Energy Outlook for Asia and the Pacific◆

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Summary

The energy outlook aims to project the level of energy demand by 2030, estimate the investment requirements to meet the demand and the CO_2 emissions that would be produced as a result of increasing energy consumption. Below are the findings of the study:

- Energy demand in Asia and the Pacific is projected to increase by about 80% between 2005 and 2030 at an annual rate of 2.4%, which represents a faster rate than the world average growth rate of 1.5%. Energy demand of developing member countries (DMCs) in the region will grow slightly faster at 2.6% per year through 2030 – driven by faster economic growth and infrastructure development.
- Coal will maintain the biggest share of energy demand of Asia and the Pacific at 38.3%. Despite maintaining the biggest share, as a result of energy efficiency improvement in the power and industry sectors – coal is projected to grow relatively slowly at 2.1% per year compared with the growth rate of primary energy demand at 2.4% per year.
- Increased demand of oil – growing at an annual rate of 2.2% – is not likely to be met by domestic production. Overall needs of oil import within the region will increase from 13.2 million barrels per day (mb/d) in 2005 to 26.0 mb/d in 2030.
- Natural gas will register an annual growth rate of 3.6% through 2030 – the fastest growth rate of all fossil fuels – due to its ease of use and lower environmental burden. Asia and the Pacific as a whole will marginally become a net importer of natural gas by 2015 and about 24% of entire natural gas demand in Asia and the Pacific would have to be met by import.
- Nuclear energy demand will increase at 5.1% per year through 2030 – the fastest annual growth rate by energy type. This rapid growth in nuclear energy within the region is affected by the expansion of nuclear installed capacity in the People's Republic of China.
- New and renewable energy (NRE) will represent the fourth-largest share of TPED, at 11.2% in 2030. In Asia and the Pacific, biomass will account for bulk of the NRE share. In view of the

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◆ This paper is based on the Asian Development Bank's commissioned study of *Energy Outlook for Asia and the Pacific*. With the updates in some historical data, and additional information, this paper presents the energy outlook for 48 regional members of ADB, and draw policy implications. Authors would like to acknowledge the valuable advice provided by Jong Inn Kim of ADB who have guided the study directions. Yuji Morita, Ryoichi Komiyama, and Peak Yean Gan of the IEEJ contributed greatly to the preparation of the energy outlook. Researchers of the Asia Pacific Energy Research Centre also assisted the study in preparing the energy outlook for APEC economies.

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replacement of biomass with commercial energy sources, NRE is projected to increase slowly, at an annual rate of 1.3%.

- Electricity demand will increase at 3.4% per year driven by the increases in income level and infrastructure development.
- CO_2 emissions in Asia and the Pacific are forecast to increase from 10,064.8 million tons of CO_2 in 2005 to 17,763.3 million tons in 2030, growing at 2.3% per year. The projected growth rate of CO_2 emissions represents a slightly slower growth rate than the projected energy demand growth of 2.4% per year.
- Asia and the Pacific will require a cumulative total of between $7.0 trillion (constant 2006 prices) and $9.7 trillion of investment to develop new energy infrastructure meeting the future energy demand increases.

1. Introduction

Asia and the Pacific involve a diverse group of countries, with different levels of economic development and energy resource endowment. Collectively, in 2007, this group covered 25.5% of the total land area of the world and had 56.3% of the world's population, but only 29.1% of the world's GDP.

The economic disparities, however, are so wide that 31 members have very low per capita GDP, ranging from $800–$5,000 (purchasing power parity or PPP, in current international dollars), while seven have per capita GDP of $5,000–$15,000, and the remaining ten have high per capita GDPs of $20,000–$50,000.

As most of these members aim to achieve economic development and improvement in living conditions while the affluent few strive to maintain their standard of living, it can be expected that the already high level of collective energy consumption of these economies will continue to grow, and that this will translate into a substantial energy investment requirement and contribute to the potential for further global warming.

This study aims to project the future demand for energy of all members of Asian Development Bank (ADB), the investment requirements to meet this demand, and the resulting CO_2 emission potential associated with the increasing energy demand. The study also attempts to draw policy implications for the enhancement of energy supply security, and sustainable development.

For simplicity of the presentation of the outlook assumptions and results, the 48 developing and developed member countries of ADB in Asia and the Pacific were aggregated into geographical groupings except Australia, Japan and New Zealand which are grouped as the Developed Group. The other groupings are as follows:

- **Central and West Asia** : comprises Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan and Uzbekistan.
- **East Asia** : comprises Hong Kong, China; Republic of Korea; Mongolia; People's Republic of China and Taipei,China.
- **The Pacific** : comprises Cook Islands, Fiji Islands, Kiribati, Marshall Islands, Federated States

of Micronesia, Nauru, Papua New Guinea, Palau, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu and Vanuatu.

- **South Asia** : comprises Bangladesh, Bhutan, India, Maldives, Nepal and Sri Lanka.
- **Southeast Asia** : comprises Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam.

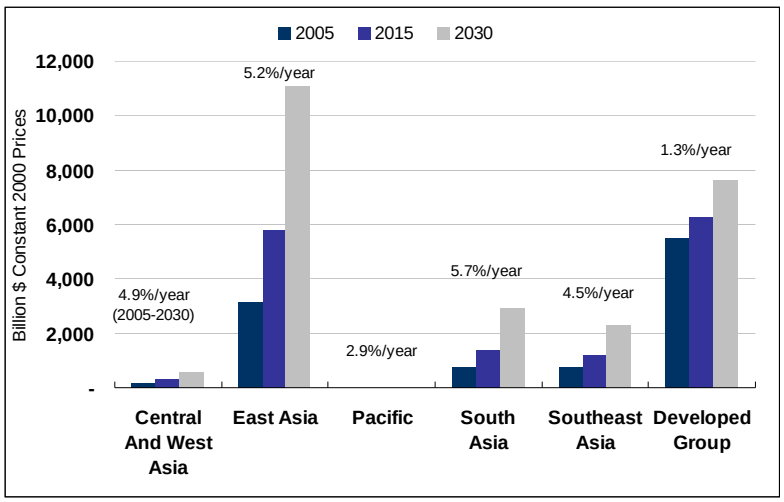
2. Macro Economic Assumptions

The GDP assumptions used in this study were derived from APERC and ADB. APERC was the source of GDP assumptions of the 15 APEC member economies that are also members of ADB, while ADB provided the assumptions for the remaining 33 members.

The assumptions for each of the 48 ADB countries in Asia and the Pacific are available, but to simplify the presentation, the countries were grouped into Central and West Asia, East Asia, the Pacific, South Asia, Southeast Asia and the Developed group. The developed members of Australia, Japan and New Zealand were aggregated into the Developed Group while the others were grouped according to subregion.

From 2005 to 2030, South Asia is assumed to experience the fastest growth rate in GDP at 5.7% per year followed by East Asia at 5.2% per year. Central and West Asia, Southeast Asia, the Pacific and the Developed group are assumed to have 4.9%, 4.5%, 2.9% and 1.3% average annual growth rates from 2005 to 2030, respectively. Fig. 2-1 shows the assumed GDP levels by country group from 2005 to 2030.

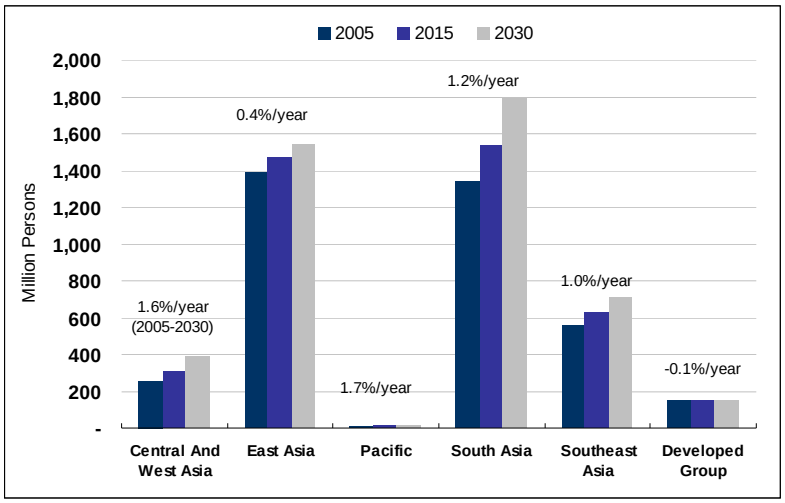
Fig. 2-1 GDP in Asia and the Pacific by Subregion (2005-2030)



The assumed population growth rates are obtained from the United Nations' World Urbanization Prospects (2007) for both the historical data and projections. Growth rates also vary for each country and across country groupings. The highest growth rate of 1.7% per annum is assumed in the Pacific subregion followed by 1.6% per annum in Central and West Asia. South

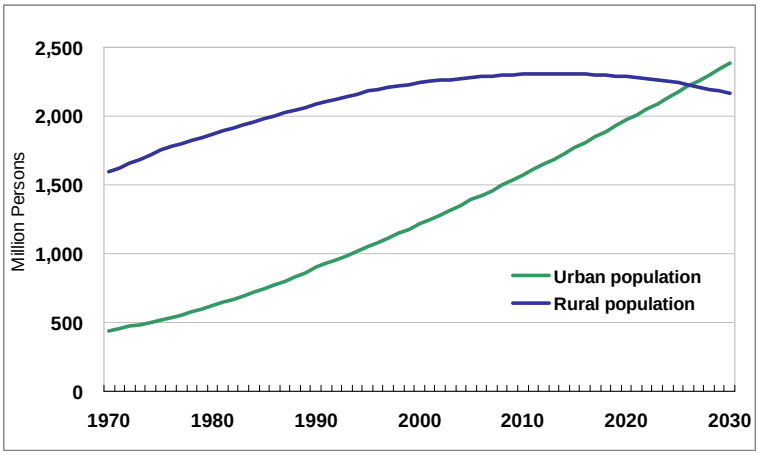
Asia, Southeast Asia, East Asia and the Developed Group are assumed to have 1.2%, 1.0%, 0.4% and -0.1%, respectively. The decreasing population in the Developed Group is driven by the 0.4% annual population decline in Japan although Australia and New Zealand will continue to have increasing but slow growth rates. Fig.2-2 shows the population levels by subregion in 2005 to 2030.

