The 3rd Qatar-Japan Joint Seminar On Technical and Economic Energy Issues

Energy Market in Asia:
- Energy & Natural Gas Outlook to 2035 -

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Koji Morita
Director and Senior Research Fellow, IEEJ

Outline of the Presentation

1. Asia/World Energy Outlook 2009
   （Reference Scenario）
2. Asia/World Energy Outlook 2009
   (Technology Advanced Scenario)
3. Summary and Conclusion

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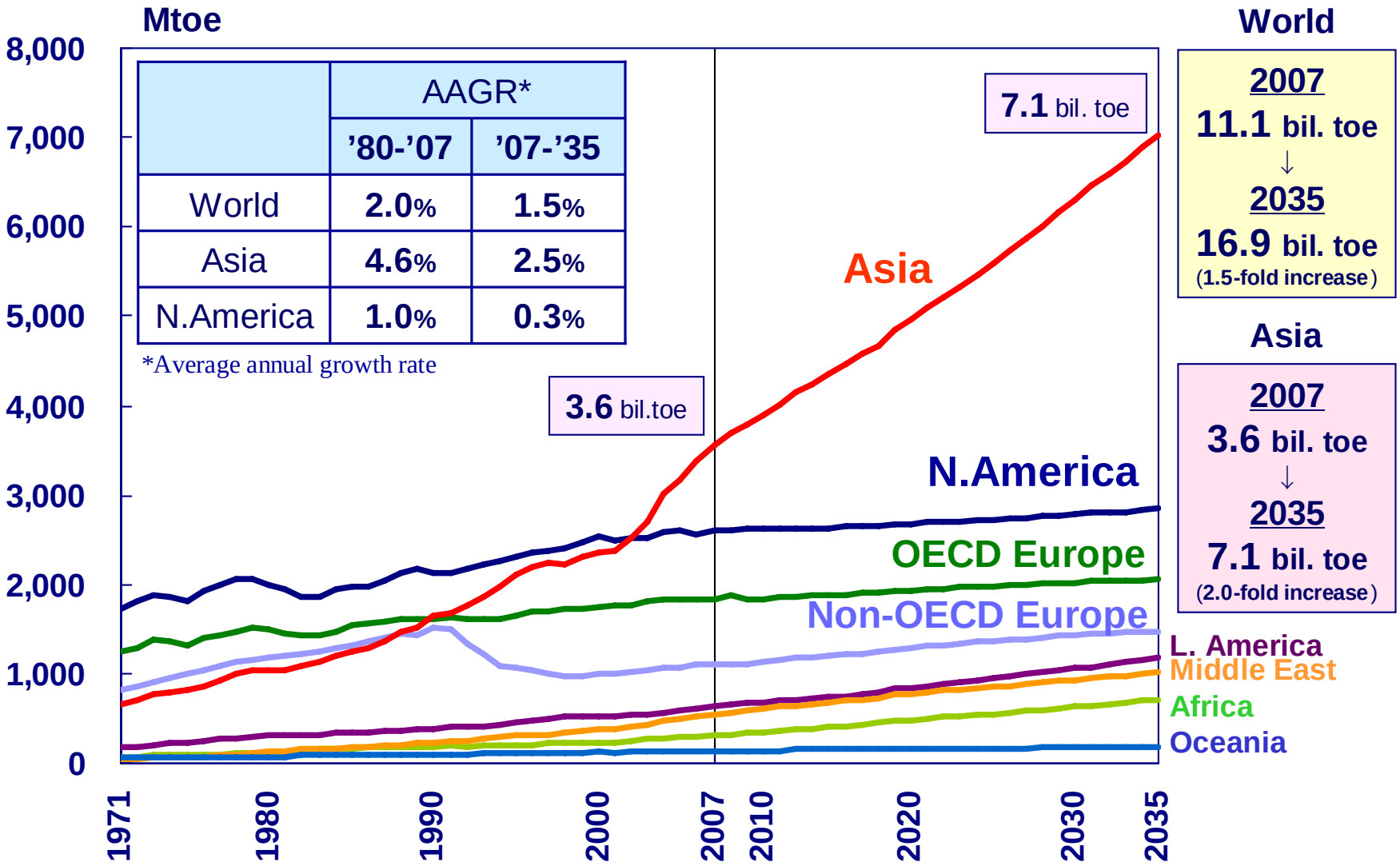
Primary Energy Demand by Region ; World



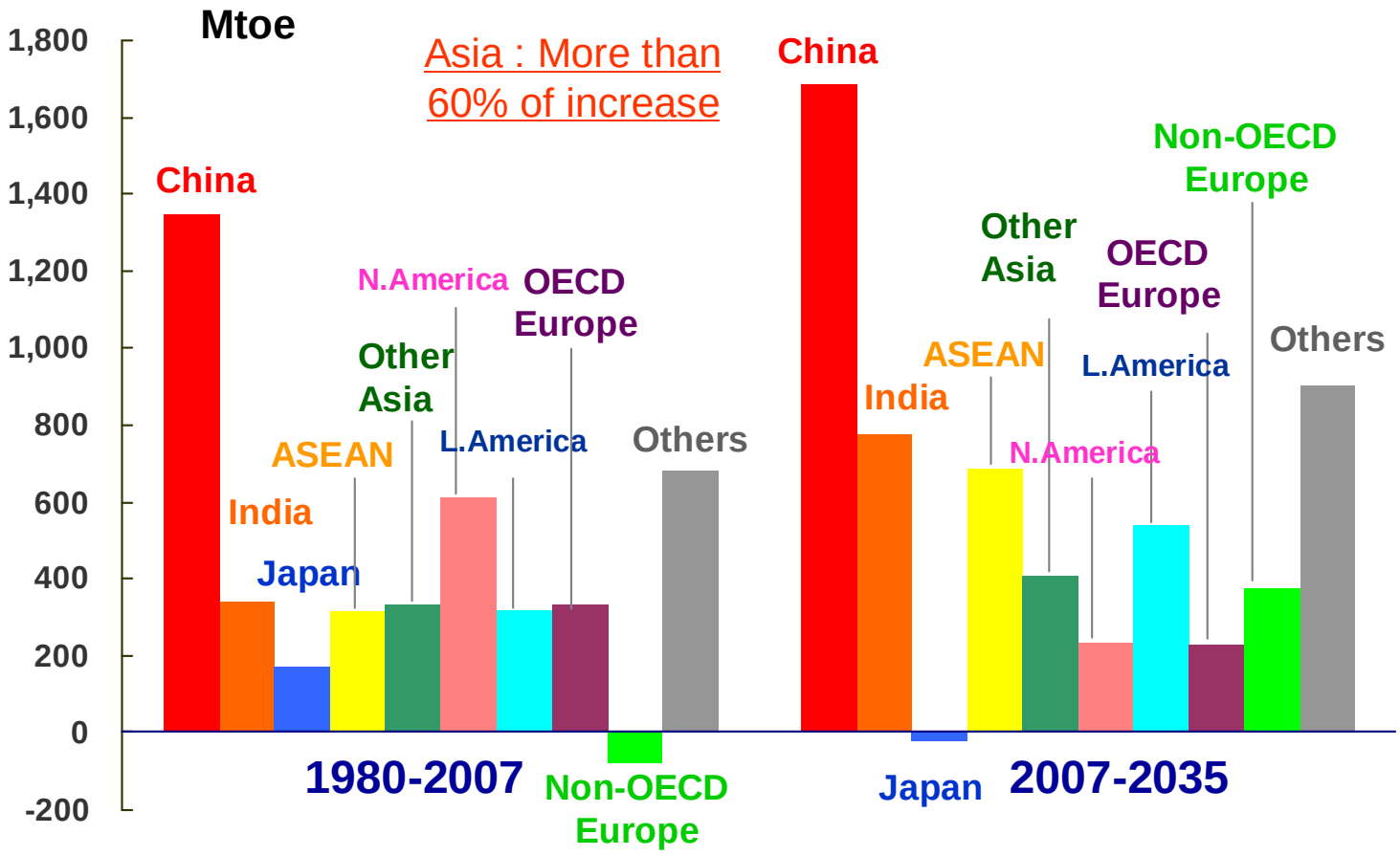
■ By 2035, primary energy demand of Asia achieves twice as much as current level, reflecting high economic growth; 3.6 billion toe(2007) → 7.1 billion toe(2035).

■ Non-OECD will represent 90% of incremental growth of global energy demand toward 2035.

