Summary of "Asian Energy Outlook"

A Joint Study to Develop the "Asian Energy Outlook"
by experts from Asian Petroleum Producing-Consuming Countries

*Please note this outlook was finalised before the day of East Japan Great Earthquake, thus does not reflect any impacts of the event.

Background and Features of the “Outlook”

- World energy market faces various uncertainties and challenges
- Common recognition that the improvement of transparency and enhancement of predictability for energy supply-demand is critical for market stabilization
- The 3rd Asian Ministerial Energy Roundtable in Tokyo (April 2009) welcomed Japan’s proposal to conduct a study to jointly develop “Asian Energy Outlook” as a mean of promoting better understanding of the market prospects
- The study has been conducted in collaboration with experts from Asian oil producing and consuming countries and international organization such as IEA, IEF and OPEC
- Workshops were held for five times in various Asian cities (Tokyo, Beijing, Riyadh, Delhi and Tokyo) to discuss, refine and finalize the Outlook, with the participation of the experts
- Institute of Energy Economics, Japan (IEEJ) played a role as the secretariat to the study

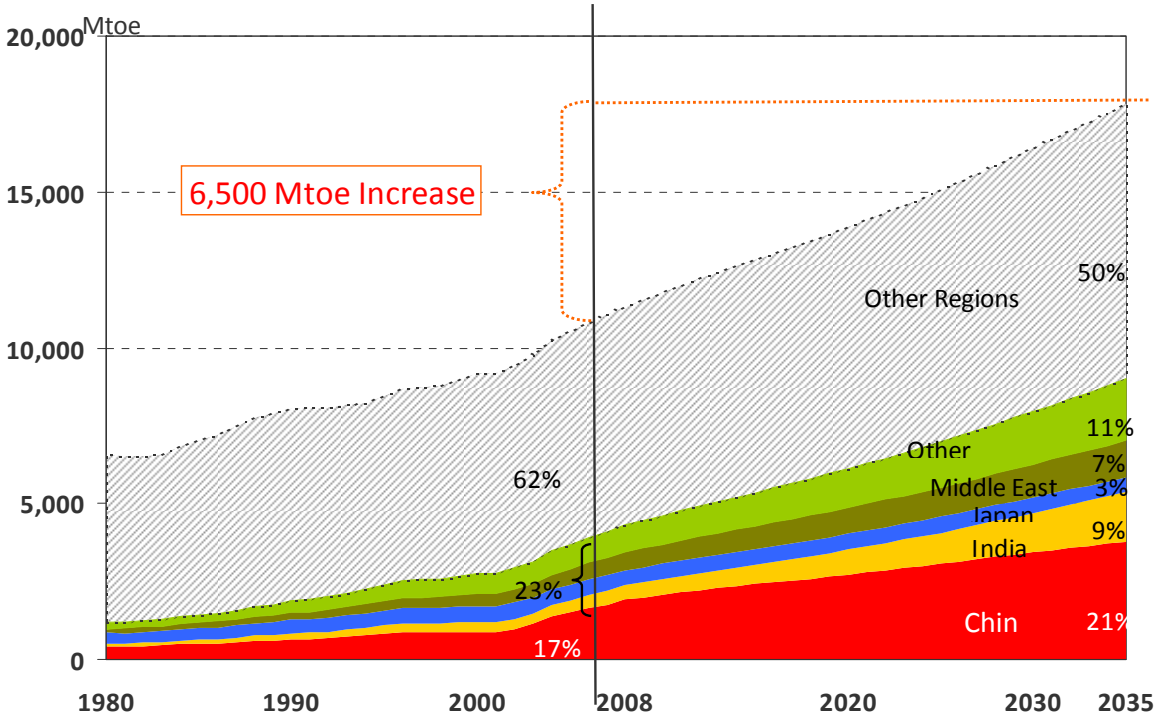
Framework Concept of the "Outlook"

- Definition of "Asia" in this study: East Asia, Southeast Asia, South Asia and the Middle East
- Projection timeline: Up to 2035
- Major Socio-economic assumptions: GDP, Population and energy prices (Refer to "Appendix")
- Study focus is given to such advanced technologies' development and deployment as: Energy efficiency, Nuclear power generation and Renewable energy
- Three scenarios were developed for the analysis of energy future
  - Business As Usual Scenario (BAU)
  - Strong Policies Scenario (SPS)
  - Maximum Impact Scenario (MIS)
- Detailed country-by-country modeling analysis for major energy consuming and importing countries in Asia such as China and India
- Country-by country modeling analysis also made for major Middle East countries

Major Findings/Conclusion of the "Outlook"

- Energy demand will continue to grow substantially in Asia, in all of the three energy scenarios of the "Outlook"
- The energy demand growth will be driven by emerging economies such as China, India as well as the countries in the Middle East
- Fossil energy will remain mainstream energy. Oil and gas demand will continue to grow steadily in Asia
- Degree of technology development/deployment will make notable difference in Asian energy future in such areas as demand growth, energy demand structure and environment implications
- Timely investment to increase energy supply for overall supply chain is essential to meet growing energy demand in the region
- Asian region, in particular in the Middle East, has sufficient energy resource potential to meet the energy demand growth in the future
- Asian countries also has sufficient capability and potential for advanced technology development/deployment as well as for human capital
- Growing energy demand and abundant supply potentials will lead to enhancement of interdependence of Asian energy consuming/importing countries and energy producing/exporting countries
- Cooperation in Asian energy producing and consuming countries is vital for mutual prosperity and global sustainable development

World Primary Energy Demand By Region (BAU scenario)



