ASIA PACIFIC ENERGY RESEARCH CENTRE

APEC ENERGY DEMAND AND SUPPLY OUTLOOK 2006

PROJECTIONS TO 2030
ECONOMY REVIEW

2006

Published by

Asia Pacific Energy Research Centre
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ACKNOWLEDGEMENTS

The development of the APEC Outlook 2006 could not have been accomplished without the contributions of many individuals and organisations. We would like to thank all those whose efforts made this Outlook possible, in particular those named below.

Above all, we would like to thank Mr. Masaharu Fujitomi, the former President of APERC for his indispensable stewardship for the project.

We wish to express our appreciation to the APERC Conference and Workshop participants who met with us and provided invaluable insights into the issues raised in the draft report.

We also would like to thank members of the APEC Energy Working Group (EWG), APEC Expert Group on Energy Data and Analysis (EGEDA), and APERC Advisory Board, along with numerous government officials, for their helpful information and comments. In particular, we would like to thank the late Prof. Garegin S. Aslanyan for his invaluable guidance and contribution to this publication. We all held him in the greatest affection and respect.

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ADMINISTRATIVE SUPPORT

Sutemi Arikawa, Shohei Okano, Sachi Goto, Mizuho Fueta and Yumiko Nishino

ACKNOWLEDGEMENT OF APERC ADVISORY BOARD MEMBERS

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CONTENTS

AUSTRALIA

- *Australia will remain a major energy exporter in the APEC region, with coal and LNG exports reaching 301 Mtoe and 76 Mtoe respectively by 2030.*
- *Total primary energy demand is projected to grow at 1.6 percent annually, driven mainly by high demand for gas and oil from the rapid expansion of energy intensive industry, especially non-ferrous refining/smelting of aluminium, titanium and magnesium.*
- *Continued reliance on fossil fuels, especially coal in the electricity sector, will increase Australia's CO_2 emissions to twice that of the 1990 level by 2030.*
- *Investment of between US$200-248 billion will be required to support the economy's energy demand growth.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Australia's primary energy consumption increased from 122 Mtoe in 2002 to 128 Mtoe in 2004, primarily from coal and gas spurred by growth in the industry and electricity sectors.

Australia is rich in indigenous energy resources and supplies nearly all of the domestic energy requirements apart from crude oil.

Energy exports are important to the economy, with Australia being the world's largest coal exporter and the third largest LNG exporter in the APEC region.[1] In 2005, out of total steaming and coking coal exports, 67 percent were exported to Japan (44 percent), Korea (11 percent), Chinese Taipei (8 percent), China and other ASEAN economies.

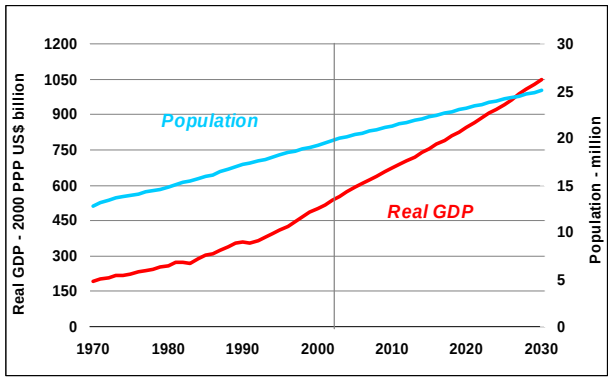
In 2005, on the back of high world energy and commodity prices, energy exports from Australia contributed 30 percent of total commodity exports of which export volumes of coal, LNG and uranium recorded historical highs. Coal exports were particularly important, earning AU$17.1 billion and accounting for 58 percent of energy exports, followed by crude oil and petroleum products AU$8.9 billion (30 percent), LNG AU$3.2 billion (10 percent) and uranium AU$475 million (2 percent).

Australia enjoys a high level of energy security due mainly to the abundant indigenous energy resources. Notwithstanding Australia's current energy security position, the economy has undertaken a wide-ranging review of energy policies culminating in the release of the "Energy White Paper Securing Australia's Energy Future" in 2004. The Energy White Paper (EWP) provides the basis for Australia's energy policy as well as Australia's energy security policy. The government's energy objectives consist of: 1) prosperity – that the value of energy resources is optimised; 2) security – that Australians have reliable access to competitively priced energy; and 3) sustainability – that environmental issues are well managed. In this context the future direction of energy resource use is to maximise the domestic utilisation of coal and to expand exports of natural gas in the form of LNG.

ENERGY DEMAND DRIVERS

Australia's GDP is projected to grow at a rate of 2.4 percent per year over the outlook period compared with the growth of 3.1 percent per year over the last three decades, approximately doubling GDP by 2030. The structure of GDP is not expected to change significantly over the outlook period. The share of the services sector will remain the largest accounting for 70 percent of the total GDP. The share of the industrial value added to GDP will remain at around 30 percent as a result of the continued expansion of energy intensive industry and increased output of manufactured products.

Figure 1 GDP and Population



Source: Global Insights (2005)

[1] In 2005, Australia was the world's fifth largest LNG exporter, exporting 10.8 million tonnes from a capacity of 11.7 million tonnes.

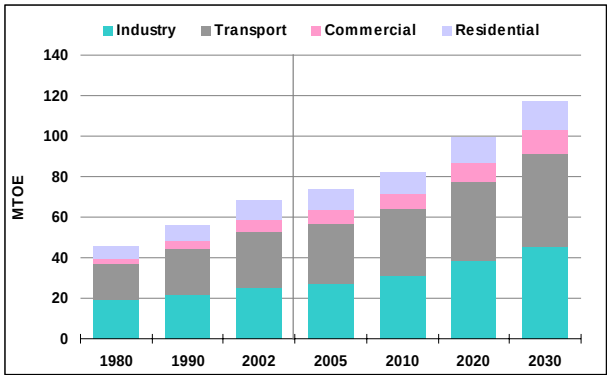
Population is projected to grow at 0.8 percent per year over the outlook period, falling slightly from the growth of 1.3 percent over the last 30 years. The population of Australia is expected to reach around 25 million in 2030, 20 percent higher than in 2002. Due to Australia's large geographical size and predominantly arid climate, the population has become largely concentrated in urban settlements on the eastern and south-eastern seaboards. In 2002, Australia's urbanisation level was 91 percent, and over the outlook period UN Habitat projects this level to increase to 96 percent in 2030.

OUTLOOK

FINAL ENERGY DEMAND

Final energy demand is expected to grow at 1.9 percent per year, the same rate of growth as the previous two decades.[2] The transport sector will account for the largest share at 40 percent, followed closely by industry (38 percent), residential (12 percent), and commercial (10 percent).

Figure 2 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 2.1 percent until 2030, faster than the average annual growth of 1.2 percent over the past two decades. The faster growth will be mainly driven by strong expansion of the energy-intensive refining and minerals processing industries. In particular, developments in the non-ferrous metal industries, including expansion of the aluminium industry and the establishment/emergence of magnesium and titanium industries will contribute to the increase in demand.[3, 4]

Natural gas and electricity, the major energy sources in the aforementioned non-ferrous metal industries, are projected to maintain the largest share throughout the outlook period, and will grow at an average annual rate of 2.8 and 2.3 percent respectively. Combined, their energy demand will account for about two-thirds of industrial energy demand in 2030. By contrast, the share of oil and coal is projected to decrease from 22 percent and 10 percent to 18 percent and 8 percent respectively, while the share of renewable energy is projected to remain constant at around 9 percent over the outlook period. Biomass, which is largely utilised in cogeneration by the food, wood, and paper and pulp industries, will account for almost all of demand for renewables. Energy intensity[5] in the industrial sector is expected to decline at an average annual rate of 0.4 percent, much slower than the 1.7 percent decline over the past two decades.

Transport

The road transport sub-sector dominates Australia's transportation sector accounting for more than 80 percent of total transport energy demand. Interstate freight and passenger transport rely heavily on road, as dispersed locations of agricultural, mining, production centres and residential suburbs are well connected by toll-free highway systems.[6] Passenger transport in urban cities is also dependent on road transport. Private vehicles offer the most convenient, reliable and fast means of transport for urban commuters, due to the lack of mass transit systems that connect city centres and suburbs.[7] As a result of this reliance, per capita energy consumption in the road transport sub-sector for Australia was 1.2 toe in 2002, taking the third highest position in the APEC region after the US and Canada.

Over the outlook period, road transport energy demand is projected to grow at an annual rate of 1.8

[2] Fuel switching from coal to natural gas in the industrial sector is the main reason for the similar growth rate over the outlook period compared with the past.

[3] ABARE (2005) assumes that alumina production will increase from 16.7 million tonnes in 2004 to 31.5 million tonnes in 2030, growing at an average rate of 2.5 percent per year.

[4] According to the "light metals action agenda", a magnesium industry will be established with production capacity of 800,000 tonnes per year to capture up to 50 percent of world demand growth for this metal over the next 20 years. Similarly, for titanium a 25,000 tonne per year industry will be established to capture a 25 percent share of the global market.

[5] The amount of energy needed to produce a dollar's worth of industrial sector's value added.

[6] A large proportion of rail freight is responsible for intrastate bulk commodity movements from the extraction or production sites to the seaport or processing centre.

[7] As urban sprawl has progressed in Australian cities.

percent, accounting for 74 percent of the total incremental increase in transport energy demand. By fuel type, the trend of growth for road transport shows substantial difference. As a result of the slower growth in population and continued energy efficiency improvements, gasoline demand for passenger vehicles is projected to grow at a moderate rate of 0.9 percent per year. In contrast, diesel demand for freight trucks is expected to grow annually at a constant rate of 2.0 percent, driven by the growth in agriculture and industrial activities at around 2.7 percent per year.

Energy demand in air transport is expected to grow at 2.8 percent per year, the fastest growing transport sub-sector. Further integration of Australia within global economic activities, and government efforts to reach bilateral/multilateral agreements on 'free skies' is expected to boost air travel. The volume of domestic air travel will also increase substantially as deregulation of the air industry continues to drive down airfares. As a result, jet kerosene demand for international air transport is projected to increase two-fold by 2030.

Rail is mainly used for bulk interstate freight/transport of commodities from extraction or production sources to the seaport or processing destinations. The extension of the trans-Australian railway from Alice Springs to Darwin, which was completed in 2003, is expected to result in increased use of rail for freight transport. For interstate passenger movement rail plays a minor role due to limited infrastructure. There was a plan to link Canberra and Sydney by TGV[8], but this plan has not been realised due to financial constraints. As a result of the growth in freight transport, rail transport energy demand is expected to grow at 0.6 percent per year.

Residential and Commercial

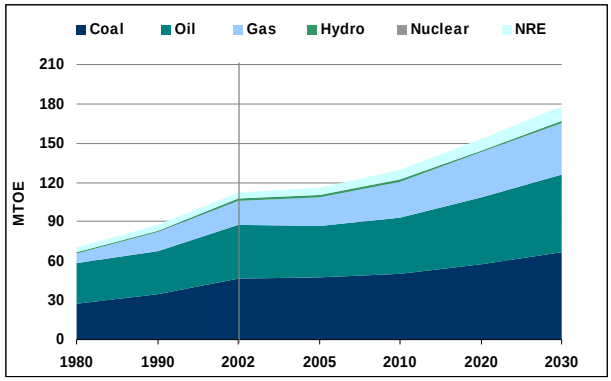
A gradual improvement in energy efficiency in the residential and commercial sectors over the outlook period will result in a slower annual growth rate for each energy source compared with the previous two decades. Australia's residential energy demand will grow at an annual rate of 1.4 percent, compared with 2.0 percent between 1980 and 2002. The energy mix is expected to broadly remain similar to that of 2002.[9] By energy source, natural gas is projected to grow at the fastest rate of 1.9 percent annually as it is expected to continue substituting kerosene. Electricity is expected to grow at the second fastest rate of 1.7 percent per year, followed by LPG for cooking and water heating at 1.4 percent per year. Fuel wood is projected to grow at an annual rate of 0.1 percent, as the main energy source for remote areas.

Energy demand in the commercial sector is mainly driven by the growth of value added for the services sector, and is expected to grow at 2.5 percent annually over the outlook period. Electricity accounts for more than 70 percent of total commercial energy demand, and this trend is expected to continue throughout the outlook period. Electricity demand is expected to grow at the fastest rate of 2.7 percent per year. Likewise, natural gas is expected to grow at 2.4 percent annually, as coal and diesel are replaced by natural gas as a fuel for boilers/on-site electricity generation in commercial buildings.

PRIMARY ENERGY DEMAND

Australia's primary energy demand is projected to grow at an annual rate of 1.6 percent over the outlook period, slower than the previous two decades at 2.2 percent per year. Among the fossil fuels, natural gas is expected to grow at the fastest rate of 2.9 percent per year, followed by oil and coal at 1.3 and 1.2 percent respectively.

Figure 3 Primary Energy Demand



Source: APERC Analysis (2006)

Natural gas demand will be largely driven by the industrial and electricity sectors, accounting for approximately 81 percent of the total incremental growth. A gradual shift towards less carbon intensive electricity generation is behind this trend with 46 percent of incremental natural gas demand projected for use in electricity generation. The majority of natural gas is expected to be supplied domestically, but given the great distance between production centres in the west of the continent and demand centres in the south and south-east, pipeline

[8] TGV (*train à grande vitesse*, French for "high-speed train")

[9] In 2030, the share of electricity in total residential energy demand will account for 50 percent, followed by natural gas at 32 percent), combustible renewables and waste (mostly wood) at 15 percent, petroleum products at 3 percent, and solar and wind the remainder.

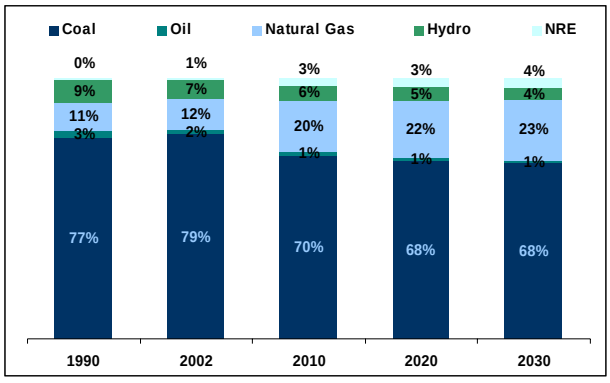
infrastructure will need to be developed. Another natural gas supply project that has been proposed is the importation of natural gas from Papua New Guinea, expected to begin in 2010.

Oil demand will be driven mainly by the transportation sector, accounting for 98 percent of the incremental growth. Given the dispersed geography of Australia, the large distances between major cities and between resource extraction locations and demand centres/export centres, transportation by road, air and rail will continue to be the major driver for oil demand over the outlook period. Australia supplies a significant volume of necessary oil requirements from domestic production; however, with a declining reserve to production ratio, oil import dependency is expected to reach 58 percent in 2030 from 21 percent in 2002.