Incremental Increase in Primary Energy Demand by Region, 2007-2035

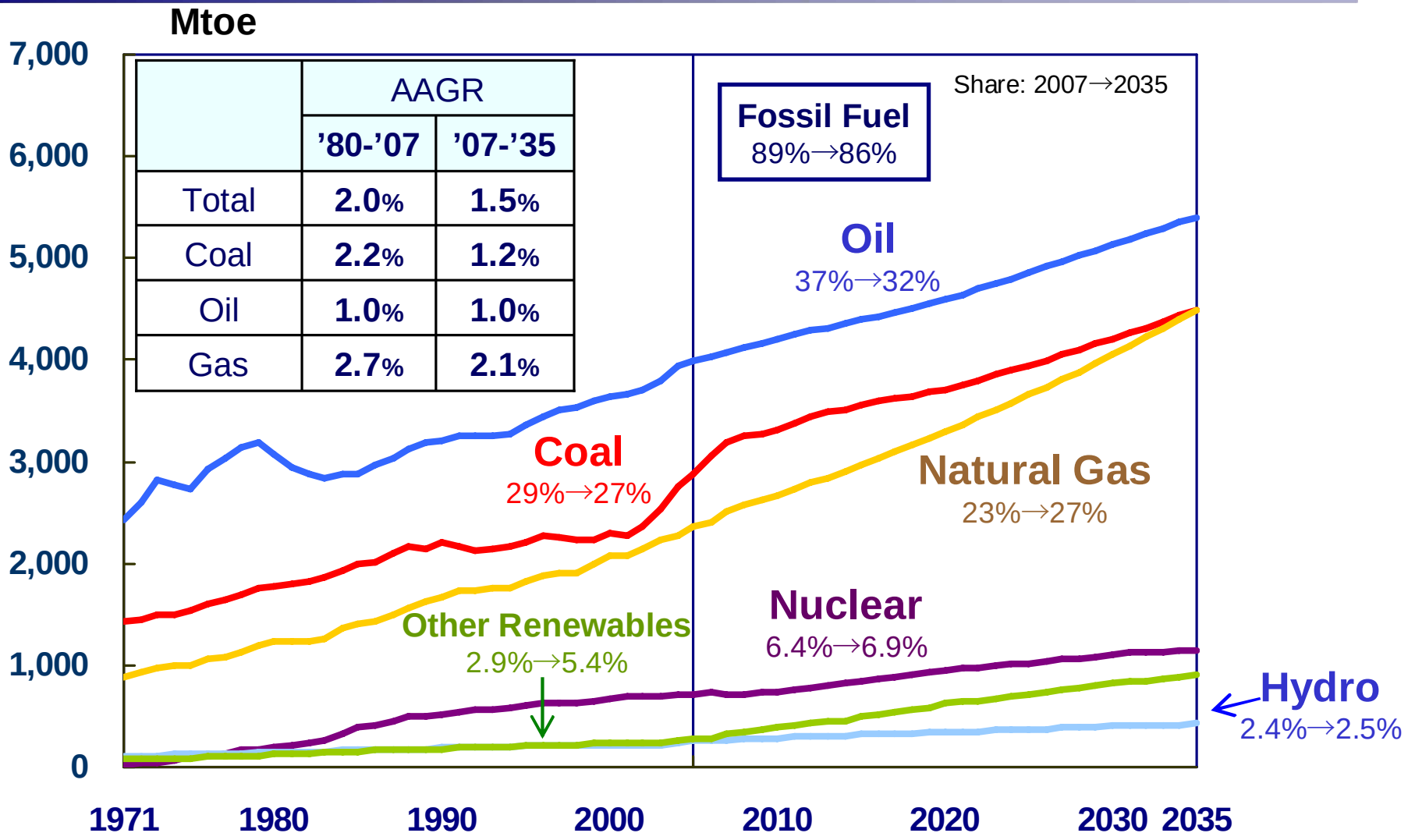
Share in increase, 2007-2035

China	India	Japan	ASEAN	Other Asia	N.America
29%	**13%**	**0%**	**12%**	**7%**	**4%**



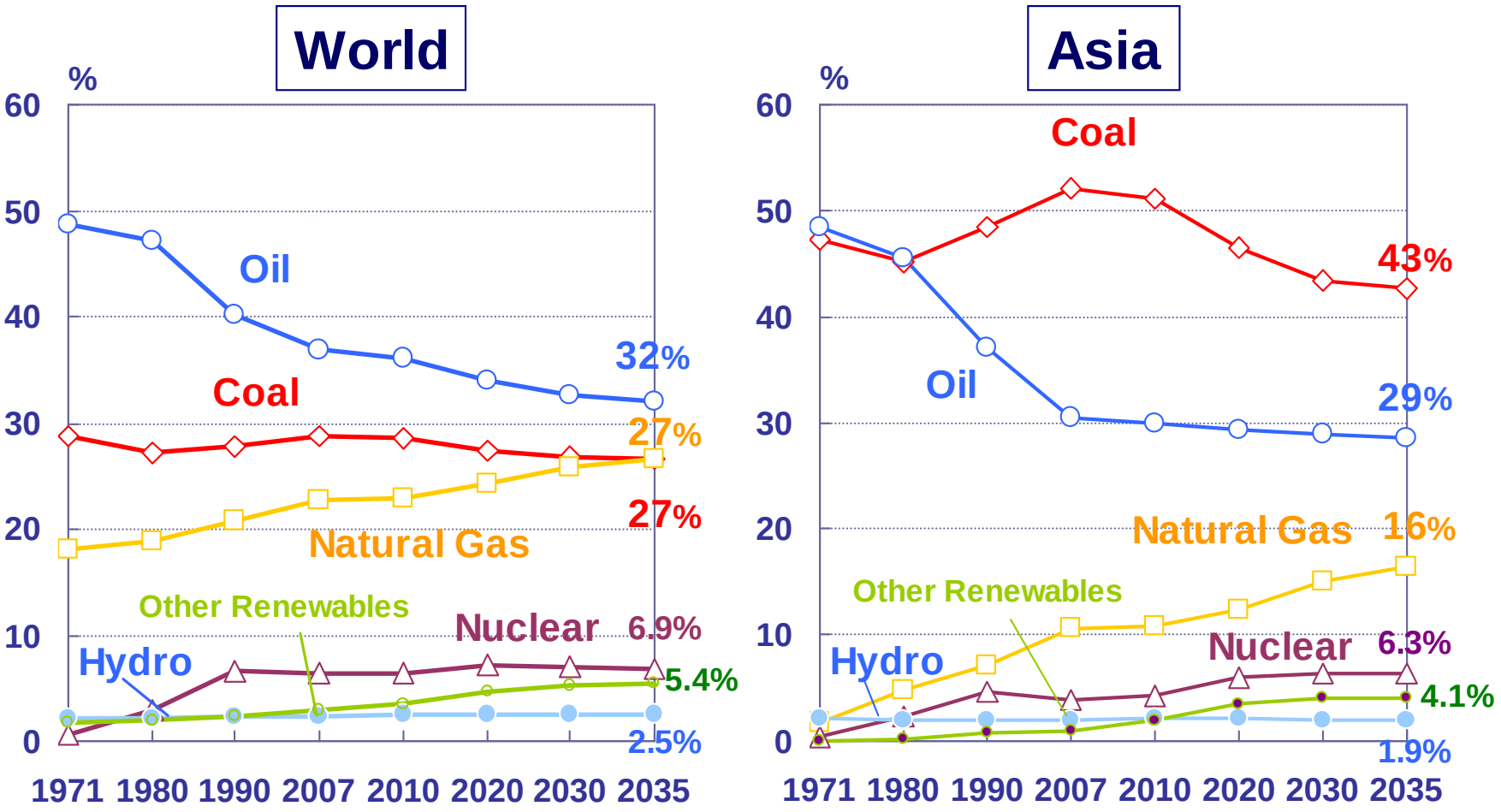
61% of global energy demand increase to 2035 is due to Asia. In particular, approximately 40% of both China and India dominates the world increase. OECD is responsible for 12%, and Non-OECD, 88%.

Primary Energy Demand by Fuel ; World



- Oil will remain the largest energy source in primary energy mix by 2035. Around 2035, natural gas demand will grow with its future extensive use in various sectors, eventually catching up with coal around 2035.
- Fossil fuel continues to be the most important fuel by 2035, though its share will slightly decrease from 89% in 2007 to 86% in 2035.

