Chapter 3

Socio-Economic and Energy Policy Assumptions

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3. SOCIO-ECONOMIC AND ENERGY POLICY ASSUMPTIONS

Growth in energy consumption and greenhouse gas emissions is driven by a variety of socio-economic factors. In the EAS region, these factors, including increasing population, rapid economic growth, increasing vehicle ownership, and increasing access to electricity, will tend to increase energy demand. Together they create what might be called a huge growth 'headwind' that works against efforts to limit energy consumption. Understanding the nature and size of this 'headwind' is critical to any analysis of energy demand in the EAS region.

3.1. Population

In the model used for this study, changes in population to 2030 are set exogenously. There is assumed to be no difference in population between the BAU case and APS. Assumed changes in population were submitted by the following countries: Australia, India, Indonesia, Japan, Republic of Korea, Laos, Malaysia, Myanmar, New Zealand, the Philippines, Thailand and Vietnam. Population projections from the United Nations[10] were used for Brunei, Cambodia and China.

In 2005, the total population in the EAS region was assumed to be about 3.2 billion – around 50 per cent of total world population.[11] Based on the forecasts provided by the individual countries, population in the EAS region is projected to increase at an average

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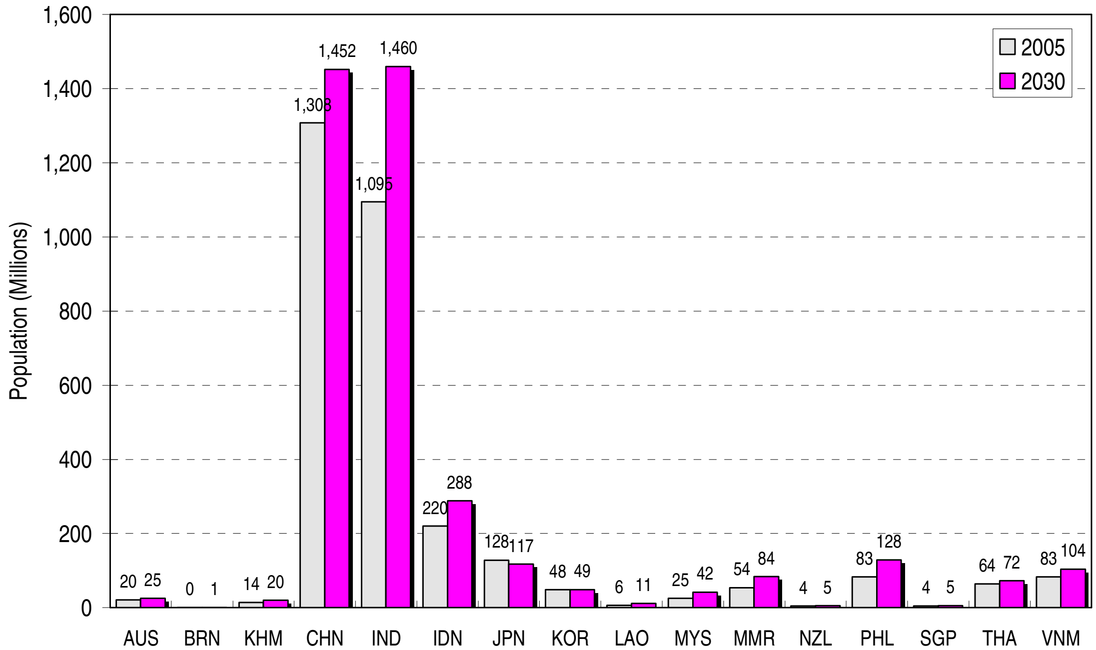
[10] United Nations (2006) *World Population Prospects: The 2006 Revision Population Database*, New York.

[11] World Bank (2007) *World Development Indicator CD-ROM 2007.* Washington DC.

annual rate of about 0.8 per cent reaching about 3.9 billion in 2030. Figure 1 shows the 2005 and projected 2030 population by country.

Figure 1: Assumed Population in the EAS Region, 2005 and 2030

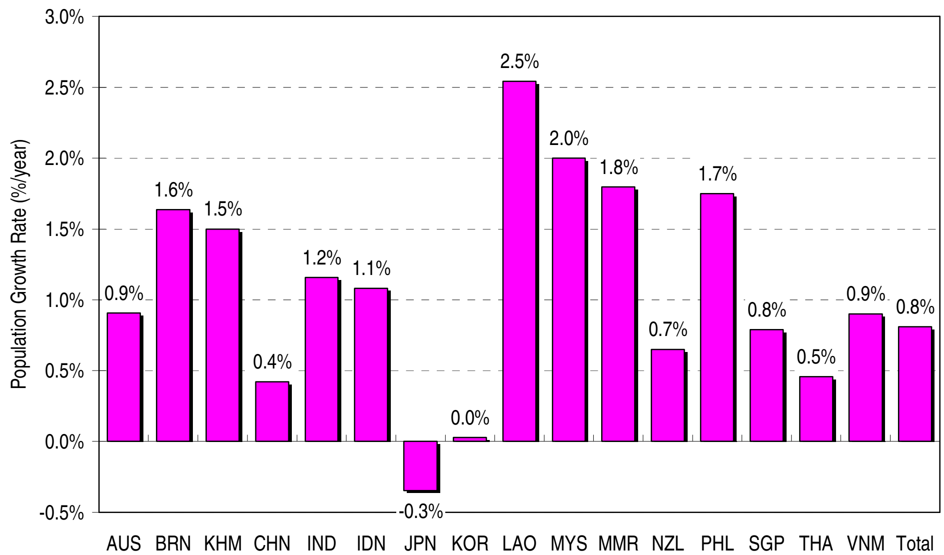


As shown in Figure 2, growth in population is generally assumed to be fastest in developing countries. China is a notable and significant exception, as it is expected to have relatively modest population growth. Nevertheless, by 2030, India and China are assumed to account for about 75 per cent of the total population in the EAS region with populations of around 1.5 billion each.