ELECTRICITY

Electricity demand is projected to increase by 2.2 percent per year over the outlook period. Overall electricity generation from fossil fuels will remain dominant, with approximately 91 percent of the electricity generation mix from coal and natural gas in 2030. Coal will maintain the dominant share in the electricity generation mix; but will gradually decrease from 79 percent in 2002 to 68 percent in 2030. This decrease in coal will be offset by corresponding increase in the use of natural gas, which is projected to grow from 12 percent in 2002 to 23 percent in 2030. While electricity generation from renewables, especially biomass, wind, solar and others are projected to grow at the fastest rate of 9.2 percent per year, starting from a low base, the share in 2030 will still be low at 4 percent.

Figure 4 Electricity Generation Mix



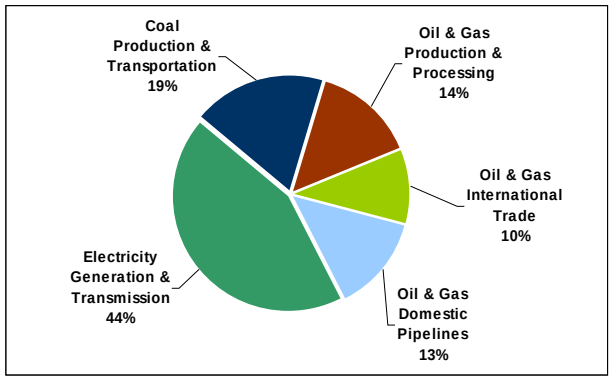
Source: APERC Analysis (2006)

Installed capacity is projected to increase at 2.4 percent per year over the outlook period to reach 94 GW in 2030, almost double the 2002 capacity. The 45 GW of additional capacity to be constructed by 2030 will be roughly distributed between coal (19 GW) and natural gas (17 GW) with the remainder from renewables.

INVESTMENT REQUIREMENTS

Australia's investment requirements over the outlook period are projected to reach between US$200-248 billion by 2030. Investment in electricity generation and transmission will have the largest share of 44 percent followed by coal production and transportation (19 percent), oil and gas production and processing (14 percent), oil and gas domestic pipeline (13 percent), and oil and gas international trade (10 percent).

Figure 5 Investment Requirements

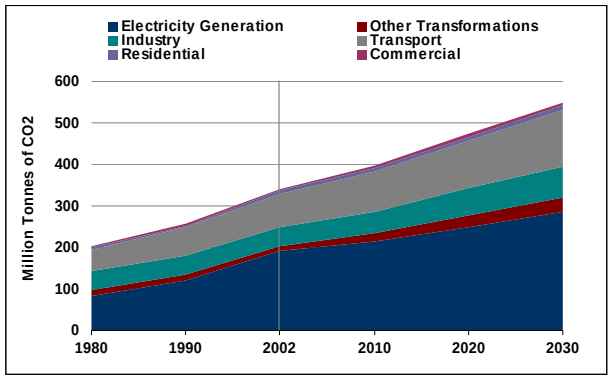


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Over the outlook period, Australia's total CO_2 emissions from the energy sector are projected to increase from 340 million tonnes of CO_2 in 2002 to 549 million tonnes of CO_2 in 2030. The majority of CO_2 emissions will come from the electricity sector at 52 percent, increasing to about 287 million tonnes of CO_2 by 2030.

Figure 6 CO_2 Emissions by Sector



. Source: APERC Analysis (2006)

MAJOR ISSUES

REDUCTION OF CO_2 EMISSIONS

Australia, although a signatory to the UNFCCC, has not ratified the Kyoto Protocol and therefore does not have a commitment to reduce CO_2 emissions under this initiative. Domestically, to reduce CO_2 emissions, the Australian authorities have introduced a range of policy measures to support the development and use of renewable energy technologies. Among the measures which have been implemented are: 1) Mandatory Renewable Energy Target (MRET) scheme[10] and 2) New South Wales (NSW) Government's greenhouse gas emissions benchmark scheme.[11]

In addition, at the State level, there have been calls to reopen and re-evaluate the debate on commercial use of nuclear energy in Australia, in the face of concerns about CO_2 emissions in addition to the burgeoning demand for electricity within the economy. While these views have been echoed at some levels of Federal Government, the Commonwealth government's policy vis-à-vis the commercial operation of nuclear power plants within Australia is that uranium is not to be used as an energy source, but to be exclusively treated as an export commodity.

The challenge for Australia over the outlook period will be to find a method through which CO_2 emissions can be reduced in an efficient and economical way. To this end, Australia along with five other economies namely: the US, Japan, Korea, China and India have embarked on a "technology-based" approach to CO_2 reduction through the establishment of the Asia Pacific Partnership on Clean Development and Climate (AP6). AP6 was established to promote an enabling environment for the development, deployment, diffusion and transfer of existing technologies as well as emerging cost effective, cleaner technologies.

DEVELOPMENT OF ENERGY INFRASTRUCTURE

Over the outlook period a significant amount of investment will be required for Australia to transport energy resources for domestic consumption from production centres to demand centres and to transport energy resources to ports for export. The challenge for Australia will be to make sure that the required infrastructural investment is undertaken in an efficient and timely manner.

In terms of natural gas, Australia's natural gas resources are remotely located in the northwest region, a great distance from major demand centres in the southern and eastern regions. Projected higher demand for natural gas in the electricity sector in the southern and eastern regions will precipitate the need for more investment in pipeline interconnection and networks to bring the gas across the economy. For example, Australia plans to link (1) Darwin with Moomba by a 2,200 km pipeline and (2) Papua New Guinea with Queensland through a 3,000 km pipeline from 2010. All the domestic oil and natural gas pipelines to be constructed in the economy over the outlook period are expected to cost between US$23-33 billion.

In terms of coal, Australia has recently undertaken measures to significantly increase the capacity of coal transportation infrastructure, including expansion of the major rail and port facilities in New South Wales and Queensland.[12] It is imperative however, that all aspects of the coal supply chain, from loading at mining sites to the loading of vessels at port are expanded systematically and in parallel to minimise misalignment of infrastructure (resulting in bottlenecks and under utilisation of the overall capacity). To meet export capacity requirements over the outlook period an estimated US$40-46 billion will need to be invested.

POTENTIAL FOR LNG EXPORT

Australia is expected to become an important LNG supplier over the outlook period with the annual production of LNG projected to reach 20 million tonnes by 2010, 49 million tonnes in 2020 and 62 million tonnes in 2030.[13]

The LNG industry has the potential to attract up to US$22 billion in new project investment over the outlook period, but is contingent on securing long-term supply contracts to underpin these investment requirements. However, due to the high LNG prices in the market, not many contracts have been signed in recent years. Once long-term sales and purchase agreements are signed, it is imperative that investment is undertaken in a timely manner such that Australia may remain a reliable and dominant LNG exporter within the Asia Pacific region.

[10] The scheme has already stimulated AU$200 million of investment in new renewable energy projects, as well as the upgrading of existing electricity generators.

[11] State initiative that aims to reduce the per-capita greenhouse gas emissions associated with electricity consumption in NSW from the benchmark 8.65 tonnes CO_2-eq in 2003 to 7.27 tonnes CO_2-eq by 2007, continuing through to 2012.

[12] The various mining companies have developed strategies to bring an extra 40 million tonnes of coal production online by 2008 at a cost of AU$2.6 billion to meet the anticipated growth in export demand through to 2015.

[13] Projection of LNG export capacity by APERC.

IMPLICATIONS

Over the outlook period Australia is projected to remain the world's largest coal exporter and through massive expansion of export capacity is also poised to be a very important player in the Asia Pacific LNG market. To this end, it is imperative that regulation to facilitate investment is continuously streamlined and that this investment is undertaken in an efficient and timely manner such that Australia remains a reliable and dominant energy exporter within the Asia Pacific region.

In terms of decreasing CO_2 emissions and in general reducing the carbon intensity of the economy, to date many initiatives have been instigated at both the Federal and State/Territorial levels of government. However, to maximise the benefits of these initiatives to the advantage of the whole economy a truly holistic approach involving coordination/integration between each level of government is recommended.

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BRUNEI DARUSSALAM

- *Brunei Darussalam's primary energy demand will increase from 2.7 Mtoe in 2002 to 3.3 Mtoe in 2030, driven by the growth in the electricity and transport sectors.*
- *Brunei Darussalam's high dependence on oil and natural gas revenues have increased the economy's vulnerability to volatility in international energy prices; prompting the economy to diversify sources of export revenues.*
- *Focus is expected to be on industry development to diversify the variety of industrial activities through the creation of an investment friendly business environment.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Brunei Darussalam's primary energy consumption has grown annually at 1.8 percent from 2000 to 2003, with oil and gas as the main sources of energy in all economic sectors. The economy is highly dependent on oil and natural gas as export commodities which constitute 97 percent of export revenues and about 37 percent of GDP in 2005.[14] Past trends in energy consumption showed that oil grew at an annual rate of 4.6 percent and actual oil consumption increased from 0.2 Mtoe in 1980 to 0.5 Mtoe in 2002.

Despite the declining trend of oil production from 12.2 Mtoe in 1980 to 9.7 Mtoe in 2002, natural gas production has been growing steadily at 1.2 percent per year over the last 3 years and has dominated the electricity generation mix, accounting for 99 percent in 2003.

The importance of the energy sector to the economy is reflected in the government's issuance of the 8th National Development Plan (NDP). The plan has emphasised the need to: 1) strengthen and expand the economy's oil and gas industry; 2) diversify non-oil intensive industries; 3) maximise the utilisation of indigenous resources; 4) improve people's living standards; and 5) protect the environment. Major policies to strengthen the hydrocarbon industry and diversify the non-oil intensive industries include: a) the development of the downstream oil and gas industry, particularly the petrochemical business which involves the production of gas-based products like ammonia, urea and methanol, and refinery derivatives like olefins and aromatics from naphtha; b) expansion of the current LNG production and export facilities; c) opening of new petroleum areas; d) expansion of electricity generation and grid extension; and e) reduction of oil and gas industry methane emissions by curbing process venting and others.

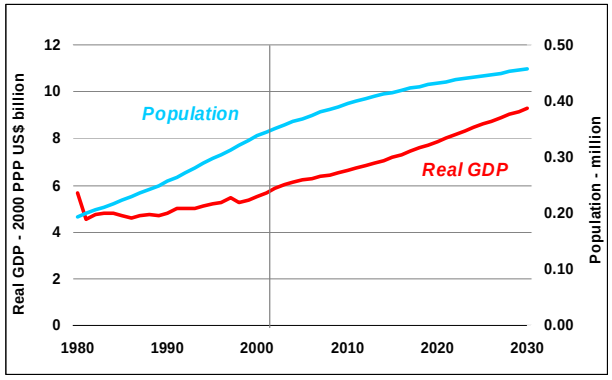
[14] Brunei Darussalam is the 4th largest oil producer in the South East Asia and the 9th largest producer of natural gas in the world.

ENERGY DEMAND DRIVERS

Brunei Darussalam's economy is expected to grow robustly at an annual rate of 1.7 percent over the outlook period, compared with 0.1 percent per year over the past two decade, as a result of increased revenue from rising oil prices, upsurge in personal spending and increased economic activity.

The economy's increasing awareness on family planning is expected to result in a marginal increase in population of about 0.95 percent per year through 2030, less than half the annual average growth rate of 2.8 percent observed over the last two decades.

Figure 7 GDP and Population



Source: Global Insights (2005)

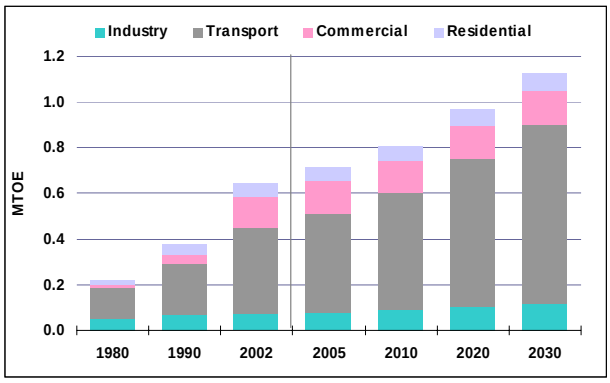
Brunei Darussalam is considered a highly urbanised economy with an urbanisation level reaching 75 percent in 2002. Due to the economy's small demographic nature – with a land area of only about 5,765 square kilometres and population of 0.35 million - and the almost even distribution of economic development among the four regional districts have resulted in a fairly stabilised urban migration across the economy. Despite the high concentration of population in urban centres, it is projected by UN Habitat that Brunei Darussalam's urbanisation level will reach 87 percent in 2030.

OUTLOOK

FINAL ENERGY DEMAND

Final energy demand, mainly oil and natural gas, is expected to grow at 2.0 percent per year over the outlook period, compared with annual growth in the previous two decades of 5.0 percent. The transport sector is projected to grow at an annual rate of 2.7 percent, followed by industry at 1.6 percent, residential at 1.3 percent, and commercial at 0.2 percent.

Figure 8 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 1.6 percent in 2030, faster compared with the average annual growth of 1.3 percent over the past two decades. The faster growth will be mainly driven by expected developments in the energy-intensive petrochemical industry. Brunei Darussalam plans to diversify its economy, which is heavily dependent on the oil and gas industry, by developing the Sungai Liang Industrial Park, which includes a methanol plant with a production capacity of 2,500 tonnes per day that is expected to begin operation in 2010.[15] Another project that has been proposed is an ammonia/urea plant with a daily production capacity of 2,000 tonnes of ammonia and 3,500 tonnes of urea. The economy plans to construct an aluminium smelting and elastomers industry over the outlook period.[16] Electricity, the major energy source in the above mentioned plants, is projected to grow at an average annual rate of 1.8 percent. The share of electricity accounted for 36 percent of total industrial energy demand in 2002, and projected to slightly increase to 37 percent in 2030. However, oil is still expected to maintain the largest share, accounting for 62 percent of the total industrial energy demand in 2030.

Transport

Driven by income growth and increasing integration into regional economic trade activities, Brunei Darussalam's transport energy demand is expected to grow at a steady rate of 2.7 percent per year. Road transport sub-sector accounts for about 51 percent, while air transport about 49 percent of the total transport energy demand. With the steady growth, per capita transportation energy demand will increase from 1.1 toe in 2002 to 1.7 toe in 2030 – ranking the fourth largest in APEC after USA, Australia, and Canada.

By fuel, gasoline for passenger vehicles will grow moderately at an annual rate of 1.3 percent. The moderate growth for gasoline demand reflects a slow down in population growth towards the end of outlook period and the saturation of passenger vehicle ownership. As the level of vehicle ownership has already reached a high of 540 units per 1,000 inhabitants, no significant change in vehicle ownership is projected over the outlook period. By contrast, demand for diesel is expected to grow at a constant rate of 3.1 percent per year, driven mostly by the growth in freight transportation activities, particularly the increase in the number of diesel vehicles and marine transport. Demand for jet kerosene for air transport is projected to grow at the fastest rate of 4.5 percent per year. Such increase will be spurred by the economy's integration into economic activities within Southeast Asia, which would give rise to more international passenger travel and freight movements.

