Chapter 4

Energy and Environmental Outlook for the East Region

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4. ENERGY AND ENVIRONMENTAL OUTLOOK FOR THE EAST REGION

4.1. Energy Consumption

The previous chapter discussed the social and economic drivers that will tend to cause energy consumption in the EAS Region to rise by 2030. These include rising population, rapid economic growth, increasing automobile ownership, and increasing access to electricity. The net result of these trends is illustrated in Figure 13 below. It shows that under the BAU case, final energy consumption is projected to increase from 1,915 Mtoe in 2005 to 4,555 Mtoe in 2030, an increase of 3.5 percent per year. In the APS case, final energy consumption is projected to rise to 3,776 Mtoe, 17 percent less than in the BAU case. 'Final energy consumption' refers to energy in the form in which it is actually consumed, that is, including electricity, but not including the fuels used to generate electricity.

Figure 13: Total Final Energy Consumption

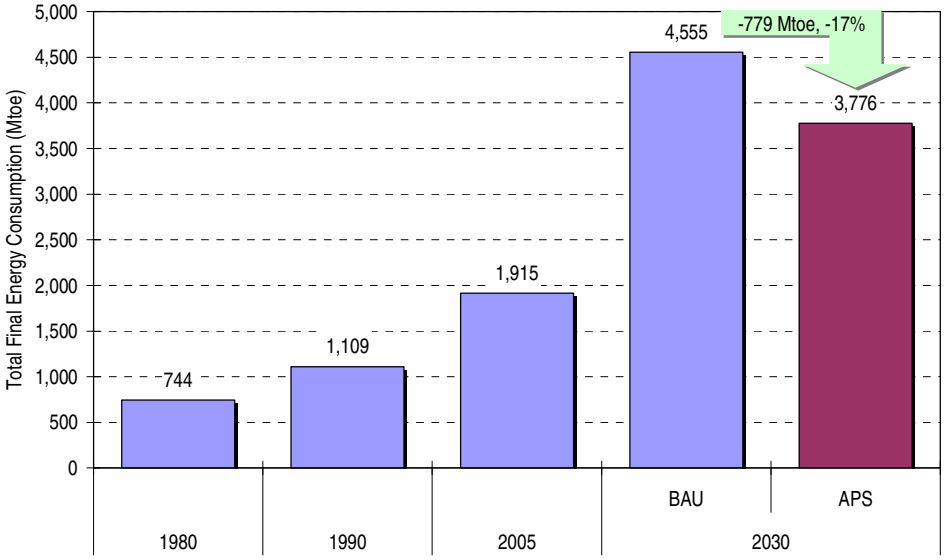


Figure 14 shows final energy consumption by sector. Final energy consumption in all sectors is projected to increase dramatically between 2005 and 2030. While in 2005, almost half of final energy consumption was for industry, by 2030, it is projected to be more evenly split between industry, transport, and 'other' (primarily residential and commercial). This trend reflects rising levels of automobile ownership, increased access to electricity, and rising living standards made possible by economic growth. Final energy consumption in most sectors is significantly reduced in the APS case compared to the BAU case. In percentage terms, the reductions are larger in the transport and 'other' sectors than in industry, suggesting that there may be more opportunities to improve energy efficiency among consumers and commercial establishments than there are in industry.