Primary Energy Mix by Fuel ; World and Asia

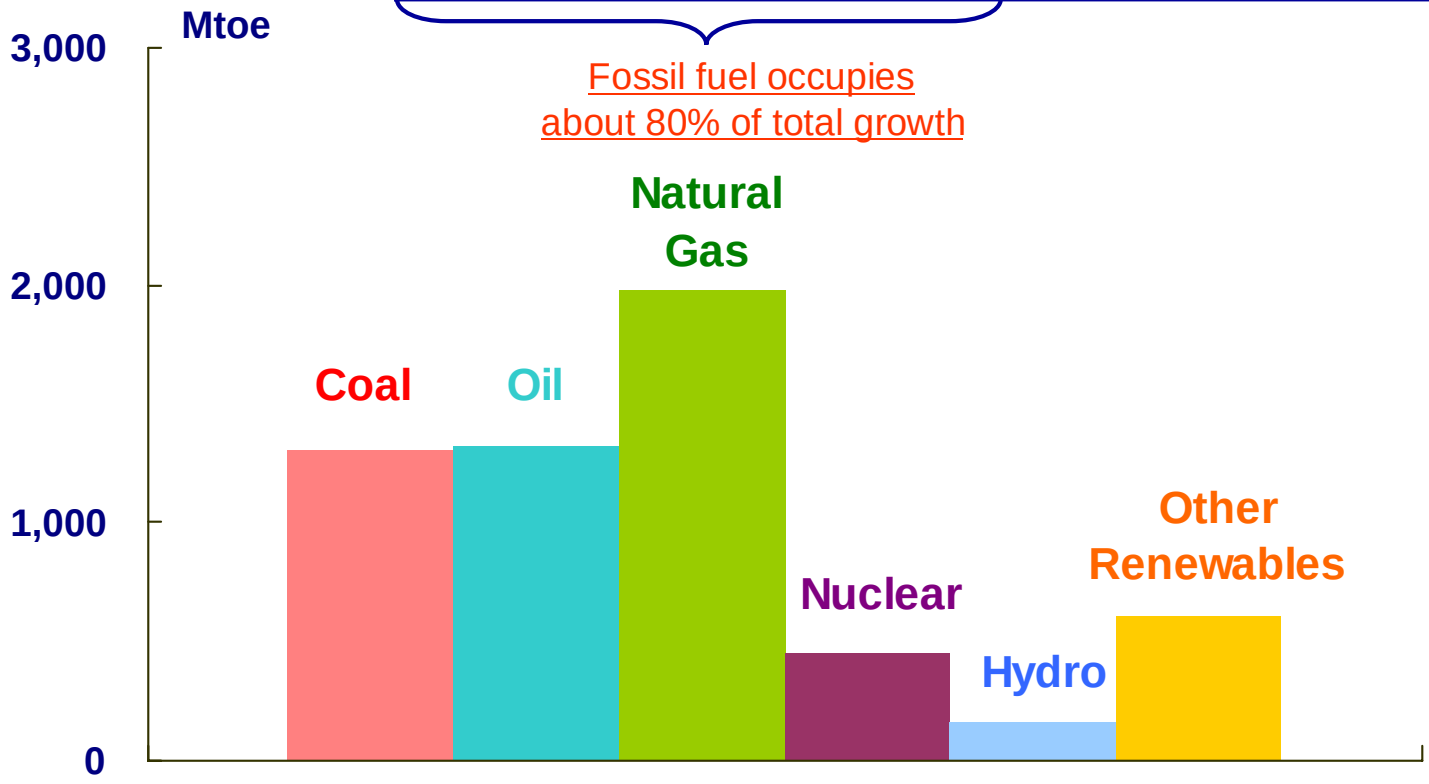


- In Asia, coal remains the largest of primary energy source reflecting on boosting electric power demand by 2035. (Coal share in Asia: 2007: 52%→2035: 43%)
- Nuclear share in Asia gradually expands with active building-up of nuclear power plants in China, India, Japan and South Korea.

Increase in Primary Energy Demand by Fuel ; World

2007-2035 Increase

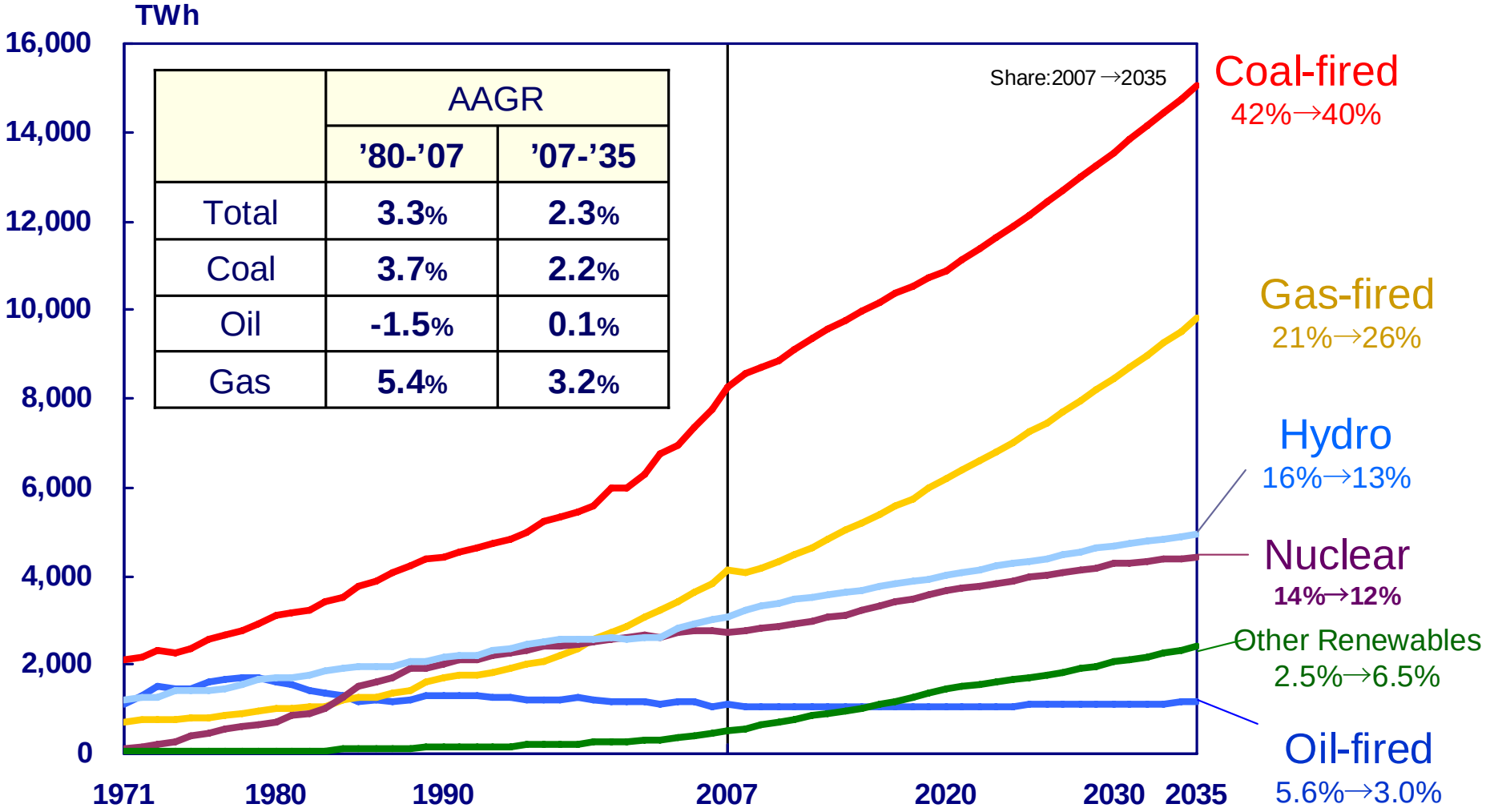
Coal	Oil	Gas	Nuclear	Hydro	Other Renewables
23 %	**22 %**	**34 %**	**8 %**	**3 %**	**10 %**



Increase from 2007 to 2035

- 79% of global energy growth by 2035 will be concentrated on fossil fuels
- Fossil fuel demand growth to 2035 in Non-OECD will be responsible for about 90% of global fossil demand increasing.