Countries with more mature economies tend to have slower population growth. Australia, New Zealand, and Singapore are assumed to have low, but still significant, population growth. The Republic of Korea's population is assumed to be roughly stable.

Japan's population is assumed to decline slowly throughout the projection period as the population continues to age.

Figure 2: Assumed Average Annual Growth in Population, 2005 to 2030



3.2. Economic Activity

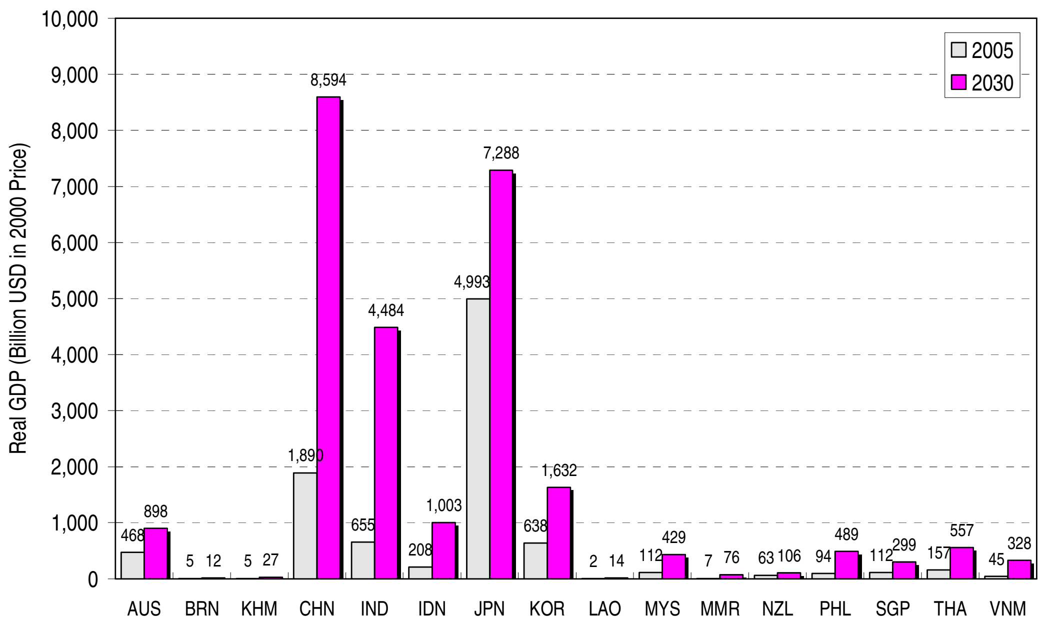
In the model used for this study, assumed changes in economic output to 2030 are set exogenously. Base year 2005 GDP data were obtained from the World Bank.[12]. Assumed GDP growth rates to 2030 were submitted by Australia, India, Indonesia, Japan, Republic of Korea, Laos, Malaysia, Myanmar, New Zealand, the Philippines, Thailand and Vietnam. For the remaining countries, assumed changes in GDP are consistent with IEEJ's *Asia/World Energy Outlook.* No difference in growth rates was assumed between the BAU and APS cases.

[12] World Bank (2007) *World Development Indicator CD-ROM 2007.* Washington DC

In 2005 total GDP in the EAS region was about 9.5 trillion in 2000 US$ and it accounted for about 22 percent of global GDP. The GDP of the EAS region is assumed to grow at an average annual rate of about 4.2 percent from 2005 to 2030. This implies that by 2030 total GDP in the EAS region will reach about 26.2 trillion in 2000 US$.

In 2005, Japan was the largest economy by far in terms of total economic output: 5.0 trillion 2000 US$. However, by 2030 China is projected to be the largest economy with an estimated GDP of about 8.6 trillion 2000 US$. Japan and India are projected to be the next largest economies with projected GDPs of about 7.3 trillion 2000 US$ and 4.5 trillion 2000 US$ respectively in 2030. See Figure 3.

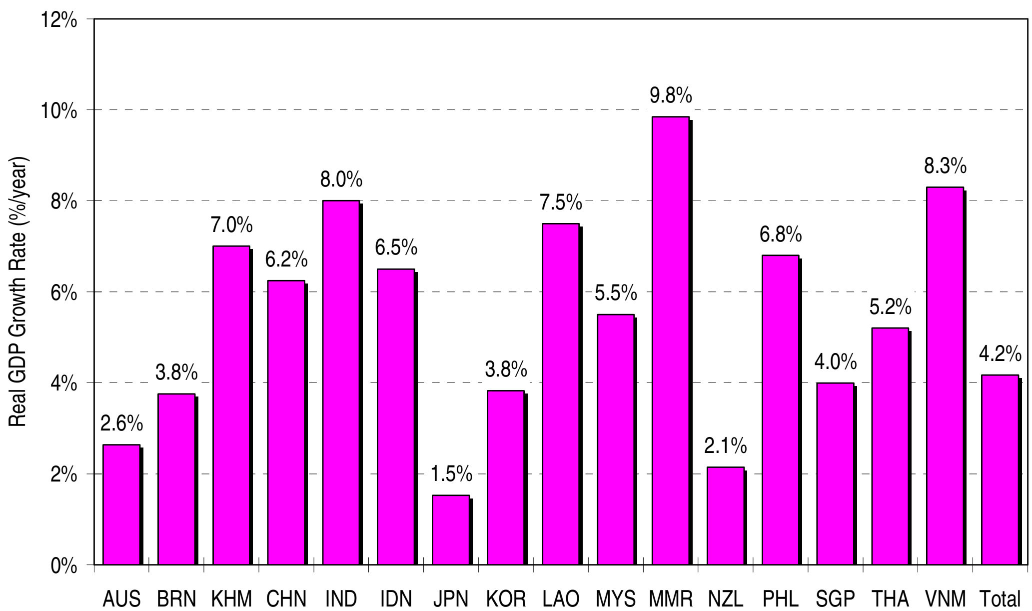
Figure 3: Assumed Economic Activity in the EAS Region