Figure 14: Final Energy Consumption by Sector

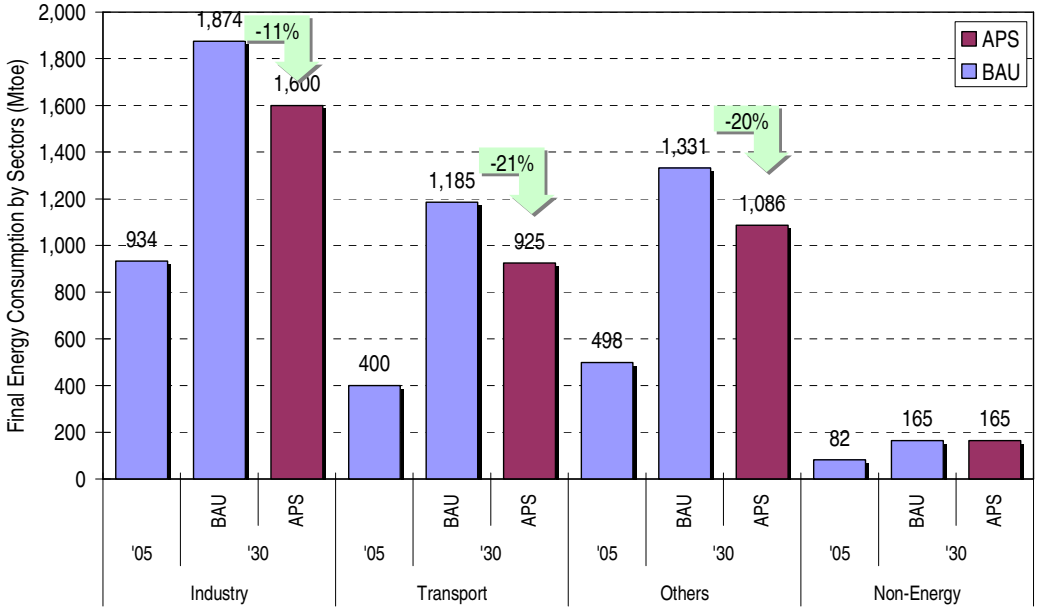


Figure 15 shows the final energy consumption by energy source. Oil was the largest final energy source in 2005, with a 45 percent market share, and is projected to actually increase its share by 2030 to 46 percent under the BAU case, reflecting rising automobile ownership and transport demand. Oil consumption is projected to increase 3.6 percent per year between 2005 and 2030. Electricity consumption increases even more in percentage terms, but not in Mtoe, with demand growing by 4.3 percent per year between 2005 and 2030. Natural gas is the fastest growing final energy source in percentage terms, growing by 5.3 percent per year between 2005 and 2030, but still achieves only about a 10 percent market share by 2030. Final energy use of coal is projected to grow by 1.7 percent per year, which means that it loses market share compared to other fuels. In the APS case, growth in final demand for all fuels is reduced compared to the BAU case, although growth in gas demand is not reduced very much.

Figure 15: Final Energy Consumption by Energy Source

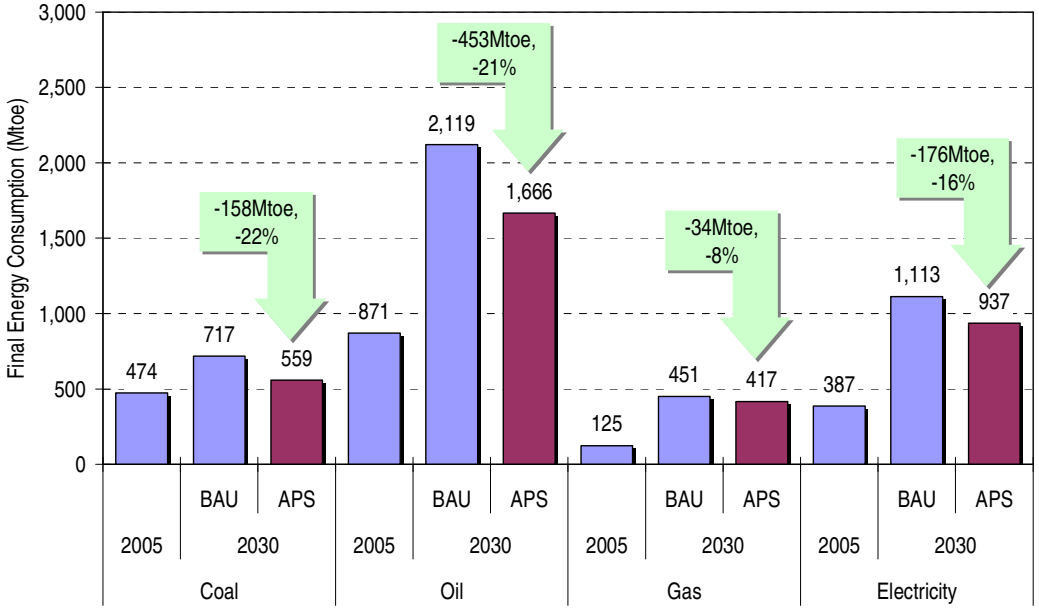
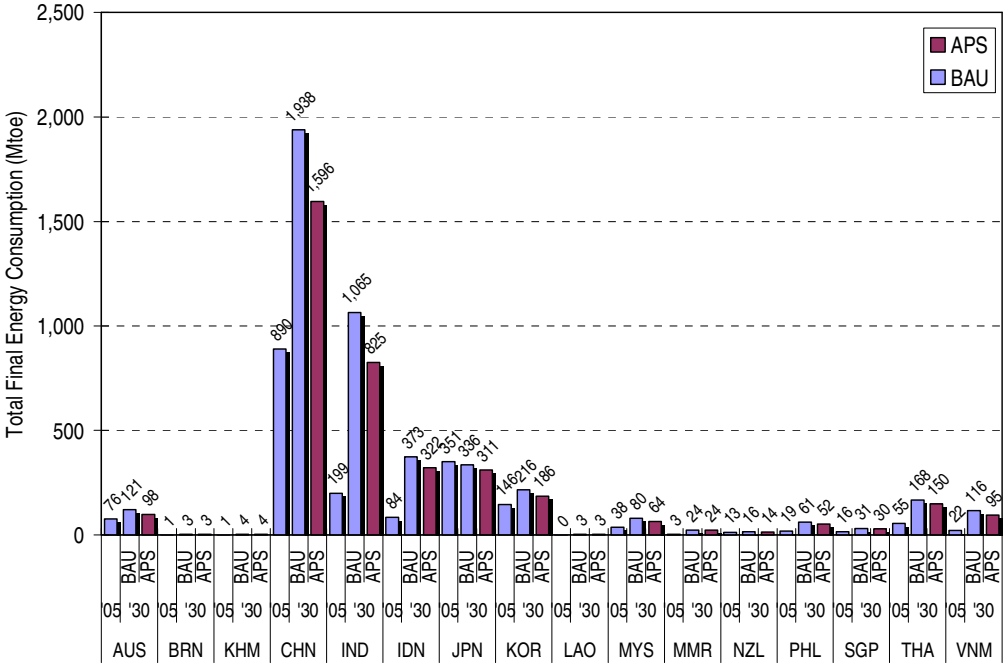