Power Generation Mix by Fuel ; World

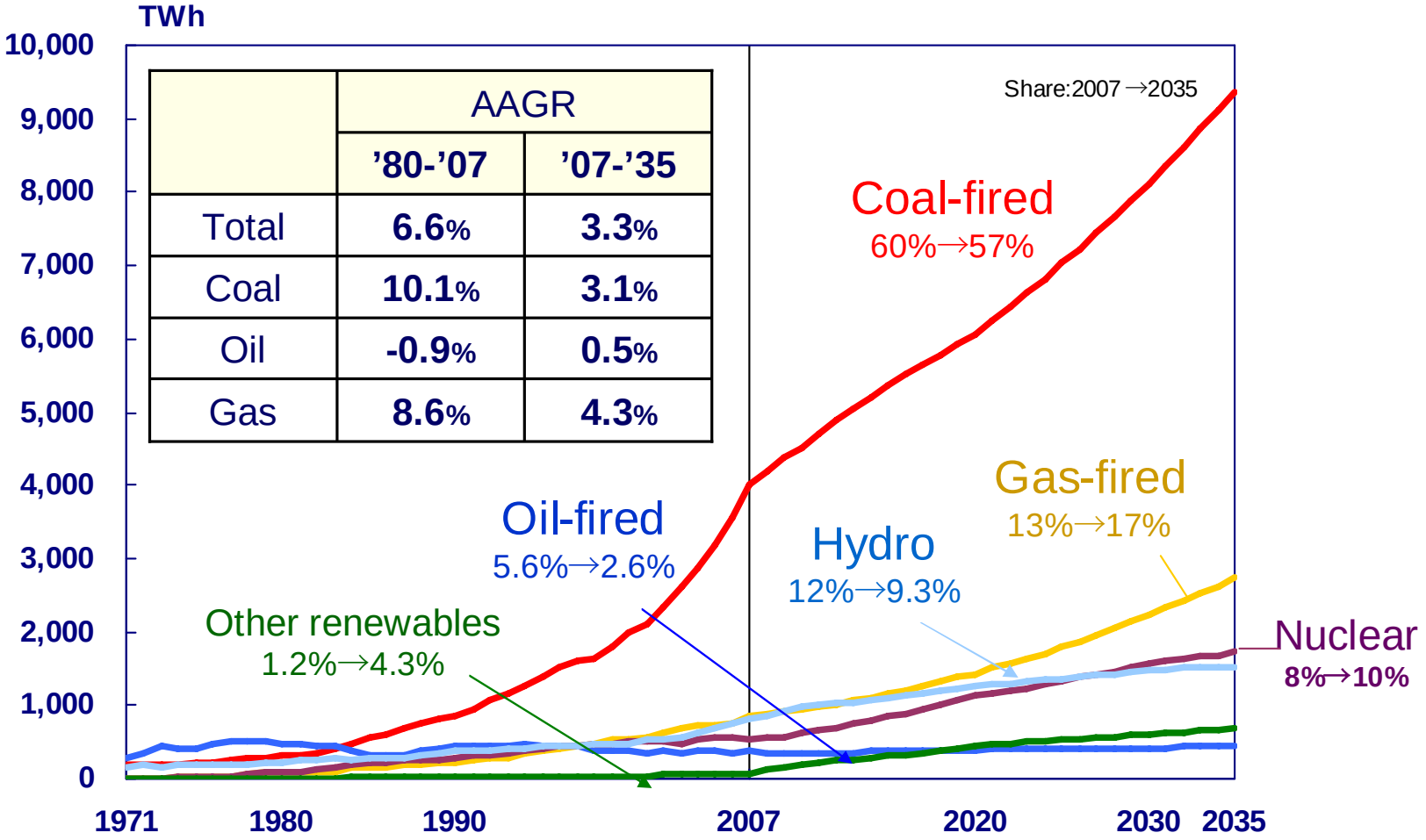


	AAGR	
	’80-’07	’07-’35
Total	3.3%	2.3%
Coal	3.7%	2.2%
Oil	-1.5%	0.1%
Gas	5.4%	3.2%

■Coal-fired power generation still remains dominant power supply option by 2035. Natural gas-fired power generation is projected to increase significantly worldwide at the highest rate among fossil fuels. Renewables excluding hydro will expand its share in power generation mix to 6.5% by 2035 from 2.5% in 2007.

■The CO2 emissions from coal-fired power generation currently dominates about 30% of global CO2 emissions. CO2 emissions from coal-fired generation will increase from 8.2 Gt-CO2 in 2007 to 12.6 Gt-CO2 in 2035. Clean coal technology (CCT) is expected to play an important role in addressing GHG issues.

Power Generation Mix by Fuel ; Asia

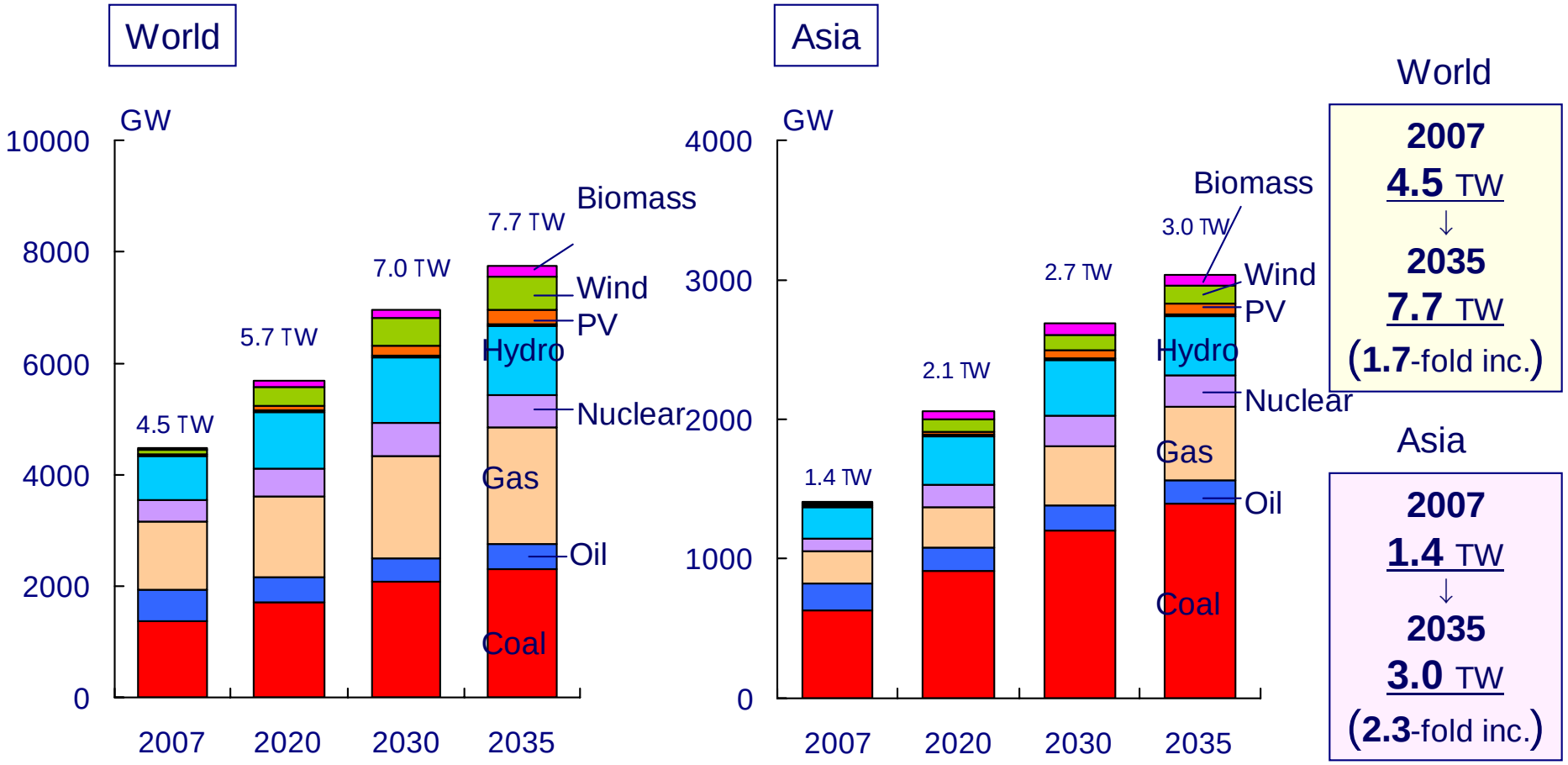


	AAGR	
	'80-'07	'07-'35
Total	6.6%	3.3%
Coal	10.1%	3.1%
Oil	-0.9%	0.5%
Gas	8.6%	4.3%

■The share of coal use in Asia will remain larger than 50%, reflecting abundant resources and the economic advantages. Gas will show a growing trend, the share of which eventually expands to 17% by 2035.The share of nuclear power generation will increase from 8% to 10%; Nuclear plays a important roll in power generation mix.