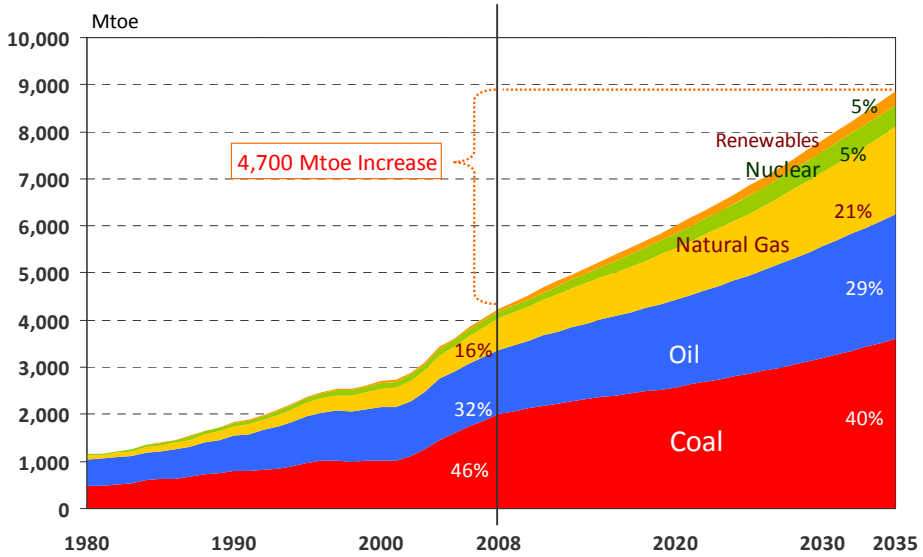
Total Primary Energy Demand

	World	Asia
2008	11,327Mtoe	4,331Mtoe
↓	↓	↓
2035	17,827Mtoe	9,000Mtoe
	(1.6 times)	(2.1 times)

- World's total primary energy demand will reach 17.8 billion ton of oil equivalent in 2035, a 1.6-fold increase from 2008.
- Asia's energy demand will grow more rapidly than other regions, reflecting its high economic growth. It's share in world primary energy demand will be 50% in 2035.
- Asia will represent 72% of incremental growth of global energy demand toward 2035.

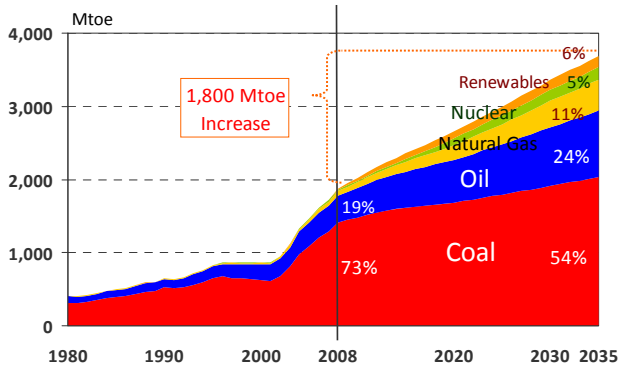
Primary Energy Demand By Fuel In Asia (BAU scenario)

Asia

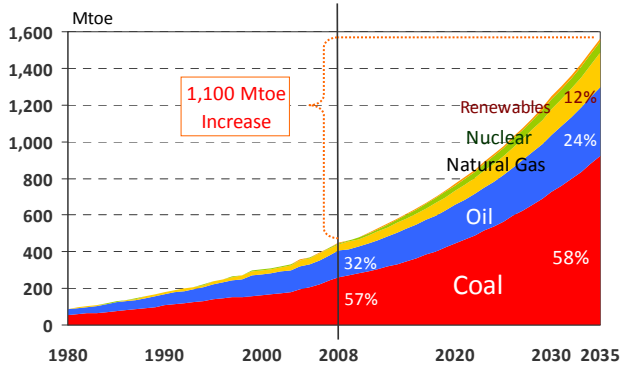


- Coal and oil will continue to maintain the dominant share in Asian energy demand through to 2035.
- The share of natural gas will increase substantially, driven mainly by demand for power generation.