Residential and Commercial

Energy demand in the residential sector is projected to grow at an annual rate of 1.3 percent up to 2030. Although it is slower than the average annual growth rate of 5.2 percent over the past two decades, the growth rate of residential energy demand will be higher than that of GDP per capita.[17] It will be mainly driven by national housing development projects, private housing development, and increase in the number of apartments. The shares of electricity and petroleum products in the total residential energy demand will remain unchanged. Electricity demand is projected to increase at 1.2

[15] In November 2005, agreement on the formation of a joint venture to construct a methanol production plant at the Sungai Liang Industrial Park signed between Brunei National Petroleum Company Sdn Bhd with two major Japanese companies, Mitsubishi Gas Chemical Company Inc and ITOCHU Corporation.

[16] Perry (2005).

[17] It is projected that GDP per capita will grow at an annual rate of 0.7 percent over the outlook period.

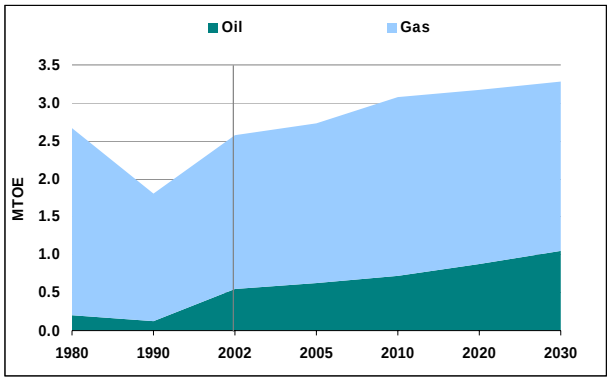
percent per year over the outlook period, accounting for 58 percent of the total residential energy demand in 2030. LPG, the dominant fuel among the petroleum products used in the residential sector, is expected to increase at 1.5 percent and will account for 42 percent of total residential energy demand in 2030.

In Brunei Darussalam, electricity is the only energy source utilised in the commercial sector. Over the outlook period, demand for electricity is expected to grow at 0.2 percent annually, much lower than the average annual growth rate of 12.2 percent in the past two decades. The slower growth in electricity demand is mainly due to the offsetting effects of two factors: higher economic development[18] and lower population growth[19].

PRIMARY ENERGY DEMAND

Over the outlook period, Brunei Darussalam's primary energy demand is projected to grow at an annual rate of 0.9 percent. Oil is projected to grow at the fastest rate of 2.3 percent per year followed by natural gas at 0.3 percent.

Figure 9 Primary Energy Demand



Source: APERC Analysis (2006)

Natural gas demand will be largely driven by the electricity sector and will account for 68 percent of total primary energy demand in 2030. To meet the rising electricity demand, the economy will continue to rely on natural gas because of the abundance. Brunei Darussalam is expected to increase the capacity of natural gas-fired electricity generation from 633 MW in 2002 to 1,036 MW in 2030.

Oil will be the main fuel utilised by all sectors with the transport sector accounting for the largest share at 89 percent, followed by industry (8 percent) and residential (3 percent) over the outlook period.

[18] Over the past two decades GDP has increased at 0.14 percent annually; however, it is projected that GDP will grow at 1.7 percent annually through 2030.

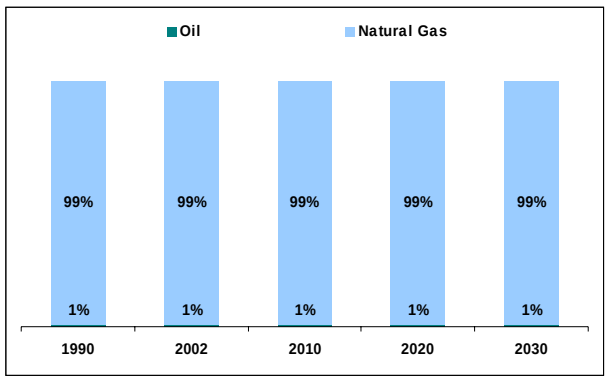
[19] APERC projects that population would increase at an annual growth rate of 0.9 percent over the outlook period.

ELECTRICITY

The electricity generation of Brunei Darussalam will increase by 26 percent from 2.7 TWh in 2002 to 3.1 TWh in 2030. Despite the substantial growth projected, per capita final electricity demand is expected to decrease from 6,580 kWh in 2002 to 5,990 kWh in 2030.

Over the outlook period, natural gas will maintain the dominant share in the electricity generation mix at 99 percent.

Figure 10 Electricity Generation Mix

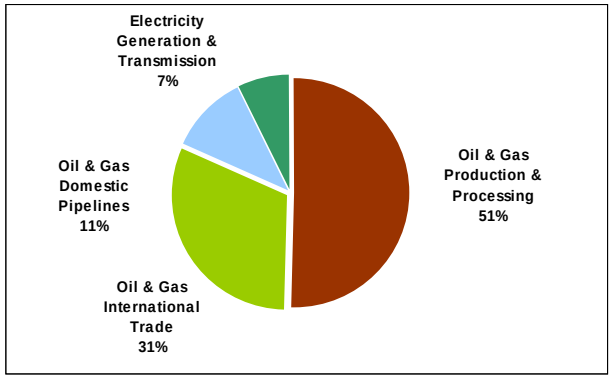


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

Brunei Darussalam's projected growth in energy demand will require the necessary investments for the development of energy supply, transformation, transport, and downstream infrastructures at a cost of between US$ 3.3-4.4 billion by 2030. Half of the total investment requirement is expected to be utilised for oil and gas production, processing and petrochemical infrastructure development reaching US$1.4-2.2 billion in the same period.

Figure 11 Investment Requirements

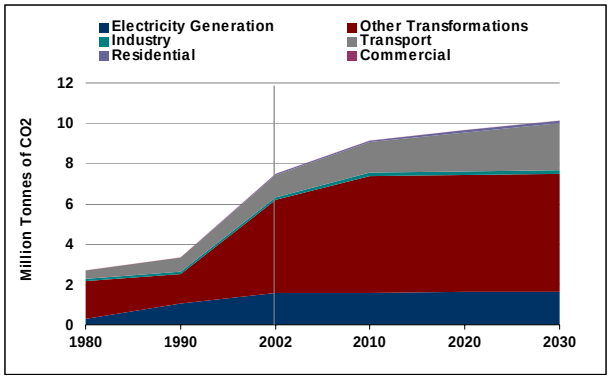


Source: APERC Analysis (2006)

CO_2 EMISSIONS

The addition of technologies to reduce emissions from oil and natural gas production is expected to result in slower growth of CO_2 emissions over the outlook period. For the period 2002 to 2030, CO_2 emissions would grow at 1.1 percent and reach a total of 10.1 million tonnes of CO_2 by 2030.

Figure 12 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

Brunei Darussalam's high dependence on oil and gas for export revenues has prompted the government to pursue measures that might maximise the economy's potential revenues from indigenous resources. A number of projects have emerged such as the Brunei Darussalam Methanol Consortium which recently concluded a joint venture agreement on gas supply and marketing, which resulted in the start of the development of the first methanol plant in the economy. The plant is expected to produce approximately 850,000 tonnes of methanol per year, most of which will be exported to Asian markets.

In addition, the Brunei Economic Development Board (BEDB) has initiated plans to develop the Sungai Liang area into a world class industrial park with shared infrastructure and utilities (including a power plant and a marine terminal) to service manufacturing and downstream projects including ammonia/urea, methanol, elastomers and aluminium smelting plants. A 500MW power plant will be built in the Sungai Liang region.

IMPLICATIONS

Expansion of the oil and natural gas sectors will further increase the economy's dependency on these energy resources, while at the same time increasing the volume of CO_2 emissions from electricity generation. As oil and natural gas reserves gradually deplete, the government may have to embark on new alternative initiatives to secure energy supply, such as renewables.

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CANADA

- *Canada's primary energy demand is projected to grow at an annual rate of 1.1 percent from 2002 until 2030.*
- *Canada is foreseen to become a net importer of natural gas by 2030. LNG is considered as an option to supply natural gas to both the domestic market and the US market via pipeline.*
- *CO_2 emissions from the utilisation of energy in 2010 are expected to exceed the 1990 level by 40 percent.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Canada's primary energy consumption increased from 252 Mtoe in 2000 to 261 Mtoe in 2003 at an annual rate of 1.1 percent over the same period. The increase in consumption is mainly due to the increased consumption of oil in the transport sector and natural gas for electricity generation.

Canada has abundant energy resources of oil, natural gas and coal mainly located in the western provinces.

The economy is a net energy exporter. Energy exports more than doubled from 59.7 Mtoe in 1990 to 128.7 Mtoe in 2003, with the economy exporting about 90 percent to the US. In 2003, natural gas accounted for about 59 percent of total net exports, followed by crude oil (31 percent), petroleum products (7 percent), and coal (3 percent).

The crude oil export ratio [20] has grown from 13 percent in 1990 to 38 percent in 2003, as a result of increasing offshore and oil-sands production off-setting the declining conventional oil production from the Western Canadian Sedimentary Basin. Crude oil production – both conventional and non-conventional oil – reached 144 Mtoe in 2003 from 94 Mtoe in 1990.

Net export ratio of natural gas has declined from a peak of 119 percent in 2001 to 95 percent in 2003, as a result of flat natural gas production combined with an increase in domestic consumption. Between 2003 and 2004, spurred by rising natural gas prices, the number of wells drilled increased by 11 percent, however production only increased by 1 percent during the same period. Due to the expected increase in demand for natural gas for electricity generation, petrochemical industry, mining, and oil and gas extraction, the net export ratio is expected to continue declining in the future.

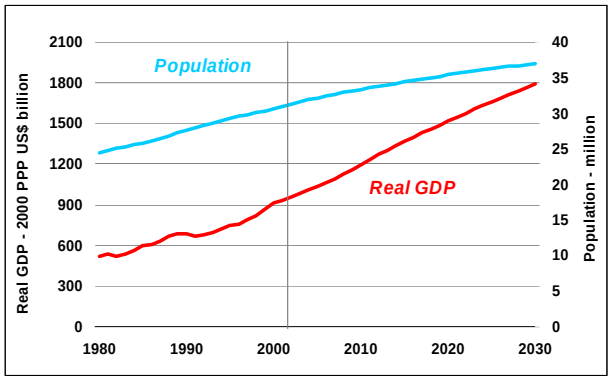
Meeting the Kyoto target poses a great challenge to the economy as it relies heavily on energy-intensive industries. In 2002, Canada ratified the Kyoto Protocol and is committed to reduce CO_2 emissions to 6.0 percent below the 1990 level. However in 2003, Canada's CO_2 emissions from energy consumption have surpassed the 1990 level by 29 percent. To meet the target, Canada released "The Climate Change Plan for Canada" in 2002. Following the release of the Plan, Canada has launched several climate change programmes including among others, the R&D for a hydrogen economy and the provision for financial incentive for energy efficiency retrofits of houses.

ENERGY DEMAND DRIVERS

Canada's economy is expected to grow at an annual rate of 2.3 percent over the outlook period. In the near term (2002-2015), increased productivity through technological innovation will result in faster GDP growth of 2.8 per cent per year. However, slower GDP growth is expected over the longer term at 1.8 percent from 2015 through 2030.

Population is projected to grow at an annual rate of 0.6 percent from 31 million in 2002 to 37 million in 2030. Despite the declining birth rate, continued immigration is expected to ensure the growth in population.

Figure 13 GDP and Population



Source: Global Insights (2005)

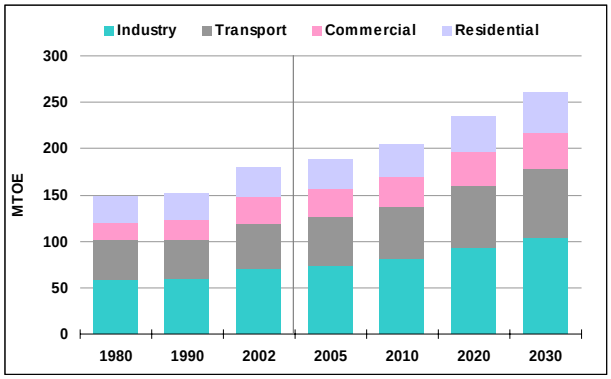
[20] Net export ratio is calculated based on the following. Net export ratio = (Import + Export)/Total Primary Energy Demand.

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 1.3 percent per year, from 180 Mtoe in 2002 to 260 Mtoe in 2030, faster than the average annual growth in the previous two decades at 0.9 percent. The industry sector is expected to account for the largest share at 40 percent, followed by transport (29 percent), residential (16 percent), and commercial (15 percent) in 2030.

Figure 14 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 1.4 percent until 2030, faster than the average annual growth of 0.8 percent over the past two decades. The higher growth in industrial value-added at 2.2 percent per year over the outlook period will lead to the faster projected energy demand growth in the sector.[21] The energy-intensive and non-energy-intensive industrial sub-sectors are expected to grow at about the same pace; therefore the structure of the industrial sector is not expected to change significantly. Strong growth in the resource extraction industries, notably oil sands development[22], will also contribute to the faster growth in energy demand. Energy intensity[23] in the industrial sector is expected to improve from 250 toe per US$ in 2002 to 196 toe per US$ in 2030 declining at an average annual rate of 0.9 percent, slightly slower than the decline of 1.1 percent over the past two decades.[24]

Natural gas, which accounted for 32 percent of industrial energy consumption in 2002, is projected to maintain the largest share of total industrial energy demand throughout the outlook period. Utilised as a feedstock to produce methanol and ammonia, and a fuel for manufacturing, natural gas is expected to grow at 1.1 percent per year. The share of electricity, the second-largest energy source in the industrial sector, is projected to increase from 26 percent in 2002 to 29 percent in 2030. This will be driven by robust increase in the use of electricity-specific processes in manufacturing such as mechanical pulping techniques in the pulp industry and electric arc furnaces in the steel industry. By contrast, the share of petroleum products is expected to decrease from 26 percent in 2002 to 24 percent in 2030. However, demand for ethane will grow robustly at an annual growth rate of 1.8 percent as a result of expansion in the ethylene manufacturing industry.[25] Coal demand is projected to decline at 0.1 percent per year as industrial production shifts from integrated steel mills to electric arc furnaces, and the demand for coking coal is reduced. The demand for renewable energy is expected to grow at the fastest rate of 1.9 percent per year, with the share increasing from 11 percent in 2002 to 13 percent in 2030, due mainly to the increasing demand for pulping liquor and hog fuel, by-products of the paper and pulp industry, which account for almost all of the demand for renewables.

Transport

Transport energy demand is dominated by the road transport sub-sector, representing around 90 percent of total transport energy consumption in 2002. The low population density and high living standards have translated into the substantial requirements for gasoline in passenger vehicles. The economy's integration within the North American market and the production of high value added manufacturing goods have resulted in the increased utilisation of diesel-powered heavy trucks as the main mode of freight transport. With the economy's heavy reliance on road transport, Canada's per capita transport energy consumption accounted for the

[21] Between 1980 and 2002, value-added of Canada's industrial sector has grown at 1.9 percent per year.

