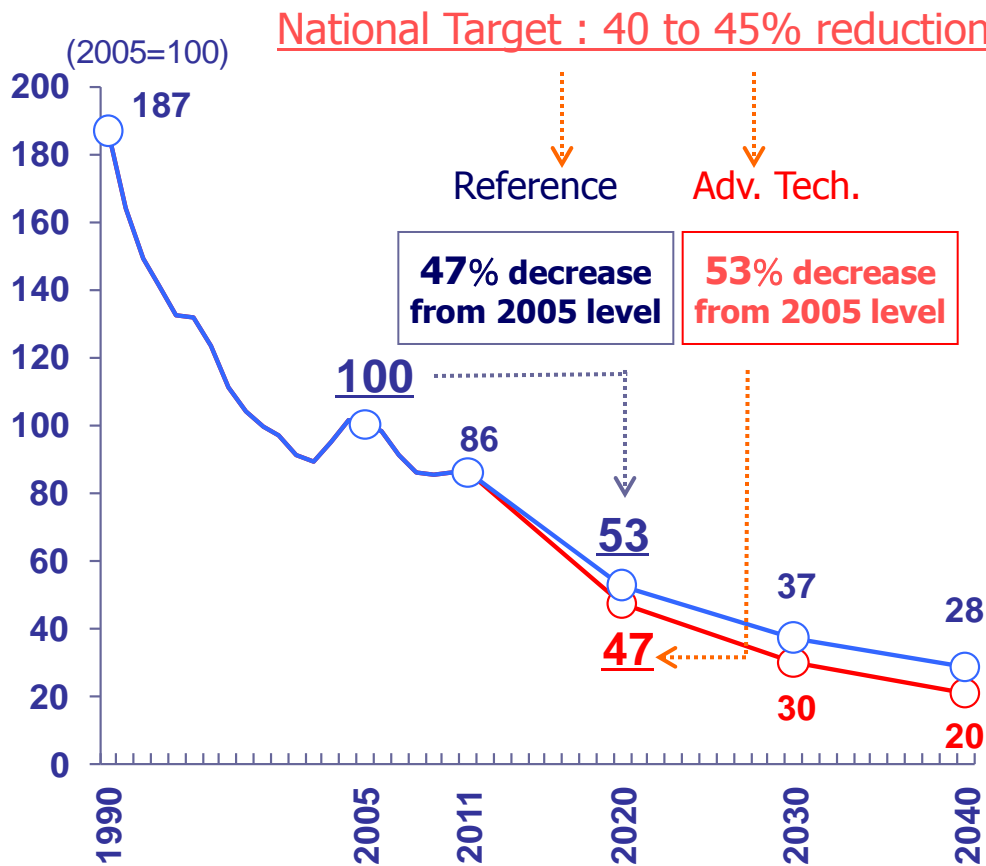
- Total power generation capacity will increase on average by 44 GW per year, from 1,032 GW in 2010 to 2,312 GW in 2040. The share of coal-fired power plant will gradually decline to 55% in 2040, still representing almost half of the world coal-fired power generation capacity.
- Total power generation will more than double, increasing from 4,716 TWh in 2011 to 9,695TWh in 2040. 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 2011 to 63% in 2040.
- In the Adv. Tech. Scenario, generation from nuclear, hydro and renewable energy will sharply expand to substitute a further decline in coal-fired generation.

CO₂ Emissions in China



- In the Reference Scenario, CO₂ emissions will increase by 3.6Gt (up 42%) between 2011 to 2040.
- In the Adv. Tech. Scenario, CO₂ emissions will be 4.5 Gt (down 37%) lower than the Reference Scenario in 2040.
- CO₂ emissions will peak during 2020s due to energy saving and fuel switching to non-fossil fuels.

CO₂ Emissions per GDP



Decomposition Analysis of CO₂ Emissions

	1990-2005	2005-2020	
		Reference	Adv. Tech.
CO ₂ Emission ΔC	5.7	4.3	3.6
Carbon Intensity Δ(C/E)	0.8	▲ 0.1	▲ 0.4
Energy Saving Δ(E/Y)	▲ 4.8	▲ 4.1	▲ 4.5
Economy Growth ΔY	10.2	8.9	

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

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

Decarbonization / Energy-Saving / Economic-Growth

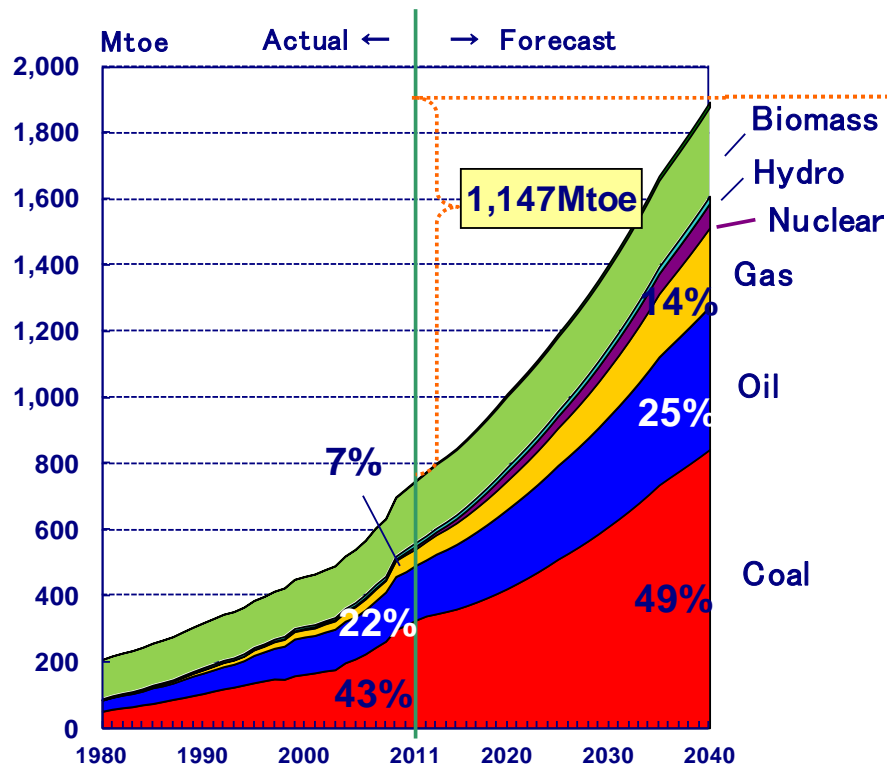
- In November 25, 2009, the State Council of the Chinese government decided to improve CO₂ intensity (calculated as CO₂ emissions per GDP) by 40%-45% from the 2005 level by 2020.
- The projected CO₂ emissions intensity (per GDP) will substantially improve beyond the official targets. The reduction is 47% in the Reference Scenario and 53% in the Adv. Tech. Scenario.

