

APPENDIX

A1. TRENDS IN ENERGY RESOURCES AVAILABILITY AND USE

This section describes past and current energy utilisation in the East Asian countries considered and a global perspective.

A1.1. World

Present levels of global energy mix (in 2004) shows that biomass accounts for 10% (1,176 Mtoe) of the world's total (11,204 Mtoe). This further shows a reduced share of biomass from 16.5% in 1995 to only 10% in 2004 (Figure A1.1).

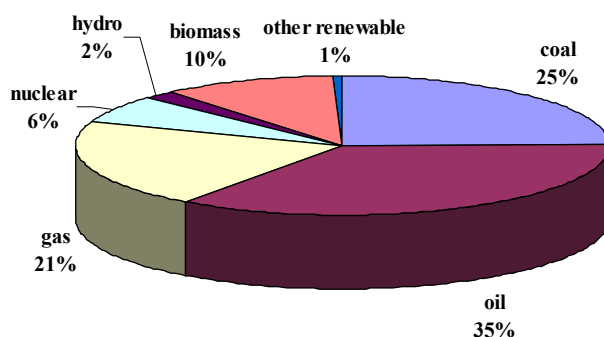


Figure A1.1 Global Fuel Energy Mix in 2004

Source: UNEP, 2007

A1.2. East Asia

Renewable energy sources account for 23% of East Asia's primary energy demand. Biomass, which is mainly used for traditional heating, is the main renewable energy source. Figure 3.3 shows the past trends of the amount of biomass utilised by some of the Asian countries with respect to the total energy supply of the region.

In 1997, energy from biomass such as wood and agricultural residues represents about 40% of total energy consumption - more than 2.5 million Terajoules per year. The bulk is from wood fuels, with an estimated value of \$7 billion per year. Main applications are in the domestic sector and small-scale industries, but also increasingly in modern systems for combined heat and power generation.

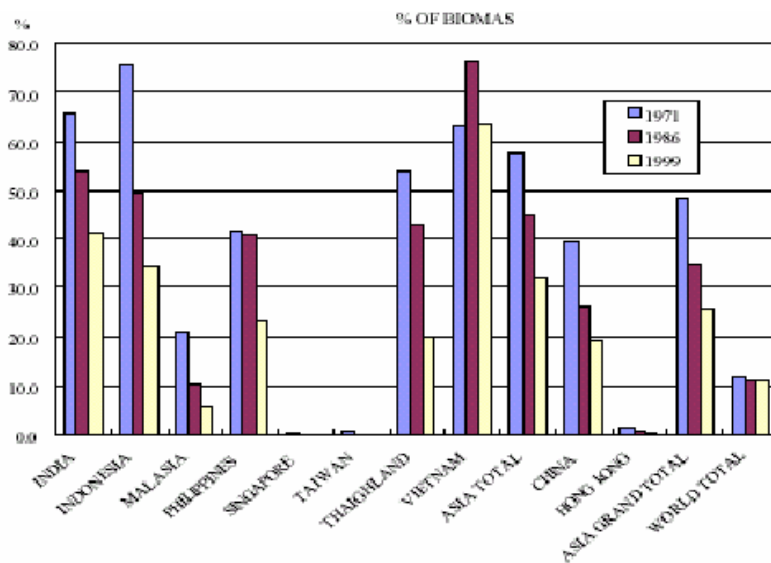


Figure A1.2 Share of Biomass to Total Energy Supply in Asia

For the five ASEAN countries where biomass is an important energy source (Indonesia, Malaysia, Philippines, Thailand and Vietnam), consumption increased on average 2% per year between 1985 and 1994, mainly due to population growth. Consumption is highest in Indonesia, accounting for more than half of the total consumption because of the large population, while the rate of increase is highest in Malaysia and Vietnam.

Primary energy consumption in the Asia-Pacific region grew by an annual average rate of 6.2% from 1980 (1,163.8 Mtoe) to 2000 (2,607 Mtoe) (BP Global, 2006). During the same period, coal and oil dominates the modest contribution of renewable sources. In eight selected countries in Asia, reliance on fossil fuels is rising sharply but the fast increase in use of renewable energy resources is also evident (Figures A1.3 and A1.4).