Fig. 2-2 Population in Asia and the Pacific by Subregion (2005-2030)



Urban population from 2005 to 2030 is projected to increase by around five times or 2.2% annually driven both by migration of rural population to urban centers and by transformation of rural areas into urban ones. As a result, rural population will peak at around 2015 and will slowly decrease towards 2030 at an annual rate of 0.2%. Urban population will surpass the rural population at around 2027 (Fig.2-3).

Fig. 2-3 Rural and Urban Population in Asia and the Pacific (2005-2030)



3. Primary Energy Demand Outlook

Primary energy demand in Asia and the Pacific is projected to increase from 4,025.3 MTOE in 2005 to 7,215.2 MTOE in 2030, growing at an annual rate of 2.4%. The projected growth rate is slower compared with the historical annual growth rate of 3.5% observed between 1990 and 2005. With this growth, per capita energy demand of Asia and the Pacific will reach 1.57 TOE—nearly 50% higher than the 2005 level. Despite the substantial increase in per capita energy demand, the projected 2030 level is still lower than the current world average per capita energy demand of 1.79 TOE in 2005.[1]

Fig. 3-1 Primary Energy Demand in Asia and the Pacific (1990-2030)

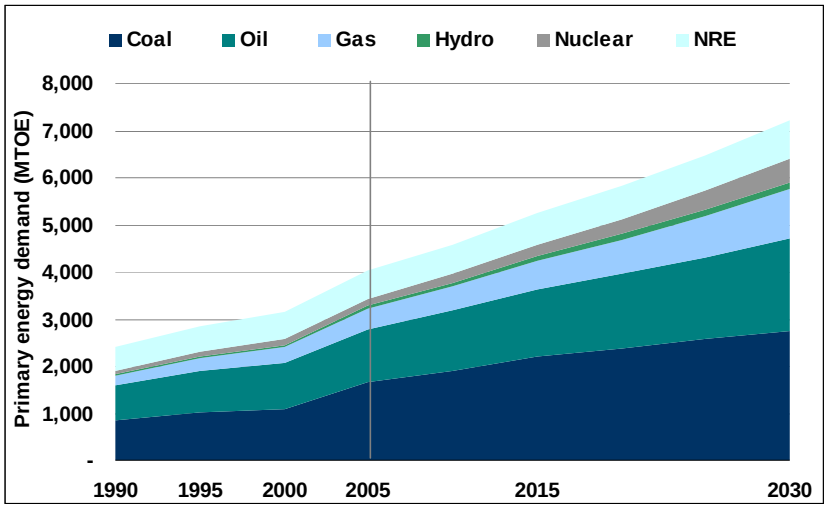
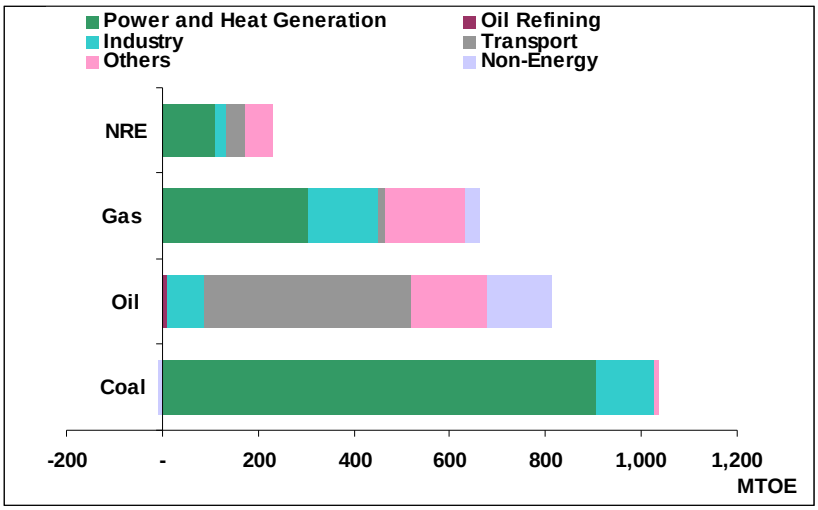


Fig. 3-2 Incremental Energy Demand Growth by Energy and by Sector (2005-2030)



[1] The world average per capita energy demand is calculated using the information from EIA. 2009. *International Energy Outlook.* Washington. D.C.

Energy demand of developing member countries (DMCs) in the region is projected to increase 2.6% per year through 2030—a slightly faster rate than the projected growth rate of Asia and the Pacific as a whole. With this growth, energy demand of DMCs will account for 89.5% of the total for Asia and the Pacific in 2030, up from 83.4% in 2005.

By energy type, **coal** will maintain the biggest share of total primary energy demand in Asia and the Pacific. Despite maintaining the biggest share, coal's share will decrease slightly, from 41.0% in 2005 to 38.3% in 2030, as it is projected to grow only 2.1% per year—a slower rate than that of TPED. Efforts toward efficiency improvement in the power sector—through both technical and operational efficiency improvement— may explain the slower projected growth of coal demand compared with history. By sector, the power sector will continue to be the biggest coal user, responsible for around 88.2% of incremental coal demand growth. The industry sector will also drive coal demand, although its contribution will be smaller, accounting for 11.5% of incremental coal demand between 2005 and 2030.

Table 3-1 Primary Energy Demand in Asia and the Pacific (1990-2030)

		Primary Energy Demand (MTOE)			Annual Growth Rates		
		2005	2015	2030	2005-2015	2015-2030	2005-2030
Coal	DMCs	1,482.2	2,040.2	2,587.8	3.2%	1.6%	2.3%
	Developed Group	166.2	171.2	173.6	0.3%	0.1%	0.2%
	Total	1,648.4	2,211.4	2,761.4	3.0%	1.5%	2.1%
Oil	DMCs	847.7	1,123.0	1,684.4	2.9%	2.7%	2.8%
	Developed Group	295.3	282.9	265.9	-0.4%	-0.4%	-0.4%
	Total	1,143.0	1,405.9	1,950.3	2.1%	2.2%	2.2%
Natural Gas	DMCs	329.4	490.3	892.5	4.1%	4.1%	4.1%
	Developed Group	96.8	124.9	151.8	2.6%	1.3%	1.8%
	Total	426.2	615.3	1,044.3	3.7%	3.6%	3.6%
Hydro	DMCs	57.0	96.1	130.4	5.4%	2.1%	3.4%
	Developed Group	9.9	10.9	11.1	1.0%	0.1%	0.4%
	Total	67.0	107.1	141.4	4.8%	1.9%	3.0%
Nuclear	DMCs	68.4	142.8	382.6	7.6%	6.8%	7.1%
	Developed Group	79.4	109.8	126.2	3.3%	0.9%	1.9%
	Total	147.8	252.6	508.8	5.5%	4.8%	5.1%
Others	DMCs	574.2	630.1	777.3	0.9%	1.4%	1.2%
	Developed Group	18.8	24.8	31.6	2.8%	1.6%	2.1%
	Total	593.0	654.8	808.9	1.0%	1.4%	1.3%
Total	DMCs	3,358.9	4,522.6	6,455.0	3.0%	2.4%	2.6%
	Developed Group	666.4	724.5	760.2	0.8%	0.3%	0.5%
	Total	4,025.3	5,247.1	7,215.2	2.7%	2.1%	2.4%

Oil will maintain the second biggest share in TPED at 27.0% in 2030, representing a slight decrease from 28.4% in 2005. Similar to coal, the projected growth rate of oil demand at 2.2% is slower than the overall average annual growth rate of primary energy demand. Although overall oil demand registers a positive growth rate, the growth trends vary by member and by sector. For example, driven by demand from the transport sector—a result of income growth and infrastructure development—oil demand will register positive growth in most of the developing regional member countries. In contrast, the power and industry sectors' use of oil in some high-income group members may increasingly be replaced by other types of energy, and this offsets the overall growth in the transport sector's oil demand.

Natural gas will increase at an annual rate of 3.6% through 2030—the fastest growth rate of all fossil fuels. Natural gas will be increasingly utilized across the sectors due to its ease of use and lower environmental burden. Despite the fast growth, the share of natural gas in TPED will represent a smaller share than coal and oil— 14.5% in 2030—due to its higher supply cost. In terms of incremental growth, the power sector will account for about 44.8% of total incremental growth between 2005 and 2030, followed by the other sectors at 25.5% and the industry sector at 22.1%.

New and renewable energy (NRE) will represent the fourth-largest share of TPED at 11.2% in 2030. Over the outlook period, NRE is projected to increase at a relatively slow rate of 1.3% per year. In Asia and the Pacific, biomass used in rural areas and other places without access to electricity and gas networks would account for the bulk of NRE. As a result of the improved accessibility to commercial energy sources and higher living standards, biomass demand will increase slowly through 2030. Meanwhile, demand for new energy sources—such as wind, solar, and geothermal—will increase at a faster rate. Due to the dominance of biomass in NRE, the overall growth rate of NRE is projected to proceed at a moderate pace.

Nuclear is projected to increase at an annual rate of 5.1% through 2030—the fastest annual growth rate by energy type. With this growth, primary nuclear energy demand will more than triple from 147.8 MTOE in 2005 to 508.8 MTOE in 2030. The bulk of the increase will come from the PRC, where nuclear capacity is expected to expand through 2030. In addition, nuclear will continue to be an important energy source for power generation, in those members such as India, the Republic of Korea, and Japan toward enhancing energy security and sustainable development

Hydro will increase at an annual rate of 3.0% through 2030, which is faster than the average growth rate of primary energy demand. Despite the projected rapid increase, hydro's share of TPED will be the smallest, at 2.0% in 2030.

4. Primary Energy Demand by Subregion and Final Energy Demand

The projected growth in primary energy demand varies substantially by subregion. For example, the projected annual growth ranges from the Pacific's 4.5% to the Developed Group's 0.5%. This reflects diversity in economic development level, population, industry structure, energy resource endowment, and technology levels across Asia and the Pacific (Fig. 4-1, and Table 4-1).

The Pacific subregion's fast energy demand growth—at an annual rate of 4.5% through 2030— mainly results from improved access to energy supply. These include improvements in electricity and road infrastructures. Despite the rapid increase, the Pacific will account for only a small part of overall energy demand in Asia and the Pacific, at 0.1% in 2030. Per capita energy demand of the Pacific subregion in 2030 is 0.64 TOE, representing about a third of the 1.57 TOE average for Asia and the Pacific.