Energy Demand and Supply in India

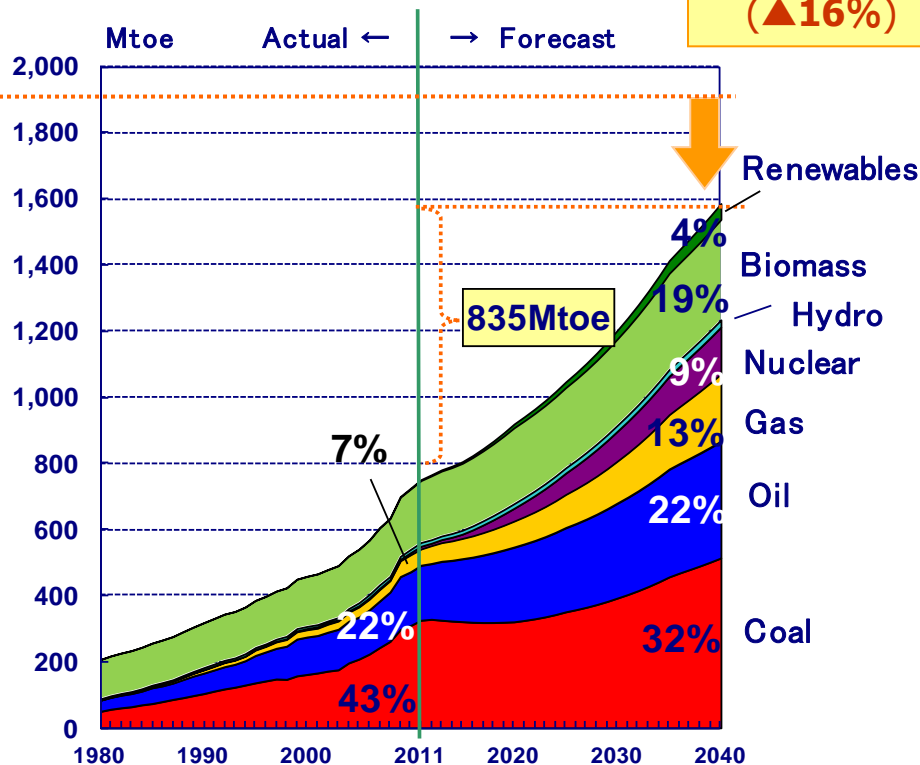
Primary Energy Demand in India

Reference
Adv. Tech.