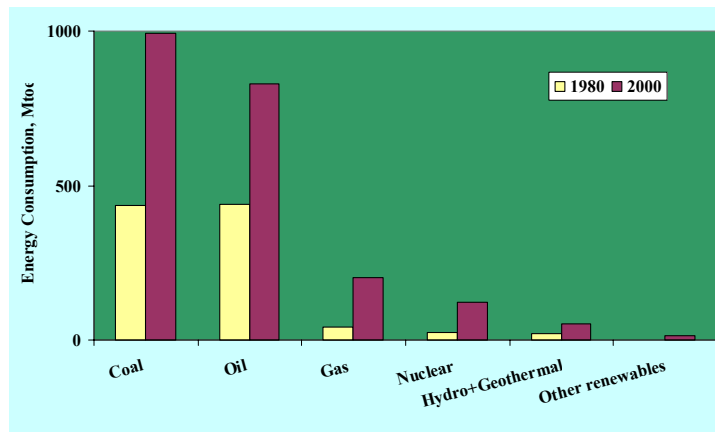


Figure A1.3 Trends in Primary Energy Consumption by Fuel Type in 8 Asian Countries

Source: Asian Energy Outlook to 2020

In year 2000, total primary energy consumption in the eight selected countries in Asia mostly was derived from fossil fuels. Coal and oil accounted for 82.5% of this energy mix (45 and 37.5%, respectively); together, natural gas, hydro and geothermal, biomass (renewables) and nuclear power contributed the remaining 17.5%. Country energy mixes vary greatly: coal is the dominant source of energy in China (70%) and India (54.6%), while oil figures more prominently as a source of energy in Japan, Korea, Indonesia, Malaysia, Philippines and Thailand (OECD, 2007). Throughout the

entire region biomass continues to supply a significant portion of the primary energy mix, mostly in the form of traditional fuels used by rural households and the urban poor (Figure A1.3).

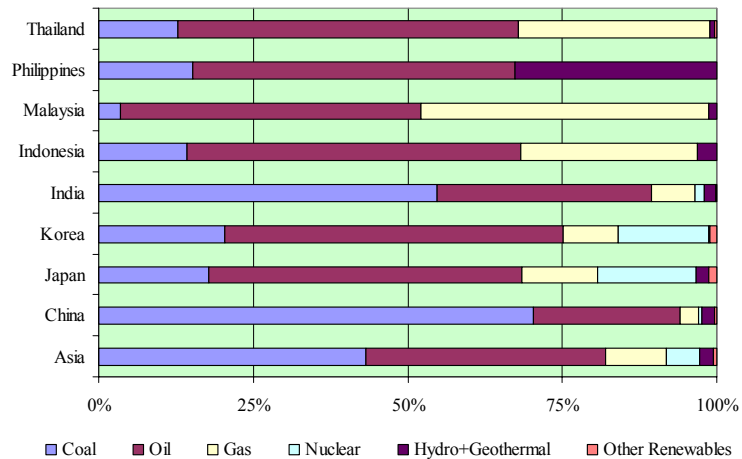


Figure A1.4 Primary Energy Mix by Fuel Type in 8 Asian Countries (2000)

Source: Asian Energy Outlook to 2020

In the Philippines, biomass contributed about 32% of the total energy mix in 2006. Biomass, by far, is the largest contributor among the indigenous sources of energy. The Department of Energy projected that biomass contribution would exhibit a declining trend up to 2014 wherein its share in the energy mix would only be 24%. However, its contribution in terms of volume expressed in million barrels of fuel oil equivalent (MMBFOE) is increasing.

Despite biomass' decreasing share in the energy mix, an optimistic trend was observed for coconut methyl ester and ethanol utilisation which would increase in the coming years.

A1.3 New Zealand and Australia

In 2002, New Zealand's total primary energy supply was 756 PJ. Oil accounted 33% (251 PJ) of the total primary energy supply, followed by gas at 32% (243 PJ), geothermal at 11% (83 PJ), coal at 7% (78 PJ), wood at 5% (34 PJ), and other renewable sources at about 2% (16 PJ) (Figure A1.5a).