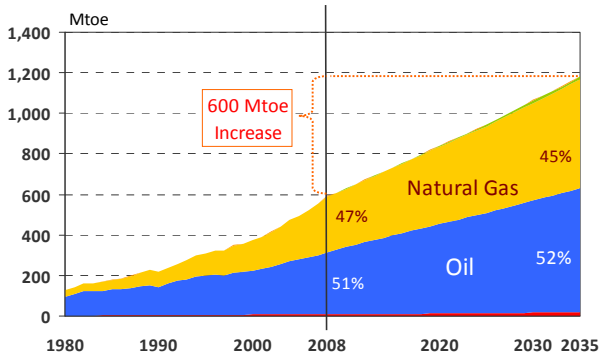
China



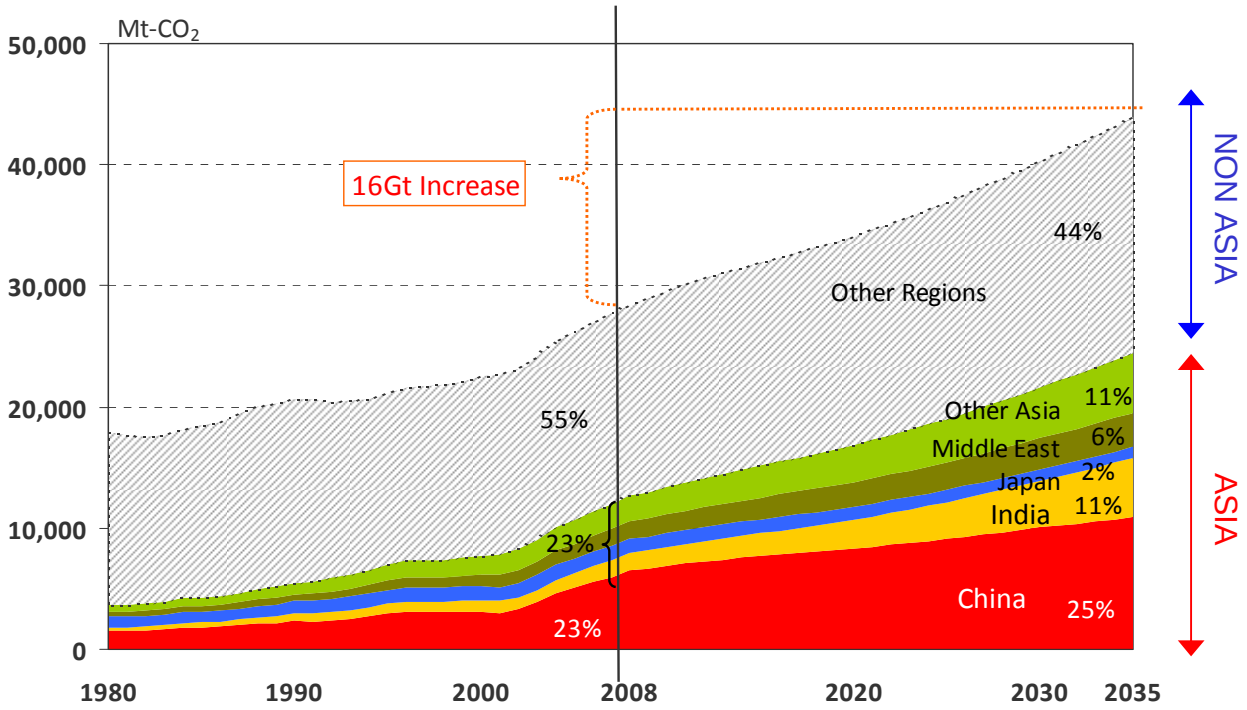
India



Middle East



World CO_2 Emission By Region (BAU scenario)

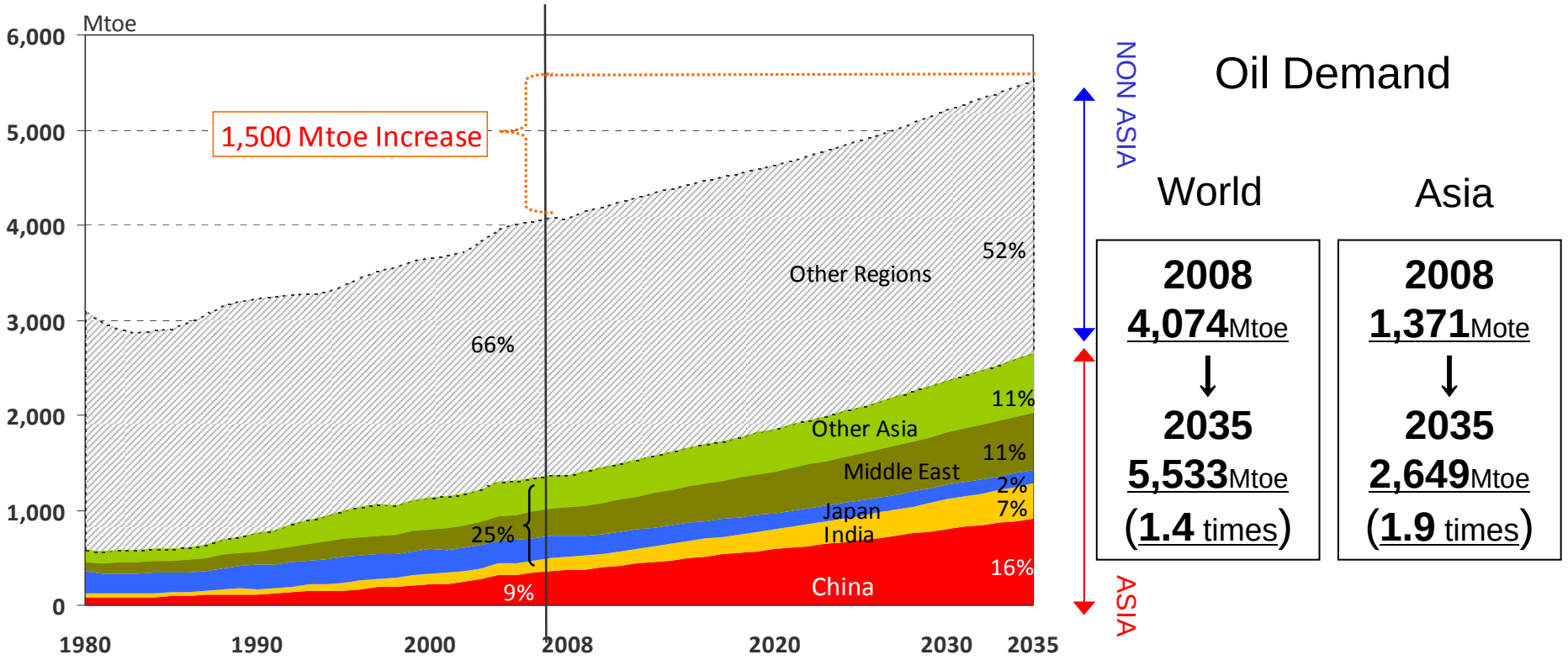


Energy-related CO_2 Emission

World	Asia
2008 **29.4**Gt–CO2 ↓ **2035** **44.9**Gt–CO2 (**1.5** times)	**2008** **12.7**Gt-CO2 ↓ **2035** **24.5**Gt-CO2 (**2.0** times)

- World's energy-related CO_2 emission will reach 45 Gt in 2035, a 1.5-fold increase from 2008.
- The share of Asia in the world's CO_2 emission will rise from 45% in 2008 to 56% in 2035.
- More than 75% of the CO_2 emission increase from 2008 to 2035 will take place in Asia.

World Oil Demand By Region (BAU scenario)



- World Oil demand will increase from 4.1 Btoe in 2008 to 5.5 Btoe in 2035, showing a 1.4-fold increase from 2008. Oil demand in Asia is expected to increase from 1.4 Btoe in 2008 to 2.6 Btoe in 2035, a 1.9-fold increase. Asia will continue to lead the world oil demand growth by 2035.
- The share of the world oil demand in Asia will increase from 34% in 2008 to 48% in 2035.

Outlook of Oil Production

mn b/d

	2008	2020	2030	2035	2008–2035	AAGR
OPEC	34.7	42.1	47.7	50.7	16.0	1.4%
non-OPEC	47.3	51.6	57.3	60.6	13.3	0.9%
North America	13.9	14.8	17.1	18.0	4.1	1.0%
Latin America	4.1	5.8	7.2	8.4	4.2	2.6%
Europe-Eurasia	16.9	17.8	19.8	21.1	4.2	0.8%
Middle East	1.6	1.6	1.6	1.6	-0.1	-0.2%
Africa	2.6	2.9	3.3	3.4	0.8	1.0%
Asia	8.1	8.7	8.4	8.1	0.0	0.0%
China	3.8	4.2	4.1	4.0	0.2	0.2%
India	0.8	1.0	1.0	1.0	0.2	0.8%
Indonesia	1.0	1.0	0.8	0.8	-0.2	-1.0%
Malaysia	0.8	0.7	0.6	0.6	-0.2	-1.2%
othe Asia	1.7	1.8	1.9	1.8	0.1	0.2%
World total	82.3	93.7	105.0	111.3	29.0	1.1%

2008
35mnB/D
↓
2035
51mnB/D
(+**16**mnB/D)

2008
47mnB/D
↓
2035
61mnB/D
(+**13**mnB/D)

share on increment

OPEC	55%
non-OPEC	46%

- Share of OPEC on increment of world's oil production is 55%.
  = OPEC is expected to play a key role as they are today.
- Oil production in Asia will slightly increase up to 2020, but in a long term it will gradually decrease.