The energy demand of South Asia is expected to increase from 582.1 MTOE in 2005 to 1,264.3 MTOE in 2030, growing at an annual rate of 3.2%. This represents the second fastest growth rate in primary energy demand by subregion, a result of the projected rapid increase in GDP

at 5.7% per year. With this fast increase, the contribution of South Asia to the total incremental energy demand growth will represent the second largest by subregion, accounting for about 21.4% in 2030.

Southeast Asia's energy demand will grow at an annual rate of 2.8% over the outlook period, reaching 988.2 MTOE in 2030, nearly double the 2005 level of 492.1 MTOE. This results from the relatively fast increase in projected GDP, at an annual rate of 4.5%. Per capita energy demand of Southeast Asia will reach 1.40 TOE in 2030, lower than the region's average of 1.57 TOE in 2030.

Central and West Asia's energy demand is projected to increase from 222.9 MTOE in 2005 to 416.9 MTOE in 2030, or an annual rate of 2.5%, driven by the relatively fast increase in GDP of 4.9% per year. Even with this growth, Central and West Asia's contribution to the overall incremental growth in energy demand will be only 6.1%.

Fig. 4-1 Primary Energy Demand by Subregion (1990-2030)

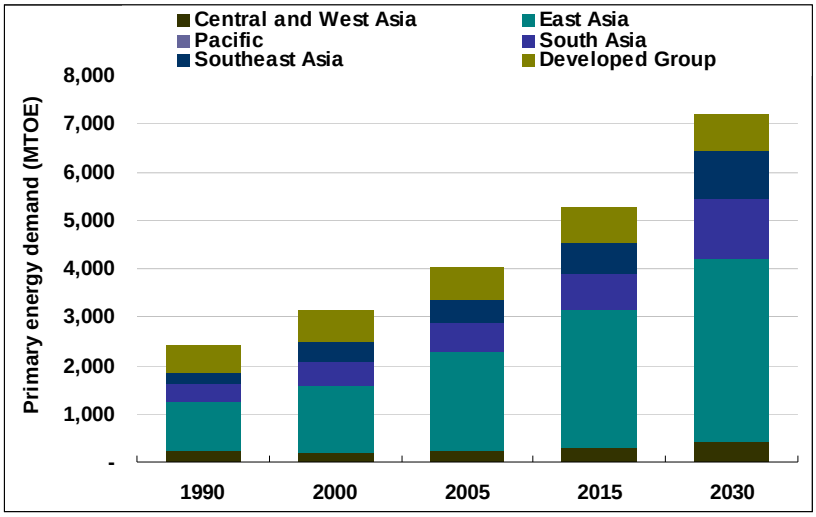


Table 4-1 Primary Energy Demand by Subregion (1990-2030)

	Primary Energy Demand (MTOE)			Annual Growth Rates	
	2005	2015	2030	1990-2005	2005-2030
DMCs	1,856.7	3,358.9	6,455.0	4.0%	2.6%
Central and West Asia	243.7	222.9	416.9	-0.6%	2.5%
East Asia	1,018.7	2,058.8	3,776.6	4.8%	2.5%
Pacific	1.7	3.0	9.0	4.0%	4.5%
South Asia	345.0	582.1	1,264.3	3.5%	3.2%
Southeast Asia	247.6	492.1	988.2	4.7%	2.8%
Developed Group	545.4	666.4	760.2	1.3%	0.5%
Asia Pacific Total	2,402.0	4,025.3	7,215.2	3.5%	2.4%

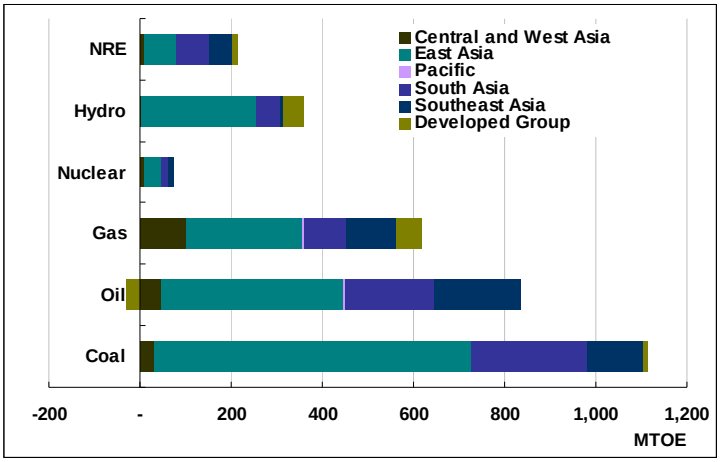
East Asia's energy demand is projected to increase from 2,058.8 MTOE in 2005 to 3,776.6 MTOE in 2030, reflecting a growth rate of 2.5% per year through 2030. Despite a robust increase in GDP at 5.2% per year through 2030, this subregion's energy demand growth is projected to

increase at a relatively slower rate. In terms of energy elasticity with respect to GDP, East Asia represents 0.47, in contrast to elasticity of 0.67 in the region. This lower elasticity reflects energy efficiency improvements through technological development across the subregion and a change in industry structure from heavy industry to services in the PRC; Hong Kong, China; and Taipei,China. Despite a relatively slow projected growth of energy demand, East Asia will be responsible for the bulk of the region's energy increments, at 53.9% between 2005 and 2030.

The Developed Group's energy demand is expected to increase slowly at an annual rate of 0.5% through 2030. The share of this region's energy demand to Asia and the Pacific's total energy demand may decline from 16.6% in 2005 to 10.5% in 2030. The projected slow growth results from a combination of various factors including energy efficiency improvements through technological progress, change in industry structure, and decline in population, mainly in Japan.

Fig. 4-2 shows the incremental growth by energy type and by subregion. It is interesting to note that the growth trend varies by energy type and by subregion. For example, East Asia and South Asia will drive the growth in coal demand mainly because of continued reliance on coal in the PRC and India, supported by domestic resource availability. Oil demand will be driven largely by the increased use in East Asia, South Asia, and Southeast Asia to fuel the transport needs, while the Developed Group exhibits a negative growth trend over the outlook period, which reflects energy efficiency improvements and the group's shift away from oil use (aside from the transport sector). Similarly, East Asia, South Asia, and Southeast Asia may drive the growth in natural gas, while Central and West Asia account for a substantial increment as well. Ease of use and lower environmental burden – compared with coal and oil – drive the growth in natural gas, while subregions that are endowed with natural gas resources, such as Southeast Asia and Central and West Asia, will find it a cost competitive option and increase utilization.

Fig. 4-2 Incremental Growth by Energy Type and by Subregion (2005-2030)

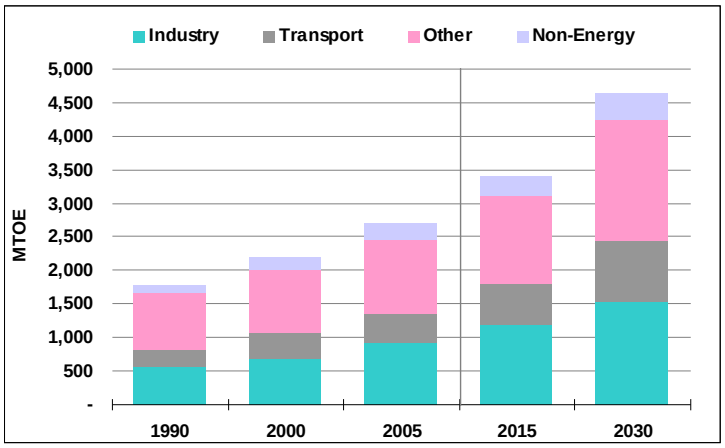


Final energy demand of Asia and the Pacific is projected to increase from 2,700.0 MTOE in 2005 to 4,634.5 MTOE in 2030, an annual growth rate of 2.2% per year. By sector, the transport

sector is projected to increase at the fastest annual growth rate of 2.9% per year through 2030. This is followed by industry at 2.1% and the others at 2.1% per year. The energy demand for the non-energy sector (such as feedstock for the petrochemical industry) will grow relatively slowly at 1.7% per year.

Despite the fast growth, the transport sector's share will remain relatively small (19.7% in 2030 from 16.6% in 2005). By contrast, the "others" sector will maintain the largest share, (39.0% in 2030 from 40.2% in 2005), reflecting the continued use of biomass in some developing members. Industry will account for the second-largest share, at 32.9% in 2030 from 33.9% in 2005.

Fig. 4-3 Final Energy Demand by Sector (1990, 2005, 2015, and 2030)

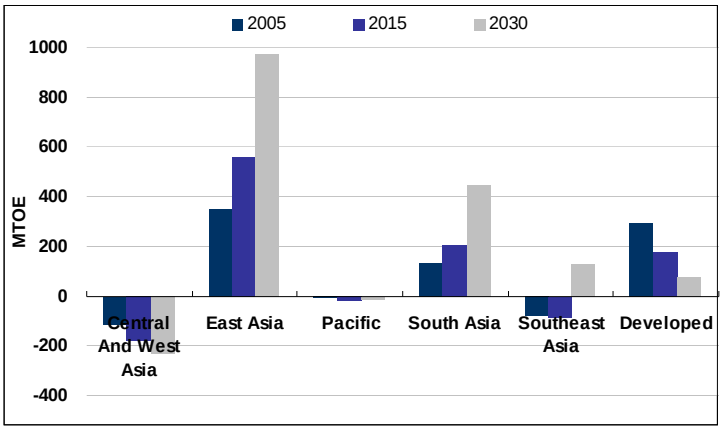


5. Energy Imports and Production

5-1 Net Energy Imports by Subregion

An increasing portion of the rapidly growing energy demand in Asia and the Pacific will be met by imports. Net imports (imports minus exports) of fossil fuels in Asia and the Pacific are expected to more than double, from 584.9 MTOE in 2005 to 1,385.1 MTOE in 2030.

Fig. 5-1 Net Energy Imports by Subregion (2005, 2015 and 2030)



Although the overall net energy import volume may increase in the future, a wide disparity is observed in the balance between energy demand and production. Central and West Asia, for example, may continue to be a net energy exporter, and is expected to export about 231.9 MTOE of fossil fuels in 2030 compared with 111.7 MTOE in 2005. The increase in oil and gas production from Azerbaijan, Kazakhstan, Turkmenistan, and Uzbekistan explains the increasing export position of this subregion.