During the same year, final energy consumption was dominated by oil, comprising 53% (269 PJ) of the total final energy consumption of 505 PJ. Electricity accounted for 25% (125 PJ), coal at 6% (33 PJ), gas at 7% (36 PJ), and geothermal at 3% (13 PJ). Wood and other renewable sources made up the remaining 6% (29 PJ) (Figure A1.5b).

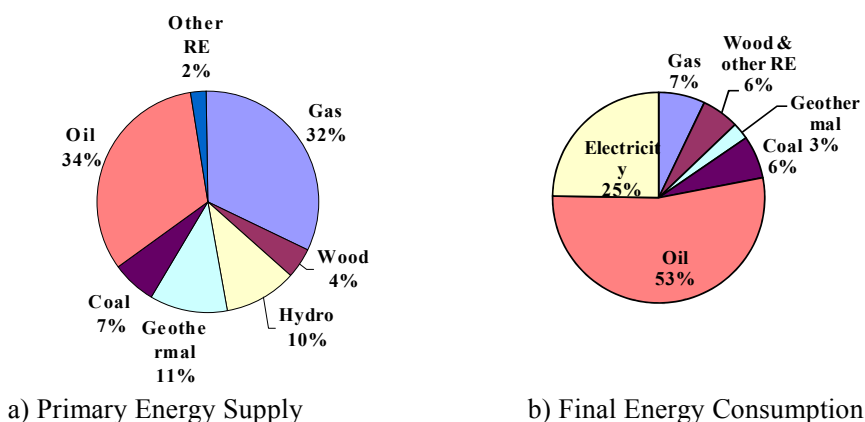


Figure A1.5 New Zealand's Primary Energy Supply and Final Energy Consumption in 2002

Source: NZ Ministry of Economic Development, 2003

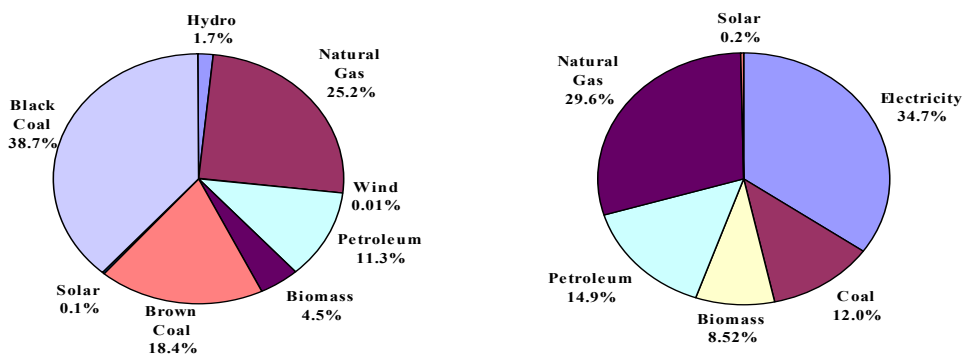
On one hand, total stationary⁴ primary energy consumption in Australia was 3,605.3 PJ in 2001. This figure includes all energy use, except final energy

⁴ Stationary energy means all energy use other than for transport.

consumption of fuels other than electricity for transport, and is equivalent to 186 GJ per head of population. It is dominated by coal (brown and black) which accounts 57.1% (2,060 PJ), followed by natural gas at 25.2% (910 PJ), petroleum at 11.3% (408 PJ), biomass at 4.5% (163 PJ), and solar, hydro and wind making up the remaining 1.8% (64.3 PJ) (Figure A1.6a).

Of the total primary energy consumption, 2,139 PJ were used in electricity generation and supply, and 229 PJ in other energy processing activities, such as oil refining. It can be seen that coal, most of which is converted to electricity for final use, accounts for well over half of total stationary primary energy consumption. Quantities of petroleum used are relatively modest, as this is predominantly the fuel used for transport sector.