Major Findings of BAU

- Total primary energy demand in Asia will reach 9.0 Btoe in 2035, a 2.1-fold increase from 2008.
- Oil demand in Asia will increase from 1.4 Btoe in 2008 to 2.6 Btoe in 2035, showing a 1.9-fold increase from 2008. Gas demand in Asia will increase from 0.7 Btoe in 2008 to 1.9 Btoe in 2035, showing a 2.8-fold increase from 2008. Coal demand in Asia will increase from 2.0 Btoe in 2008 to 3.6 Btoe in 2035, showing a 1.8-fold increase from 2008. Of the incremental growth in the Asian Coal demand from 2008 to 2035, China will account for 39% and India for 41%.
- Due to the substantial increase of the energy demand, the consumption of the fossil fuel will expand rapidly. It is important to ensure means toward stable energy supply. Asian region has sufficient energy resource potential to meet the energy demand growth in the future by the efforts to create appropriate investment conditions.
- In the BAU Scenario, energy-related CO2 emission in Asia will reach 24 Gt in 2035, a 1.9-fold increase from 2008.

Concept of the alternative Scenarios

BaU Scenario -- continuation of current market situation and policies

- Energy efficiency improvement will continue, based on the historical trend.
- For nuclear power and renewable energy projects, only those in actual construction or confirmed projects are being accounted for.

Maximum Impact Scenario -- the maximum success of energy efficiency and diversification policies

- Assumes that the achievement of the most ambitious energy policy targets of each country will be pursued.

Strong Policies Scenario

-Assumes more moderate achievement of policies than the Maximum Impact Scenario.

Assumptions on the Alternative Scenario

Countries all over the world more strengthen the numerous measures contributing to ensuring energy security and mitigating global warming issues. Combined with that, technological 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

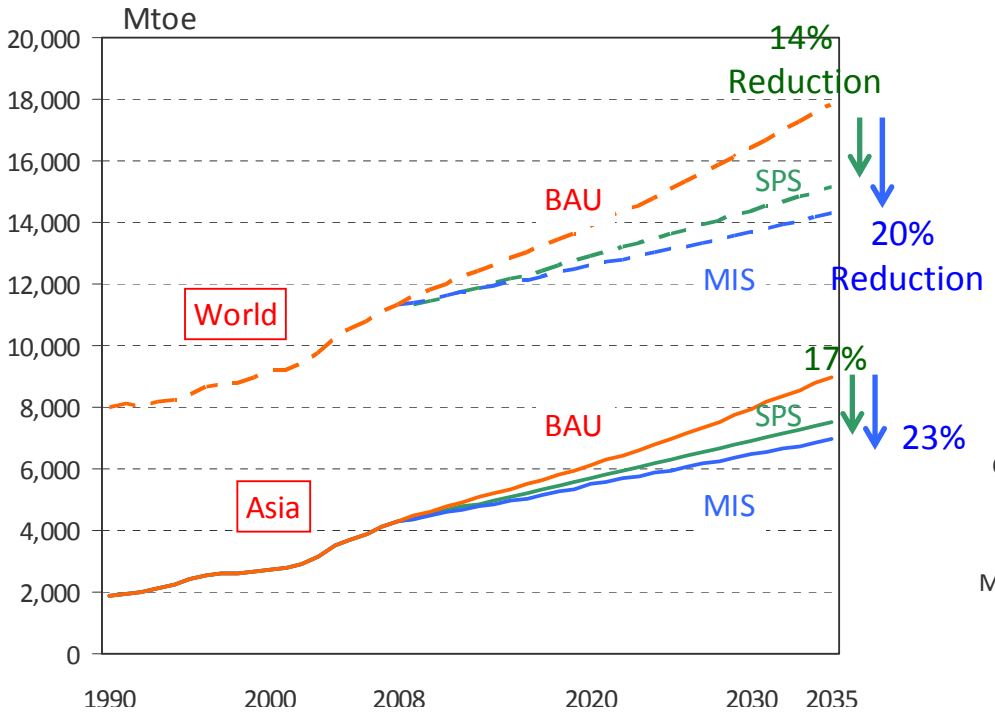
More expansion of Coal-fired power plant (USC, IGCC, IGFC), Natural gas MACC

■ CCS

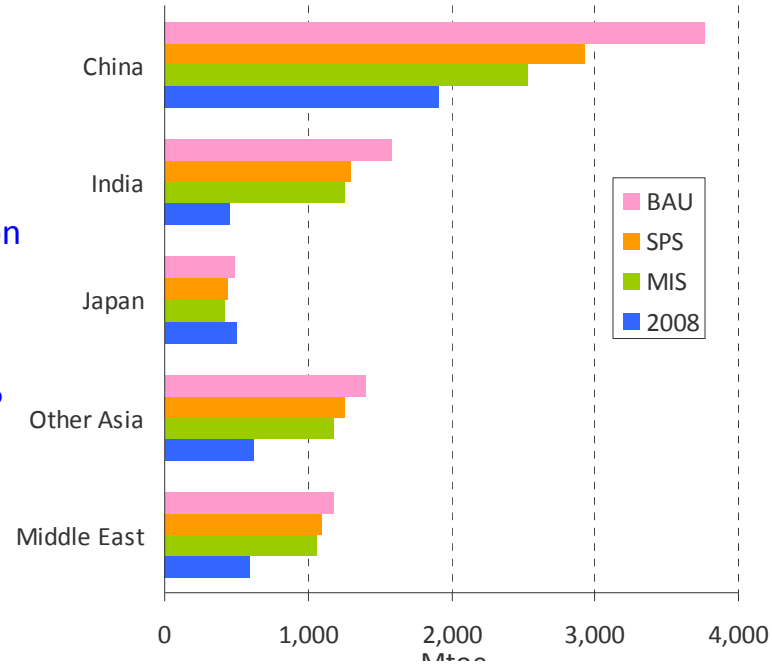
Introduction in power generation (coal-fired, gas-fired) and industrial sector