As shown in Figure 4, economic growth rates are assumed to be quite high in the developing countries, with the highest growth rates in Cambodia, Myanmar, Laos, and

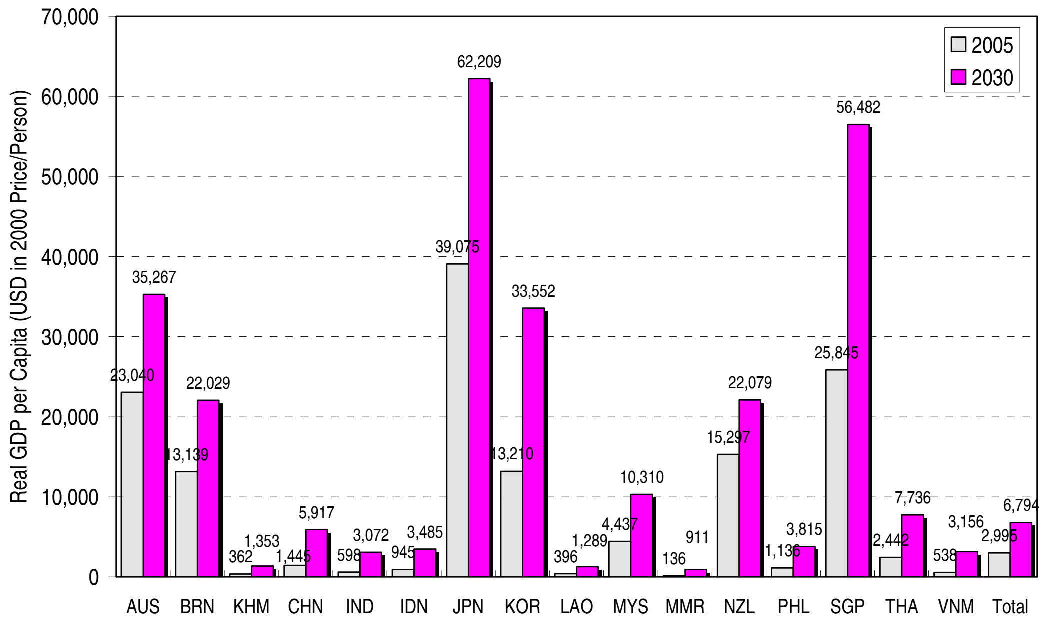
Vietnam. However, economic growth in other developing countries is also assumed to be rapid. Due to the large size of their economies, the rapid growth in China, India, and Indonesia is likely to be especially significant for energy demand. Countries with more mature economies—Australia, Brunei, Japan, Korea, New Zealand, and Singapore--are assumed to experience slower, but still significant, economic growth.

Figure 4: Assumed Average Annual Growth in GDP, 2005 to 2030



Average GDP per capita in the EAS region is assumed to increase from about 3,000 US$ in 2005 to about 6,800 US$ in 2030. However, as shown in Figure 5, there is, and will continue to be, significant differences in GDP per capita. In 2005, per capita GDP was assumed to range from about 136 US$ in Myanmar to about 39,075 US$ in Japan. In 2030, per capita GDP is assumed to range from about 911 US$ in Myanmar to about 62, 209 US$ in Japan.

Figure 5: Per Capita Income in EAS Region, 2005 and 2030



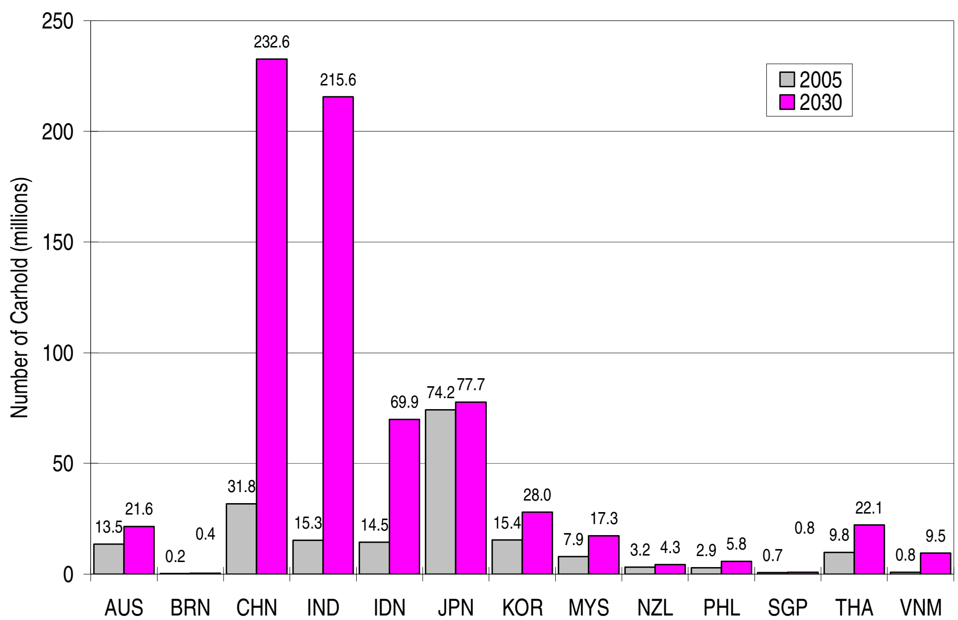
3.3. Vehicle ownership

Growth in the transport sector is one of the primary drivers of growth in energy consumption, and the major driver of oil consumption. In the model used in this study, energy demand by all forms of transport are modelled. However, road vehicle ownership is a key exogenous input. Assumed changes in road vehicle ownership were submitted by: India, Indonesia, Japan, Republic of Korea, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. Projections of road vehicle ownership in other countries were made using information from the Japan Automobile Manufacturer's Association *World Vehicle Statistics.*[13] There is assumed to be no difference in road vehicle ownership between the BAU case and APS.

[13] Japan Automobile Manufacturer's Association (2007) *World Vehicle Statistics*, 2007, Tokyo.