Reference Scenario

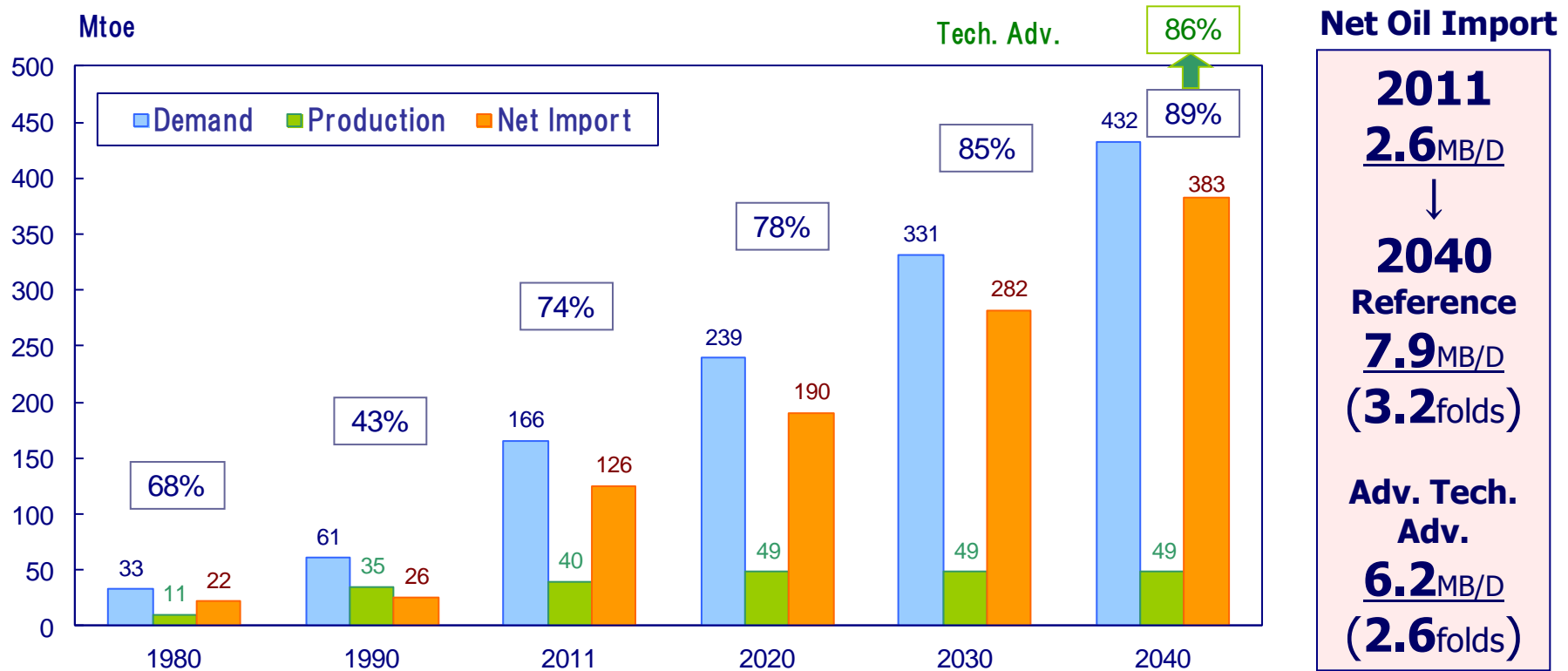


Adv. Tech. Scenario



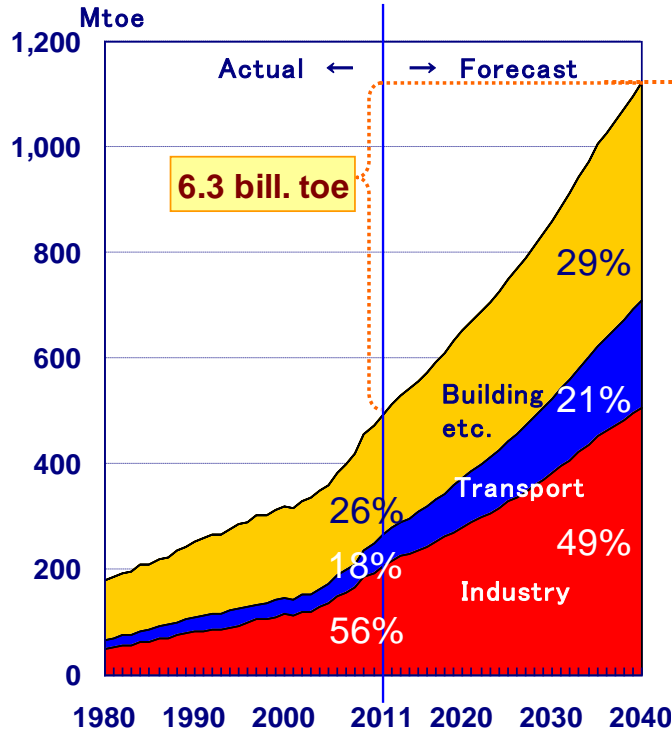
- In the Reference Scenario, TPED will increase at annual rate of 3.3%. Fossil fuels will account for 90% of the incremental energy growth by 2035.
- Driven by the power and industry sectors, coal demand will maintain the largest share at about 49% throughout the projection period.
- The power and industry 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 2040, compared with the Reference Scenario, TPED will be 312 Mtoe lower (16%) in the Adv. Tech. Scenario.

Oil Demand and Supply in India

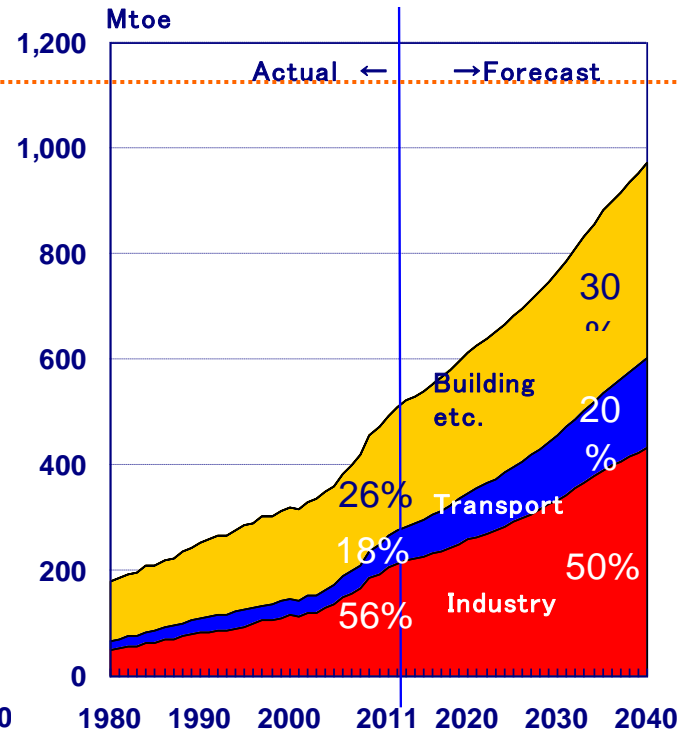


- Net oil import is projected to expand from 126 million ton (2.6mb/d) in 2011 to 383 million ton (7.9 Mb/d) in 2040. Net oil import ratio will reach 89% in 2040.
- In the Advanced Technologies scenario, net oil import ratio will reach 86% by 2040.