Total Primary Energy Demand (Alternative Scenarios)

TPED (World, Asia)

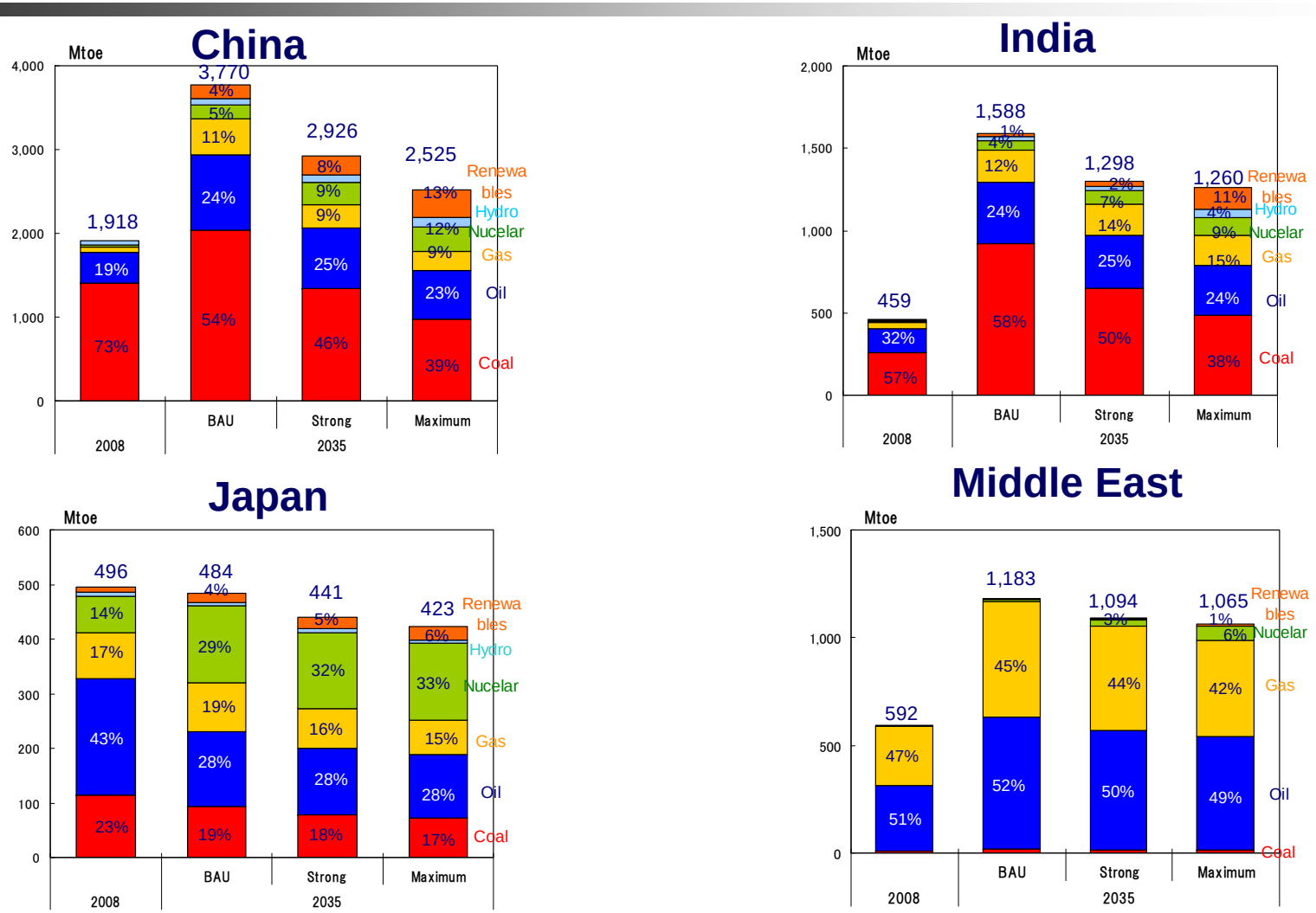


TPED in 2035



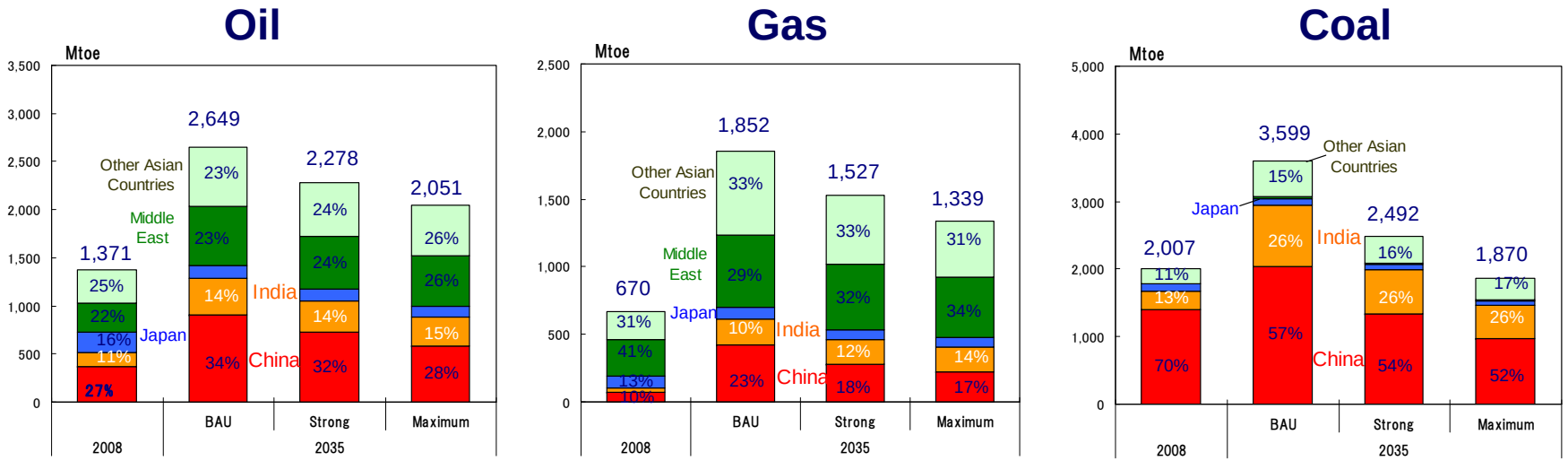
- World's total primary energy demand in 2035 will be reduced by 14% in SPS and 20% in MIS.
- Energy saving in Asia accounts for 59%(SPS) and 59%(MIS) of the world's energy saving potentials.