[22] Oil sands production is expected to increase by three times the 2002 level by 2030.

[23] The amount of energy needed to produce a dollar's worth of industrial sector's value added.

[24] This could be explained by the fact that mining (which includes oil and gas) and forestry (logging) industries will likely require exploitation of more remote and difficult to access resources, thus limiting energy intensity improvement.

[25] Ethylene production is expected to increase from 4.7 million tonnes in 2002 to 5.6 million tonnes by 2010, then to 7.1 million tonnes in 2030.

second highest in the APEC region after the US, at 1.6 toe per person in 2002.

Over the outlook period, transportation energy demand is expected to grow at 1.6 percent per year, from 49 Mtoe in 2002 to 76 Mtoe in 2030. In 2030, road transport will represent the largest share at 92 percent, followed by rail (3 percent), marine (2.4 percent) and air (2.3 percent). With steady demand growth, per capita transport energy demand is projected to reach 2.0 toe in 2030.

By fuel type, gasoline, the main fuel for road transport, is expected to steadily increase at 1.5 percent per year. The popularity of light trucks, including minivans and sport utility vehicles (SUVs) is expected to continue in the future, resulting in the increase in gasoline demand.[26] The expected growth in export and further need for just-in-time delivery is expected to boost diesel demand for heavy trucks.

Residential and Commercial

Along with income and population growth, energy demand in the residential sector is expected to grow annually at 1.1 percent from 31 Mtoe in 2002 to 42 Mtoe in 2030, growing faster than the average annual growth rate of 0.5 percent between 1971 and 2002. Due mainly to the long and extremely cold winter, the energy demand for space and water heating in this sector and is projected to account for 80 percent of total energy demand in 2030. Most households in Canada are expected to continue using gas for heating thereby increasing the demand for natural gas at an annual rate of 1.5 percent. Subsequently, as coal and petroleum products are replaced by natural gas, the share of natural gas in total residential energy demand is expected to increase from 45 percent in 2002 to 50 percent in 2030. Electricity is projected to take the second largest share of total residential energy demand at 40 percent in 2030, growing at an annual rate of 1.2 percent per year, slower than the previous two decades.[27]

As in the residential sector, space and water heating accounted for 60 percent of total energy demand in the commercial sector in 2002. During the outlook period, energy demand in the sector is projected to grow at 1.0 percent per year, driven by growth in the services sector.[28] Natural gas is projected to grow at 1.3 percent per year, increasing the share of total commercial energy demand from 38 percent in 2002 to 42 percent in 2030. Electricity demand is projected to increase from 11 Mtoe in 2002 to 14 Mtoe in 2030 and grow at an annual rate of 0.9 percent.[29] The projected growth is driven by the increase in demand for lighting, and the increasing diffusion of electric equipment in commercial buildings. The demand for petroleum products, particularly LPG in remote areas, is projected to grow at 0.7 percent per year, accounting for 22 percent of total commercial energy demand in 2030.

PRIMARY ENERGY DEMAND

Canada's primary energy demand is projected to grow at an annual rate of 1.1 percent over the outlook period. Among the fossil fuels, natural gas is expected to grow at the fastest rate of 1.7 percent per year, followed by oil at 1.2 percent per year. Coal is however projected to decline annually at 1.2 percent through 2030.

Natural gas will increase across all sectors, with electricity generation accounting for the largest incremental demand growth at 46 percent, followed by residential and commercial (26 percent), industry (17 percent) and other (10 percent). Given the declining trend of natural gas production and the continued domestic demand growth, Canada is expected to become a net importer of natural gas by 2030. LNG is considered as an option to supply gas to both the domestic and US markets through pipelines. To secure the future supply of natural gas, seven LNG receiving terminals have been proposed, however as of 2006, only Irving Oil and Anadarko Petroleum Corporation have received federal and provincial environmental approval.

Oil demand will be driven mainly by the transportation sector accounting for 77 percent of the oil demand growth, followed by industry at 20 percent. Most of the demand will be met by domestic production which is projected to increase from 133 Mtoe in 2002 to 236 Mtoe in 2030. Much of the increase in crude oil production is expected to come from oil sands, the output of which is projected to triple over the outlook period if the necessary infrastructure for production and transportation are developed.

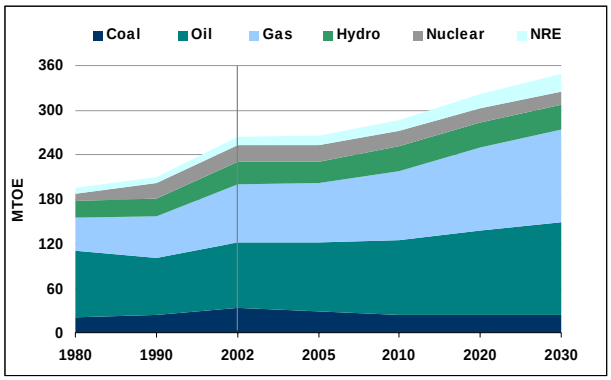
[26] From 1990 to 2002, the stock of light trucks increased by an annual rate of 2.5 percent, with the share increasing from 25 percent in 1990 to 31 percent in 2002. All other type of passenger vehicles has however declined at 0.4 percent per year, over the same period.

[27] Households in Canada have a high ownership level of electric appliances. In 2002, the diffusion ratio of refrigerators was 1.2, while that of China was 0.5, and Japan was 1.2 in 2002.

[28] The value added for the services sector is projected to grow at 2.6 percent per year.

[29] By 2030, electricity will account for 37 percent of the total commercial energy demand.

Figure 15 Primary Energy Demand



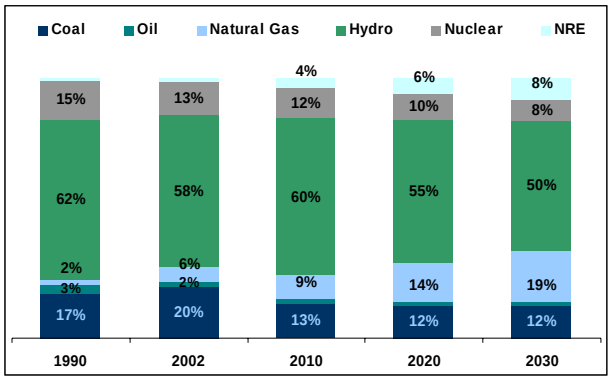
Source: APERC Analysis (2006)

Due to environmental concerns, coal demand is projected to decline sharply at a rate of 4.5 percent per year until 2010 and thereafter maintain sustained positive growth of 0.2 percent per year to the end of the outlook period. The province of Ontario's electricity generation mix will undergo a major change, replacing some coal-fired electricity generation plants by other types. This will result in the sudden decline in coal demand by 2010.

ELECTRICITY

Electricity demand is expected to grow annually at 1.4 percent through 2030. Electricity demand for the industry sector is expected to grow at the fastest rate of 1.8 percent per year, followed by the residential sector at 1.2 percent per year, and the commercial sector at 0.9 percent per year.

Figure 16 Electricity Generation Mix



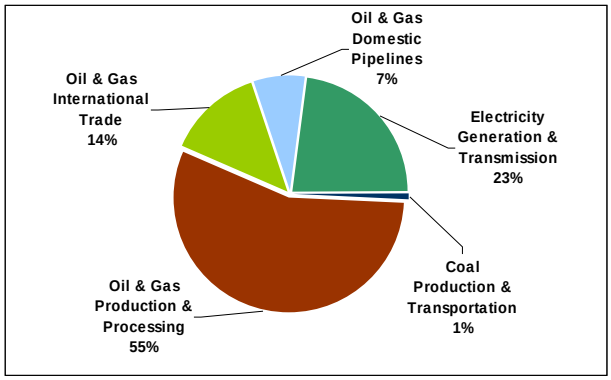
Source: APERC Analysis (2006)

By fuel, hydro will continue to be the main source of electricity generation, but the share in the electricity generation mix will decline from 58 percent in 2002 to 50 percent in 2030. Nuclear electricity generation will decline at an annual rate of 0.5 percent per year – leading to a decline in the share from 13 percent in 2002 to 8 percent in 2030. Although two nuclear units at the Bruce A nuclear power station restarted operation in 2005, over the outlook period construction of new nuclear capacity is likely to face strong public opposition. The share of coal in the electricity generation mix will decrease from 20 percent in 2002 to 12 percent in 2030, due mainly to the decision by Ontario to phase out coal-fired electricity generation. The reduced share of coal and nuclear in the generation mix will however be offset by an increase in the share of natural gas from 6 percent in 2002 to 19 percent in 2030.

INVESTMENT REQUIREMENTS

Canada's continued growth in domestic energy demand, including projected growth in energy exports will require new investment particularly in oil and gas production and processing reaching between US$175-257 billion and accounting for the largest share in the economy's estimated total energy investment requirements of between US$335-464 billion by 2030.

Figure 17 Investment Requirements

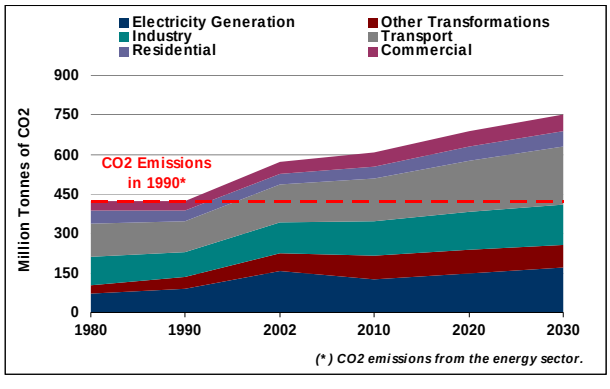


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Despite the declining use of coal for electricity generation, the economy's total CO_2 emissions from the energy sector are expected to increase from 574 million tonnes of CO_2 in 2002 to 751 million tonnes of CO_2 in 2030.

Figure 18 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

MEETING THE KYOTO TARGET

Canada is committed to reduce CO_2 emissions to 6 percent below the 1990 level during the first commitment period between 2008 and 2012. However meeting the target poses difficult challenges for the economy. In 2010, CO_2 emissions from the energy sector are projected to exceed that of the 1990 CO_2 emission level by as much as 40 percent.

To reduce GHG emissions and ensure clean air, water, land and energy, the government is committed to develop a "made-in Canada programme". Canada's 2006 Budget has allocated CAN$2 billion over the next five years for the aforementioned climate change programme. The Budget also proposes a tax credit on the purchase of public transit passes and allocates CAN$900 million for provinces and territories through a Public Transit Capital Trust. The Budgets Fiscal Balance document indicates that the federal government is committed to work with the provinces and territories to harmonise the current differences in legislation and regulation on energy and environment among all levels of government in formulating a national climate change policy.

IMPLICATIONS

Due to the economy's geographical proximity to the US, Canada is expected to continue to serve as an important energy supplier to the US market. In enhancing energy supply security of North America, Canada may need to ensure the timely investment of needed energy supply infrastructure. This will include investment in pipeline for oil sands, LNG receiving terminals and enhancement of electricity transmission systems.

Meeting the Kyoto target poses a great challenge to the economy as it relies heavily on energy intensive industry, including oil and natural gas production. Although each level of government has the right to formulate their own environmental legislations and regulations, there is a need to harmonise all the differences and changes in legislation/regulations to cope with climate change issues. This effort marks an important step for Canada to establish a coherent energy policy towards the enhancement of energy security and sustainable development.

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CHILE

- *Chile's GDP is projected to continue growing robustly at 4.9 percent annually between 2002 and 2030.*
- *Economic growth is mainly driven by the industrial sector (mining); Chile being the world's largest producer and exporter of copper.*
- *High dependence on imported natural gas for electricity generation and lack of transmission infrastructure across the economy are fast becoming a problem of energy security.*
- *Environmental protection and sustainable development concerns, clean energies such as natural gas, hydropower and renewables are priorities in the government policy.*
- *The investment requirements over the outlook period will amount to between US$64-83 billion.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Chile's total primary energy consumption grew annually at 1.8 percent from 2001 to 2004. Electricity consumption has increased by 5.1 percent in the same period, primarily through the expansion of the mining sub-sector - particularly for copper - of the industrial sector. Chile is the largest copper producer and the second largest copper refiner in the world. Additionally, rising income has resulted in higher passenger vehicle ownership and robust economic activity has resulted in more freight transportation, which has consequently increased oil consumption accounting for 25 percent of the total incremental energy consumption between 2001 and 2004.

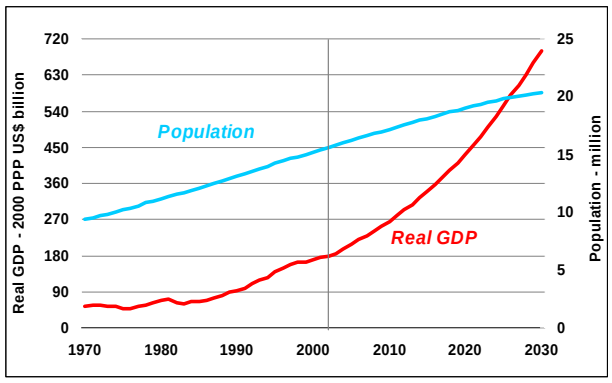
Except for hydro, Chile has very limited indigenous energy resources and therefore must rely on imports to sustain growth. Between 2002 and 2004, imports of natural gas increased at an average annual rate of 15.5 percent, coal at 8.5 percent and oil at 4.8 percent. The economy's net energy import ratio has increased from 41 percent in 1980 to 63 percent in 2002.

The instability of natural gas supply from Argentina as a result of supply cuts in 2004, which reduced by half the contracted volumes on some days, has prompted the economy to reconsider energy policies vis-à-vis the supply of natural gas and reducing high import dependence on Argentina. Chile has formulated a new policy that advocates the construction of a liquefied natural gas (LNG) import facility. In addition the construction of new hydro power plants and a greater focus on the development of new and renewable energy sources has been considered.

ENERGY DEMAND DRIVERS

Chile's growth in energy demand will be led mainly by increased economic activity with GDP projected to grow at 4.9 percent annually over the outlook period. Expansion in industrial sector activities, particularly in the mining sub-sector is expected to contribute to the economy's GDP growth.[30]

Figure 19 GDP and Population



Source: Global Insights (2005)

Population growth is projected to be restrained at 1.0 percent per year over the outlook period, and by 2030 Chile's total population is expected to reach over 20 million. UN Habitat projects that the share of Chile's urban population will reach 92 percent in 2030 from 87 percent in 2002.

OUTLOOK

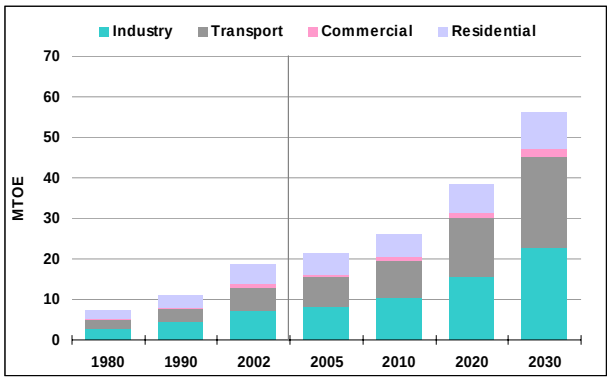
FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 4.0 percent annually, 0.3 percent less than that of the previous two decades. The

[30] Between 2002 and 2004, on the back of high commodity prices, export revenues for Chile's ferrous and non-ferrous mineral products have contributed about 29 percent to the economy's GDP.

industrial sector's share will remain the largest at 41 percent, followed by the transport sector at 40 percent, and the residential and commercial sectors at 16 percent and 3 percent respectively in 2030.