Figure 16 shows the final energy consumption by country. The most striking result indicated by this graph is that India and China are projected to dominate EAS Region final energy demand by 2030. They are projected to account for about two-thirds of EAS Region final energy demand (66 percent) by 2030, up from about 57 percent in 2005. Just five countries—China, India, Indonesia, Japan, and Republic of Korea—are projected to account for 86 percent of EAS Region final energy demand in 2030, with the growth in final energy demand concentrated in just three countries: China, India, and Indonesia. In fact, these "big three" countries are projected to account for 83 percent of the growth in energy demand of the entire EAS Region between 2005 and 2030. In the APS case, growth in most countries, including the 'big three', is significantly reduced. However, the big three are still projected to account for 84 percent of the growth in energy demand in the EAS region between 2005 and 2030.

Figure 16: Total Final Energy Consumption by Country



The pattern followed by primary energy demand is, as one would expect, similar to final energy consumption. “Primary energy demand” refers to energy in its raw form, before any transformations, most significantly the generation of electricity. Figure 17 shows that total primary energy demand is projected to increase from 3126 Mtoe in 2005 to 7362 Mtoe in 2030 in the BAU case, an increase of 3.5 percent per year. In the APS case, demand is projected to grow to 5,888 Mtoe by 2030, 20 percent less than in the BAU case. The reduction in 2030 primary energy demand in the APS case compared to the BAU case of 1474 Mtoe is roughly equivalent to the current consumption of China. The fact that the percentage growth in primary energy demand is less than the growth in final energy consumption in both the BAU and APS cases primarily reflects improvements in thermal efficiency in electricity generation between 2005 and 2030.