Total Primary Energy Demand by Region (Alternative Scenarios)



- Total primary demand will be slightly diversified by the introduction of the nuclear and Renewables.

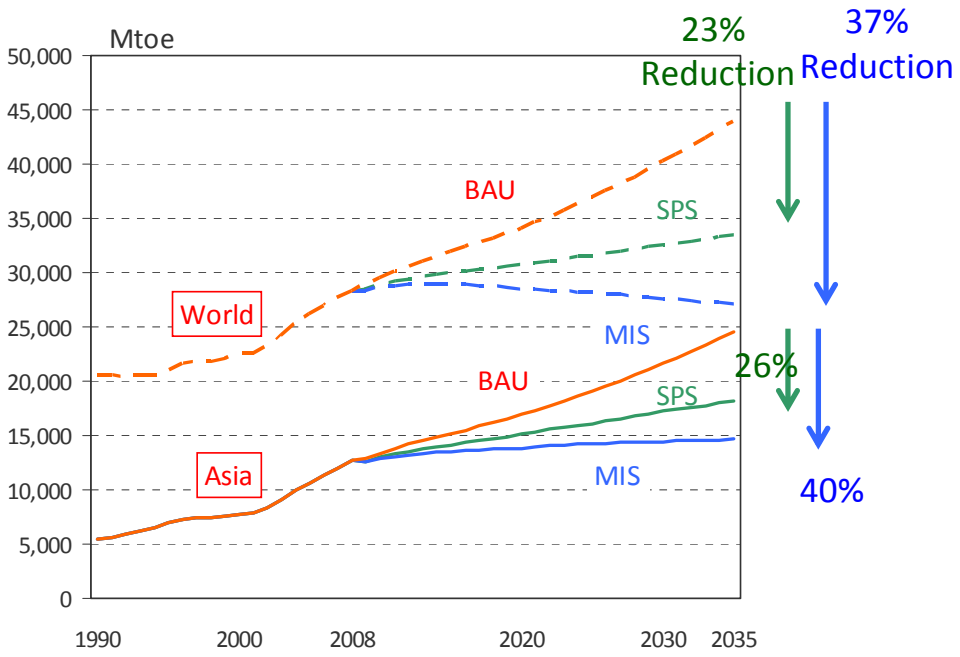
Energy Demand by Fuel In Asia (Alternative Scenarios)



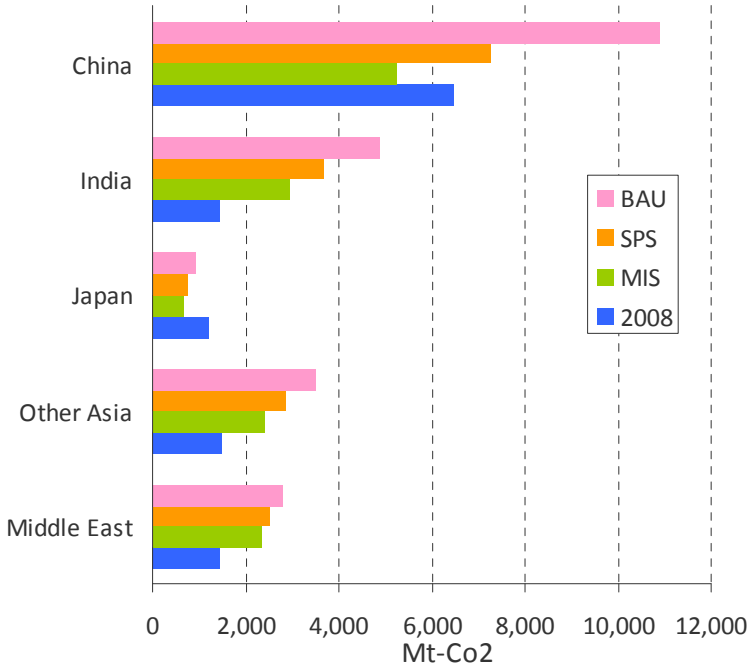
- Oil demand will decrease by 14%(SPS) and 23%(MIS) in 2035 compared with the BAU Scenario. Gas demand will decrease by 18%(SPS) and 28%(MIS) in 2035 compared with the BAU Scenario.
- Coal demand has the largest potential for energy saving. It will decrease by 31% in 2035 in SPS compared with BAU Scenario. In MIS, it will decrease by 48% compared with BAU Scenario and will be less than the current level in 2035.
- In all Scenarios, Oil and Gas will increase from the current level. Oil demand in MIS will show 1.5-fold growth to 2035 from 2008. Gas demand in MIS will show 2.0-fold growth to 2035 from 2008.

CO_2 Emissions (Alternative Scenarios)

CO2 (World, Asia)



CO2 in 2035



- World's CO_2 emission in 2035 will be reduced by 23% in SPS and 37% in MIS.
- CO_2 emission reduction in Asia accounts for 60%(SPS) and 59%(MIS) of the world's energy saving potentials.