Reference Scenario



Adv. Tech. Scenario



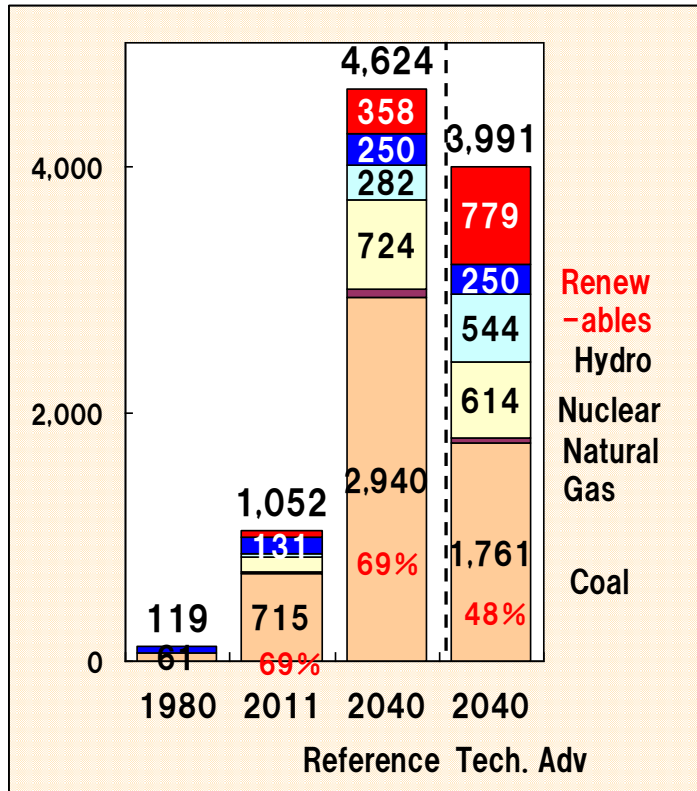
▲0.15
bill. toe
(▲13%)

(The industry sector includes non-energy use)

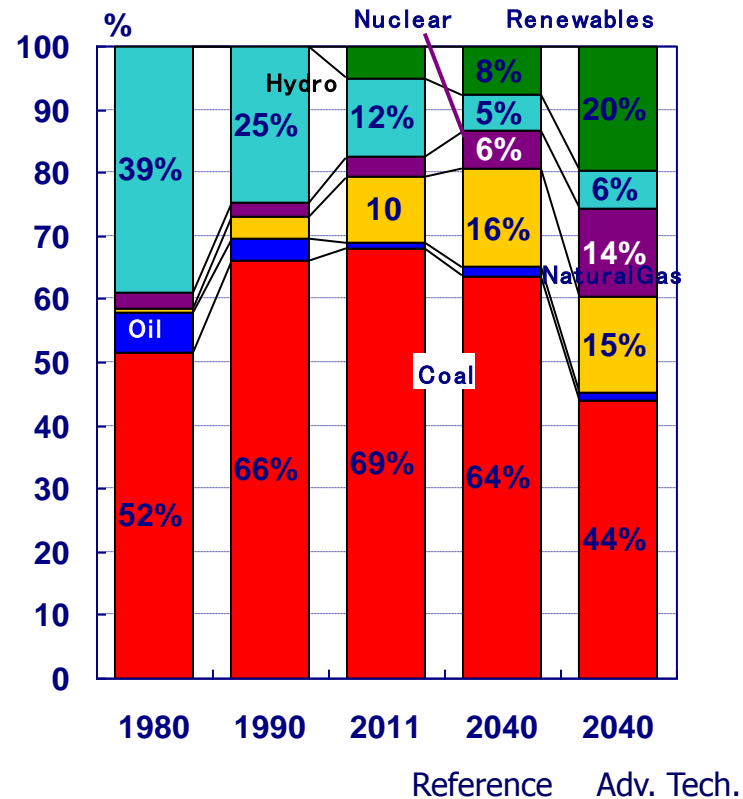
- Industry will increase rapidly due to industrialization and production increases from the heavy industry.
- Electricity demand grows at an annual rate of 5.5%.
- In the Adv. Tech. Scenario, energy demand will be 150 Mtoe lower (13%) in 2040 compared with the Reference Scenario.