■The CO2 emissions from coal-fired power generation currently dominates about 30% of global CO2 emissions. CO2 emissions from coal-fired generation in Asia will expand by 3.8 Gt-CO2 from 4.1 Gt-CO2 in 2007 to 7.9 Gt-CO2 in 2035, this growth being about 30% of global CO2 emissions increase. Clean coal technology (CCT) is expected to play an important role in addressing GHG issues.

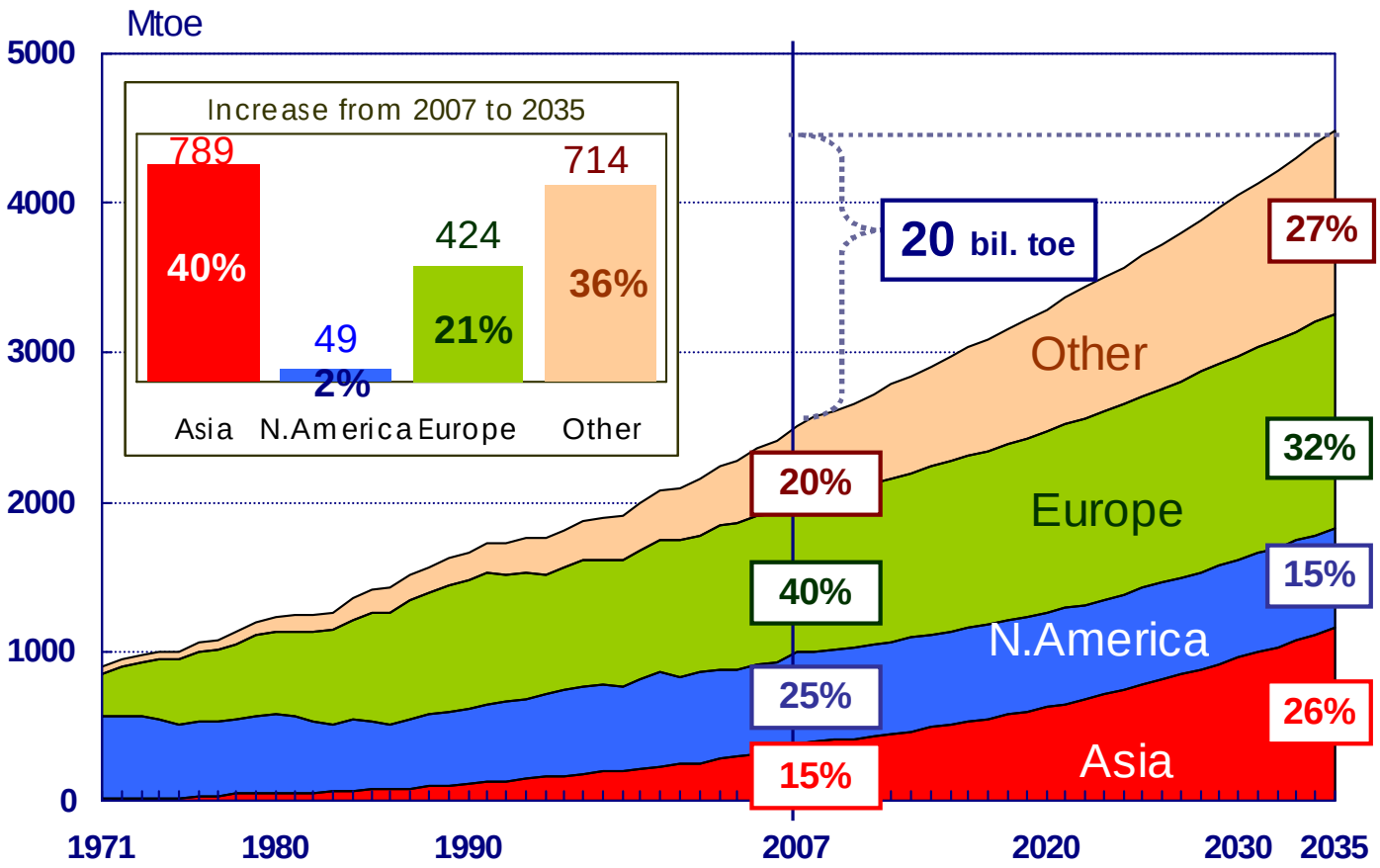
Power Generation Capacity; World and Asia



■World power generation capacity is projected to grow from 4.5TW in 2007 to 7.7TW in 2035 (3.2 TW growth).

■ The largest increase in world power generation capacity is expected in Asia (1.6TW growth, 50% of world capacity increase).

Gas Demand by Region ; World

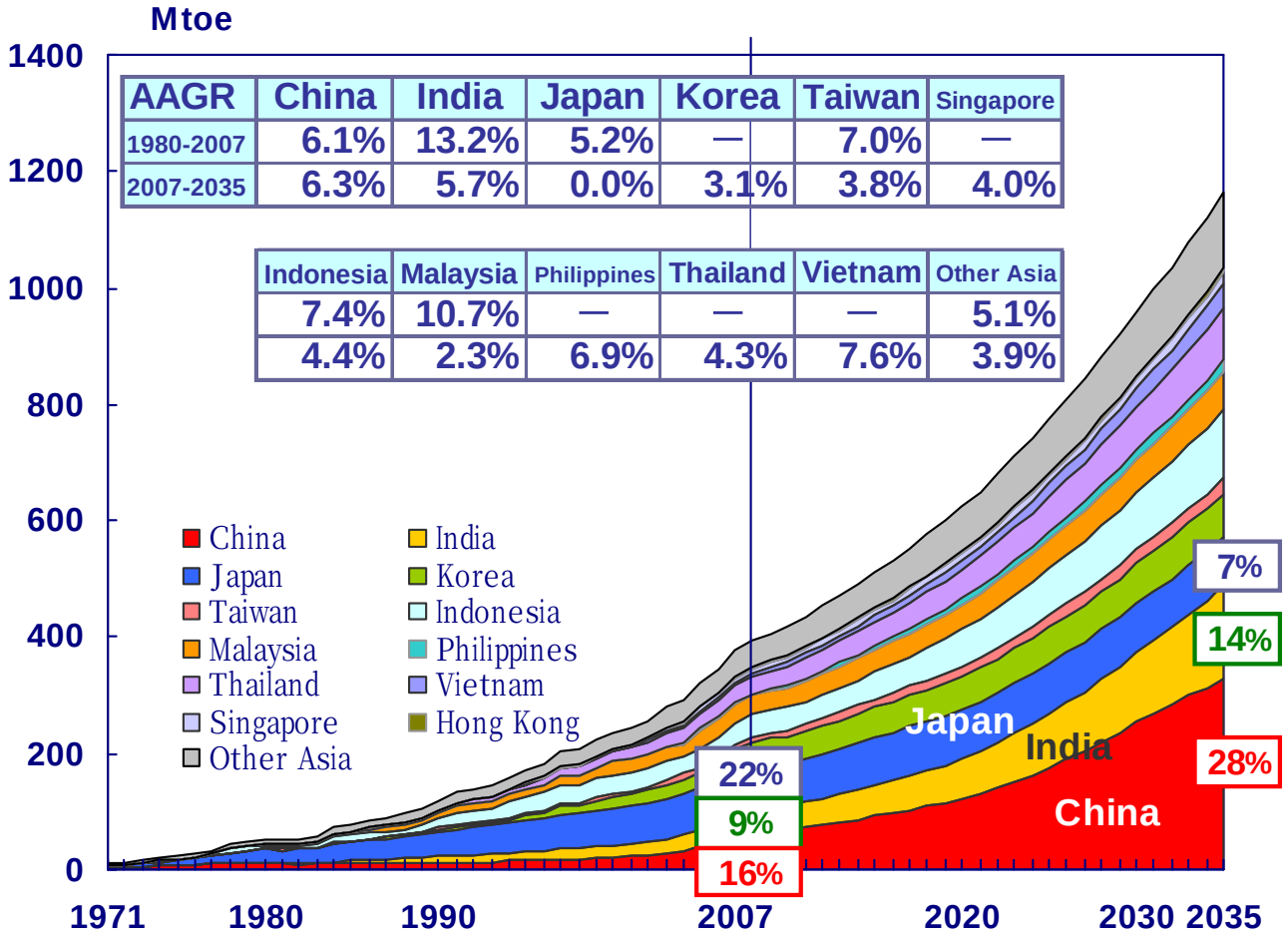


2007
2.5 billion toe
(2.8 trillion m³)
(2.0 bil. tonnes LNG)
↓
2035
4.5 billion toe
(5 trillion m³)
(3.6 bil. tonnes LNG)

1.8-fold increase
(2.2 tril. m³ inc.)
(1.6 bil. tonnes LNG inc.)