Major Findings of Alternative Scenarios

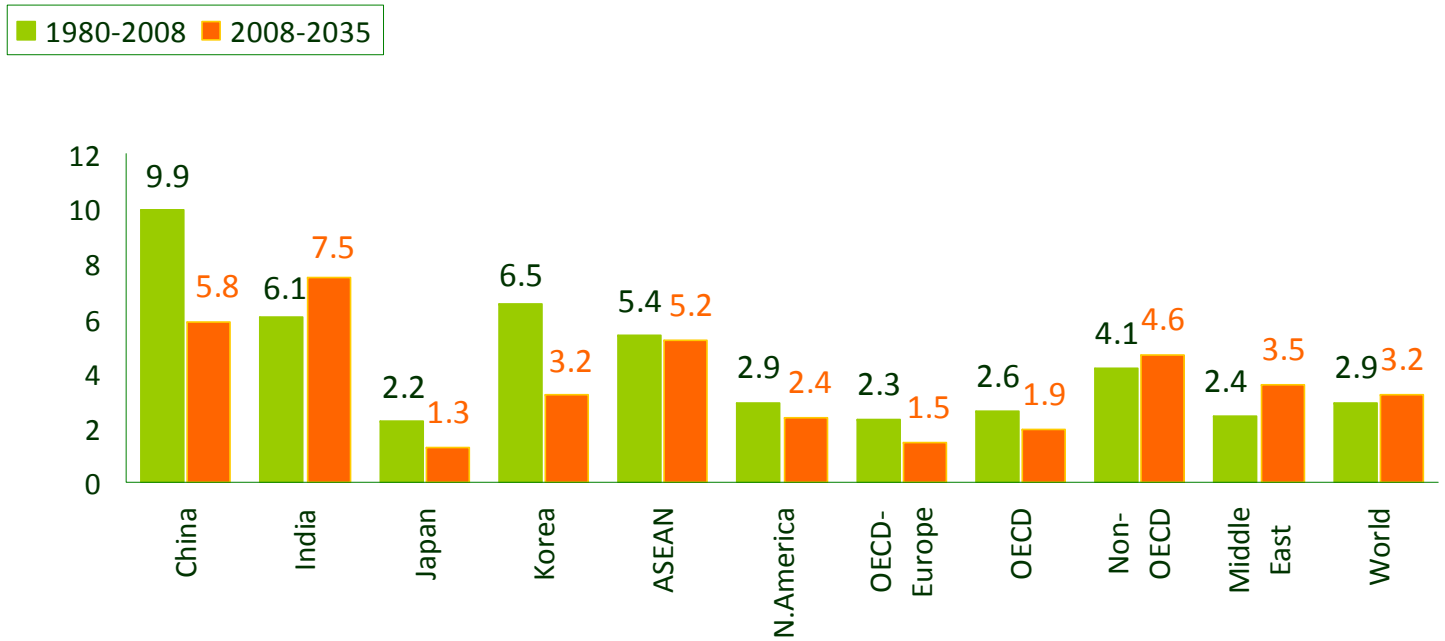
- In 2035, TPED of Asia in the SPS will decrease by 17% compared with the BAU. In the MIS, it will decrease by 23% lower than that in BAU in 2035.
- Similarly, Oil demand in 2035 will decrease by 14% in SPS and by 23% in MIS compared with the BAU. Gas demand in 2035 will decrease by 18% in in SPS and by 28% in MIS compared with the BAU. Coal demand in 2035 will decrease by 31% in SPS and by 48% in MIS compared with the BAU.
- Coal demand has the largest potential for energy saving. In 2035, it will decrease by 31% in SPS and by 48% in MIS compared with BAU Scenario.
- Although Oil demand and Gas demand in 2035 will be lower than that in the BAU Scenario, in Both Scenarios, SPS and MIS, they will be higher than the current level. Oil demand will show 1.5-fold growth and Gas demand will show 2.0-fold growth in MIS to 2035. It is important to ensure the energy supply security to meet growing energy demand.
- CO2 emission reduction in Asia in 2035 will be reduced by 26% in SPS and 40% in MIS compared with the BAU Scenario. In these Scenarios, environmental load will decrease including CO2 reduction by the effective use of energy because of the technology deployment.

Recommendations

- Enhance cooperation and dialogue between energy producing and consuming countries in Asia
- Further promote better understanding of market prospects
  - To improve energy data/information transparency in the Asian region
  - To conduct joint work to enhance predictability of energy supply-demand in the region, focusing on significant emerging uncertainties such as impacts of non-conventional oil and gas development, new energy technologies, downstream market, etc.
- Promote timely investment to meet growing energy demand in the region
- Enhance technology cooperation and capacity building in Asian region
- The 4th Ministerial Roundtable should be highlighted as a very important platform to further enhance cooperation and dialogue