Figure 20 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 4.2 percent, slightly lower than the average annual growth of 4.4 percent over the past two decades. The shift in industry structure, from manufacturing to service industry, will lead to the lower projected growth in energy demand in this sector. In addition, the decrease in the share of mining and quarrying (especially the copper industry) to the total value-added of the industrial sector will result in this lower growth trend in the latter part of the outlook period. Among the fuels used in the industrial sector, electricity is projected to maintain the largest share throughout the outlook period. Electricity, as a major input for copper production, will grow at an average annual rate of 5.0 percent, with its share increasing to 42 percent in 2030 from 34 percent in 2002. Petroleum products are likely to take the second largest share of 29 percent by 2030. Demand for diesel which is largely used as a fuel in copper production and agricultural activities is expected to lead the growth in industrial oil demand. Natural gas is also projected to grow robustly at 4.2 percent per year as it continues to replace fuel oil and coal for boilers in the mining and manufacturing sectors. The share will remain constant at 12 percent through to 2030.

Transport

For the past two decades, Chile's transport energy demand has grown annually at 4.5 percent. The largest portion of incremental growth came from the road transport sub-sector, accounting for 86 percent. Income growth and development of urban areas has spurred the growth of passenger vehicle ownership, and led to the 4.6 percent increase in gasoline consumption in the same period. Economic recovery starting from the early 1990s has driven a more than two-fold increase in diesel consumption for the trucking/freight segment. Development of a highway system – through effective utilisation of private financing – has facilitated the flow of inter-city passenger and freight traffic.

Over the outlook period, Chile's transport energy demand is projected to increase at an annual rate of 4.9 percent – a faster pace than the previous three decades at an annual rate of 3.6 percent. By sub-sector, the road transport sub-sector is projected to grow substantially, accounting for 87 percent of the incremental energy demand (2002-2030), with the remainder coming from energy demand for the air transport sub-sector. Increasing utilisation of transportation will result in per capita energy demand reaching 1.1 toe in 2030 from 0.38 toe in 2002.

As economic development continues to be supported by the export of mining, forestry and agricultural products, requirements for freight transport – mainly for the trucking sub-sector – will grow substantially. As a result diesel demand for freight is expected to grow at an annual rate of 5.3 percent. Gasoline demand for passenger transport is projected to grow at 4.6 percent annually. Income growth will boost the level of passenger vehicle ownership from 79 per 1,000 population in 2002 to 185 per 1,000 population in 2030. Towards the end of the outlook period, after 2020, population growth is projected to decline resulting in lower demand for road transport thereby the slower growth in gasoline demand. In addition, the government initiative to restrict overall bus travel along Santiago City streets, as a measure to reduce pollution, is projected to contribute to the lower diesel demand and increase in gasoline demand. [31]

Residential and Commercial

Along with the strong income growth and improvement in living standards, energy demand in the residential sector is projected to grow by 2.3 percent annually throughout the outlook period. In 2030, electricity is projected to take the largest share in total residential energy demand, accounting for 34 percent. Due to the implementation of a rural electrification program, electricity will grow at the fastest rate at 5.9 percent per year between 2002 and 2030. The share of biomass (mostly fuel wood) is projected to decline at 0.2 percent per year, to

[31] In 2001, the government announced the "Atmospheric Decontamination and Prevention Plan", which restricts overall bus travel on Santiago's city streets in addition to restrictions on the utilisation of leaded gasoline for passenger vehicles.

become the second largest fuel in total residential energy demand by 2030, after reaching a peak in 2009. Biomass is however expected to be continuously used to provide electricity to remote areas where the national electricity grid is inaccessible. Petroleum products are expected to grow by 3.6 percent per year, comprising mostly LPG at 80 percent. LPG will continue to replace biomass for cooking and heating in residential buildings, with the share increasing from 17 percent in 2002 to 27 percent in 2030.

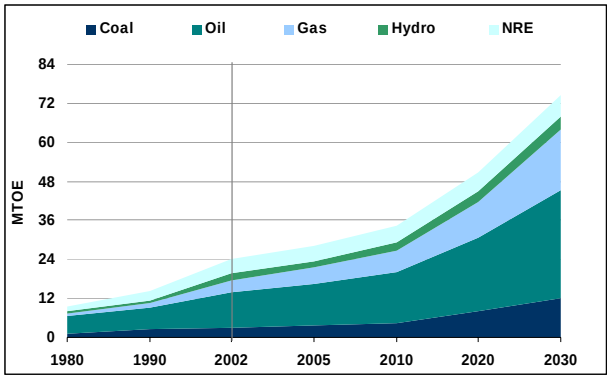
Energy demand of the commercial sector is expected to grow at an annual rate of 3.8 percent, consistent with the growth of value added for the services industry at 5.6 percent annually throughout the outlook period. Driven by the increase in demand for cooling and lighting in commercial buildings, electricity is projected to grow at 3.7 percent annually and maintain the largest share over the outlook period. Following electricity, natural gas is projected to account for the second largest share in total commercial energy demand. As natural gas will continue to replace diesel for electricity and heat production and compete with LPG in the commercial sector, demand for natural gas is expected to grow the fastest at 6.3 percent annually.

PRIMARY ENERGY DEMAND

Chile's primary energy demand is projected to grow at an annual rate of 4.1 percent, a slight decrease compared to the previous two decades at 4.3 percent per year. Among fossil fuels, natural gas is expected to grow at the fastest pace of 5.9 percent per year, followed by coal at 5.3 percent and oil at 4.0 percent.

Natural gas demand will be largely driven by the electricity sector, with gas-fired electricity generation accounting for more than 45 percent of total electricity generation in 2030.

Figure 21 Primary Energy Demand



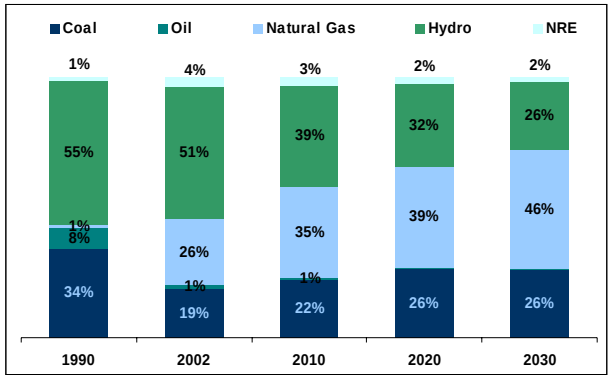
Source: APERC Analysis (2006)

ELECTRICITY

Electricity demand in Chile will increase at 5.0 percent per year, to nearly quadruple that of the 2002 level over the outlook period.

The share of natural gas in the generation mix will increase from 26 percent in 2002 to 46 percent in 2030. The installed capacity of natural gas-fired electricity generation is expected to more than quadruple from 3 GW in 2002 to 14 GW in 2030.[32] Coal-fired electricity generation and hydro will each account for about 26 percent of the total electricity generation mix in 2030.

Figure 22 Electricity Generation Mix

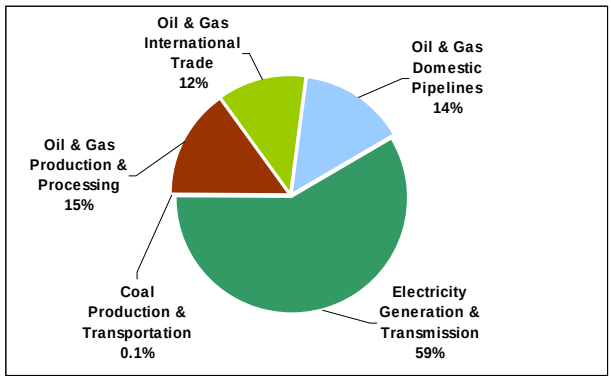


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

The investment requirements over the outlook period are expected to be between US$64-83 billion. Investment in electricity generation and transmission to meet the increasing demand for electricity in mining and refining of non-ferrous metals will account for the largest share of 58 percent, followed by oil and gas production and processing (15 percent), oil and gas domestic pipeline (14 percent) and oil and gas international trade – including the construction of an LNG import terminal – (12 percent).

Figure 23 Investment Requirements



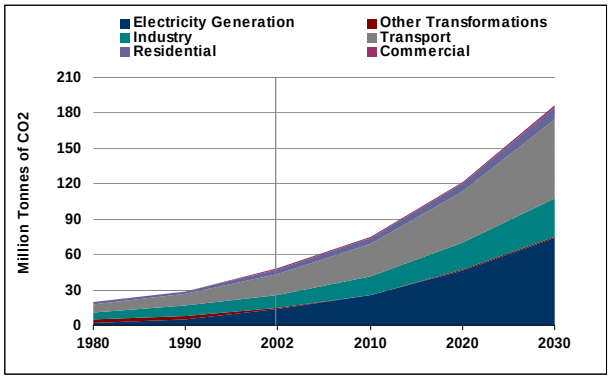
Source: APERC Analysis (2006)

[32] This will be achieved over the next decade by the construction of 10 new combined-cycle gas-fired power plants.

CO_2 EMISSIONS

Over the outlook period Chile's total CO_2 emissions from the energy sector are projected to increase from 48 million tonnes of CO_2 in 2002 to 186 million tonnes of CO_2 in 2030. In 2030, emissions from the electricity sector are projected to account for the largest share at 39 percent (74 million tonnes), followed by transportation on 36 percent. (67 million tonnes)

Figure 24 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

INDEPENDENT OVERSEAS DEVELOPMENT AND DIVERSIFICATION OF SUPPLY

The rate of production for oil and natural gas in Chile has continued to decline over the past decade as existing wells reach economic life and exploration efforts elsewhere within the economy have proven unsuccessful. With rising demand and decline in domestic production, Chile's net oil import dependency is projected to increase from 93 percent in 2002 to 100 percent in 2030.

Recognising the need to augment the depleting reserves and rising energy consumption, the government through the national oil company ENAP (Empresa Nacional del Petroleo) has aggressively undertaken upstream joint exploration and development activities overseas. Sipetrol, ENAP's foreign exploration subsidiary, is responsible for the company's international activities. The company has entered into 15 joint venture agreements over the last 15 years. Operations have extended in various economies around the world such as Argentina, Colombia, Ecuador, Iran and Egypt.

The government of Chile has further moved to diversify supply sources of natural gas in 2004 as a result of supply cuts from Argentina - Chile's predominant supplier of natural gas. This culminated into a plan to construct a 2.7 million tonnes per year capacity LNG receiving terminal. The LNG terminal is currently under construction and expected to be operational in 2008.

Chile is not only putting investment in overseas upstream projects, but also trying to forge long-term relationships for securing oil supply by strengthening political ties with neighbour economies such as Peru and Bolivia. A plan to build a cross border oil pipeline project between Chile and Peru was earlier proposed, but stopped due to disagreement in the sea demarcation in the borders between Peru and Chile.

FRAGMENTED AND MONOPOLISTIC NATURE OF THE ELECTRICITY SECTOR

Chile's electricity sector consists of four separate power grids, the most important of which is the Central Interconnected System (SIC) which serves 90 percent of Chile's population and more than 40 percent of the economy's land area. SIC installed generation capacity is mostly hydro at around 61 percent while the other areas are mostly thermal. The unbalanced distribution of electricity generation capacity across the economy has become a growing concern, particularly during times of draught, threatening electricity supply from hydro generating plants.

In addition, Endesa (a multinational electricity company based in Spain) is the single largest generator and market power, having almost 50 percent of the generation capacity in the SIC region. The exclusion of smaller generators as members of the Centre for Economic Load and Dispatch Committee (that is, in the SIC region only 7 of the largest generators are represented) raises issues of fair competition, pricing, and rulemaking.

IMPLICATIONS

Although it could be argued that the fragmented nature of Chile's electricity distribution network is based on specific regional needs, geographical distribution of population, and cost limitations of interconnecting the systems, past events have shown the system's vulnerability to changes in weather and fuel supply sources. To stabilise the system and possibly to prevent future electricity supply disruptions, the government may have to look into the possibility of linking the grids. Grid linkages could optimise supply across the network and possibly promote competition within the sub-networks, and subsequently bring down the cost of electricity to the consumers.

On a broader scale, as Chile becomes more dependent on natural gas in the electricity sector, regional integration will become a more pressing point for consideration and gas pipeline and

electricity interconnection networks between the surrounding economies, such as Peru, Bolivia, and Argentina, will greatly enhance the security of energy supply within the region.

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CHINA

- *Rapid growth in China's economy will result in an almost three-fold increase in energy demand through 2030.*
- *Over the outlook period, China will account for about 42 percent of APEC's overall energy demand growth, 67 percent of coal demand growth, more than 30 percent of oil demand growth, and about 24 percent of natural gas demand growth.*
- *China's oil import dependency will increase from 22 percent in 2002 to 70 percent in 2030.*
- *The investment requirement will amount to between US$1.9-2.3 trillion, representing 37 percent of the overall APEC investment requirements for the energy sector.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Along with rapid industrialisation and improvement in living standards, China's energy consumption has surged in recent years. Between 2002 and 2004, total primary energy consumption grew by 38 percent – the fastest pace that China has experienced over the past decade. Because of the expanding needs for electricity generation and industrial production, coal consumption increased substantially, accounting for 89 percent of the total energy consumption growth in 2002 to 2004. Rising vehicle ownership and industrial development resulted in a greater increase in oil consumption, accounting for 11 percent of the total energy consumption growth over the same period.

To meet the substantial energy consumption growth, China is intensifying the production of all types of energy. Coal production increased from 1.95 billion tonnes in 2004 to 2.19 billion tonnes in 2005, the highest recorded production in the last three decades. Chinese oil companies have been intensifying western and offshore oil production to make up for the decline in Daqin oil field. Natural gas production increased from 41.5 BCM in 2004 to 50 BCM in 2005. With the annual additions of 60 GW, installed electricity generation capacity reached 441 GW in 2004 from 355 GW in 2002.

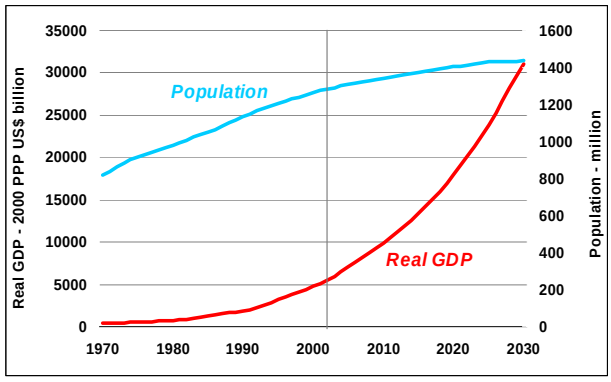
Much of the growth in domestic energy consumption, especially for crude oil and products, has recently been met by imports. The growth of domestic crude oil production and expansion of refinery capacity has not been fast enough to keep pace with the rapid increase in consumption for diesel and gasoline. In 2005, China imported 2.54 million b/d of crude oil – a 3.5 percent increase over 2004. The repercussions of the increase in Chinese oil imports to the global oil market have been felt significantly, creating a tight balance between demand and supply.