By contrast, East Asia's net imports may nearly triple from 348.9 MTOE in 2005 to 970.3 MTOE in 2030. In fact, the projected growth rate of energy import in East Asia at an annual rate of 4.2% registers a faster pace than that of energy demand growth at 2.5%.

The Pacific subregion will turn into a net importer of oil by 2030, while this subregion is expected to become a net natural gas exporter reflecting the projected increase in natural gas exports from Papua New Guinea and Timor-Leste.

Similarly, South Asia's net energy imports are expected to more than triple from 132.6 MTOE in 2005 to 447.6 MTOE in 2030, growing at an annual rate of 4.7%. In South Asia, India's expected increase in oil and gas demand will be increasingly met by imports.

Southeast Asia may turn into a net energy importer at 125.4 MTOE in 2030—changing from a net energy exporter at 79.5 MTOE in 2005. Not only will this subregion become a net importer of natural gas by 2030, its growing oil demand will be increasingly met by imports given the decline in production from the current major producers such as Indonesia, Malaysia, Thailand, and Viet Nam.

The Developed Group's net imports of fossil fuels are projected to decline from the current 294.6 MTOE in 2005 to 73.7 MTOE in 2030. Australia's production increases and exports of coal and natural gas explain the overall decline in net imports of the Developed Group.

5-2 Oil Production and Imports

While overall energy import requirements in Asia and the Pacific are likely to increase, the trend offers variation by energy type and by subregion.

Fig. 5-2-1 Net Oil Imports by Subregion
(2005, 2015, and 2030)

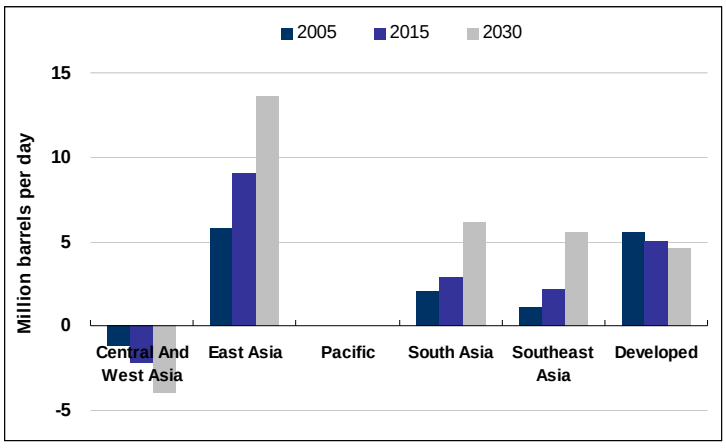
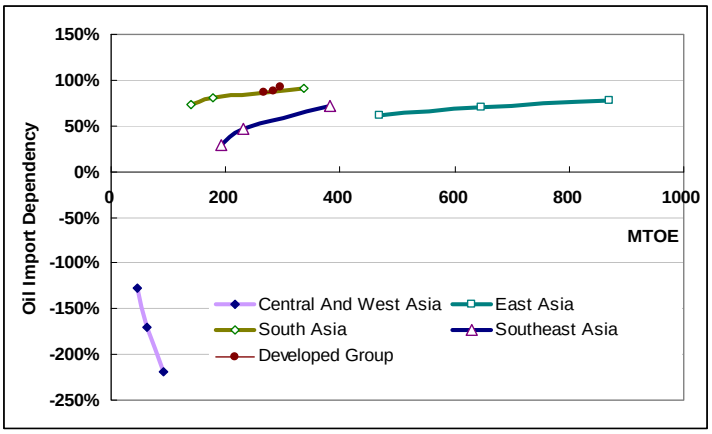


Fig. 5-2-2 Oil Demand and Net Oil Import Dependency by Subregion (2005, 2015, and 2030)

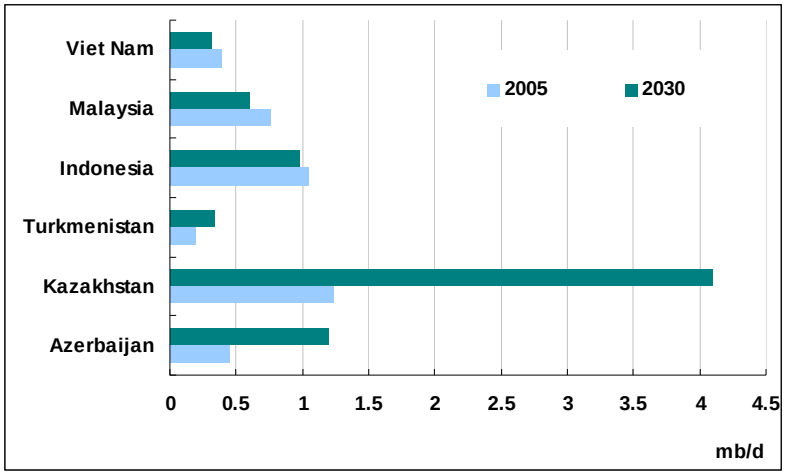


Net imports of oil (including crude oil and petroleum products) are expected to increase substantially, from 655.1 MTOE (or 13.2 mb/d) in 2005 to 1,294.3 MTOE (or 26.0 mb/d) in 2030—the biggest increase in fossil fuels. By subregion, excluding Central and West Asia, the other subregions will be transformed into net importers of oil. The substantial growth in oil demand by the PRC and India—combined with the slow growth in domestic oil production—will lead these subregions' needs for oil imports. Southeast Asia's expected rise in net oil imports will result from the decline in oil production from current major oil producers such as Indonesia, Malaysia, and Viet Nam. The Pacific region's oil demand represents the lowest level in Asia and the Pacific at 4.2 MTOE in 2030, transforming it into a net importer by 2030. The overall net oil imports of the Developed Group may decline from the current 275.6 MTOE (or 5.51 mb/d) to 231.2 MTOE (4.64 mb/d), reflecting the decline in Japan's oil demand.

In Central and West Asia, expected production increases in Azerbaijan, Kazakhstan, and Uzbekistan may contribute greatly to the substantial increase in oil exports. These members' oil exports will be spurred by the expansion in pipeline infrastructure.

The oil production trend varies by subregion. Current major oil producers in Southeast Asia such as Indonesia, Malaysia, and Viet Nam are projected to decrease their production by 2030. For example, as the oil fields mature, Indonesia's oil production may decrease from 52.4 MTOE (1.05 mb/d) in 2005 to 48.8 MTOE (0.98 mb/d) in 2030. In contrast, oil production from Central and West Asia—including Azerbaijan, Kazakhstan, and Turkmenistan—will increase by 2030. With the investment in both upstream and midstream segments, the vast oil reserves in Central and West Asia could increase supplies to consumers both within and outside of the subregion, thereby making a great contribution to improving overall oil supply security.

Fig. 5-2-3 Oil Production from Selected Members (2005 and 2030)



5-3 Natural Gas Production and Imports

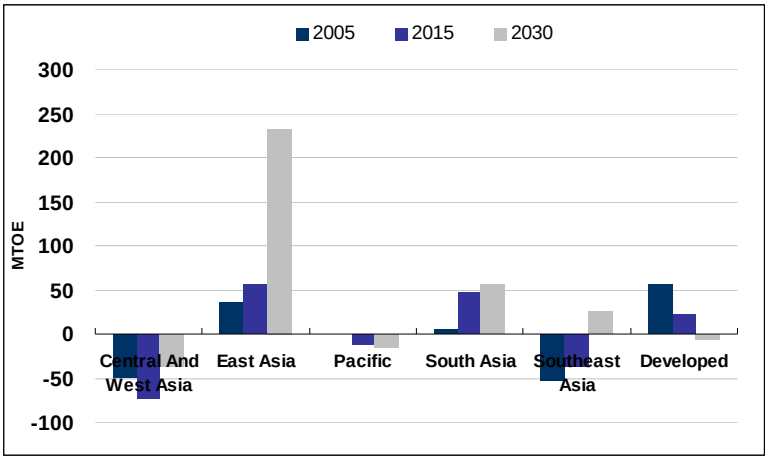
The outlook for net natural gas imports varies by subregion and by time period. This diversity mainly results from different timing for the demand increases and different resource endowments.

As Fig. 5-3-1 shows, Central and West Asia is projected to maintain its net export position in natural gas, with untapped reserves in Azerbaijan, Kazakhstan, Turkmenistan, and Uzbekistan that could be developed by 2030.

In contrast, both East Asia and South Asia are expected to require substantial natural gas imports by 2030, mainly as a result of increased demands for natural gas in the PRC and India.

Southeast Asia is forecast to maintain a net export position until sometime around 2025, and by 2030 this subregion as a whole is forecast become a net importer of natural gas. The major natural gas producers such as Brunei Darussalam, Indonesia, and Malaysia are expected to continue to maintain their net export positions. However, the substantial demand increase from the Philippines, Singapore, and Thailand (resulting from increased natural gas demand for power generation) may transform this subregion into a net importer.

Fig. 5-3-1 Net Natural Gas Imports by Subregion (2005, 2015 and 2030)

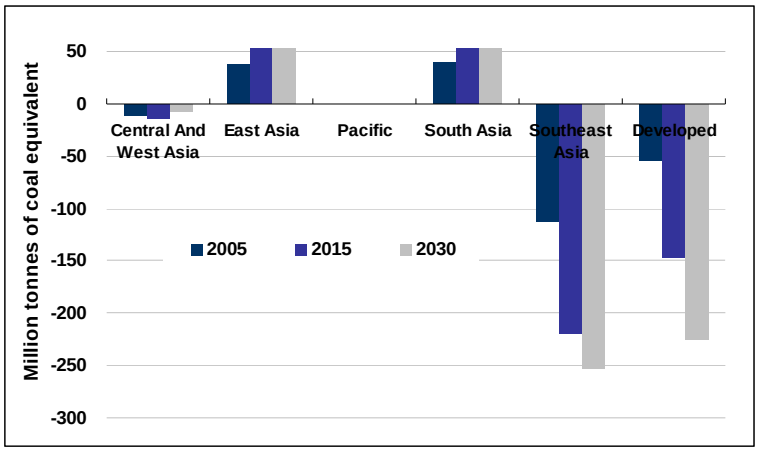


The Developed Group is expected to become a net natural gas exporter by 2030 because of the expansion of Australia's liquefied natural gas (LNG) exports. With the start-up of new projects, Australia will be able to export more than 80 million tons of LNG by 2030.