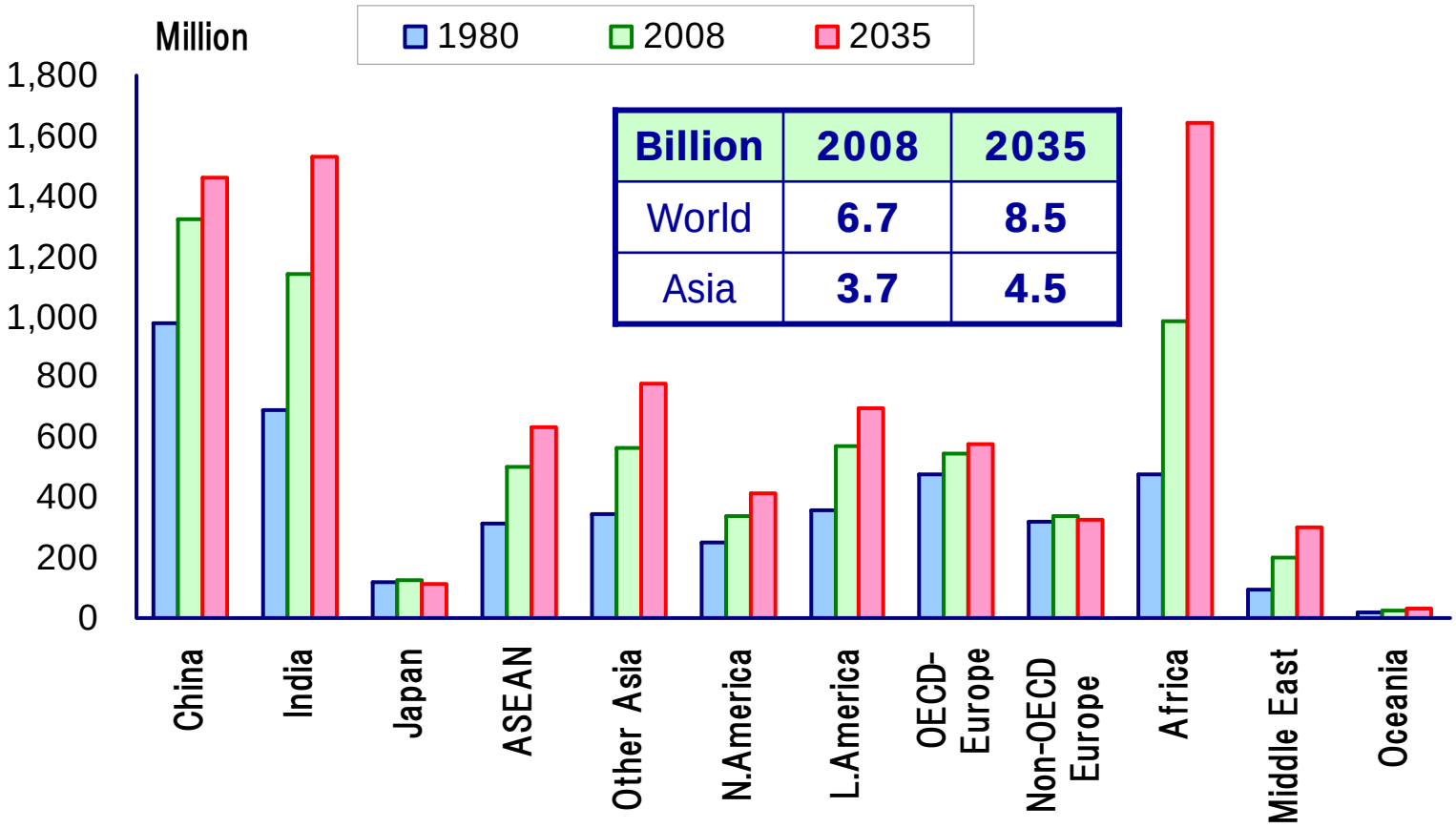
APPENDIX 1 Major Assumptions : GDP growth

Average Annual Growth Rate (%)



- World economy will continue to grow steadily at 3.2% per annum through 2035. Repercussions from the recent financial crisis were globally felt to slow the economic growth, but with the economic stimulus measures by numerous countries will lead to early recovery.
- GDP in China will continue to achieve an annual growth rate of 5.8% per year shifting from the investment- and export-driven growth to the domestic demand-driven one.
- GDP in India will register a high growth rate at 7.5% 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.

APPENDIX 2 Major Assumptions : Population



Billion	2008	2035
World	6.7	8.5
Asia	3.7	4.5

China

2008
1.32 bil
↓
2035
1.46 bil
(**0.14** bil growth)

India

2008
1.14 bil
↓
2035
1.53 bil
(**0.38** bil growth)

- Of the incremental increase in world population over the period 2008-2035, developing countries account for roughly 90%.
- Population in China and India together will reach about 3 billion and its share will increase to 35% by 2035.
- Chinese population will peak in 2030 as a result of declining birth rate. India's population will represent the biggest in the world by 2035.

APPENDIX 3　Major Assumptions : Energy Prices

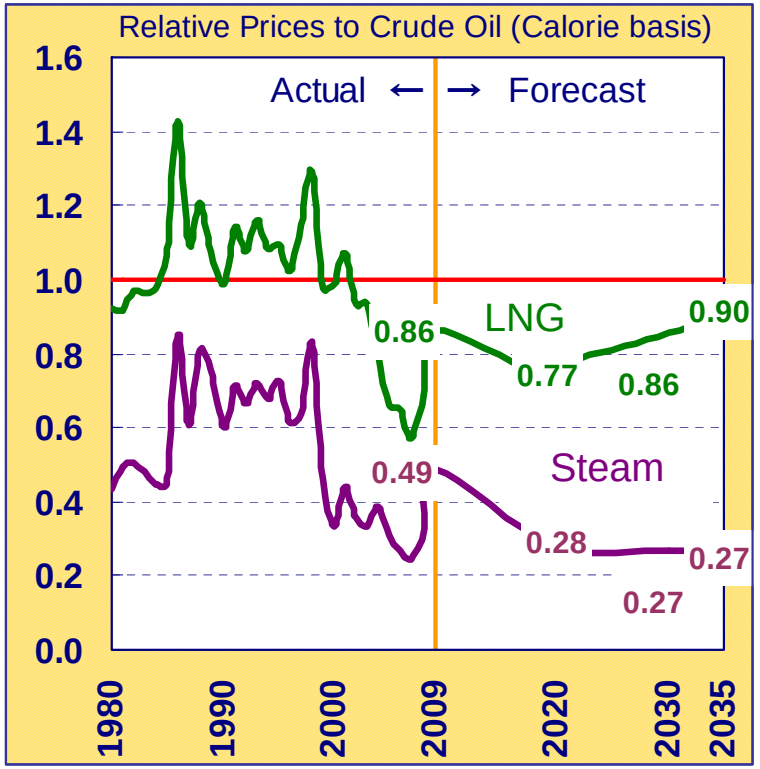
【Real Price & Nominal Price】

		2000	2009	2020	2030	2035
Crude Oil	**Real**	**32**	**60**	**100**	**110**	**115**
USD/bbl	Nominal	28	60	124	167	192
LNG	**Real**	**282**	**468**	**689**	**845**	**929**
USD/t	Nominal	251	468	856	1,280	1,554
Steam Coal	**Real**	**39**	**109**	**104**	**110**	**115**
USD/t	Nominal	35	109	129	167	192

*　Real prices are set in 2009.
** Inflation rates are assumed at 2% annually.

*** Energy prices are explained by Japan's import energy price (on a CIF basis).

【Relative Prices to Crude Oil】



■Crude oil price 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.

■ By 2020, the relative price of natural gas (compared with crude oil price) will become lower from the 2009 level because of the increased supply of unconventional gas. But for the long-term, the price gap between crude oil and LNG will become smaller due to a rapid growth of natural gas consumption.

Thank you for your attention.

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