The number of 4-wheeled vehicles in the EAS region is assumed to increase from about 190 million in 2005 to about 700 million in 2030. As shown in Figure 6, vehicle ownership varies significantly between countries reflecting differences in economic development, population, city structures, population density, transport infrastructure and relative costs between transport modes. Generally, these statistics do not include motorcycles. The inclusion of motorcycles would significantly increase the numbers of vehicles in some countries, particularly in key developing economies such as Vietnam and Thailand.

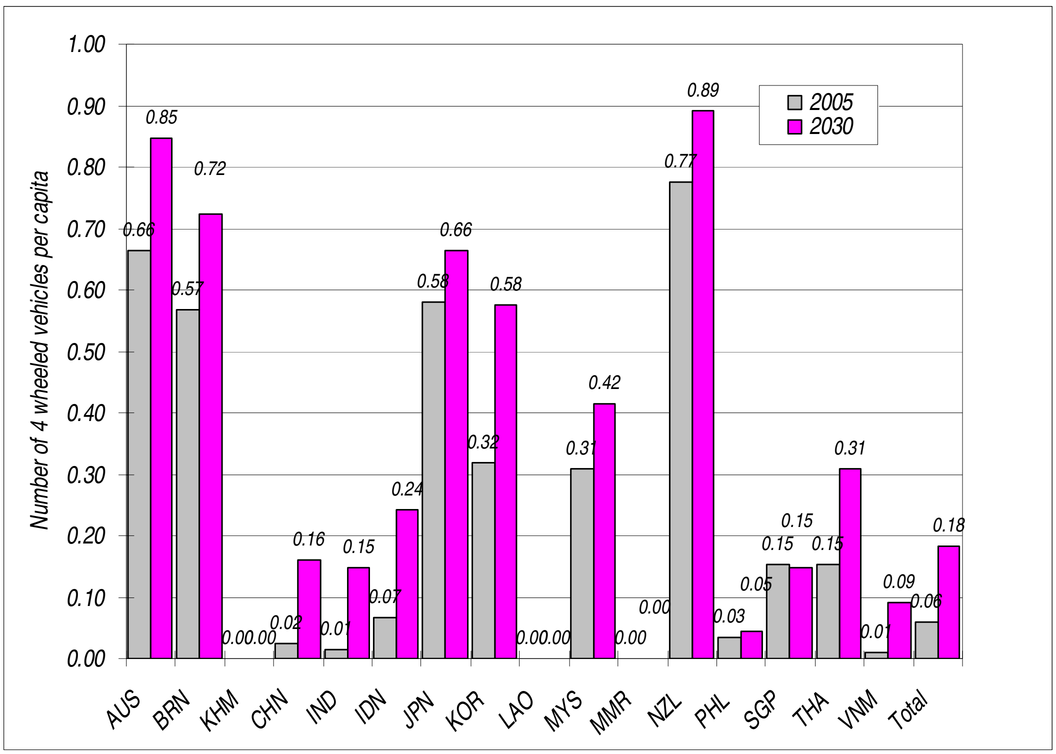
Figure 6: Number of Road Vehicles in the EAS Region



Strong population and economic growth is projected to drive significant increases in demand for transport services in India and China. By 2030 the number of road vehicles in China and India is projected to increase to about 233 million and 216 million respectively. However, in both countries, despite the huge growth in road vehicles, rail is expected to meet an increasing share of total transport demand.

Per capita vehicle ownership is projected to increase in the EAS region from about 0.06 vehicles per person in 2005 to about 0.18 vehicles per person in 2030. However, as shown in Figure 7, vehicle ownership on a per capita basis is projected to vary significantly between countries.

Figure 7: Per Capita Road Vehicle Ownership in the EAS Region



3.4. Electricity Generation

3.4.1 Thermal Efficiency

The thermal efficiency of electricity generation reflects the amount of fuel required to generate a unit of electricity. Thermal efficiency was another exogenous assumption of the model used in this study. Base year 2005 thermal efficiencies by fuel type (coal, gas, and oil) were derived from International Energy Agency data.[14] Thermal efficiency projections by fuel (coal, gas, and oil) were submitted by the following countries: Australia, Japan, New Zealand, Thailand and Vietnam, and growth rates in thermal efficiency were derived from these projections. For the remaining countries, assumptions about the potential changes in thermal efficiency were based on IEEJ *Asia/ World Energy Outlook 2007.*

Thermal efficiency in the EAS countries is expected to improve considerably over time in the BAU case as more advanced generation technologies such as natural gas combined cycle and supercritical coal plant are implemented. In many countries, there are also assumed to be additional improvements in the APS case. Figure 8 and Figure 9 show the assumed improvements in thermal efficiency for gas- and coal-fired electricity generation. Oil is not shown as it represented less than 6 percent of electricity generation in the EAS region in 2005 and this share is expected to decline to less than 2 percent by 2030. It can be seen that there are large differences between the least and most efficient countries. This suggests there are significant opportunities to improve generation efficiency in some countries.

[14] IEA (2007) *Energy Balances of OECD Countries 2007 and Energy Balances of Non-OECD Countries 2007*. Paris.