- World gas demand is expected to increase from 2,800 bcm in 2007 to 5,000 bcm in 2035, 1.8-fold increase.
- Of incremental growth in global natural gas from 2007 to 2035, Non-OECD will dominate 83%; World gas demand will grow around Non-OECD countries.

Gas Demand by Region ; Asia



AAGR	China	India	Japan	Korea	Taiwan	Singapore
1980-2007	6.1%	13.2%	5.2%	—	7.0%	—
2007-2035	6.3%	5.7%	0.0%	3.1%	3.8%	4.0%

Indonesia	Malaysia	Philippines	Thailand	Vietnam	Other Asia
7.4%	10.7%	—	—	—	5.1%
4.4%	2.3%	6.9%	4.3%	7.6%	3.9%

2007

0.38 billion toe

(420 billion m³)

(0.31 bil. tonnes LNG)

↓

2035

1.17 billion toe

(1.29 trillion m³)

(0.95 bil. tonnes LNG)

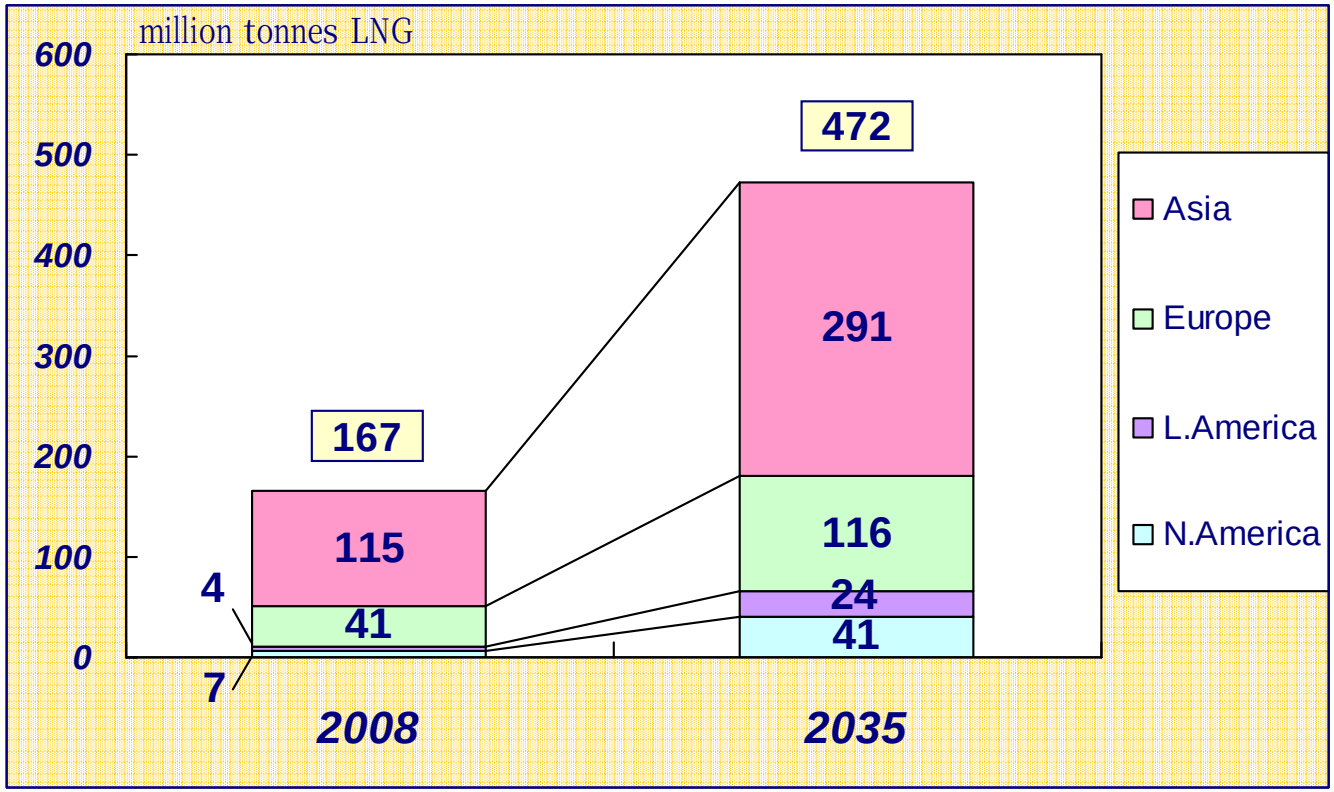
3.1-fold increase

(880 bil. m³ inc.)

(640mil. tonnes LNG inc.)

Gas demand in Asia will considerably increase mainly due to increasing demand for power generation, municipal gas use and its environmental premium.

LNG Demand Outlook ; World



■ World LNG demand will expand from 167 million ton in 2008 to 472 million ton in 2035, achieving 2.8-fold growth. LNG demand in Asia-pacific region continues to be dominant throughout 2035.

■The development of LNG project is major challenge in order to ensure world LNG market.

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Assumptions on Technologically Advanced Scenario

Countries all over the world more strengthen the numerous measur es contributing to ensuring energy security and mitigating global warming issues. Combined with that, technologi cal development and international transfer of technology will be promoted and advanced technology internationally becomes commercially available as a result.

Regulation, National target, SSL etc.

Carbon tax, Emissions Trading, RPS, Subsidization、FIT、Efficiency Standard, Automobile Fuel Efficiency Standard, Low Carbon Fuel Standard, Energy Efficiency Labeling, National Target etc.

Promotion of R&D, International Cooperation

Encouragement of Investment for R&D, International Cooperation on Energy Efficient Technology, Support on Establishment of Efficiency Standard

【Demand Side Technology】

■ Industry

Best available technology on industrial process such as steel making, cement, paper, oil refinery etc. become internationally penetrated

■ Transport

Clean energy vehicles (high fuel efficient vehicle, Hybrid vehicle, Plug-in hybrid vehicle, Electric vehicle, Fuel cell vehicle) globally expand.

■ Building

Efficient electric appliance (Refrigerator, TV etc.), High efficient water-heating system (heat-pump etc.), Efficient air conditioning system, Efficient lighting, Strengthening heating insulation

【Supply Side Technology】

■ Renewable

More expansion of Wind, PV, CSP, Biomass power generation, Bio-fuel

■ Nuclear

Acceleration of more nuclear power plant, Enhancement of operating ratio

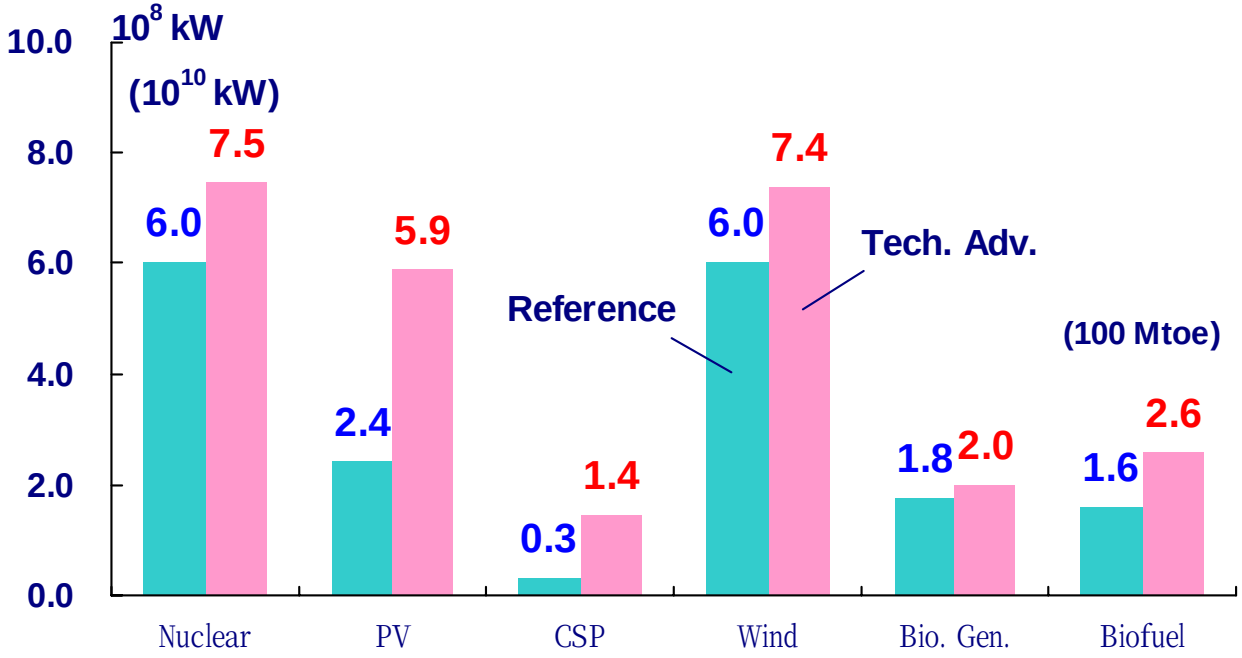
■ High Efficient Fossil-fired Power Plant