Given the rising energy demand and constraints over energy supply, China places energy security as the top priority of its energy policy goals. The 11th five-year plan delineates measures for the enhancement of energy security, with a strong emphasis on efficient energy use. By 2010, China aims to improve energy intensity by 20 percent compared with the 2005 level. To achieve the target, a number of measures have been implemented: 1) modernisation of energy industries with the closure of small coal mines, power plants, refineries, and iron and steel production plants, and 2) introduction of efficient technologies throughout the energy supply chain – from production, transportation to consumption.

ENERGY DEMAND DRIVERS

China's economy is expected to grow robustly, with an annual growth rate of 6.4 percent over the outlook period, which is the fastest rate in the APEC region. The robust growth is lead by continued investment activities, expanding domestic demand and exports. In addition, China's accession to the WTO will make the economy more attractive to foreign investors, with the opening of its market.

Figure 25 GDP and Population



Source: Global Insights (2005)

Despite the economy's potential growth, there are risks surrounding the development of China. In the short to medium term, restructuring of state-

owned enterprises (SOEs) remains one of the major tasks to be undertaken by the central government. However local governments have been strongly opposing the closure of inefficient operations, for fear of a rise in unemployment. Based on the World Bank estimates, China may have to provide about 8-9 million re-employment opportunities annually for workers laid-off during the restructuring process.

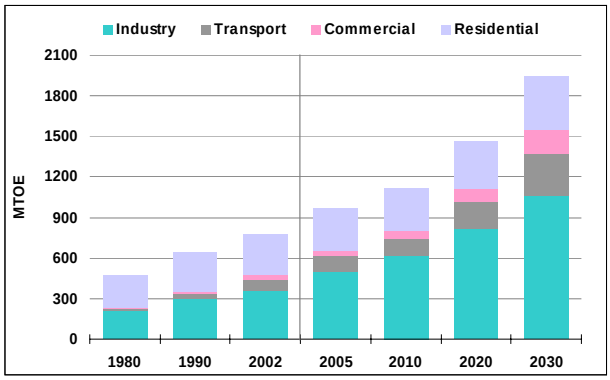
Population growth is projected to be restrained at 0.4 percent per year over the outlook period, compared with the previous three decades of 1.4 percent growth per year. Despite its modest growth, by 2020 China's population will reach over 1.4 billion, comprising 20 percent of the total world population. Economic growth continues to transfer labour and other inputs from agriculture to the industrial and services sectors of urban areas. UN Habitat projects that the share of China's urban population will reach 60 percent in 2030 from 38 percent in 2002. Urban dwellers will seek greater use of automobiles for their mobility and electric appliances for their living, which will in turn result in substantial growth of commercial sources of energy.

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 3.3 percent per year, slightly higher compared with annual growth in the previous two decades of 2.3 percent. The industry sector will maintain the largest share at 56 percent, followed by residential (20 percent), transport (16 percent) and commercial (8 percent).

Figure 26 Final Energy Demand



Source: APERC Analysis (2006)

Industry

China's industrial energy demand is projected to grow at an average annual rate of 3.9 percent until 2030, faster than its average annual growth of 2.6 percent over the past two decades. More than two-thirds of the energy required in the industrial sector will be used by heavy industry such as chemicals, metals, non-metallic minerals, mining and quarrying. China's output of intermediate industrial products such as steel, cement and fertilizer is projected to grow at an average annual rate of more than 6.0 percent. Over the outlook period, energy intensity in the industrial sector is expected to decline at an average annual rate of 2.5 percent, reaching 77 toe per US$ million in 2030 from 158 toe per US$ million in 2002.[33]

Coal has been the major source of energy in China's industrial sector, although other fuels such as oil and electricity have nibbled at its share.[34] Over the outlook period, coal's share of total industrial energy demand is expected to decline, and will reach 32 percent by 2030 from 48 percent in 2002. Coal is mainly used in the production of crude steel, cement, and chemicals.

By contrast, petroleum products are projected to grow robustly at 4.0 percent per year, accounting for 21 percent of the total industrial energy demand in 2030. Demand for naphtha as a feedstock for ethylene is projected to lead the growth in industrial oil demand. Capacity additions of ethylene plants are under way, and production is expected to increase from the current 5.4 million tonnes to 12.8 million tonnes by 2010, then to 38.8 million tonnes in 2030.[35] Diesel demand for mining and quarrying, construction, agriculture and the fishing industry is also projected to contribute to the growth in industrial oil demand.

Natural gas is projected to grow at 5.1 percent per year, compared with 3.5 percent in the previous two decades. Despite its relatively fast growth, the share of natural gas to total industrial energy demand will reach only 5 percent in 2030. Currently, industrial gas use is limited to fertiliser production, which is heavily subsidised.[36] In view of the future reform of natural gas pricing - removing subsidies for industrial users - industrial natural gas penetration is expected to only be modest.

[33] Since 1980, China's energy intensity for industrial sector has been improved remarkably at an average annual rate of 6.1 percent, the highest pace in the APEC region.

[34] The share of coal in the industrial sector stood at 70 percent in 1980, 67 percent in 1990, and 48 percent in 2002.

[35] Industrial naphtha consumption will increase at an annual rate of 5.6 percent until 2030. Despite the expansion of ethylene production capacity, domestic production will not meet China's total demand.

[36] In Sichuan the well-head price of natural gas for fertiliser use is 0.59 Chinese Yuan per m^3, while natural gas price is 0.73 Yuan for industrial use, 0.77 Yuan for residential use, and 1.01 Yuan for commercial use.

Over the outlook period, electricity is projected to represent the fastest growth, at an annual rate of 5.8 percent. Its demand will surpass that of coal as the leading fuel, accounting for 35 percent of industrial energy demand in 2030. Manufacturing would account for the largest proportion of growth for electricity demand in the industry sector.

Transport

China's transportation energy demand is projected to grow at 4.9 percent annually (2002-2030), the second fastest rate in the APEC region, after Viet Nam. Despite the rapid growth, per capita transportation energy demand will remain small at around 0.2 toe per person in 2030, compared with the APEC average of 0.67 toe per person in the same period.

Throughout the outlook period, road transport is projected to maintain the largest share in total transportation energy demand. It will grow from 62 percent in 2002 to 70 percent in 2030. By fuel type, gasoline, a main fuel for passenger vehicles, will account for a three-fold increase, while diesel for trucks and farm vehicles, is expected to grow five-fold. Continued income growth will increase passenger vehicle ownership. Following the commitment to the WTO, China has been gradually lowering the tariffs on imported cars and parts, and will completely remove them in 2007, thereby making cars more affordable to the general public. To cope with the rising demand for freight traffic and ease congestion, China plans to invest US$ 240 billion over the next 30 years to extend highway road networks. As a result, it is projected that 3.6 million passenger vehicles will be added every year, leading to a four-fold increase in road transportation energy demand.

The air transport sub-sector is expected to grow the fastest among all the transportation sub-sectors, increasing at an annual growth rate of 6.9 percent over the outlook period. The air transport sub-sector energy demand is projected to surpass that of rail sometime in 2020 and attain the second largest position in total transport energy demand. China's increasing integration to the global economy and rapid growth of personal income will expand the need for international travel, as well as long-distance travel within the economy. In view of the 2008 Olympic Games in Beijing and the expected rise in passenger and freight traffic, Beijing has been developing a new airport which can accommodate 60 million passengers per year by 2015 – more than doubling the capacity from that of 27.5 million in 2002.

Rail transport sub-sector constitutes an important component of freight transport since China depends on rail for transporting coal, mineral products and oil. In 2002, coal accounted for the largest share of rail freight volume, at about 45 percent. Over the outlook period, however, China is expected to reduce reliance on rail for coal transportation; as the economy plans to locate power plants close to coal mines, and deliver electricity through transmission lines to the end user. Likewise, pipeline will replace rail as a means for transporting oil and oil products. With the replacement of rail by other modes of transport, energy demand for rail will grow moderately at 1.7 percent per year up to 2030.

Similar to the rail transport sub-sector, which serves as a means to transport coal, oil and minerals, energy demand for the marine transport sub-sector, excluding international maritime, is projected to grow by 3.8 percent per year (2002-2015) and 3.1 percent per year (2015-2030). The projected decline in growth of marine transport energy demand is mainly due to a shift of modes of transporting coal and oil into other means of transport such as wire, pipeline and trucks during the second half of the outlook period.

Residential and Commercial

Over the outlook period, energy demand in the residential sector is projected to increase at an annual rate of 1.0 percent – a slower pace compared with 1.5 percent annual growth rate over the previous three decades. Along with income growth and infrastructure development, commercial energy sources will replace biomass, which accounted for 71 percent of the residential demand in 2002. Natural gas is expected to grow at the fastest annual growth rate of 7.8 percent. Electricity demand is projected to grow at an annual rate of 6.0 percent, raising the share of electricity in total residential energy demand from 6 percent in 2002 to 22 percent in 2030. Demand for oil products in the residential sector is projected to grow at an annual rate of 5.5 percent.

Energy demand in the commercial sector is projected to grow by 6.4 percent per year. Natural gas demand is expected to grow at the fastest rate of 16.9 percent per year as it continues to replace coal, and oil products for environmental reasons. Demand for electricity, the main fuel for commercial sector, is expected to increase at 9.9 percent per year with the increase in demand for cooling and lighting in commercial buildings.[37] Heat demand is projected to

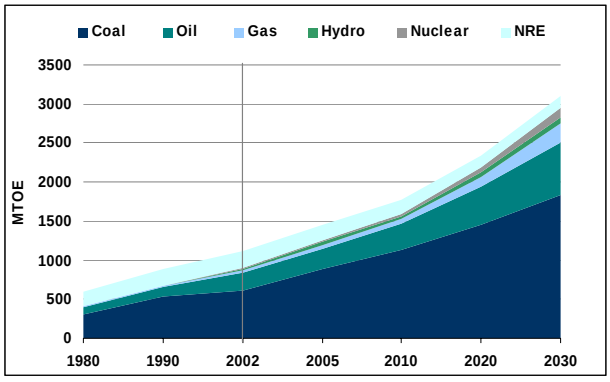
[37] Energy Research Institute under National Development and Reform Commission of China projects that the total floor space of commercial building will reach 26.8 billion km² by 2020 from 8.7 billion km² in 2000.

grow at the fast rate of 8.3 percent per year, while its share in total commercial energy demand will remain at 3 percent in 2030.

PRIMARY ENERGY DEMAND

China's total primary energy demand (TPED) is projected to grow at an annual rate of 3.7 percent – at a faster pace than the previous two decades of 2.9 percent per year. Among the fossil fuels, natural gas is projected to grow at the fastest annual growth rate of 7.4 percent followed by oil at 4.1 percent and coal at 4.0 percent over the outlook period.

Figure 27 Primary Energy Demand



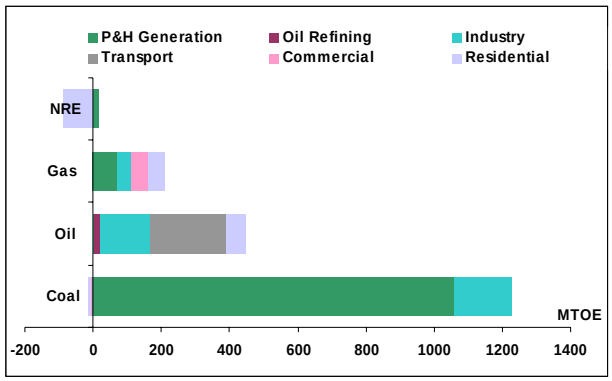
Source: APERC Analysis (2006)

Coal demand will be largely driven by the electricity sector, accounting for more than 85 percent of the total incremental growth. To meet the rising electricity demand, China is expected to continue relying on coal - the most cost competitive option among all fuel types. As a result, installed capacity of coal-fired generation is expected to more than triple from 244GW in 2002 to 769GW in 2030.

The transportation and industry sectors will boost demand for oil by 50 percent and 33 percent of the total oil demand growth respectively. With the rising demand and decline in domestic production, China's net oil import dependency is projected to increase from 22 percent in 2002 to 70 percent in 2030. Recognising its vulnerability to outside shocks, China has been trying to secure oil supply by intensifying its upstream investment activities in Kazakhstan, Venezuela, Sudan, Iraq, Iran and Peru. China is not only making investment in overseas upstream projects. In addition, the first cross border oil pipeline project between China and Kazakhstan started operation in December 2005. To establish long-term relationships for securing oil supply, the Chinese government is extending its political ties with such neighbour economies as Indonesia and Russia.

The Chinese government has set a target to increase the share of natural gas in TPED from the current 2 percent to 10-15 percent in 2020. Although the target represents less than half of the current natural gas proportion in Europe and the US, there are some impediments to achieving this target. The negotiation with LNG suppliers has not brought positive outcomes since the time of Guandong and Fujian projects. Amid rising LNG prices, the gap between the proposed sales price and purchase price have not narrowed. In terms of domestic supply, the West-East gas pipeline project started commercial operation in 2004; however, end users' switch from LPG to gas has been relatively slow due to the high initial access fee. Thus the share of natural gas in TPED is expected to only reach 6 percent in 2020, and 8 percent in 2030.

Figure 28 Sectoral Contributions to the Incremental Growth by Source



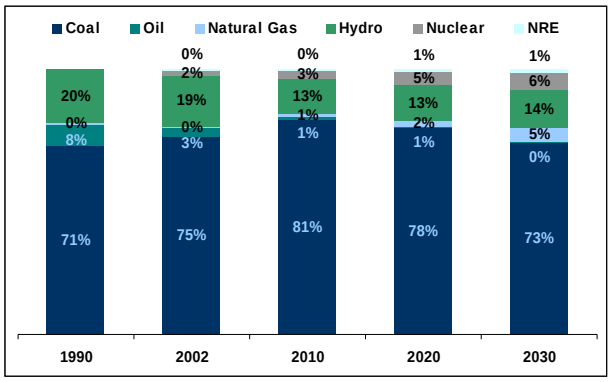
Source: APERC Analysis (2006)

ELECTRICITY

Electricity demand in China will increase by 6.3 percent per year over the outlook period, more than quintupling from the 2002 level. With this fast growth, China's total electricity demand will surpass that of the US sometime around 2025. Despite the substantial growth, per capita electricity demand will reach 5,000 kWh in 2030 – less than two-thirds of the APEC average.