Figure 8: Thermal Efficiencies of Gas Electricity Generation

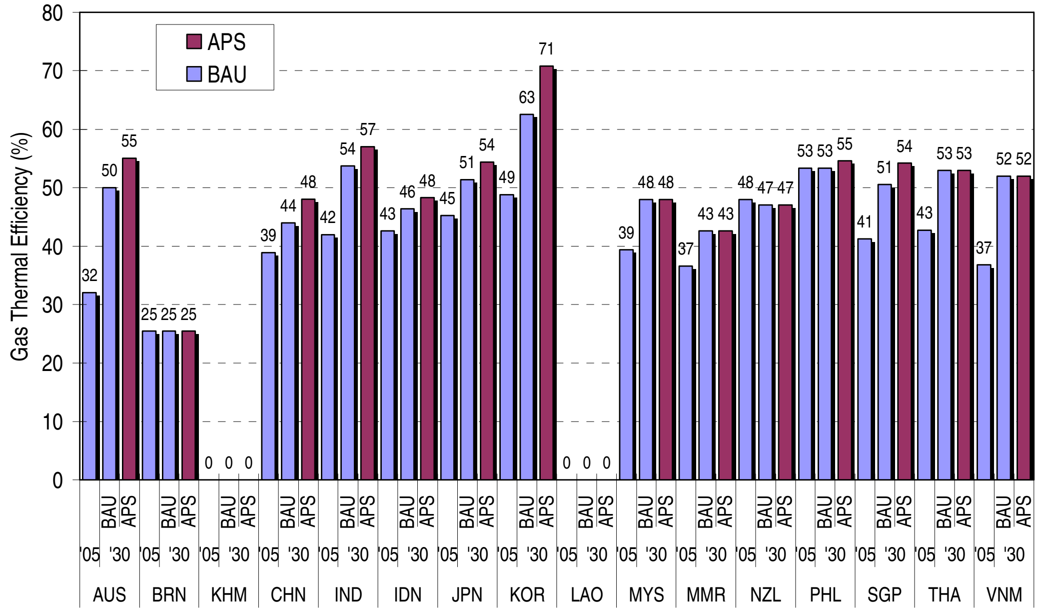
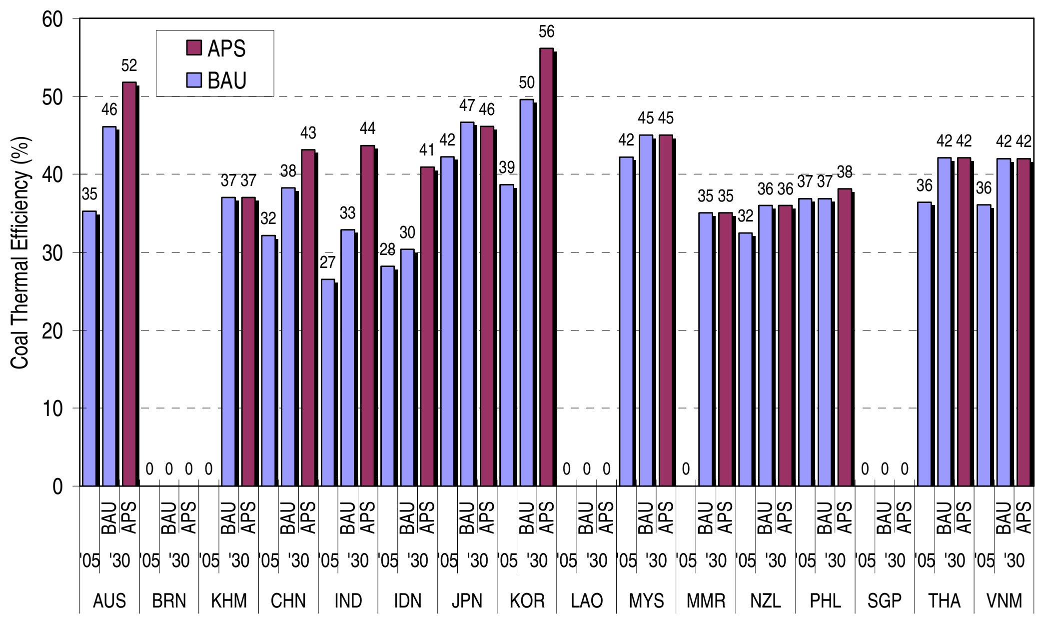


Figure 9: Thermal Efficiencies of Coal Electricity Generation

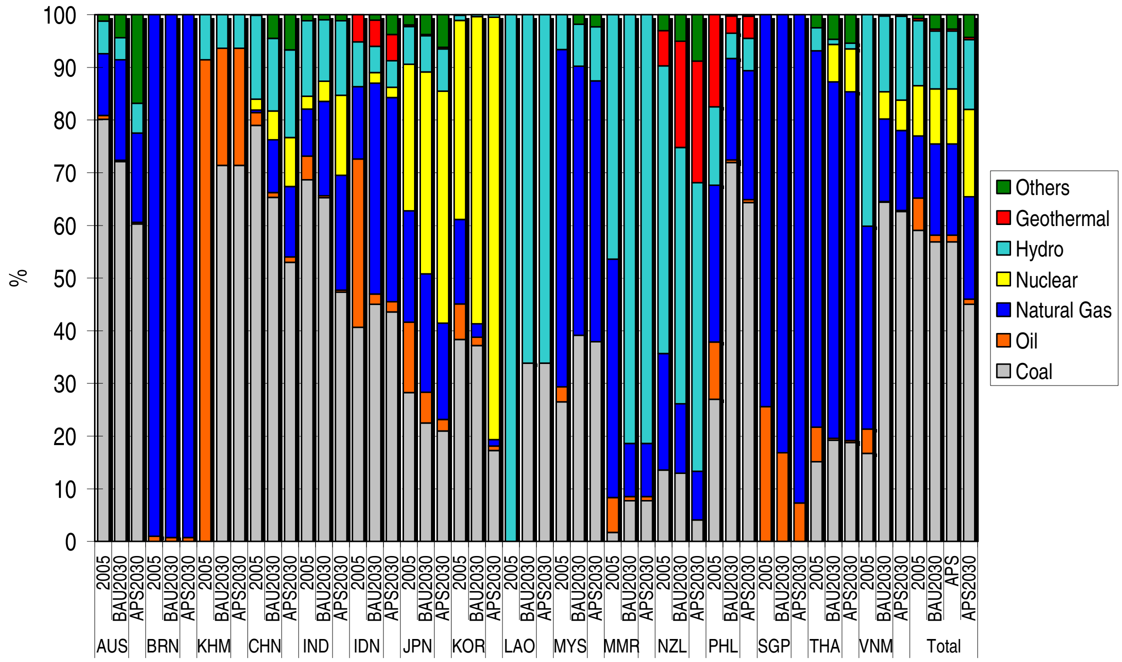


3.4.2 Electricity Generation Fuel Mix

The combination of fuels used in electricity generation differs between countries, reflecting both historical and current conditions, including access to resources and access to technology. It was, therefore, an exogenous input to the model. It is an important input, not only because it is a key driver of demand for primary fuels, but also because the fuel mix used can have important implications for greenhouse gas emissions. Only two countries did not provide electricity generation fuel mix assumptions for the BAU case: China and Cambodia. For these two countries, IEEJ developed their own estimates based on other sources. For the APS case, it was initially assumed that hydro and nuclear output would remain the same as in the BAU case, and any reduction in electricity demand would be distributed among the other fuels in proportion to their BAU share. These initial APS results were then reviewed by the WG members from each country, who in some cases suggested additional changes. The projected electricity generation mix is shown in Figure 10.