During the same year, final energy consumption was dominated by electricity, comprising 34.7% (651 PJ) of the total final energy consumption of 651 PJ. Natural gas accounted for 29.6% (556 PJ), petroleum at 14.9% (280 PJ), coal at 12% (226 PJ), and biomass at 8.5% (160 PJ) (Figure A1.6b).



a) Primary Energy Consumption

b) Final Energy Consumption

Figure A1.6 Australia's Stationary Primary Energy and Final Energy Consumption in 2001 (Sadder H. et. Al. 2004)

A2. FUTURE ENERGY DEMAND GROWTH

If current trends continue, primary energy consumption in the eight selected countries in Asia will increase by 89% from 2,206 Mtoe in 2000 to 4,171 Mtoe in 2020. Energy demand in Asia is expected to reach 4,570 Mtoe by 2020, accounting for 33 percent of global energy demand (Asian Energy Outlook to 2020).

Though the current rate of growth in the renewables sector is fast, only modest increases in supply are projected unless greater growth rates are realized in the future. With projected increase in China's share of global energy demand from 10% in 2000 to 15% in 2020, it is also expected to lead the region in terms of renewable energy consumption at 35 Mtoe by 2020 (Asian Energy Outlook to 2020).

New Zealand's primary energy supply is projected to grow at an annual average rate of 1.1% from 756 PJ in 2002 to 903 PJ by 2020. Growth is due to several factors including costs, changing availability of energy sources, technology and climate change considerations. Prominent examples of such factors are the depletion of the Maui gas field, the potential increase in the use of wind and geothermal energy and the government's ratification of the Kyoto Protocol (NZ Ministry of Economic Development, 2003).

Final energy consumption in New Zealand is projected to grow at an annual average rate of 1% from 505 PJ in 2002 to 599 PJ in 2020. This comprises electricity demand increasing by 1.2% per annum (pa), gas by 4% pa, oil by 0.72% pa, biomass by 2.3% pa, and coal by 1.3% pa (NZ Ministry of Economic Development, 2003).

The foregoing projections for New Zealand energy sector was based on a number of assumptions under the Reference scenario considered by the Ministry of Economic Development. Key assumptions include: GDP growth of 2.5% pa from 2007, oil prices rising from US\$ 20/bbl in 2004 to US\$ 25/bbl by 2020, constant exchange rate at NZ\$ 1 = US\$ 0.5 up to 2025, Pohukura and Kupe gas fields available in 2007 and 2008, respectively.

On the other hand, Australia's stationary final energy demand is projected to grow at an annual average rate of 1.5% from 1,877 PJ in 2001 to 2,943 PJ in 2040. By this time, energy mix will still be dominated by electricity – 38.3% (1,127 PJ) and natural gas – 27.4% (807 PJ). Biomass contribution will slightly decline from 8.5% (160 PJ) in 2001 to 6.9% (204 PJ) in 2040, though its actual figure of consumption has increased. In these projections, key assumptions used are: the energy intensity change for the whole economy, i.e. aggregate energy intensity of the Australian economy, was -1.4% pa with GDP used as the overall measure of production. It is further assumed that there would be a shift within the economy towards a greater emphasis on sectors which are less energy intensive, such as services, and away, in relative terms, from more energy intensive sectors, such as chemicals and metal processing (Sadder H. et. Al. 2004).

The International Energy Outlook 2007 considered a reference case scenario for projecting the world's total marketed energy consumption. This scenario assumes that current laws and policies remain unchanged throughout the projection period.

Total world consumption of marketed energy is projected to increase from 11,204 Mtoe in 2004 to 17,095 Mtoe in 2030—a 53-percent increase over the projection period.

Much of the growth in energy demand will occur in Asia. Energy demand in Asia is expected to grow from 3,471 Mtoe in 2004, accounting to 31% of world’s total, to 4,307 Mtoe (33%) in 2010 and to 6,926 Mtoe (40%) by 2030 (Table A2.1).

Table A2.1 Projections of Marketed Energy Consumption in Asia and World
(2010-1030)

Year	Marketed Energy Consumption (Mtoe)	
	Asia	World Total
2010	4,307 (33%)	12,882
2015	4,960 (35%)	14,099
2020	5,613 (37%)	15,299
2030	6,926 (40%)	17,095

Source: Energy Information Administration, 2007

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