Figure 17: Total Primary Energy Demand

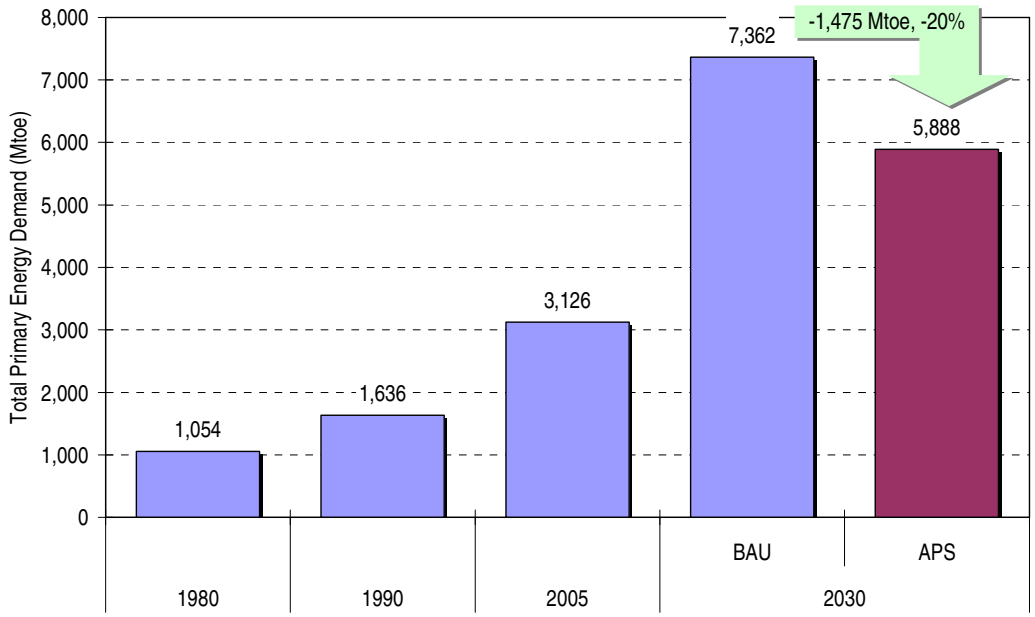


Figure 18 shows primary energy demand by energy source. Coal is currently the largest source of primary energy in the EAS region, and is projected to still be the largest in 2030. Coal is also projected to have the largest growth over this period as measured in Mtoe (1698 Mtoe), but not in percent (up 3.0 percent per year). This growth is mainly due to increased use of coal for electricity generation. Oil has the next largest growth as measured in Mtoe (1218 Mtoe), and a faster growth in percentage terms (up 3.2 per cent per year). This growth is mainly due to rising automobile ownership and transport demand. The highest percentage growth is projected to be in natural gas, up 5.2 percent per year, reflecting the growing use of gas in both electricity generation and as a consumer fuel. Nuclear is also projected to grow quickly in percentage terms (up 4.8 percent per year), but still accounts for only about 6 percent of EAS Region primary energy demand in the year 2030.

In the APS Case, growth in coal and oil primary consumption is projected to be sharply reduced. Natural gas growth is reduced much less. These results reflect a shift from coal-fired electricity generation to natural gas and nuclear in the APS Case, along with measures to reduce the demand for transport fuels.

Figure 18: Primary Energy Demand by Energy Source

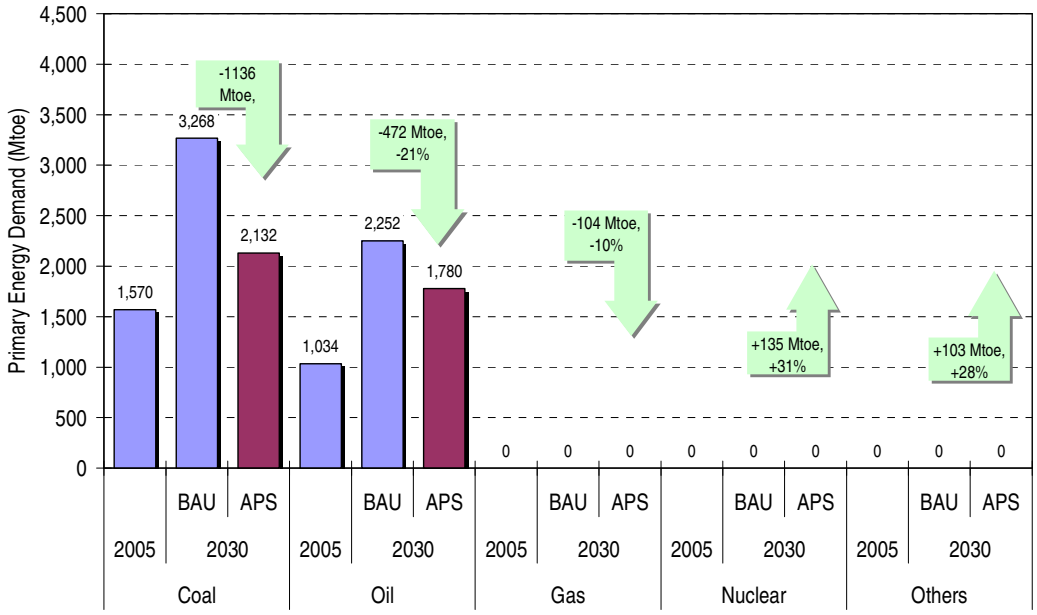
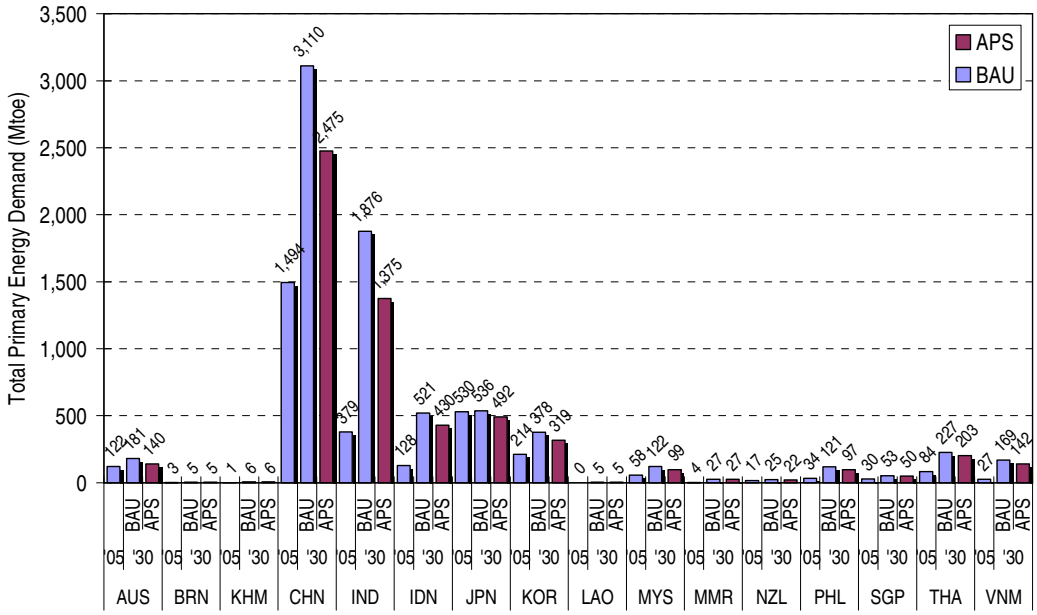