Power Generation Mix in India

【Power Generation】



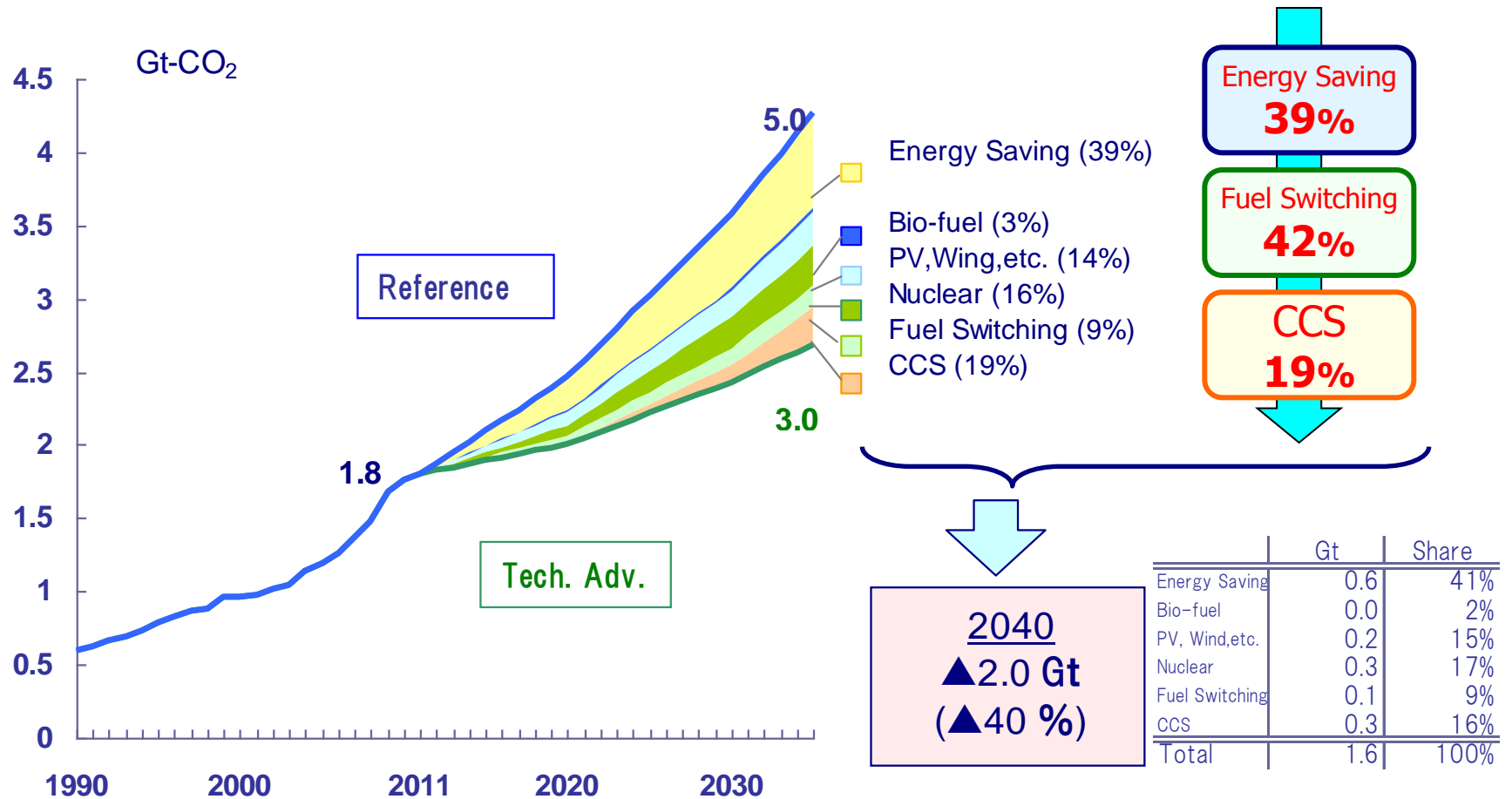
【Power Generation Mix】



- 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 4.6 GW in 2011 to 30GW in 2030 (an 6.6-fold increase).

CO₂ Emissions Reduction in India

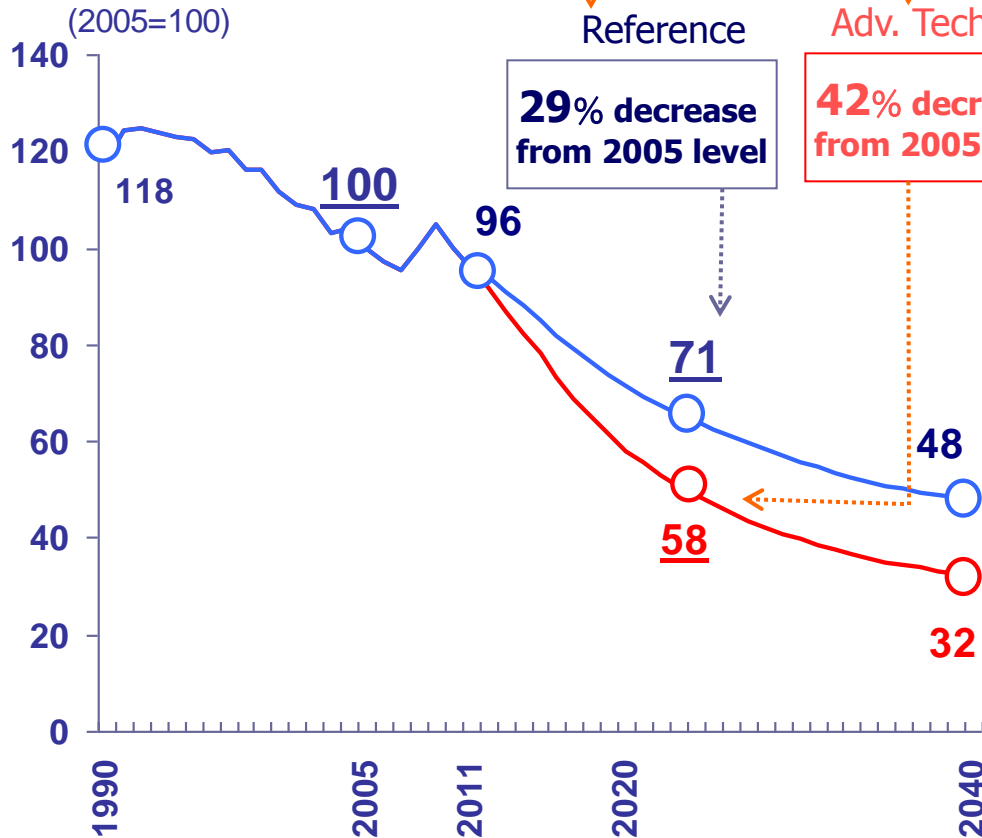
Reference
Adv. Tech.



- In the Reference Scenario, CO₂ emission will increase by 3.2 Gt (175%) in 2040 from 2011.
- In the Adv. Tech. Scenario, CO₂ emissions will be 2.0 Gt (40%) lower from the Reference Scenario.