5-4 Coal Production and Imports

The region's need for coal imports is expected be relatively low compared with the other fossil fuels. Although diversity exists by member and by subregion, the region as a whole may maintain its net export position in coal from 67.8 MTOE (101.7 million tons of coal equivalent) in 2005 to 208.6 MTOE (312.9 million ton of coal equivalent) in 2030. By member, Australia and Indonesia will expand their exports, nearly doubling their current coal exports to make the region as a whole self-sufficient in coal supply.

Fig. 5-4-1 Net Coal Imports by Subregion (2005, 2015, and 2030)



6. Electricity Outlook

6-1 Electricity Demand

Electricity demand in Asia and the Pacific is projected to increase from 4,978 terawatt-hours (TWh) in 2005 to 11,593 TWh in 2030 with an annual rate of 3.4%. This is more than a doubling between these years, but indicates a slower growth rate than the historical trend of 5.7% between 1990 and 2005 (Table 6-1). Especially, the average annual growth rate of electricity demand in the DMCs between 2005 and 2030 will be faster, at 4.0%, than that of Asia and the Pacific as a whole.

By subregion, East Asia is projected to represent the highest electricity demand at 6,167 TWh in 2030, mainly led by the PRC, although the subregion's annual growth rate of electricity demand is expected to slow from 9.3% in the historical period (1990–2005) to 3.5% (2005–2030). In contrast, South Asia's electricity demand is likely to maintain robust growth at 5.5% on average, increasing nearly fourfold to 1,927 TWh in 2030, followed by Southeast Asia (4.8%) and the Pacific (4.0%), a result of economic development and improved electricity supply infrastructure. Although electricity demand in Central and West Asia is not as high as in the other subregions in

absolute terms, its growth rate is projected to increase 3.4% a year over the outlook period after the region experienced negative growth in the historical period.

Table 6-1 Electricity Demand by Subregion (1990-2030)

	Electricity Demand (TWh)					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
DMCs	1,275	2,396	3,756	6,037	10,024	7.5%	4.0%
Central and West Asia	246	177	214	304	487	-0.9%	3.4%
East Asia	679	1,507	2,594	4,107	6,167	9.3%	3.5%
Pacific	2	3	4	6	11	4.7%	4.0%
South Asia	220	388	503	893	1,927	5.7%	5.5%
Southeast Asia	128	321	441	726	1,432	8.6%	4.8%
Developed Group	907	1,150	1,221	1,373	1,569	2.0%	1.0%
Asia Pacific Total	2,181	3,546	4,978	7,409	11,593	5.7%	3.4%

Electricity demand may correspondingly increase along with economic development and improvement in living standards. This is observed in Asia and the Pacific, as demonstrated in Fig. 6-1-1 which traces patterns between electricity demand per capita and GDP per capita between 1990 and 2030. In addition, Fig. 6-1-2 focuses on the subregions with GDP per capita below $8,000 to compare the general trend more clearly. East Asia represents the highest per capita electricity demand among those subregions because the developed industry and higher living standards will in turn translate into a higher electricity requirement per capita, followed by Southeast Asia. By 2030, the income level of Central and West Asia is projected to stand at a similar level to that of South Asia, but Central and West Asia's per capita electricity demand will be about 17.6% higher than that of South Asia. The difference stems from a number of factors including greater accessibility to electricity supply, lower electricity tariff levels (backed by the vast energy reserves), and cold winters in Central and West Asia.

Fig. 6-1-1 Electricity Demand per Capita and GDP per Capita (1990-2030)

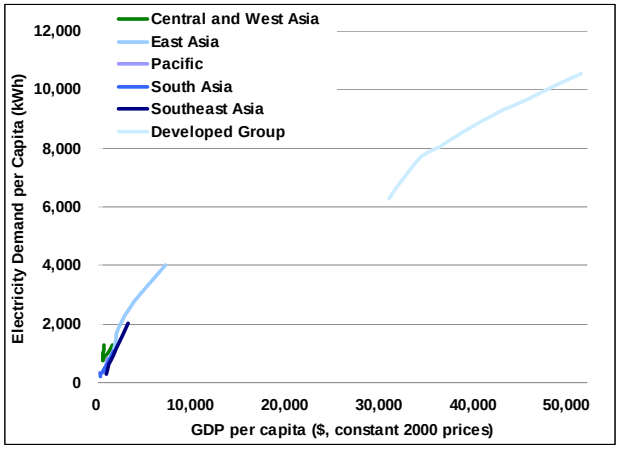
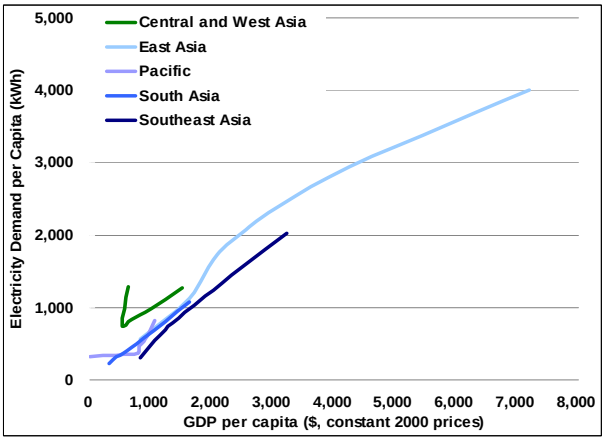


Fig. 6-1-2 Electricity Demand per Capita and GDP per Capita below $8,000 (1990-2030)



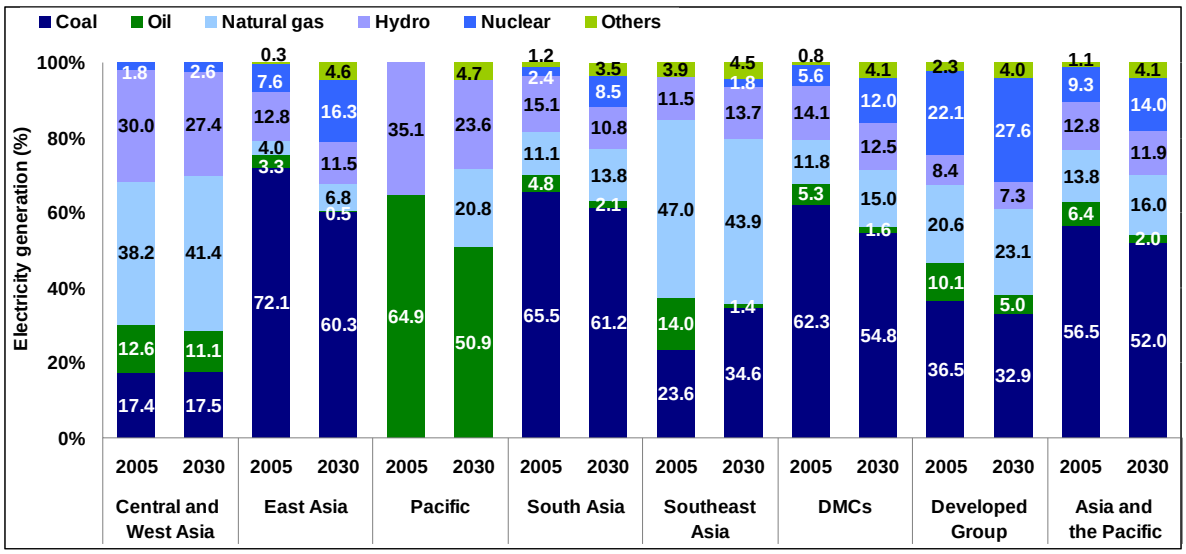
6-2 Electricity Supply

Total electricity generation in Asia and the Pacific will grow annually at 3.4% on average, reaching 14,016 TWh in 2030 (Table A-2). In 2030, nearly three-quarters of the total electricity generation will be taken up by three members; the PRC (6,374 TWh, 45.5%), India (2,414 TWh, 17.2%), and Japan (1,324 TWh, 9.4%). Among the members compared, there is a wide diversity in the projected generation, ranging from China at the highest to the Maldives's 0.7 TWh at the lowest in 2030.

6-3 Electricity Generation Mix

The mix of electricity generation varies substantially by subregion (Fig. 6-3). In Asia and the Pacific, coal is projected to maintain the largest share, while natural gas and nuclear are projected to expand their shares moderately in the generation mix. Coal is likely to be the main source of electricity generation due to abundant resource availability and price competitiveness compared with the other types of energy. In the subregions that are endowed with vast natural gas reserves, such as Central and West Asia, and Southeast Asia, natural gas-fired generation will continue to dominate the electricity generation mix. Nuclear generation will expand in some members as a means to improve energy security, diversify energy sources, and reduce CO_2 emissions. In contrast, the share of oil-fired and hydropower electricity generation are projected to decline through 2030 in Asia and the Pacific. All the subregions are likely to reduce dependence on oil in order to enhance energy security. Lastly, new and renewable energy in electricity generation is expected to increase in the future, although its share will remain low. Penetration of new and renewable energy will depend on cost competitiveness and technology availability.

Fig. 6-3 Electricity Generation Mix (2005 and 2030)



Note : "Others" include geothermal, solar, wind, and renewables.

7. CO_2 Emissions Outlook

The CO_2 emissions in Asia and the Pacific will increase from 10,064.8 million tons of CO_2 in 2005 to 17,763.3 million tons of CO_2 in 2030, growing at an annual rate of 2.3%. The projected growth rate of CO_2 emissions is slightly slower than the projected energy demand at 2.4%. This reflects the slight improvement in overall CO_2 intensity (or CO_2 emissions per unit of TPED) in Asia and the Pacific. As a result of this growth, per capita CO_2 emissions of ADB regional members will average 3.9 tons of CO_2 in 2030, up from 2.7 tons in 2005.