Coal is projected to remain the dominant source of electricity generation in the EAS region as a whole in both the BAU and APS cases. However, the share of coal in electricity generation in the EAS region is projected to decline from about 57 per cent in the BAU case to about 45 per cent in the APS case by 2030 as countries are assumed to implement policies designed to reduce the emissions intensity of electricity generation. In the APS case, the share of lower emission fuels such as natural gas, nuclear, and non-hydro renewables are expected to be higher than in the BAU case on average in the EAS region. As mentioned in Section 3.5.1, the use of oil in electricity generation is assumed to decline to almost negligible levels.

Figure 10: Share of Fuel Type in the Electricity Generation Mix in the EAS Region



3.4.3 Access to Electricity

At the WG meetings, a number of the developing countries reported on initiatives to significantly expand access to electricity in their countries by 2030. Currently, many households in these countries lack access to electricity, and eliminating this situation is a major development goal. Although this increasing access to electricity is another one of the drivers of increasing energy demand in the EAS region, it was not explicitly represented in the model used for this study. Nevertheless, the impact of increasing access to electricity on electricity demand should be largely reflected through the impact of the rapid GDP growth that is assumed to be experienced in these same countries.

If this study is repeated in the future, it is recommended that WG members be asked to specify assumptions regarding percent of households with access to electricity. Even if this figure is not used as an input to the model, it is useful to know as an indicator of one key driver of electricity demand.

3.5. Use of Biofuels

WG members from each country were asked to submit information regarding the potential use of biofuels in the BAU case and APS case. Some, but not all, countries in the EAS region have plans to increase the contribution of biofuels in the transport fuel mix to enhance energy security or meet other policy objectives. For China and Japan, the assumptions on the use of biofuels were based on IEEJ *Asia/ World Energy Outlook 2007.* Table 3 summarises the assumptions regarding use of biofuels.

Table 3: Summary of Biofuels Assumption by Country

Country	Period	Assumptions
Australia	2010	Minimum: 1.1-1.4% of transport fuel; maximum 5% of transport fuel
Brunei Darussalam	No definite date	No targets on biofuels
China		No report on bio-fuels targets
Cambodia		No targets for bio-fuels
India	2011-12	Aims to produce enough bio-diesel to achieve 20% blend for high speed diesel
Indonesia	2005 - 2010 2011 - 2015 2016 - 2025	Biofuel utilization of 2% of energy mix or 5.29 million KL Biofuel utilization of 3% of energy mix or 9.84 million KL Biofuel utilization of 5% of energy mix or 22.26 million KL

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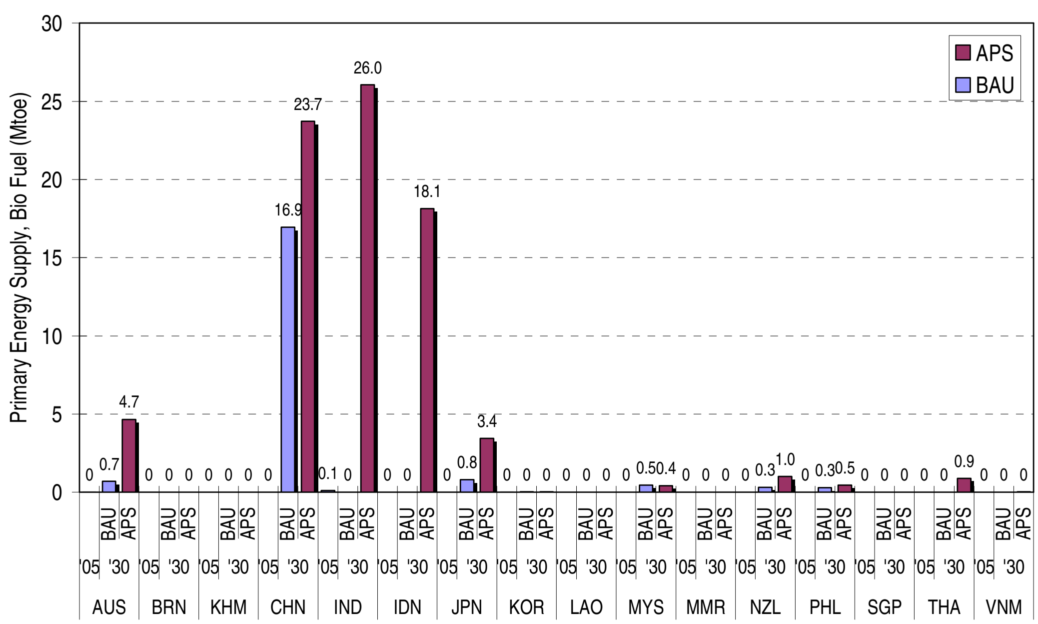
Japan	2005-2030	No report on bio-fuels targets
Republic of Korea	2005-2030	No report on bio-fuels targets
Lao PDR	2006-2030	No targets on bio-fuels but R&D is being carried out
Myanmar		Can produce 700 million gallons of jatropha oil annually
New Zealand	2006-2030	Mandatory bio-fuels sales obligation of 3.4% by 2012
Philippines	2006-2030	Law requires 10% gasoline-bio-ethanol blend and 2% diesel-bio-diesel blend 2 years from enactment of the law (roughly 2009)
Thailand	2006-2021	To increase the use of ethanol to 50% of gasoline consumption; aims to blend 10% biodiesel with diesel starting 2012
Vietnam	2005-2030	10.7 ktons per annum of bio-diesel from fish oil and recycled cooking oil starting 2008

Figure 11: Biofuels in the EAS Region



In Figure 11 the assumed use of biofuels by country is presented. The largest increases in biofuels consumption in the APS case are expected in India, China and Indonesia. In all countries, biofuels are expected to meet only a small portion of the transport fuel demand by 2030.