More expansion of Coal-fired power plant (USC, IGCC, IGFC), Natural gas MACC

■ CCS

Introduction in power generation (coal-fired, gas-fired) and industrial sector

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



Non-fossil fuel
Mtoe

2007
1300 Mtoe
↓
2035

Reference	Tech. Adv.
2500 Mtoe	**3000 Mtoe**
(2-fold inc)	(2.3-fold inc)

Share of non-fossil fuel

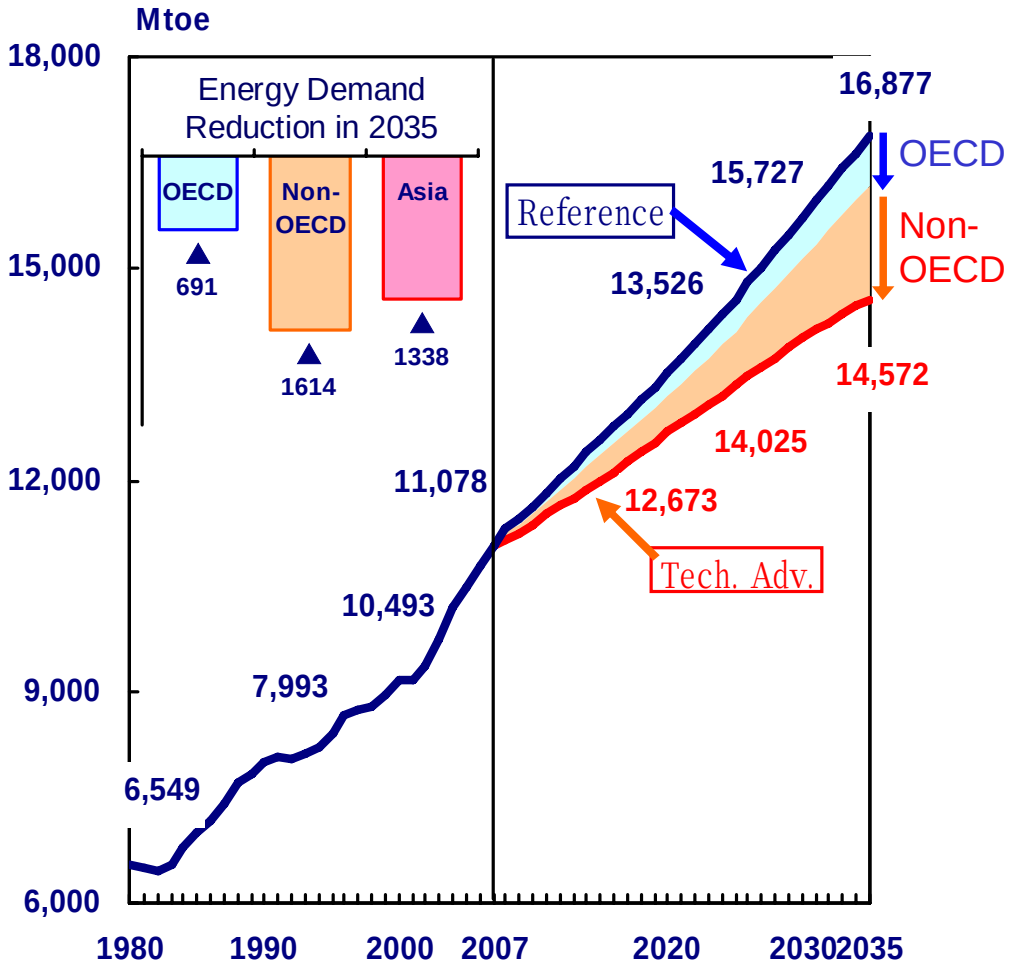
2007
12%
↓
2035

Reference	Tech. Adv.
15%	**21%**

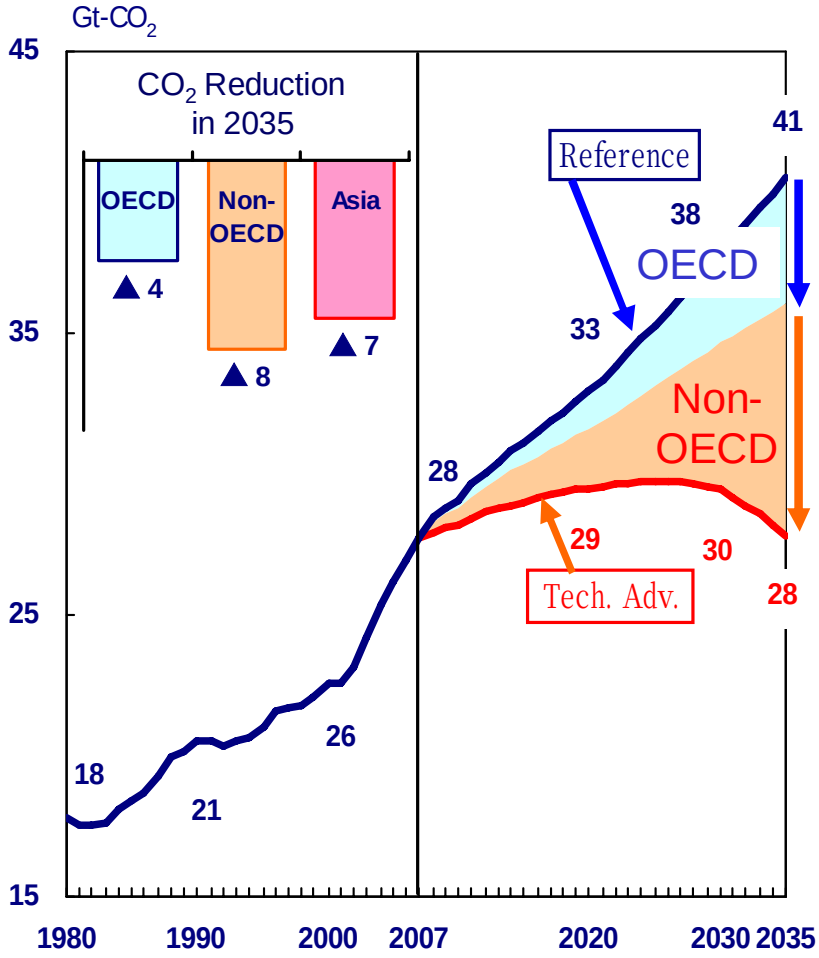
- Further expansion of nuclear and renewables is likely to be realized on the basis of global electricity demand increase.
- Biofuel will more boost if cellulosic biofuel, which is not competitive with food production and land use, becomes commercially viable.
- Industry sector, building sector and transport sector respectively achieves 300Mtoe(9% saving), 500 Mtoe (14% saving) and 400 Mtoe (14% saving) of energy saving in 2035 compared with reference scenario.
- Average efficiency of fossil fuel-fired power generation reach 47% at 2035 in Tech. Adv. Scenario while that in reference scenario shows 42%