CO₂ Emissions per GDP

National Target : 20 to 25% reduction by 2020



Decomposition Analysis of CO₂ Emissions

	1990-2005	2005-2020	
		Reference	Tech. Adv.
CO ₂ Emissions ΔC	4.8	5.0	3.5
Carbon Intensity Δ(C/E)	1.1	0.6	▲ 0.1
Energy Saving Δ(E/Y)	▲ 2.2	▲ 2.9	▲ 3.5
Economic Growth ΔY	6.0	7.4	

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

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

Decarbonization / Energy-Saving/ Economic-Growth

- India announced to improve its CO₂ intensity (calculated as CO₂ emissions per GDP) by 20 to 25% from 2005 level by 2020.
- The improvement in CO₂ emissions per GDP in 2020 will exceed those targets reaching 29% in the Reference Scenario and 42% in the Adv. Tech. Scenario.

Asia/World Energy Outlook through 2050

GDP, Population and Energy Price

	2011	2040	2050
GDP (2010 real price)	65 tril. \$ (AAGR in 1990-2011:2.8%)	151 tril. \$ (AAGR in 2011-2040:2.9%)	189 tril. \$ (AAGR in 2040-2050:2.3%) (AAGR in 2011-2050:2.9%)
Population	7.0 bil.	9.1 bil. (2.1 bil. increase from 2011)	9.6 bil. (2.6 bil. increase from 2011)
GDP per Capita	9 thousand \$	17 thousand \$	20 thousand \$
Oil Price (On a Japanese CIF basis, 2012 real price)	(2012) 115 \$/bbl	127 \$/bbl (Nominal price:221 \$/bbl)	130 \$/bbl (Nominal price:276 \$/bbl)

- Global GDP will grow annually at 2.9% from 2011 to 2050.
- World total population will expand from 7.0 bil. in 2011 to 9.6 bil. in 2050.
- Crude oil price (on a Japanese CIF basis, 2012 real price) is assumed to increase from 115\$/bbl in 2012 to 130 \$/bbl in 2050.

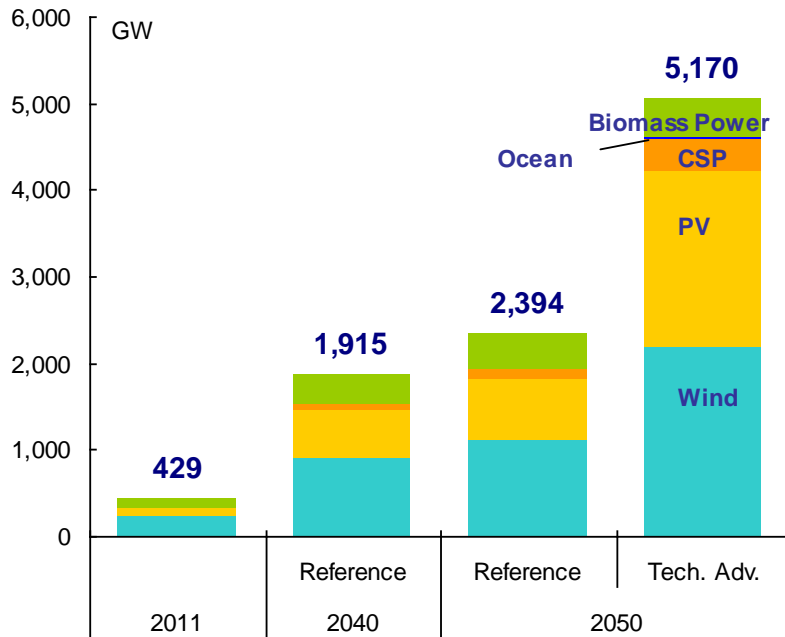
Assumed Energy and Environmental Technologies

	2011 Actual	2040		2050	
		Reference	Adv. Tech.	Reference	Adv. Tech.
Nuclear	388 GW	631 GW	885 GW	717 GW	1,058 GW
Conversion Efficiency	Coal: 35% Gas: 41%	Coal: 39% Gas: 49%	Coal: 40% Gas: 57%	Coal: 41% Gas: 50%	Coal: 43% Gas: 53%
Photovoltaic	89 GW	548 GW	1,458 GW	708 GW	2,025 GW
CSP	0.8 GW	65 GW	187 GW	94 GW	372 GW
Wind	229 GW	905 GW	1,710 GW	1,120 GW	2,195 GW
Biomass Power Gen.	99 GW	344 GW	392 GW	403 GW	448 GW
Biofuel	61 Mtoe	190 Mtoe	249 Mtoe	221 Mtoe	283 Mtoe
CCS	-	0	5.1 bil. Ton	0	5.9 bil. Ton
Adv. Vehicle in Annual Sales PHEV EV/FCV	-	7% 1%	19% 29%	10% 4%	16% 36%
Average Fuel Efficiency of new vehicle sales	(2010) 14 km/L	19 km/L	28 km/L	20 km/L	30 km/L