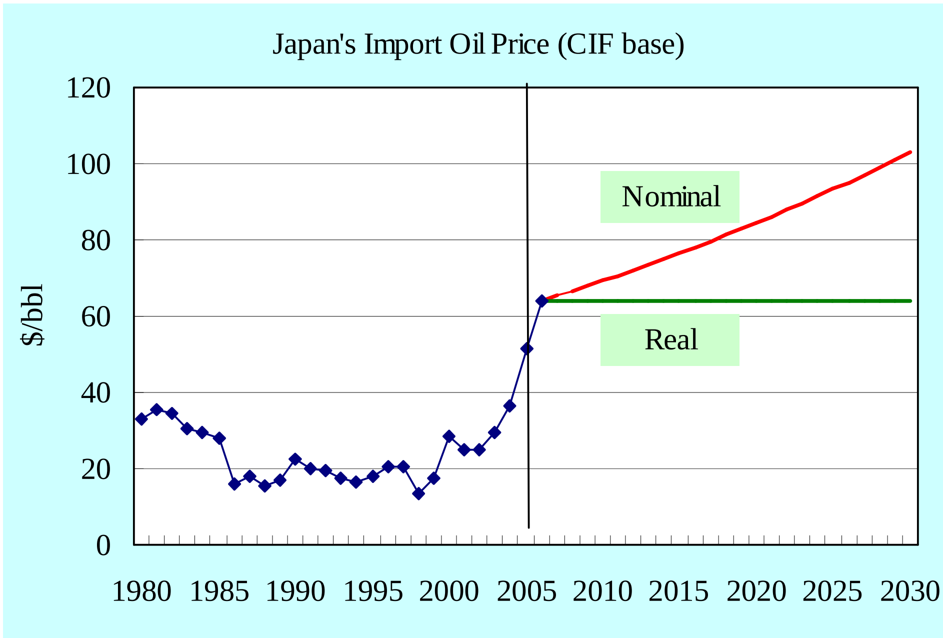
3.6. Crude Oil Price

Future changes in crude oil prices remain highly uncertain. In this modelling exercise the crude oil price, as measured by Japan's average import price, is assumed to remain constant at its actual 2006 value of about US$62.8 a barrel from 2006 to 2030 (Figure 12). Oil prices have increased rapidly since 2006, and even during the time this study was conducted. The impacts that changes in oil prices so far would have on the study results are probably modest, as oil is mostly used in transport, and the elasticity of demand for transport fuels is notoriously low. However, if oil prices continue to rise, they could be one socio-economic driver that would work for, rather than against, efforts to limit energy demand.

3.7. Energy Intensity (Primary Energy Demand/GDP) Goals

Information regarding projected changes in energy demand in the APS case were obtained through one of two methods. For two countries with specific goals to reduce intensity (primary energy demand/GDP), information on those goals were provided by the WG members. These countries were Indonesia and Republic of Korea. APS case energy demand was then calculated to match the sought-after change in energy intensity, with GDP remaining unchanged.

Figure 12: Oil Price Assumptions to 2030



3.8. Energy saving Goals

For the remaining countries, the information about the potential energy savings achievable under specific policy initiatives to reduce energy consumption and increase energy efficiency was used. They specified which policy initiatives were existing policy, and should be applied to the BAU case, and which were proposed policies, and should apply to the APS case. Quantitative energy savings were estimated based on the country's own modelling.

Projected energy savings for specific policy initiatives were submitted by: Australia, China, India, Japan, Lao PDR, Malaysia, New Zealand, the Philippines, Singapore, Thailand and Vietnam. Brunei Darussalam, Cambodia, and Myanmar have energy saving policies, but did not submit quantitative information on the energy savings. Table

4 below summarizes the energy saving goals submitted by each country.

Table 4: Summary of Energy Saving Goals Collected from each EAS Country

	BAU Case	APS Case
Australia	Australia has no official energy savings goal but has committed to reducing CO_2 emissions by 60% by 2050 when compared with 1990 levels. Energy efficiency is expected to make a major contribution to these emissions reductions. The Commonwealth Government has a range of policy measures to stimulate the uptake of energy efficient products, technologies and practices. The measures span the residential, commercial and industrial sectors and include: • Minimum Energy Performance Standards for a range of appliances and equipment, and the phasing-out of inefficient light bulbs; • The Energy Efficiency Opportunities (EEO) program which requires Australia's largest energy users to undergo rigorous energy use assessments; • Green Leases for the procurement of Government sector buildings; and • A range of building standards and rating tools. In addition, Australia's States and Territories have a large number of programs aimed at improving energy efficiency.	
Brunei	There are existing EEC plans and programs but no quantified energy savings such as: • Awareness and Education program • EEC Standard and Labelling • Shift to Energy-Efficiency Technologies • Energy Audit in Buildings and Industries	
Cambodia	There are Energy Efficiency Goals but without quantified energy savings: • Achieve sustainable market transformation towards more efficient energy use • Facilitate increased access to financing of EE projects • Establish and implement regulatory frameworks that are supportive of EE	
China	• GDP is projected to increase at an average annual rate of about 7.5% between 2006 and 2010 and 7.2% between 2010 and 2020	• 20% reduction in energy consumption from 2006 to 2010 at 2.2% per annum and at 3% per annum to 2020 [Assumption template submitted by China]

(Continued)