Figure 19 shows primary energy demand by country, which is similar to the pattern for final energy consumption by country shown in Figure 16. Five countries - China, India, Indonesia, Japan, and Republic of Korea - are projected to account for 87 percent of EAS Region primary energy in 2030. The 'big three' - China, India, and Indonesia - will dominate the growth in EAS Region primary energy, accounting for 83 percent of the growth over the period from 2005 to 2030. In the APS Case, growth in primary energy demand in most countries is significantly reduced, but the pattern of dominance of demand by five countries and of growth by three countries remains the same.

Figure 19: Primary Energy Demand by Country



4.2. Carbon Dioxide (CO2) Emissions from Energy Consumption

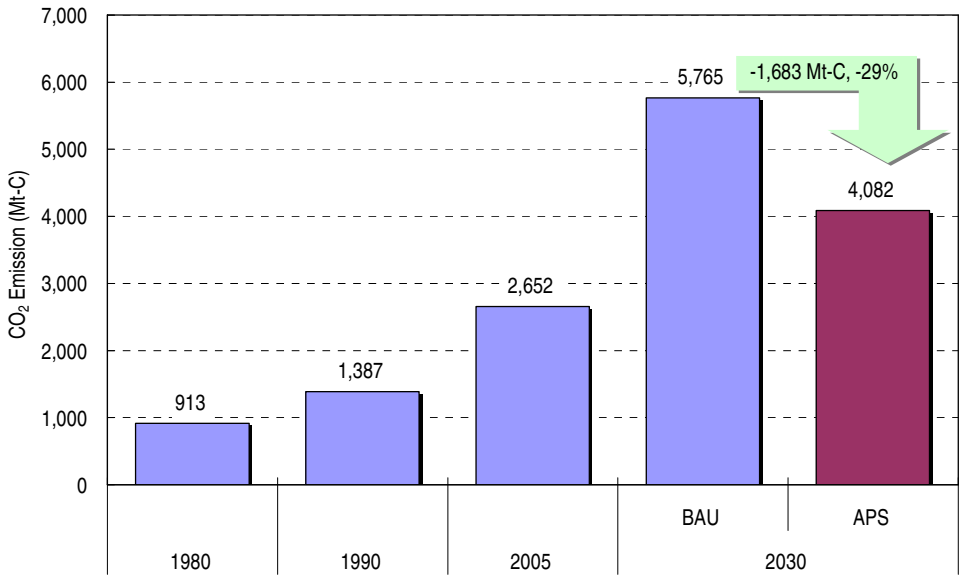
4.2.1. CO2 Emission Results

As shown in Figure 20, CO_2 emissions from energy consumption in the BAU case are projected to increase from 2,652 metric tons of carbon (Mt-C) in 2005 to 5,765 Mt-C in 2030, implying an annual growth rate of 3.2 percent. This is slightly lower than the growth in total primary energy demand of 3.5 percent per year. In the APS case, CO_2 emissions are projected to be 4,082 Mt-C in 2030, 29 percent lower than under the BAU case.

While the emission reductions under the APS are significant, CO_2 emissions from energy consumption in the APS case in 2030 will still be above 2005 levels and far

above 1990 levels. The scientific evidence suggests these reductions will not be adequate to prevent severe climate change impacts. The analysis of the Intergovernmental Panel on Climate Change (IPCC) suggests that to keep the global mean temperature rise at not much more than 2°C compared to pre-industrial levels, global CO_2 emissions would need to peak in the 2000-2015 time period and be reduced to between 15 and 50 percent of year 2000 levels (that is, a reduction between 85 and 50 percent) by 2050. Even to keep temperature rises in the 3°C range, CO_2 emissions would need to peak in the 2010-2030 time period and be 70 to 105 percent of year 2000 levels by 2050.[15]

Figure 20: Total CO_2 Emissions



[15] See "Summary for Policymakers" in *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Table SPM.5.