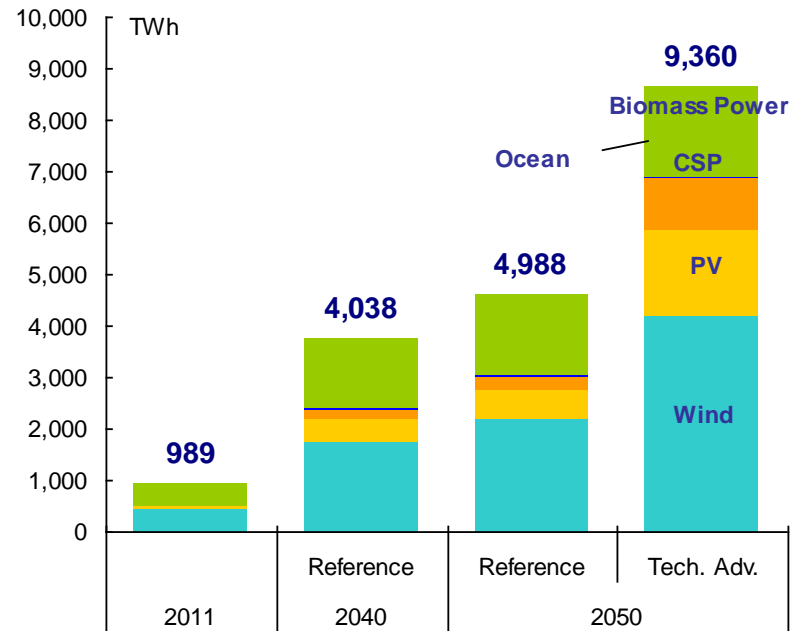
CSP: Concentrated Solar Power, **CCS:** Carbon Capture and Storage,
PHEV: Plug-in Hybrid Electric Vehicle, **EV:** Electric Vehicle, and **FCV:** Fuel Cell Vehicle

Renewable Power Generation (World)