Fig. 7-1 CO_2 Emissions (2000-2030)

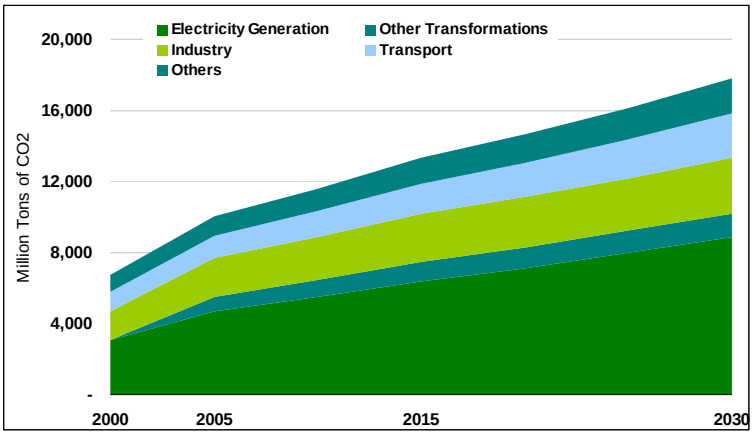
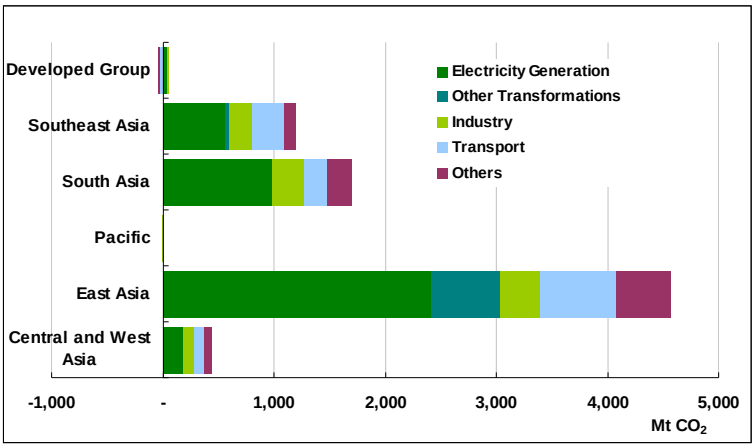


Fig. 7-2 CO_2 Emissions Increment by Subregion and by Subsector (2005-2030)



CO_2 emissions of DMCs will increase at a faster annual rate of 2.6% through 2030. This compares with the projected growth rate of energy demand at 2.6% per year through 2030.

By sector, the CO_2 emissions from the transport sector in Asia and the Pacific will increase the fastest, at an annual growth rate of 2.8% through 2030. With this growth, the transport sector's share of total CO_2 emissions will increase from 12.5% in 2005 to 13.7% in 2030. This is followed

Fig. 7-3 CO_2 Emissions Share by Subregion (2005 and 2030)

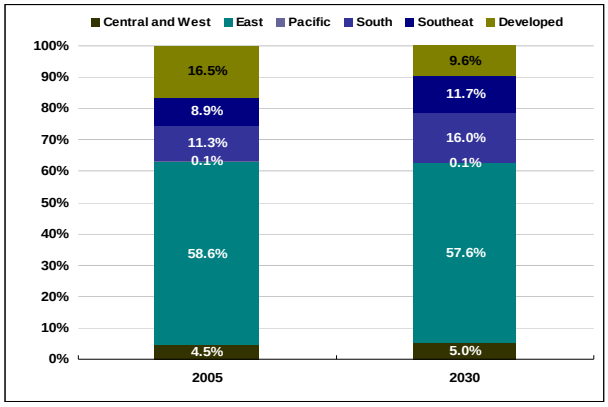


Table 7-1 CO_2 Emissions by Subregion (1990, 2000, 2005, 2015, and 2030)

	Million Tons of CO_2				Annual Growth Rates	
	1990	2005	2015	2030	1990-2005	2005-2030
DMCs	4,161	8,402	11,637	16,060	4.8%	2.6%
Central and West Asia	581	455	625	891	-1.6%	2.7%
East Asia	2,638	5,902	8,123	10,226	5.5%	2.2%
Pacific	3	8	14	22	9.2%	4.3%
South Asia	568	1,142	1,632	2,843	4.8%	3.7%
Southeast Asia	370	896	1,243	2,079	6.1%	3.4%
Developed Group	1,365	1,663	1,674	1,704	1.3%	0.1%
Asia-Pacific Total	5,526	10,065	13,311	17,763	4.1%	2.3%
World	21,488	28,296	33,111	37,879	1.9%	1.2%
OECD	11,506	13,632	13,617	14,588	1.1%	0.3%

Note : The outlook for World and OECD are from EIA (2009). These are included for the purpose of comparison with Asia and the Pacific.

by the power sector, where CO_2 emissions are expected to increase at an annual rate of 2.6% through 2030. This sector's share may increase from 46.3% in 2005 to 49.3% in 2030. The emissions of the others sectors will increase at an annual rate of 2.4%. The share of this sector to total CO_2 emissions will remain constant, at around 11% through 2030. The industry sector's CO_2 emissions are expected to grow relatively slowly, at an annual rate of 1.5% through 2030.

By subregion, East Asia's CO_2 emissions will represent the highest level in 2030 at 10,226 million tons of CO_2, followed by South Asia at 2,843 million tons, Southeast Asia at 2,079 million tons, the Developed Group at 1,704 million tons, and Central and West Asia at 891 million tons. The Pacific region will represent the lowest level at 22 million tons of CO_2.

In terms of the incremental CO_2 emissions by sector, the power sector is expected to contribute greatly to the overall incremental emissions across the region. By subregion, the biggest incremental emissions may come from East Asia, followed by South Asia, Southeast Asia, and Central and West Asia.

Fig. 7-4 CO_2 Intensity by Subregion (1990-2030)

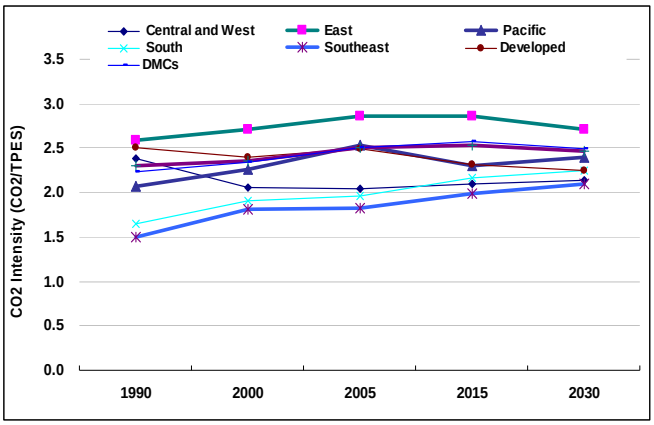


Table 7-2 CO_2 Emissions Intensity by Subregion (1990, 2000, 2005, 2015, and 2030)

	CO_2 Intensity (CO_2/TPED)					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
DMCs	2.24	2.35	2.50	2.57	2.49	0.7%	0.0%
Central and West Asia	2.38	2.05	2.04	2.10	2.14	-1.0%	0.2%
East Asia	2.59	2.70	2.87	2.86	2.71	0.7%	-0.2%
Pacific	2.07	2.27	2.53	2.31	2.40	1.3%	-0.2%
South Asia	1.65	1.90	1.96	2.17	2.25	1.2%	0.5%
Southeast Asia	1.50	1.81	1.82	1.99	2.10	1.3%	0.6%
Developed Group	2.50	2.40	2.49	2.31	2.24	0.0%	-0.4%
Asia-Pacific Total	2.30	2.36	2.50	2.54	2.46	0.6%	-0.1%
World			2.44	2.39	2.22		-0.4%
OECD			2.25	2.15	2.09		-0.3%

Note : The outlook for World and OECD are from EIA (2009). These are included for the purpose of comparison with Asia and the Pacific.

Although East Asia's CO_2 emissions are likely to represent the highest level in 2030, its share of the total emissions of Asia and the Pacific may decrease slightly from 58.7% in 2005 to 57.6% in 2030. This reflects the projected slow growth of CO_2 emissions of this subregion (an annual rate of 2.2% through 2030, compared with the average growth rate of Asia and the Pacific at 2.3%). Similarly, the Developed Group's share will decrease from 16.5% in 2005 to 9.6% in 2030. In contrast, South Asia's and Southeast Asia's shares of the total are expected to increase. South Asia's share will increase from 11.3% in 2005 to 16.0% in 2030, while Southeast Asia will increase from 8.9% in 2005 to 11.7% in 2030. Central and West Asia's share are projected to increase slightly from 4.5% in 2005 to 5.0% in 2030.

Fig. 7-5 Per Capita CO_2 Emissions by Subregion (1990-2030)

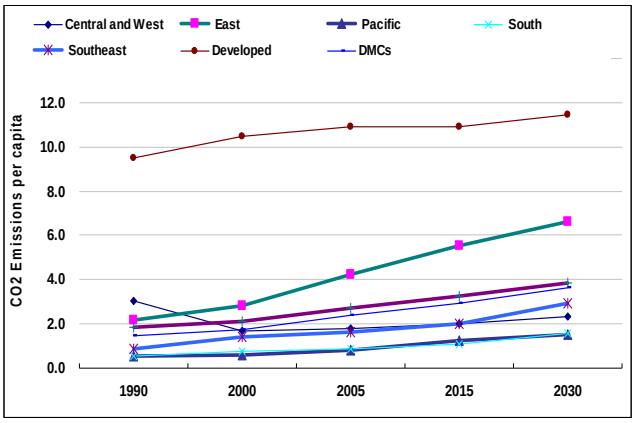


Table 7-3 Per Capita CO_2 Emissions by Subregion (1990, 2000, 2005, 2015, and 2030)

	Per Capita CO_2 Emissions					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
DMCs	1.46	1.75	2.37	2.94	3.62	3.3%	1.7%
Central and West Asia	3.02	1.68	1.77	2.03	2.32	-3.5%	1.1%
East Asia	2.16	2.80	4.24	5.52	6.63	4.6%	1.8%
Pacific	0.54	0.59	0.83	1.25	1.54	3.0%	2.5%
South Asia	0.56	0.77	0.86	1.06	1.59	2.8%	2.5%
Southeast Asia	0.86	1.39	1.61	1.98	2.93	4.3%	2.4%
Developed Group	9.49	10.48	10.92	10.91	11.48	0.9%	0.2%
Asia-Pacific Total	1.84	2.12	2.72	3.24	3.88	2.6%	1.4%
World			1.77	1.96	2.16		0.8%
OECD			11.66	11.03	11.16		-0.2%

Note : The outlook for World and OECD are from EIA (2009). These are included for the purpose of comparison with Asia and the Pacific.

As an indicator for understanding the underlying factors in the change in the share of total CO_2 emissions, CO_2 intensity (or CO_2 emissions requirement per unit of TPED) is calculated. A higher CO_2 intensity would mean higher CO_2 emissions per unit of energy demand.