Although much depends upon the mitigation that is possible at later dates, and on the response of other regions, it would appear unlikely that global emissions could meet either of these profiles given the contribution of the EAS region to global total emissions under the APS results. Yet the consequences of insufficient reductions in emissions could be severe. For example at 2^oC compared to pre-industrial levels, up to 30 percent of species become at increasing risk of extinction, most corals become bleached, and droughts and water availability become an increasing problem worldwide. At 3^oC, millions of people could experience coastal flooding each year.[16]

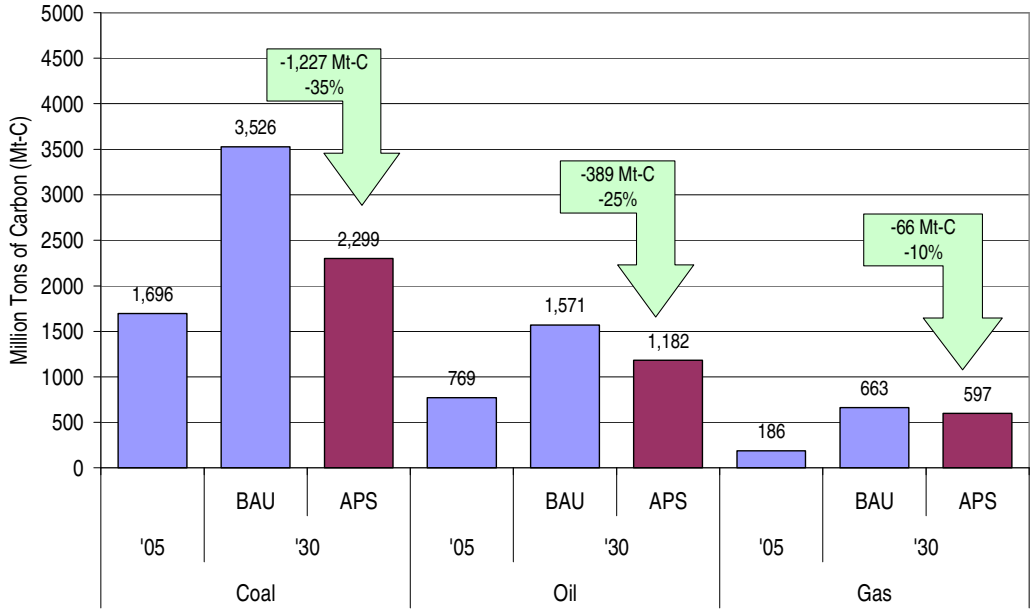
As shown in Figure 21 both total CO_2 emissions and growth in CO_2 emissions are projected to be dominated by coal and oil. In the BAU case, coal is projected to be the largest source of CO_2 emissions and the source of the largest growth in CO_2 emissions as measured in tonnes, up 1830 Mt-C or 3.0 percent per year, from 2005 to 2030. This growth reflects primarily the increasing use of coal for electricity generation in the EAS Region. Oil is also projected to be a major source of CO_2 emissions, and major source of growth in CO_2 emissions as measured in tonnes, up 802 Mt-C or 2.9 percent per year from 2005 to 2030. This growth reflects primarily the increasing use of fuels derived from oil for automobiles and transport. Natural gas shows the largest projected percentage increase in emissions over the 2005 to 2030 period, up 5.2 percent per year, but the growth in natural gas emissions in tonnes, up 477 Mt-C, is significantly less than either coal or oil.

In the APS case, the growth of CO_2 emissions from coal and oil is projected to be

[16] These examples are taken from "Summary for Policymakers" in *Climate Change 2007: Synthesis Report. Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Figure SPM.7. The examples assume that 1^o C of temperature increase has already occurred, as per this same report, Figure SPM.1.

significantly lower, but still substantial. Natural gas emissions in the APS case are only a bit less than in the BAU case. However, this result is to be expected, since many countries switch from coal and oil to less CO_2-intensive natural gas for electricity generation in the APS case.