Primary Energy Demand & CO_2 Emissions

Primary Energy Demand

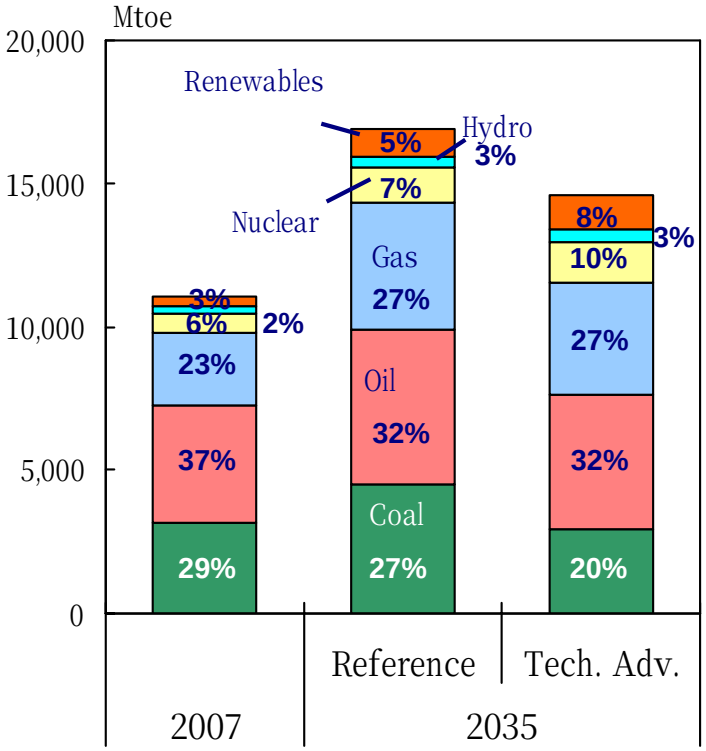


CO_2 Emissions

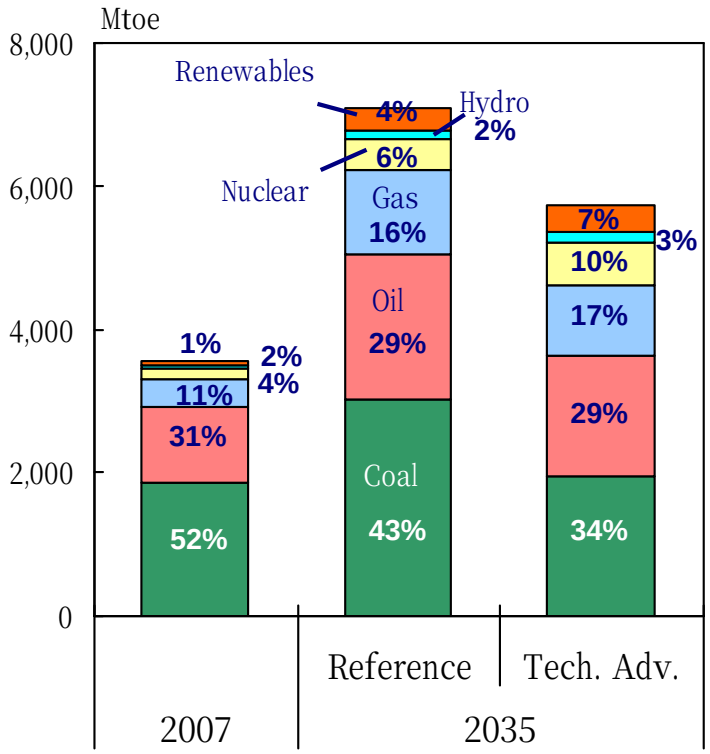


Primary Energy Mix

【World】



【Asia】



Share of Non-fossil fuel in TPES (World)

2007
12 %
↓
2035

Reference	Tech.Adv.
15 %	**21 %**
(3points up)	(9points up)

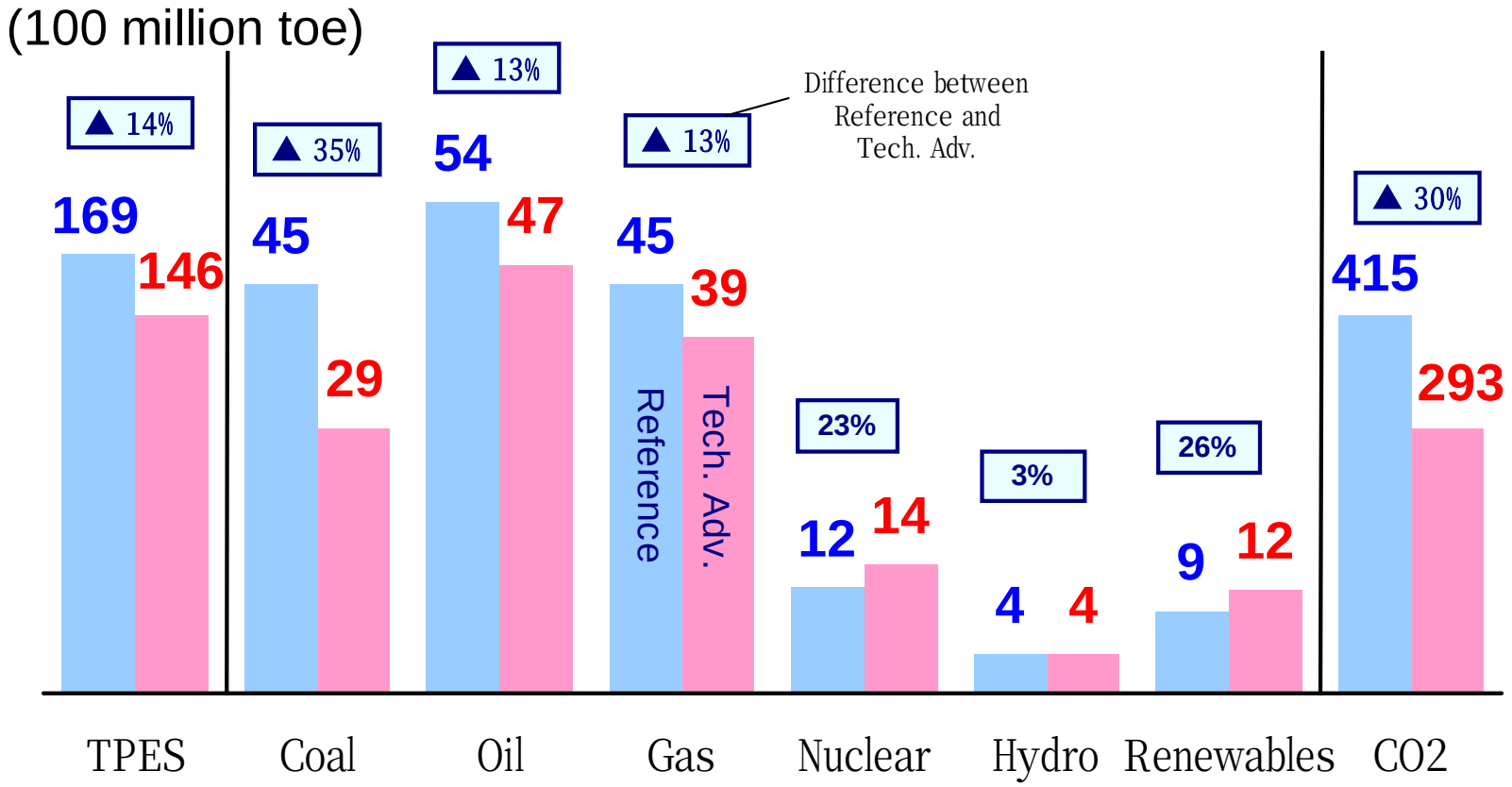
Share of Non-fossil fuel in TPES (Asia)

2007
7 %
↓
2035

Reference	Tech.Adv.
12 %	**19 %**
(5points up)	(12points up)

- Even at 2035 in Tech. Adv. scenario, fossil fuel dominates about 80% of TPES in both Asia and the world and will play an important role.
- Natural gas in Asia region increase its share with higher growth rate in the energy mix of 2035; 16% for the Reference Scenario and 17% for the Tech. Adv. Scenario.

Reference and Tech. Adv. Scenario in 2035 (World)



■Coal demand shows notable difference between Reference and Tech. Adv. scenario, due to the elaborate deployment of clean coal technology in Tech. Adv. Scenario.
■Global oil demand at 2035 is 113 mb/d in Reference scenario and 98 mb/d in Tech. Adv. Scenario.

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Summary …

1. Fossil fuel consumption will continue to increase in coming decades.
   - Fossil fuels will remain substantial in the world energy mix, likely to reduce its share only slightly from 89% in 2007 to 85% in 2035.
   - In the Asia, fossil fuels are also likely to maintain a high share at 80% in 2035 even for the Advanced Technology Scenario.

2. Natural gas demand will increase mainly due to increasing demand for power generation, municipal gas use and its environmental premium.
   - Natural gas in Asia region is forecast to increase its share with higher growth rate in the energy mix of 2035; 16% for the Reference Scenario and 17% for the Technology Advanced Scenario.
   - Great potential is expected for LNG to be introduced especially in Asia.

Thank you for your attention.

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Contact: report@tky.ieej.or.jp