Throughout the outlook period, coal will maintain the dominant share in the generation mix at around 73 percent. China plans to shutdown small-scale coal-fired generation plants near urban areas, and build relatively large-scale coal-fired generation plant, with the unit size 600 MW, near the coal mines. Natural gas-fired generation will account for about 5 percent of the total generation mix. In coastal areas, gas-fired generation will replace coal-fired generation to improve air quality.

Figure 29 Electricity Generation Mix



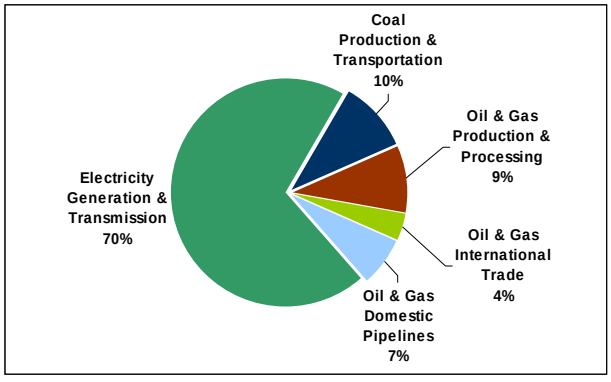
Source: APERC Analysis (2006)

With respect to nuclear, installed capacity will increase substantially from the current 8GW to 30GW in 2020, and further increase to 58GW in 2030. Despite the substantial increase in installed capacity, the share of nuclear in the generation mix will only be about 5 percent in 2030. Hydro will see the major expansion in the near term with the opening of Three Gorges Dam project in 2009. By 2030, hydro capacity is expected to expand to 297GW from 86GW in 2002.

INVESTMENT REQUIREMENTS

China's high energy demand growth will require new investments of between US$1.9-2.3 trillion by 2030. A large part, or 70 percent, will come from the construction of additional electricity generation and transmission facilities during the outlook period.

Figure 30 Investment Requirements

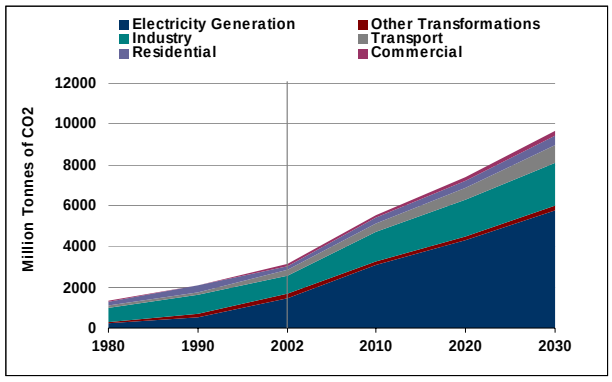


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Over the outlook period China's total CO_2 emissions from the energy sector is projected to increase from 3,128 million tonnes of CO_2 in 2002 to 9,648 million tonnes of CO_2 by 2030, more than half of which (59 percent) will come from the electricity sector at about 5,764 million tonnes of CO_2 by 2030.

Figure 31 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

QUEST FOR OVERSEAS OIL AND GAS

China is richly endowed with energy resources like coal, oil, and hydro. However, the development of these energy sources is not sufficient to meet the economy's growing demand. As such, net import dependency of oil is projected to increase from 22 percent in 2002 to 70 percent in 2030. The increasing energy imports, combined with depleting domestic resources, have raised concerns over energy supply security.

To ease the tightness between demand and supply of oil, Chinese oil companies are actively investing in overseas exploration and development (E&D) projects. Chinese oil firms' involvement in overseas oil and gas E&D projects has reached US$7 billion in 2004 through 65 E&D projects in 30 economies worldwide. In 2004 alone, China sourced 17.5 million tonnes of crude oil from overseas exploration and development projects, accounting for 21 percent of its total imported crude oil.

There are two distinguishing features regarding overseas investment activities by Chinese oil companies. First, they tend to bid aggressively against their rivals and at times they commit high capital investments relative to the size of reserves. Such examples were found in some projects in Venezuela, and Kazakhstan. Second, Chinese oil companies invest in hard-to-reach economies. For example, they invest in oil projects in Sudan and Iran, where oil and gas resources are not fully explored by foreign oil companies.

ELECTRICITY SUPPLY INFRASTRUCTURE DEVELOPMENT AND REGULATORY REFORM

Driven by the fast economic development, China's electricity demand is projected to experience an almost five-fold increase from 1,416 TWh in 2002

to 7,162 TWh in 2030, and surpass that of the US sometime around 2025 to become the biggest electricity consumer in the APEC region. To meet the growth in electricity demand, China's electricity sector needs to invest up to about US$1.4-1.6 trillion in electricity generation and transmission facilities, representing the largest electricity sector investment requirements in the APEC region.

A series of measures have been undertaken to enhance electricity supply security and to improve operational efficiency of the electricity industry. Restructuring of the electricity industry has been carried out since 2002 in an attempt to optimise the electricity supply system, to enhance electricity supply security, and to lower electricity price. The government divested the generation and transmission assets of the former State Power Corporation into five generation and two transmission companies. Wholesale market deregulation is also planned for lowering electricity tariffs.

The benefits of electricity industry reform would only be realised after the infrastructure is built. However, the current reform process does not offer incentives, attractive enough to investors, especially to those generators with advanced technologies. Results from a recent trial run on wholesale electricity market exchange in some Chinese provinces showed a wide gap between the bidding prices of generators with old technologies and those with new technologies. Unlike the previous practice, new electricity prices would not guarantee the adequate rate of return for generators, thereby limiting the scope for introduction of generators using new technologies. Efforts are needed to create a regulatory framework that is attractive for investors, through benchmarking price with efficiency level of electricity generation plant.

ENERGY EFFICIENCY IMPROVEMENT

As a result of the recent rise in energy consumption, China's energy intensity (energy consumption required to produce a unit of GDP), has deteriorated. Energy intensity in 2005 was about 10 percent higher than that of 2000. In the future, China's energy intensity is projected to improve, from 204 toe per US$ million in 2002 to 100 toe per US$ million in 2030.

Faced with dwindling energy production, and deteriorating environmental conditions, China recognises the importance of efficient use of energy in all sectors. In the 11th five-year plan (2006-2010) China sets a target to improve energy intensity by 20 percent in 2010 compared to that of 2005.

The 11th five-year plan identifies several areas for improving energy efficiency. This includes energy production and processes in electricity, petrochemical iron and steel and coal mines.

Energy intensity of heavy industries in China is significantly higher than the level of developed economies, as their production facilities are small in scale, fragmented, and unproductive. China plans to shutdown antiquated plants and upgrade others to improve operational efficiency of production facilities. For example, China plans to shutdown its 28,000 coal mines, and restructure them into 13 clusters, each of which will have production capacities between 50 million to 100 million tonnes per year. By 2010, China plans to shutdown 64 small-sized power plants with total capacity of 5.35GW.

However, improving performance would require layoffs, which are often impossible without local government support. Sougang Steel – one of the steel companies - employs more than 100,000 people to produce seven million tonnes of steel, while international standards would require only 10,000 to 20,000 to produce the same amount of steel. In other words, the attempt to close small scale operations would face strong opposition from local government as they are the key contributors to local economic growth as well as the last resort to generate employment.

IMPLICATIONS

Rapid growth in China's economy will translate into substantial growth in energy demand. Over the outlook period, China should account for about 42 percent of overall energy demand growth in the APEC region, which by fuel represents 67 percent of coal demand growth, more than 30 percent of oil demand growth, and about 24 percent of natural gas demand growth. With the substantial demand growth, net import of oil is expected to reach 70 percent in 2030 from 22 percent in 2002.

As energy demand is expected to grow far beyond domestic output, China placed energy security as a primary energy policy goal, and identified energy efficiency improvement as an important means for the enhancement of energy security. However, achieving the goal will be a difficult process due to the distinct features of China's energy sector, notably the relationships between central, provincial and local governments. The realignment of different goals among different levels of governments would be needed to attain security of energy supply, and to improve environmental conditions.

Cross-border energy projects will provide an option to enhance energy supply security. China and Russia reached an agreement to develop a natural gas pipeline. For the realisation of these cross-border energy projects, China would need to cooperate with neighbouring economies to establish a framework that can facilitate legislative arrangements, and technical coordination.

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HONG KONG, CHINA

- *Hong Kong, China's primary energy demand is projected to grow annually at 3.0 percent over the outlook period, mostly from oil to support the strong demand for international air transport.*
- *Further improvement in living standards and increased requirements for road and air transport will boost the growth of energy demand.*
- *High dependence on road transport is fast becoming a serious concern from the point of view of air pollution and traffic congestion.*
- *Natural gas demand for electricity generation is expected to increase three-fold by 2030 to become the major fuel.*

RECENT ENERGY TRENDS AND ENERGY POLICY

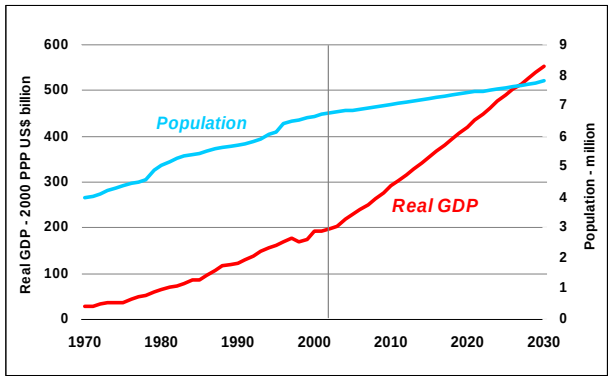
Hong Kong, China's primary energy consumption has grown at 0.7 percent per year (2001-2003), while that of GDP grew at 2.0 percent per year. The decoupling of energy consumption growth from GDP growth is due to Hong Kong, China's economic structure which is dominated by the service industry.

The absence of domestic energy sources has made Hong Kong, China a net importer for oil (mainly from Singapore) and natural gas (from China). Privately owned electric and gas utilities supply energy for the economy's daily requirements. Government has kept a free market economic policy and only intervenes when necessary to safeguard the interests of consumers, ensure public safety, and protect the environment. To this end, the government has encouraged the utilities to increase energy efficiency and has promoted the use of clean fuel for electricity generation. Hong Kong, China has also restricted future construction/development of additional coal-fired power plants to improve air quality and reduce CO_2 emissions. In future licensing agreements, the government will set conditions on power companies to install effective emission reduction facilities to achieve the government's emission reduction targets. The government has also introduced fuel quality and emission standards on vehicles to reduce roadside pollution.

ENERGY DEMAND DRIVERS

Hong Kong, China's economy has been constantly driven by its vibrant financial services sector. GDP is expected to grow annually by 3.8 percent over the outlook period, slower than the average annual growth rate over the past two decades. Besides the traditional financial, logistics, property, tourism and producer services, growth is supported by more knowledge-based and services industries such as fitness and beauty, theme park, business consulting, and the environmental industry. By 2030, the share of GDP in the services sector is expected to reach more than 95 percent. Population is expected to grow slowly at 0.5 percent annually over the outlook period, reaching 7.8 million in 2030.

Figure 32 GDP and Population



Source: Global Insights (2005)

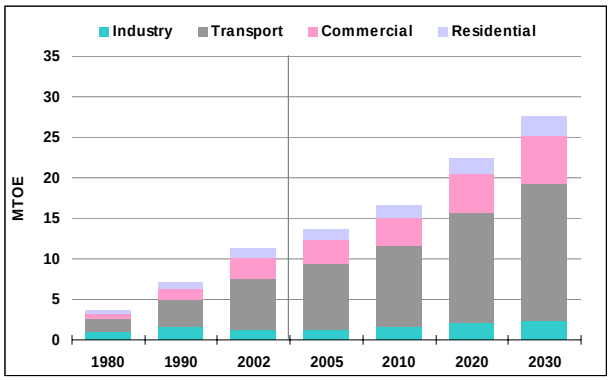
Due to limited land availability and intensive housing and building developments by government and private developers, the level of urbanisation reached 100 percent in 1995, making Hong Kong, China one of the most highly urbanised economies in the APEC region.

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 3.2 percent per year, slower than the 5.3 percent annual growth rate in the past two decades. In 2030, the transport sector will maintain the largest share at 61 percent, followed by commercial (21 percent), residential (9 percent), and industry (9 percent).

Figure 33 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 2.1 percent until 2030, faster than its average annual growth of 1.0 percent over the past two decades. After peaking in 1999, Hong Kong, China's industrial energy consumption has plummeted at an annual rate of 16.8 percent, due mainly to the decline in industrial production. Energy demand however is projected to recover and grow slowly over the outlook period, reflecting the expected increase in industrial production [38] and higher emphasis on exports to Mainland China. But demand would not surpass the 1999 peak until after 2025. Petroleum products are the dominant fuel used in industrial production processes, and subsequently demand is projected to grow at 2.4 percent per year. Diesel will account for almost all of the industrial oil demand.

Transport

Transport energy demand is projected to more than double from 6.2 Mtoe in 2002 to 16.8 Mtoe in 2030. Much of the growth will come from the demand for jet kerosene for international air transport, accounting for more than 80 percent of the incremental transportation energy demand over the outlook period. The rest of the projected incremental transportation energy demand will come from the road transport sub-sector. Due to the rise in fuel requirements for international air transport, per capita transport energy demand will increase substantially from 0.92 toe in 2002 to 2.2 toe in 2030.

Hong Kong, China's international airport has been ranked the biggest in Asia in terms of passenger handling capacity since 2003. It serves as a regional aviation hub, as well as the gateway to the Pearl River Delta of Mainland China. Over the outlook period, Mainland China's greater integration into the global economy is expected to further spur the growth of passenger air travel between Hong Kong, China and Mainland China. Globalisation of economic activities has increased the freight volume of air transport, and the trend is expected to continue, with Hong Kong, China's international airport serving as a logistical hub for international freight. As a result of these factors, the demand for jet kerosene is projected to increase at an annual rate of 4.6 percent over the outlook period.

Diesel demand for freight trucks is projected to grow at an annual rate of about 1.5 percent. Freight trucks will continue to serve as an important means of transporting manufactured products from the Pearl River Delta of Mainland China to the port of Hong Kong, China, with diesel consumption taking more than 80 percent of the energy demand for road transport.

The further rise in income and sprawling suburbs will increase vehicle ownership from 59 vehicles per 1,000 population in 2002 to 102 vehicles per 1,000 population in 2030, resulting in the two-fold increase in gasoline demand. Despite the substantial growth, per capita gasoline demand in Hong Kong, China will remain low at 0.11 toe in 2030 – about one-third of APEC average in 2030. [39]

Residential and Commercial

Energy demand in the residential sector is primarily driven by the requirements for space cooling, water heating and cooking, which accounts for about 70 percent of the total energy demand in this sector. The other major uses of energy are lighting, refrigeration, and operation of appliances and other equipment. Thus, electricity and city gas are the two major fuels for the residential sector. Over the outlook period, residential energy demand is expected to grow at 2.6 percent per year in parallel with income growth [40] and improving living standards. Electricity is projected to maintain the largest share of total residential energy demand, accounting for 68 percent in 2030. With increasing energy demand for space cooling, demand for electricity is expected to grow at 2.4 percent per year, which is much slower than the 7.3 percent annual growth in the past three decades. City gas, which consists of LPG and town gas, will maintain the second largest share of total residential energy

[38] Value-added of Hong Kong, China's industrial sector is projected to grow at an average annual rate of 2.2 percent between 2002 and 2030.