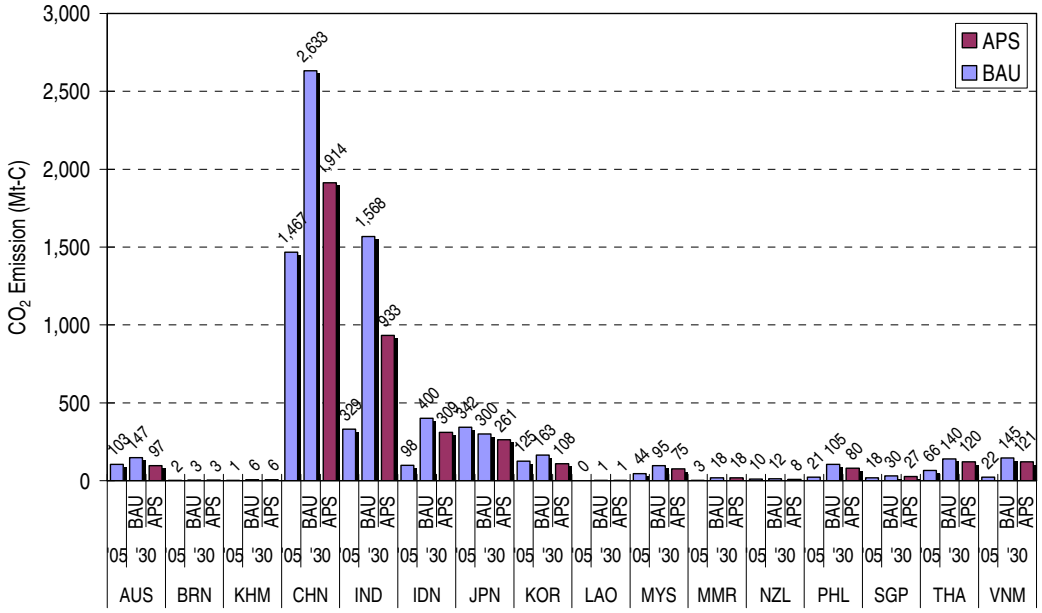
Figure 21: CO_2 Emissions by Energy Source



As shown in Figure 22, emissions and emission growth in the EAS Region is projected to be dominated by China and India. In fact, China and India will account for 1166 Mt-C and 1238 Mt-C respectively of the projected 3113 Mt-C growth in EAS Region emissions from 2005 to 2030 under the BAU case, or 77 percent of the EAS Region total. Adding in 302 Mt-C from Indonesia accounts for 2706 Mt-C, or 87 percent of the EAS Region total. No other country will account for a growth of more than 123 Mt-C. Japan is the only country in the EAS Region whose emissions are expected to decline

under the BAU case.

Figure22: CO_2 Emissions by Country



Under the APS case, China and India are still dominant, accounting for 447 and 604 Mt-C respectively of the projected 1430 Mt-C growth in EAS Region emissions from 2005 to 2030, or 74 percent. Adding in 210 Mt-C from Indonesia accounts for 1261 Mt-C or 88 percent of the EAS Region total. No other country will account for more than 100 Mt-C. Emissions from Australia, Japan, Republic of Korea, and New Zealand are expected to decline under the APS case relative to 2005 levels.

4.2.2. Fundamental Drivers of CO2 Emissions

The CO_2 emission results discussed above may be viewed as the net result of a chain of four drivers, two of which are moving in a direction favourable to CO_2 emission reductions, and two of which are moving in an unfavourable direction.

i) Emissions per unit of primary energy are projected to decline modestly from 0.85 t-C/toe in 2005 to 0.78 t-C/toe in 2030 under the BAU case, or 8 percent. Under the APS case, the decline is larger: to 0.69 t-C/toe in 2030, or 19 percent. The reduction under the APS case appears to reflect a shift away from coal and oil, the two most emission-intensive fuels.

ii) Primary energy per unit of GDP is projected to decline modestly from 331 toe/million US$ in 2005 to 281 toe/million US$ in 2030 under the BAU case, or 15 percent. Under the APS case, the decline is larger, to 224 toe/million US$ in 2030, or 32 percent. The reduction under the APS case reflects projected improvements in energy efficiency. Looking at (i) and (ii) in combination, emissions per unit of GDP decline from 281 t-C/million US$ in 2005 to 220 t-C/million US$ in 2030 under the BAU case, or 22 percent. Under the APS, the decline is larger, to 156 t-C/million US$ in 2030, or 44 percent lower than 2005.

iii) Working against these declines in emissions per unit of primary energy and primary energy per unit of GDP is the projected dramatic increase in GDP per person in the EAS Region, from 3,000 US$/person in 2005 to 6,800 US$/person in 2030, an increase of 127 percent. Looking at (i), (ii), and (iii) in combination, emissions per person are projected to increase from 0.84 t-C/person in 2005 to 1.49 t-C/person in 2030 under the

BAU case, or 77 percent. Under the APS, emissions rise to only 1.05 t-C/person in 2030, or 26 percent higher than 2005.