The CO_2 intensities of South Asia and Southeast Asia—whose share of total emissions are expected to increase—will increase at annual rates of 0.5% and 0.6%, respectively, over the outlook period. The increases in CO_2 intensity result from the subregions' increased share of coal in total energy demand. In contrast, CO_2 intensities are expected to decline in East Asia (0.2% per year) and the Developed Group (0.4%) over the outlook period, and each subregion's share of the total emissions will decline. The decline in CO_2 intensities results from the increased shares of non-fossil fuels such as nuclear and new and renewable energy.

A wide gap is observed among the subregions in terms of projected per capita CO_2 emissions. Due to the diversity in fuel choice, economic development, industry structure, and living standards, per capita CO_2 emissions in 2030 range from the Pacific subregion's low of 1.54 to the Developed Group's 11.48 (Fig.7-5).

8. Energy Investment Outlook

To meet the rapid energy demand growth of 2.4% per year until 2030, Asia and the Pacific will require between $7.0 trillion (constant 2006 prices) and $9.7 trillion of investment in the energy sector.

Fig. 8-1 Energy Investment Outlook by Sector (High Case, 2005-2030)

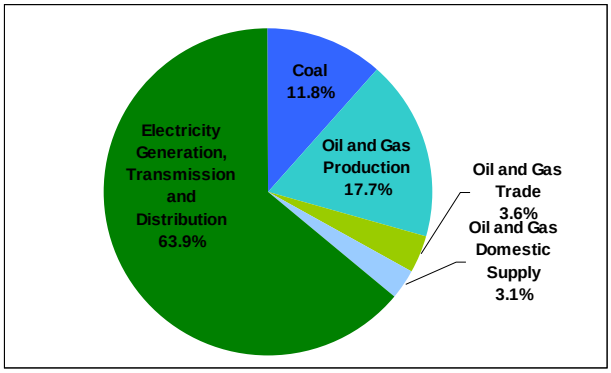
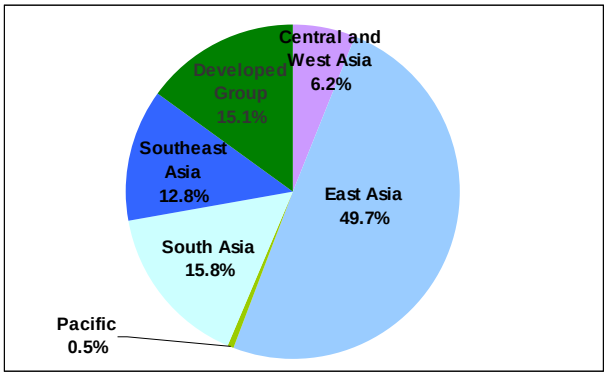
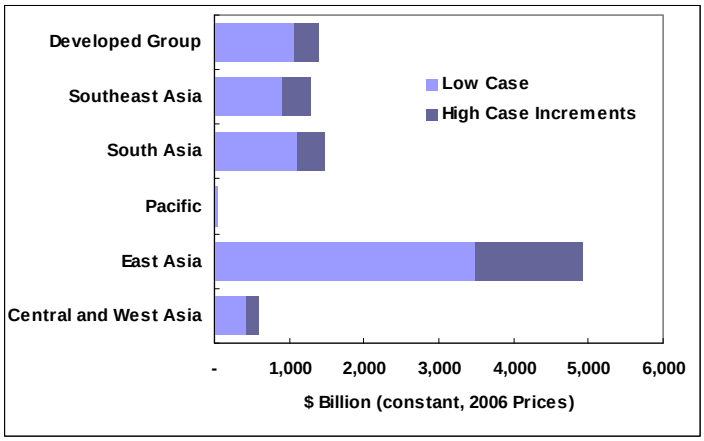


Fig. 8-2 Energy Investment Outlook by Subregion (High Case, 2005-2030)



As Fig. 8-1 shows, the electricity sector—including generation, transmission, and distribution — will require the largest investment, accounting for 63.9% of the total. This is followed by the investment for oil and gas production at 17.7% and coal (including production and transport) at 11.8%. The investment required to build infrastructure for oil and gas trade accounts for 3.6% of the total investment requirements. Investment needs for domestic oil and gas supply account for the smallest share of 3.1%.

Fig. 8-3 Energy Investment Outlook by Subregion (Low Case and High Case Increments)



Subregional shares of the total energy investment requirements are shown in Fig. 8-2. East Asia will account for nearly half of the entire energy investment requirements of Asia and the Pacific. South Asia will follow, accounting for 15.8% of total investment, and the Developed Group will take up the third-largest share at 15.1%.

East Asia's dominance in the overall investment requirement for Asia and the Pacific is explained by the PRC's dominance in this subregion. Its estimated investment requirement of between $3.5 trillion and $4.9 trillion represents more than 40% of the investment requirements in Asia and the Pacific. Of the total investment for the PRC, approximately 68% will be dedicated to electricity generation, transmission, and distribution.

South Asia represents the second-largest investment requirement by subregion. This mainly results from the substantial investment requirements for India. Between 2005 and 2030, India is expected to require between $1.0 trillion and $1.4 trillion of investment in the energy sector. For India, nearly 80% of total energy sector investment would have to be dedicated to electricity generation, transmission, and distribution.

The Developed Group accounts for the third-largest investment requirement by subregion, as it reflects Japan's needs for new infrastructure and facilities—mainly for electricity generation and transmission—and those of Australia for developing coal and natural gas necessary to export into markets in Asia and the Pacific.

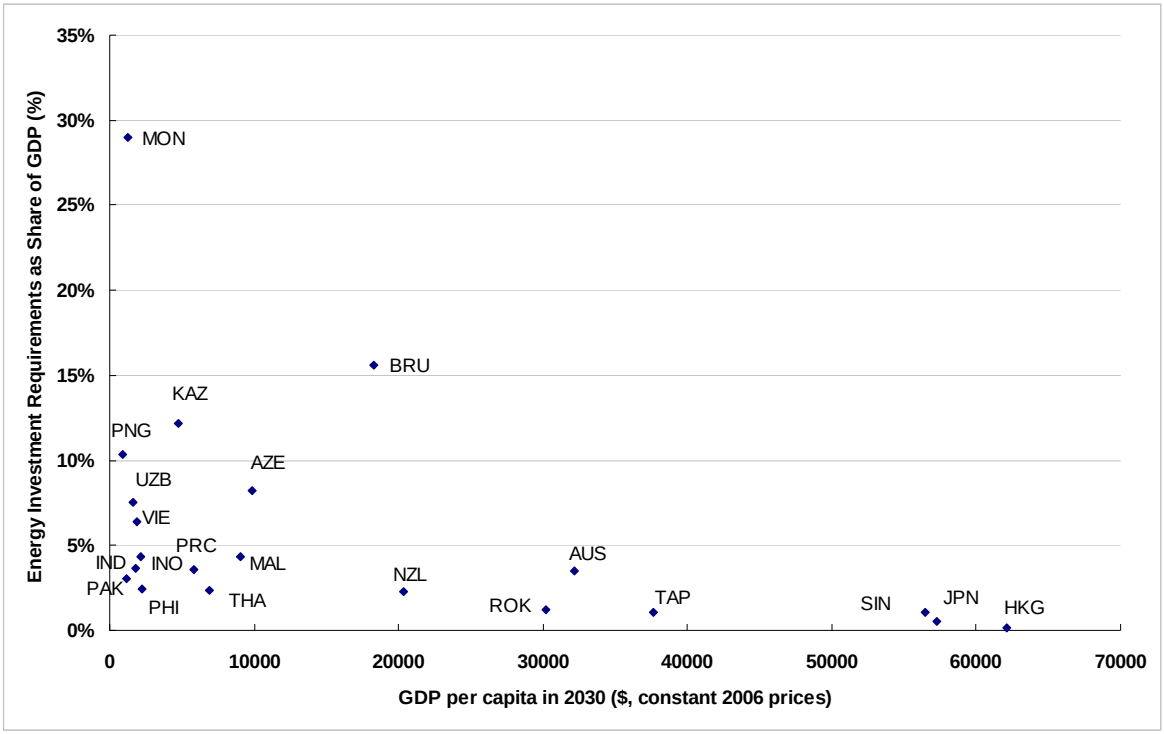
Out of the total investment requirements for Central and West Asia, Kazakhstan represents the biggest investment requirement—between $120 billion and $169 billion—about 60% of which is dedicated to investment for coal, oil, and natural gas production and transport. Pakistan takes the second position in Central and West Asia, with an investment requirement between $100 billion and $133 billion over the outlook period, half of which should be devoted to the electricity sector; the member's need to develop domestic natural gas resources, as well as infrastructure to import natural gas, will take up about 40% of total investment. Azerbaijan and Uzbekistan represent relatively large investment requirements compared with the size of their energy demand. About half of the investment for the two members will be dedicated to upstream development and the infrastructure necessary to deliver those resources for export purposes.

Fig. 8-4 shows the cumulative energy investment requirements as a share of cumulative GDP between 2005 and 2030. This is compared with the projected GDP per capita in 2030 for each member analyzed. For comparison, the results from the high investment case are presented.

There is a general downward trend in terms of the share of investment requirements as GDP per capita increases. For example, for those members with high GDP per capita, at around $60,000 in 2030 (2006 constant prices)—such as Hong Kong, China and Japan—the share of energy investment requirements per GDP account for 0.1% and 0.5%, respectively. Likewise, in members where GDP per capita is projected to exceed $30,000 by 2030, such as Taipei,China; Singapore; and the Republic of Korea, the share of energy investment in GDP will respectively account for 1.1%, 1.1%, and 1.2%. Some resource-rich members such as Australia and Brunei Darussalam have relatively high investment requirements per GDP, at 3.5% and 15.6%, respectively, although their GDP per capita is projected to represent high levels of $32,000 (Australia) and $18,000

(Brunei Darussalam) by 2030. These results from those members' need to invest in the upstream segment along with the facilities required to process and transport the energy sources for export.

Fig. 8-4 Energy Investment Requirements as Share of GDP



AUS = Australia; AZE = Azerbaijan; BRU = Brunei Darussalam; PRC = People's Republic of China; HKG = Hong Kong, China; IND = India; INO = Indonesia; JPN = Japan; KAZ = Kazakhstan; ROK = Republic of Korea; MAL = Malaysia; MON = Mongolia; NZL = New Zealand; PAK = Pakistan; PHI = Philippines; PNG = Papua New Guinea; SIN = Singapore; TAP = Taipei,China; THA = Thailand; UZB = Uzbekistan; VIE = Viet Nam.