Electric Power Capacity

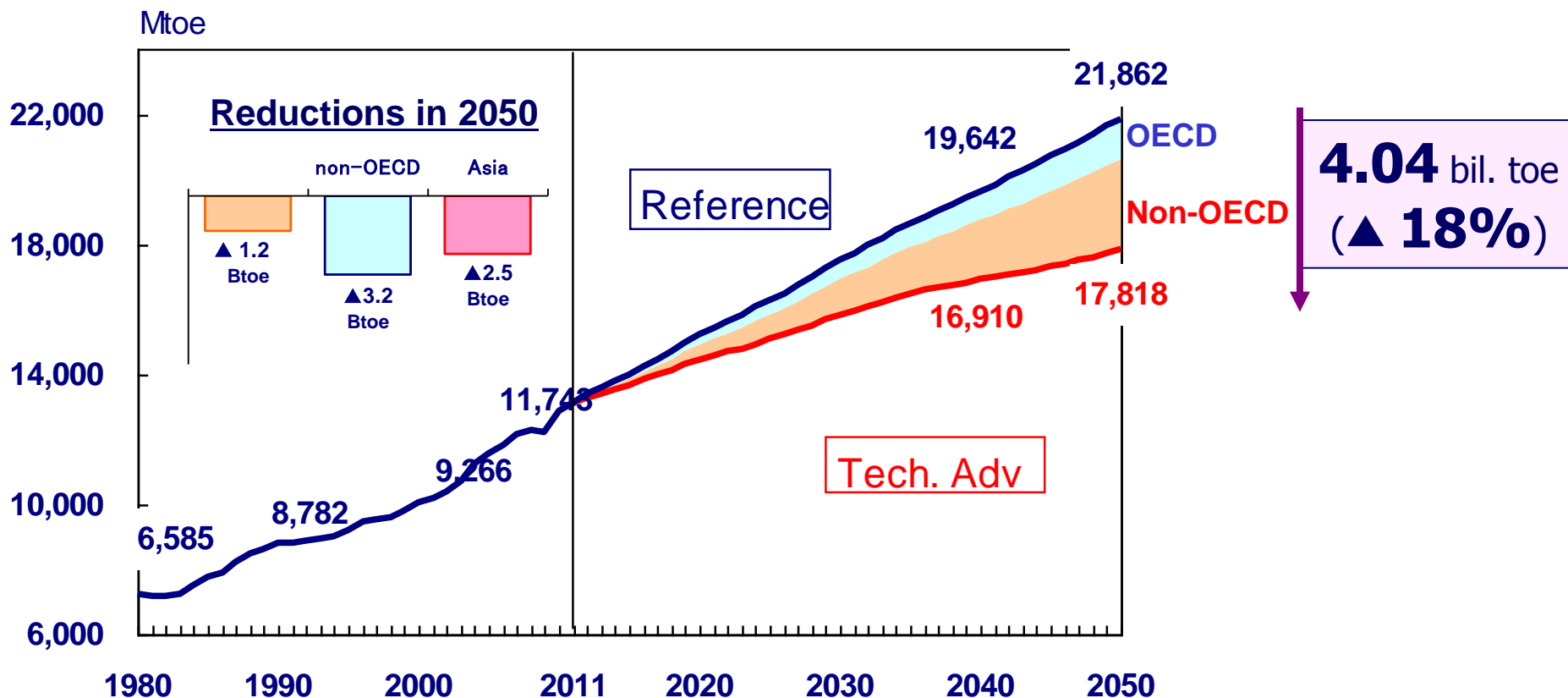


Electric Power Generation



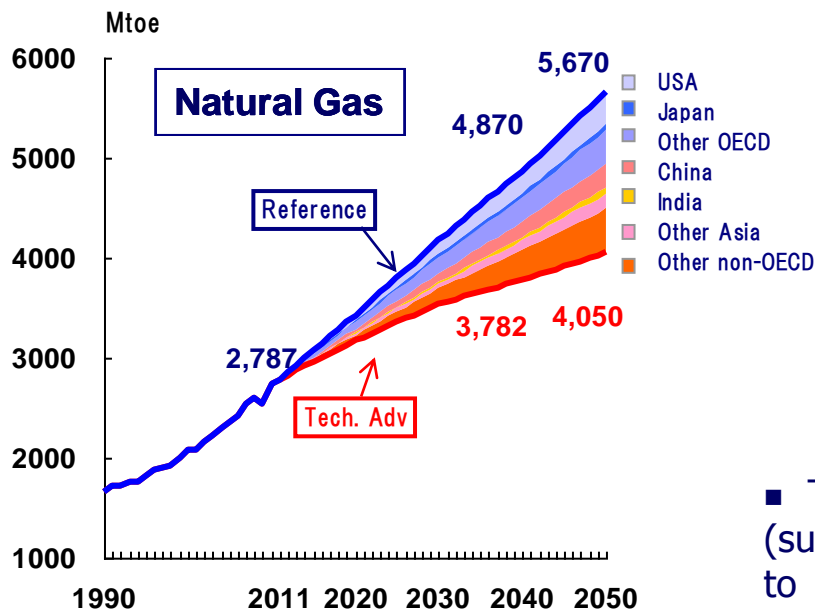
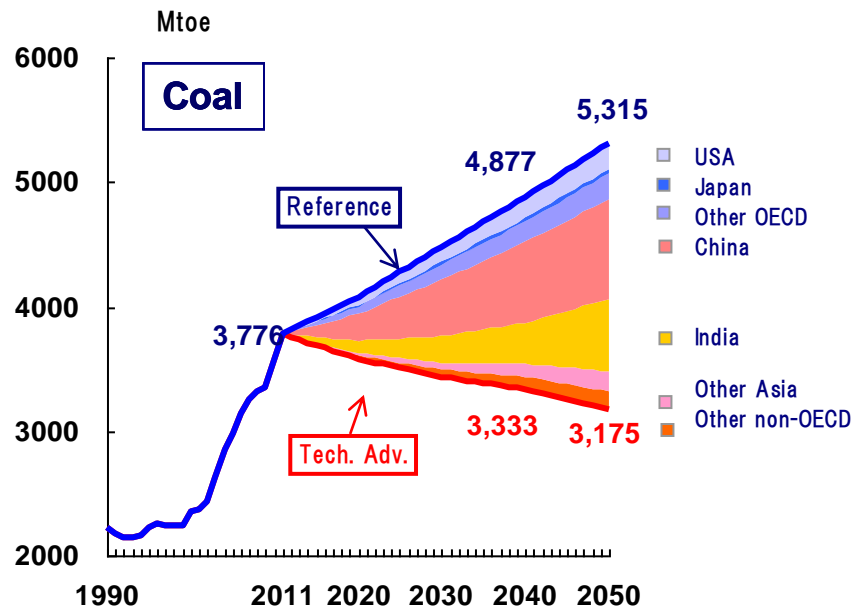
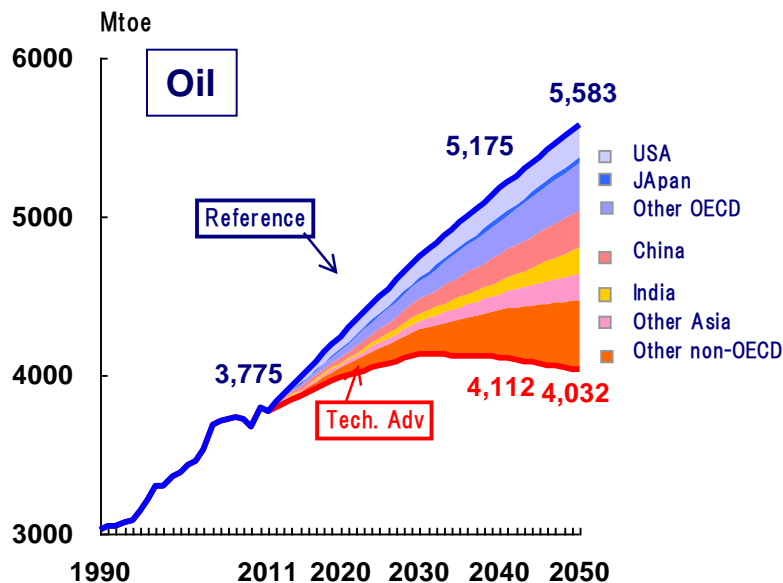
- In the Adv. Tech. Scenario, by 2050, renewable power generation capacity, excluding hydro, will expand 12 times as much as that of 2011.
- Wind power capacity in 2050 will exhibit a 10-fold increase compared with that in 2011; PV capacity, 23-fold increase; CSP capacity, 447-fold increase; ocean energy capacity, 83-fold increase; biomass capacity, 5-fold increase.

Primary Energy Demand (World)

Reference
Adv. Tech.

■ In 2050, world primary energy demand in the Adv.Tech. Scenario will be decreased by 4.04 Btoe in comparison with the Reference Scenario. The demand by OECD and non-OECD will be decreased by 1.2 Btoe and 3.2 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	207	13%
Japan	37	2%
Other OECD	298	19%
China	240	15%
India	166	11%
Other Asia	160	10%
Other non-OECD	443	29%
OECD	542	35%
non-OECD	1,009	65%
Developing Asia	566	36%
World	1,551	100%

(Coal)

	Mtoe	Share
USA	210	10%
Japan	38	2%
Other OECD	206	10%
China	804	38%
India	578	27%
Other Asia	162	8%
Other non-OECD	142	7%
OECD	454	21%
non-OECD	1,686	79%
Developing Asia	1,544	72%
World	2,140	100%

(Natural Gas)

	Mtoe	Share
USA	339	21%
Japan	56	3%
Other OECD	333	21%
China	239	15%
India	69	4%
Other Asia	144	9%
Other non-OECD	441	27%
OECD	727	45%
non-OECD	893	55%
Developing Asia	452	28%
World	1,620	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