Figure 23: Emissions per Unit of Primary Energy

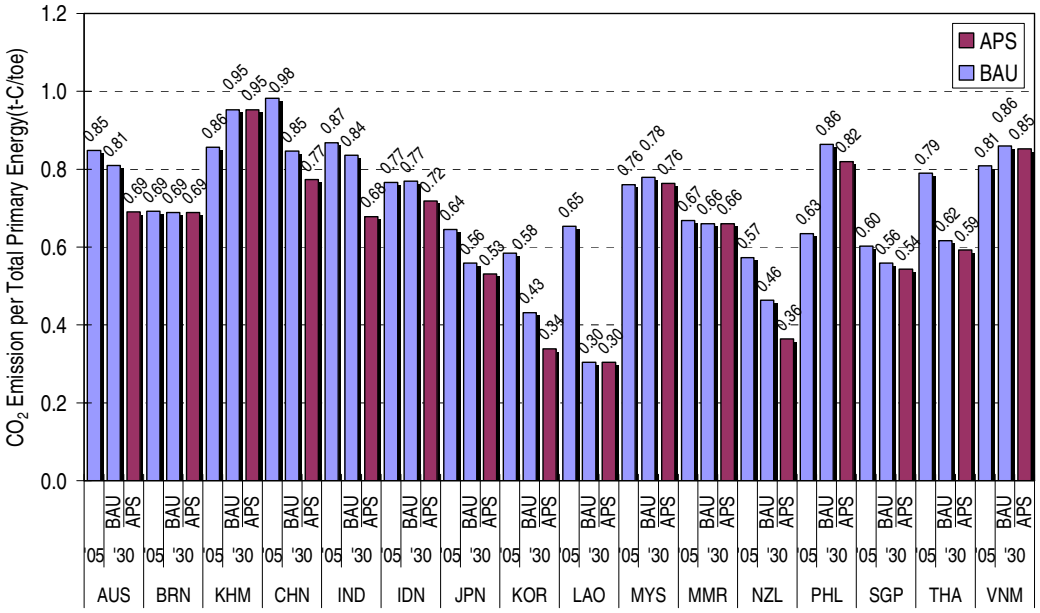
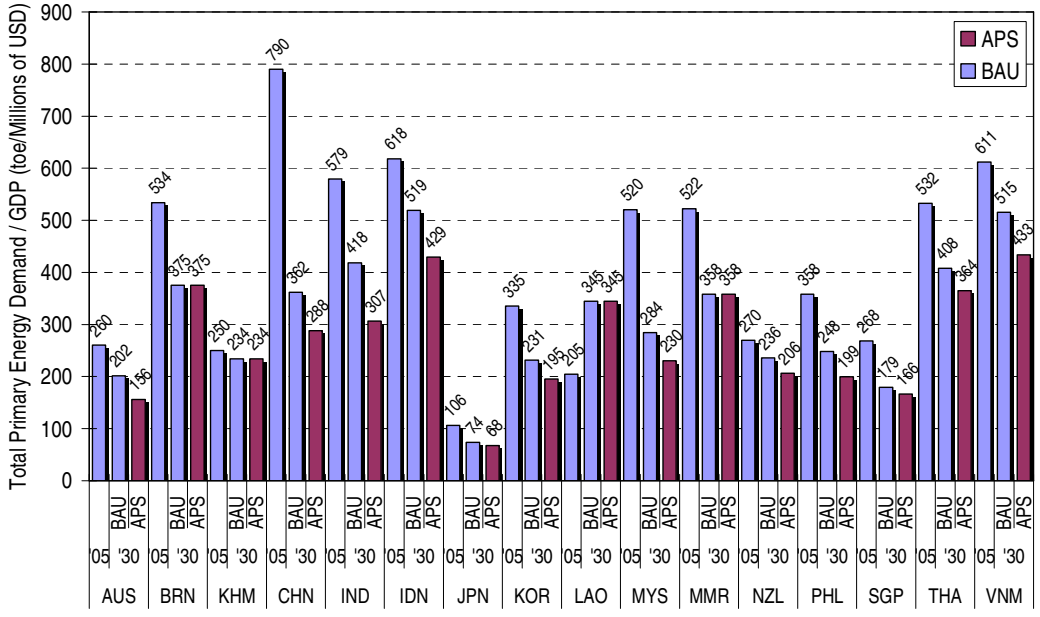


Figure 24: Primary Energy Demand per Unit of GDP



iv) Finally, population in the EAS Region is expected to grow from 3,156 million in 2005 to 3,862 million in 2030, or 22 percent. This population growth adds to the growth in emissions per capita to result in a net growth in emissions from 2652 Mt-C in 2005 to 5765 Mt-C in 2030 under the BAU case, or 118 percent. Under the APS, emissions grow to 4082 Mt-C in 2030, or 54 percent.

Figure 25: CO_2 Emissions per Unit of GDP