The members with GDP per capita below $10,000 in 2030 show wide a disparity in terms of their share of investment requirements as a percentage of GDP. They range from Mongolia's 29% at the highest level to the Philippines' 2.4% at the lowest. Factors such as industry structure and resource availability contribute to these differences. Mongolia's high investment requirements relative to GDP result from the member's expansion in coal production for export. By contrast, the Philippines' relatively low investment requirements result from the relatively slow projected growth in energy demand (2.4% annually).

9. Implications

Energy demand in Asia and the Pacific is projected to increase at diverse trends by member depending on the pace of economic development, industrialization, urbanization, and technology applications. Likewise, the choice of energy type in future may differ substantially by member reflecting the resources endowment, cost of import, and government policies. Asia and the Pacific's energy demand as a whole, however; may increase at a faster rate than the world average.

An increasing proportion of this rapidly growing energy demand in Asia and the Pacific would have to be met by imports. In particular, oil import dependency may increase substantially in Asia and the Pacific. To ensure stable oil supply, intra-regional trade is encouraged between the several resources rich members and importing ones. Efforts are needed to create a foundation that can promote regional cooperation facilitating such a trade for the benefit of mutual prosperity.

As a result of the projected fast growth in energy demand, CO_2 emissions of Asia and the Pacific as a whole is projected to increase at a faster pace than the world average. Particularly at those members that are at the early stages of economic development with the income level below $10,000, a shift from non-commercial energy based supply structure to commercial based ones may progress in future. For example, some members in South Asia, Southeast Asia and the Pacific seek to improve the electrification rate for socio-economic development. At the back of projected improvement in access to commercial energy sources, it is critical for members to consider policy options that can promote efficient use of energy. Additionally, transfer of advanced technology from the developed members to developing ones may also be an important option that can help reduce the projected growth trends in energy demand and CO_2 emissions.

The projected investment requirements for building new energy infrastructure differ by member. Meanwhile, there is a general trend that the burden of investment requirements – relative to the size of economy – tend to be larger for developing members compared with that of developed ones. How to finance the projected investment requirements may pose challenges to the developing members given the tight government/utilities financial conditions. Appropriate incentives would have to be provided to promote investment by the private sector and foreign investors. Multilateral Development Banks or Export-Import Banks can play the important roles by their involvement to improve the projects' creditworthiness, and assist in facilitating investment. Likewise, cooperation among the regional members on energy trade may need to make progress as it can reduce overall investment through facilitating optimal resources allocation, and enhance energy supply security.

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Appendix 1. Model Structure

In order to forecast energy demand, an econometric approach was applied. The IEEJ model is utilized in the majority of the countries' analyses. Demand equations are econometrically estimated using the historical data, while future values are projected using the explanatory variables. The IEEJ model allows historical trend analysis of socioeconomic variables and its correlation with energy trends.

The steps taken to forecast energy demand and supply are explained in the following figure.

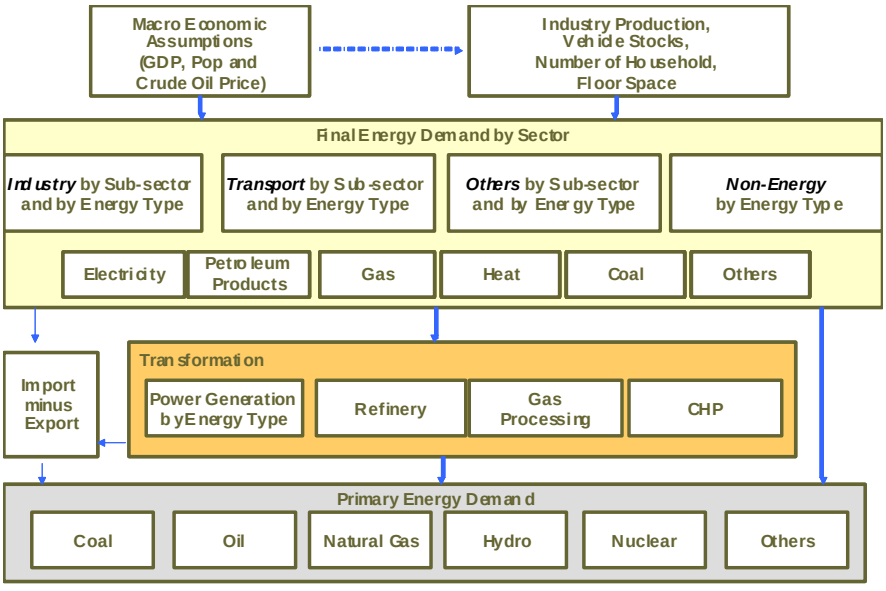
For those countries that have socioeconomic data such as industrial production, vehicle stocks, household numbers, and floor space, the future assumptions are derived by using the key macroeconomic assumptions—including GDP, population, and crude oil price. These socioeconomic variables offer the basis for analyzing final energy demand. For those countries where socioeconomic data is not available, the key macroeconomic indicators are used as the underlying driver for final energy demand.

Once the final energy demand projections by type of energy are ready, the transformation analysis—including electricity generation, oil refining, gas processing, and coal transformation—follows. In addition, the international electricity trade is analyzed as a source of electricity supply.

Using the outcomes from the analyses of final energy demand, energy requirements, and transformation, the primary energy demand outlook by energy type is produced.

Given the projected primary energy demand, energy imports and exports are analyzed by type of energy based on domestic energy reserves information and assessment of energy supply infrastructure development for pipelines, tankers, and receiving terminals.

Fig. A-1 IEEJ Model Structure



The level of disaggregation in the analysis by sector and by energy type depends on the data availability. Of course, an extensive literature survey was conducted to reflect policy shifts in the outlook results. For example, in a case where the historical trends do not necessarily offer an accurate assessment of future energy demand due to a change in policy, the analysis is conducted outside of the model, and the results are reflected in the model as exogenous variables.

For the countries with relatively short data periods, the Long-Range Energy Alternatives Planning System (LEAP) software was utilized to project future energy demand and supply using the intensity approach. Intensity approach is based on historical trend analysis in combination with a literature survey to determine the level of energy intensities (energy requirement per unit of GDP or per unit of population). Inter-country comparison was carried out to appropriately assess future energy intensity levels.

Appendix 2. Oil Price Assumption

The crude oil price assumption was obtained from the International Energy Agency (IEA) World Energy Outlook 2008. With this assumption, the average IEA crude oil import price is assumed to reach $100 per barrel (constant 2007 prices) by 2015 and then rise to $122 per barrel in 2030 (Table A-1).

Table A-1 Oil Price Assumption

	Oil Price Assumption ($/barrel)			
	2000	2007	2015	2030
Real Price (2007 prices)	33.3	69.3	100.0	122.0
Nominal Price	28.0	69.3	120.0	206.0

Source : International Energy Agency (2008)

Appendix 3. Electricity Generation

Table A-2 Electricity Generation in Asia and the Pacific (1990, 2005, and 2030)

		Electricity Generation (TWh)			Annual Growth Rates	
		1990	2005	2030	1990-2005	2005-2030
Central and West Asia	Afghanistan	1	1	16	-1.1%	12.0%
	Armenia	10	6	10	-3.2%	1.8%
	Azerbaijan	23	21	59	-0.6%	4.2%
	Georgia	14	7	15	-4.2%	2.8%
	Kazakhstan	87	68	120	-1.7%	2.3%
	Kyrgyz Republic	16	16	27	0.3%	2.1%
	Pakistan	38	94	302	6.3%	4.8%
	Tajikistan	18	17	22	-0.4%	1.0%
	Turkmenistan	15	13	21	-0.9%	1.9%
	Uzbekistan	56	48	61	-1.1%	1.0%
	Subtotal	**278**	**292**	**654**	**0.3%**	**3.3%**
East Asia	Hong Kong, China	29	38	63	1.9%	2.0%
	Republic of Korea	105	388	624	9.1%	1.9%
	Mongolia	3	4	9	0.1%	3.8%
	People's Republic of China	621	2,500	6,374	9.7%	3.8%
	Taipei,China	88	224	359	6.4%	1.9%
	Subtotal	**847**	**3,153**	**7,428**	**9.2%**	**3.5%**
Pacific	Fiji Islands	0	1	2	3.8%	4.4%
	Papua New Guinea	2	3	8	3.5%	4.1%
	Timor-Leste	—	0	1	—	5.3%
	Other Pacific Islands	0	0	1	6.9%	2.2%
	Subtotal	**2**	**5**	**13**	**4.4%**	**4.1%**
South Asia	Bangladesh	8	23	87	7.4%	5.6%
	Bhutan	2	2	12	2.8%	6.8%
	India	289	699	2,414	6.1%	5.1%
	Maldives	0	0	1	14.6%	5.5%
	Nepal	1	3	8	7.6%	4.4%
	Sri Lanka	3	9	27	7.1%	4.6%
	Subtotal	**303**	**736**	**2,549**	**6.1%**	**5.1%**
Southeast Asia	Brunei Darussalam	1	3	4	7.1%	1.3%
	Cambodia	—	1	8	—	9.2%
	Indonesia	33	127	318	9.3%	3.7%
	Lao PDR	1	4	60	10.2%	12.1%
	Malaysia	23	85	265	9.1%	4.7%
	Myanmar	2	6	56	6.1%	9.4%
	Philippines	25	57	165	5.5%	4.4%
	Singapore	16	38	105	6.1%	4.1%
	Thailand	44	132	400	7.6%	4.5%
	Viet Nam	9	53	235	12.9%	6.1%
	Subtotal	**155**	**506**	**1,618**	**8.2%**	**4.8%**
DMCs Total		1,586	4,691	12,261	7.5%	3.9%
Developed Group	Australia	154	245	367	3.1%	1.6%
	Japan	836	1,088	1,324	1.8%	0.8%
	New Zealand	32	43	64	1.9%	1.6%
Developed Group Total		**1,022**	**1,377**	**1,755**	**2.0%**	**1.0%**
Asia and the Pacific Total		**2,608**	**6,068**	**14,016**	**5.8%**	**3.4%**

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