	BAU Case	APS Case
India		• Projected 26 % energy saving in 2030 compared with BAU • TPES/GDP (kgoe/Rs GDP): 0.013 in 2030 • Industry: Improved efficiency to decrease energy consumption in 2030 relative to BAU by: Coal and Coal products: 9% Petroleum products: 21% Electricity: 16% • Residential and Commercial: • Reduction in electricity consumption of 25% relative to BAU in 2030 • Transportation: Reduction of energy consumption by 17% relative to BAU from modal shift from road to rail and from private to public transportation as well as energy efficiency improvements in vehicles
Indonesia	• 10-15% saving potential [in final energy consumption] with little or no cost	• 30% Saving potential with investment [in final energy consumption]
Japan	• Final energy consumption of 372 Mtoe in 2005 and 359 Mtoe in 2030	• Final energy consumption: 372 Mtoe in 2005 and 336 Mtoe in 2030
Republic of Korea	• Reduce primary energy intensity from 0.358 toe/thousands USD from 2005 to 0.237 Mtoe/thousand USD by 2030 from various sectoral EEC programmes	• Further reduce primary energy intensity to 0.2 Mtoe/thousand USD by 2030

(Continued)

	BAU Case	APS Case
Lao PDR		• An energy efficiency and conservation programme in the government sector aims to reduce the government's energy consumption by about 10% relative to BAU case from 2010 to 2030 [Government Offices]
Myanmar	• Monitoring of electricity consumption and restriction on the use of government vehicles- no quantified energy savings • Energy Audit in Refineries and Cement Plants- no quantified energy savings • Voluntary Actions- no quantified energy savings	
Malaysia	• Industry sector will encourage the implementation of EE measures to improve plant, equipment and processes as well as the use of high-efficiency motors • EE programmes will focus on efficient lighting and air conditioning systems in Residential and Commercial sector	• 10% reduction in energy consumption in government buildings in 2006 [by 2010 relative to BAU case]

(Continued)

	BAU Case	APS Case
New Zealand		Increase energy productivity at 2030 relative to BAU case ▪ Save 3 PJ/year by Labelling and efficiency standards in equipment and buildings ▪ Save 23 PJ/year by housing insulation and retrofits ▪ Save 42-53 PJ/year by 2020 by vehicle efficiency improvement, modal shift and improved city design ▪ Save 0.5 PJ/year through Smart electricity networks
Philippines		Projected energy savings from 2006 to 2030 ▪ Residential and Commercial: 63 Mtoe ▪ Industry: 21.8 Mtoe ▪ Transport 34.4 Mtoe
Singapore		Estimated energy savings from 2005-2030 • Industry: 0.1 Mtoe, • Buildings: 0.7 Mtoe, • Transport: 0.4 Mtoe, and • Residential: 0.2 Mtoe
Thailand	• TPES/GDP (toe/ million Baht): 24.1 in 2005, 23.3 in 2011, 20.7 in 2020	• 21.2 in 2011, 18.8 in 2020 • Energy Saving Target 2011 onward: Total: 9.1%, Industry & Commercial: 9.4%, Residential: 10%, Transport:5.4%

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	BAU Case	APS Case
Vietnam		• Aims to reduce 3-5% of total energy consumption in the 2006 -2010 period (equivalent to 5Mtoe) and 5-8% (equivalent to 13.1Mtoe) in the 2011-2015 period by EE measures. • Industry: aim to reduce 5% of energy consumption of the industrial sector (equivalent 2.6Mtoe) in 2006-2010 and 8% (equivalent 6.4Mtoe) in the 2011-2015 • Service sector: reduces energy consumption in newly built buildings by 20%

Table 5 below summarizes the quantitative impact of the energy saving goals and policies.

Table 5: Quantitative Impact of Energy Saving Goals and Policies

2030 (toe/Million USD in 2000 Price)

	Submitted			Result		
	BAU	APS	APS/BAU	BAU	APS	APS/BAU
AUS	-	-	-	202	156	-23%
BRN	-	-	-	375	375	0%
KHM	-	-	-	234	234	0%
CHN	-	-	-	362	288	-20%
IND	446	327	-27%	418	307	-27%
IDN	549	381	-31%	519	429	-17%
JPN	70	61	-13%	74	68	-8%
KOR	237	200	-16%	231	195	-16%
LAO	-	-	-	345	344	0%
MYS	-	-	-	284	230	-19%
MMR	-	-	-	361	361	0%
NZL	-	-	-	236	206	-12%
PHL(2010)	320	-	-	248	199	-20%
SGP	-	-	-	179	166	-7%
THA(2020)	507	461	-9%	408	364	-11%
VNM	-	-	-	515	433	-16%
Total				281	224	-20%

3.9. Concluding Comments

Economic growth in the EAS countries is needed to provide for the regions' growing population. Economic growth is assumed to exceed population growth in the 2005 to 2030 time period. The strong economic growth in the EAS countries could mean significant declines in poverty and significant increases in living standards for hundreds of millions of people. With economic growth will come increasing access to electricity and rising levels of vehicle ownership.

The continued reliance on fossil fuels to meet the increases in energy demand may be associated with increased greenhouse gas emissions and climate change challenges unless cleaner technologies are used. Even if the fossil fuel resources are sufficient, much of the fuel is likely to be imported from other regions, and no assurance can be given that they will be secure or affordable. Fossil fuel consumption using today's technologies will lead to considerable increases in greenhouse gas emissions, creating new long-term threats to the region's living standards and economically vitality. Growing adverse health impacts throughout the region are also likely as a result of particulate emissions.

Yet efforts to limit energy consumption will be very challenging in these circumstances. Just to keep EAS region energy consumption and emissions at current levels will require that improvements in EEC, along with the switch to low emission fuels and/or carbon capture and storage for fossil fuels, match economic growth. Yet, as will be discussed in Section 4.2, sharp reductions are being called for by scientists. This huge 'headwind' working against EEC and emission reductions poses a challenge to the EAS region that urgently needs to be addressed.