[39] In 2003, more than 89 percent of the commuters in Hong Kong used public transport. Reliance on public transport for commuting is expected to continue in future.

[40] APERC projects that the income would grow by 3.0 percent annually.

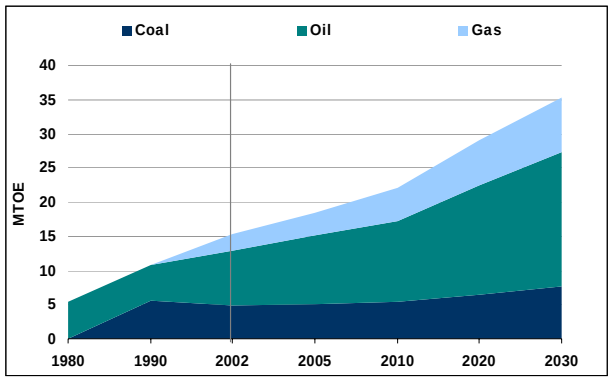
demand.[41] As city gas replaces kerosene for cooking in households, new residential projects, and the development of gas pipeline distribution networks[42], gas demand is expected to grow further at 3.3 percent per year over the outlook period.

Economic growth is the main driver influencing energy demand in the commercial sector, with space cooling and lighting being the primary uses of electricity.[43] Commercial energy demand is projected to grow at an annual rate of 2.9 percent, with over half of the growth resulting from increased use of electricity. The share of electricity in total commercial energy demand will increase from 78 percent in 2002 to 85 percent in 2030, maintaining the largest share of this sector. With sustained growth in the services industry[44], demand for electricity is projected to grow by 3.2 percent annually. LPG and city gas will account for the remainder of the total commercial energy demand both for cooking and water heating. Between 2002 and 2030, LPG is projected to grow by 2.0 percent per year and city gas by 0.6 percent per year.

PRIMARY ENERGY DEMAND

Total primary energy demand is projected to grow at an annual rate of 3.0 percent over the outlook period. Oil will maintain the highest share in the total primary energy demand, increasing from 51 percent in 2002 to 55 percent in 2030, supported by strong demand growth in the transport sector. Natural gas is expected to increase the fastest at 4.3 percent per year as new electricity generation will be met by natural gas-fired generation. Therefore the share of natural gas will increase from 16 percent in 2002 to 22 percent of total primary energy demand in 2030. In addition from the last quarter of 2006, natural gas will be used as feedstock for city gas production for residential and commercial sectors. Consequently, the share of coal will decrease from 30 percent in 2002 to 21 percent in 2030.

Figure 34 Primary Energy Demand

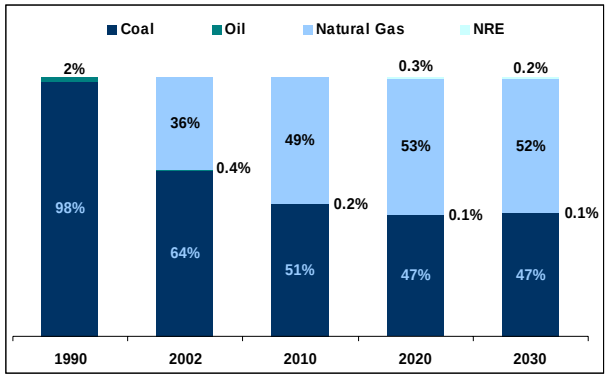


Source: APERC Analysis (2006)

ELECTRICITY

Hong Kong, China's electricity demand is projected to increase from 3.3 Mtoe in 2002 to 7.2 Mtoe in 2030, with an average annual growth rate of 2.8 percent per year over the same period. In 2030, the per capita electricity demand of Hong Kong, China is expected to reach 10,222 kWh, which is relatively low compared with other developed economies in the APEC region, such as 10,940 kWh toe for Japan and 16,188 kWh for the US.

Figure 35 Electricity Generation Mix



Source: APERC Analysis (2006)

Due to the government's decision not to permit the construction of additional coal-fired power plants, new capacity additions over the outlook period will be dominated by natural gas-fired combined-cycle units, consequently increasing the share of natural gas in the electricity generation mix from 36 percent in 2002 to 52 percent in 2030. Coal on the other hand, will decrease from 64 percent to 47 percent over the same period. Due to strong public opposition in relation to nuclear and limited land availability, nuclear power plants are not expected to be constructed over the outlook period. Hong Kong, China will however continue to import electricity from the Guangdong Daya Bay Nuclear

[41] Natural gas will take 32 percent of the total residential energy consumption in 2030.

[42] The government has encouraged the installation of piped gas supply in new buildings to discourage further growth in the use of LPG cylinders in domestic dwellings.

[43] Among energy consumption in commercial sector, the percentage of energy consumption in space conditioning was 20 percent, while that of lighting was 16 percent in 2002.

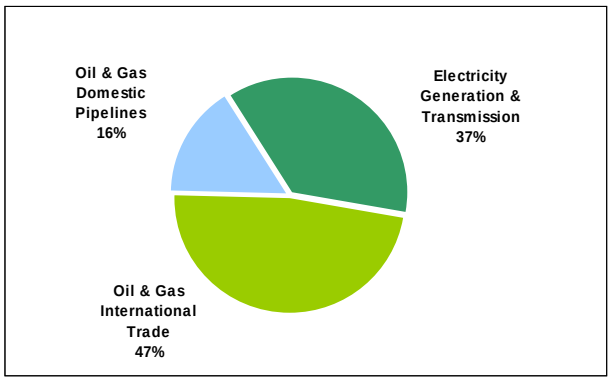
[44] APERC projects that value added in services industry would grow at 4.0 percent per year throughout the outlook period while increase its share in the total GDP from 90 percent in 2002 to 95 percent in 2030.

Power Station, which will continue to supply 9,800 TWh of electricity to the economy in 2030. [45]

INVESTMENT REQUIREMENTS

The total energy investment requirements necessary to finance the infrastructure needed to meet Hong Kong, China's modest energy growth will reach between US$11.8-16.5 billion by 2030. The majority of investment, at about US$5.0-7.8 billion is earmarked for the expansion of the economy's oil and gas international trade facilities which include a natural gas pipeline connection between Hong Kong, China and the LNG receiving terminal in Guangdong, Mainland China.[46] Additional electricity generation units, upgrading transmission and distribution systems, and grid interconnection to Mainland China would likewise require about US$4.9-6.0 billion in new investment. Other investments to improve energy efficiency, abatement of air pollutants, and development of alternative fuels for transport programs will be pursued both through government and private funding.

Figure 36 Investment Requirements



Source: APERC Analysis (2006)

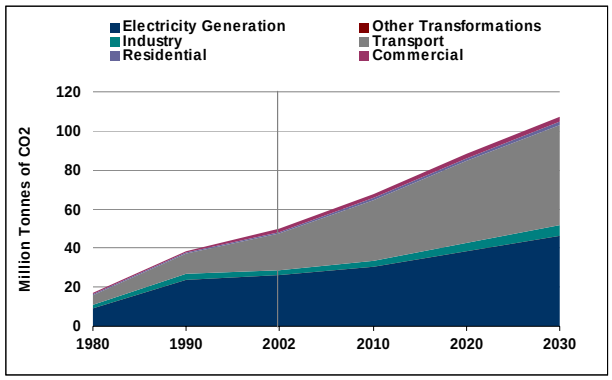
CO_2 EMISSIONS

CO_2 emissions from the energy sector are expected to increase by 2.8 percent annually through to 2030. Transport will remain the largest contributor to total emissions with the share projected to increase to 48 percent in 2030 from 38 percent in 2002, mainly from increased energy demand in the international air transport sub-sector. The share of CO_2 emissions from electricity generation is projected to decrease by 8.0 percent over the outlook period as less carbon intensive natural gas is utilised for new power plants.

[45] Once power supply agreement with Daya Bay expires in 2013, Hong Kong, China will have to continue sourcing electricity supply from Mainland China.

[46] Installation of submarine gas pipelines from Guangdong LNG receiving terminal to Hong Kong, China was completed in 2005.

Figure 37 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

FUTURE FUEL FOR ELECTRICITY GENERATION

The government is expected to impose more stringent environmental regulations on electricity companies, which will eventually change the electricity generation mix. In anticipation of these new environmental regulations, electricity companies have started to introduce less carbon-intensive natural gas-fired generation since as early as 1996. Hong Kong Electric Company Limited (HEC) has signed a long-term gas supply contract with the China National Offshore Oil Corp. (CNOOC) for the supply of natural gas from the Guangdong LNG receiving terminal with the first delivery expected at the end of 2006. CLP Group – the other incumbent electricity company – has been importing natural gas from the Yacheng gas field of Mainland China since 1996. As natural gas reserves in the Yacheng gas field are expected to deplete over the next decade, the CLP Group is considering building an LNG receiving terminal in Hong Kong, China to ensure the long-term supply of natural gas.

As an alternative measure to improving air quality, renewable energy for electricity generation has been considered by the two electricity companies. For example, in February 2006, HEC started operation of the first commercial-scale wind turbine on Lamma Island with an installed capacity of 800 kW, however, this only accounts for less than 1 percent of the total electricity generation capacity of HEC. The CLP Group also plans to develop renewable electricity generation capacity by 2012, accounting for approximately 5 percent of the company's existing total electricity generation capacity.

AIR QUALITY IMPROVEMENT

Hong Kong, China is only a small emitter of GHGs, accounting for approximately 0.2 percent of

global emissions. In 2003, the emissions per capita were 5.94 tonnes of CO_2, which was much lower in comparison with other APEC economies (10.85 tonnes of CO_2 for Chinese Taipei and 8.98 for Singapore). At present, 60 percent of total GHG emissions in Hong Kong, China come from electricity generation, and mitigation of these emissions will remain a major challenge for the government. For example, the government has encouraged the power companies to further improve the efficiency of their coal-fired units, reducing carbon intensity. The government has also considered mandating the phase out of inefficient industrial boilers and industrial technologies and equipment. In addition, the government is promoting the use of alternative cooling technologies such as water-cooled air-conditioning systems in commercial buildings, which can save approximately 20 to 30 percent of electricity compared with traditional technologies.

The government has been implementing measures to reduce air pollution from road transport and trans-boundary air pollution. As an example of road transport measures, as of January 2006, Euro IV emission standards have been imposed on newly registered vehicles. In addition, the government has initiated the reduction of emissions from local vehicles by replacing diesel powered taxis and light buses with that of LPG or electric-driven vehicle types.[47] In relation to trans-boundary pollution from industrial and commercial operations in the Pearl River Delta (PRD) region, the government in conjunction with the Guangdong Provincial Government reached an agreement to reduce the trans-boundary air pollutants by 20 to 55 percent in 2010, using 1997 as the base year.

IMPLICATIONS

Electricity tariffs are expected to increase, if CLP Group builds an LNG receiving terminal as a means to secure natural gas supply, because of the high cost nature of the LNG supply chain and the present institutional setup. The electricity market currently lacks incentives to lower electricity tariffs since electricity is supplied by the two independent, vertically integrated power companies each of which has their own distinct territories. Unless the government implements market reform to introduce competition between the two companies, there is little chance that electricity tariffs will decrease.

To combat serious air pollution problem, arising from road transport, the government may need to consider the implementation of comprehensive measures in addition to existing regulations. For example, following the case of Singapore, Hong Kong, China could consider instituting a quota system for car ownership, and electronic road pricing. These measures will reduce road traffic volume and limit the growth of vehicle ownership, and consequently reduce the air pollution from the road transport.

To cope with the trans-boundary air pollution problems, the government could further cooperate with the Guangdong Provincial Government. For example, common motor fuel standards could be implemented as the current motor fuel standards of Hong Kong, China are higher than that of Guangdong Province. Recently, due to the higher fuel price in Hong Kong, China, drivers of freight trucks refill gasoline or diesel oil in Guangdong Province and use the fuel in Hong Kong, China, leading to worsening air quality of Hong Kong, China.

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[47] As of 2004, almost all taxis in Hong Kong, China are LPG vehicle type, and about 2,400 diesel light buses, representing over 80 percent of the newly registered public light buses, have been replaced with LPG vehicle type.

INDONESIA

- *Primary energy demand is projected to grow at an annual rate of 2.7 percent to reach 359 Mtoe in 2030, a two-fold increase over 2002.*
- *Indonesia is currently a net energy exporter. However, Indonesia is at the turning point of becoming a net energy importer and during the outlook period the net energy import ratio will increase from minus 55 percent in 2002 to 0 percent in 2030.*
- *To secure energy supply Indonesia needs to address both demand and supply-side issues. On the demand side improving efficiency and public infrastructure through economics incentives, mandatory standards, and optimal pricing and on the supply side, investment to increase the reserves of natural gas, oil and coal.*

RECENT ENERGY TRENDS AND ENERGY POLICY

With Indonesia's recovery from the Asian financial crisis of 1998, energy consumption has grown rapidly in recent years. Primary energy consumption increased from 137.4 Mtoe in 2000 to 168.9 Mtoe in 2004, growing at 5.2 percent per year compared with 2.9 percent per year between 1995 and 2000. Among the fossil fuels, coal increased at the fastest rate of 12.7 percent per year, due mainly to the increase in consumption for electricity generation between 2000 and 2004. Natural gas grew at the second fastest rate of 8.4 percent per year driven by the growth in the industry sector.

Indonesia is endowed with indigenous energy resources such as natural gas, coal and oil, and is self sufficient in terms of energy supply except oil. Indonesia is the world's largest LNG exporter and the second largest coal exporter after Australia. In 2004, coal accounted for 46 percent of total net exports, followed by natural gas (26 percent), crude oil (20 percent), and oil products (7 percent), thus the economy maintained a net energy export position of 56 percent in 2004, although exports have decreased from 62 percent in the early 1990s.

Indonesia has been a net oil importer since 2002.[48] Oil production decreased from 70.6 Mtoe in 2000 to 54.6 Mtoe in 2004 due to depleting reserves and lack of investment for exploration and development.

Natural gas production has been increasing at a moderate rate of 1.1 percent per year, growing from 71.1 Mtoe in 2000 to 74.2 Mtoe in 2004. In 2004, export of LNG accounted for about 41 percent of the total natural gas production, and export through pipeline to Singapore and Malaysia accounted for about 4.8 percent of total natural gas production. The economy is expected to remain the world's biggest LNG exporter in the next few years; however LNG export capacity is likely to decline in the long-term due to dwindling natural gas reserves and increasing domestic demand. The initial sign of tightening supply of natural gas was observed when the economy announced the deferment of 51 LNG cargoes for export between 2005 and 2007.

Faced with falling oil production, and slowing growth of natural gas production, Indonesia places energy supply security as a priority of the energy policy goal. The "Blue Print Energy Policy 2025" was issued in 2005 to delineate measures through which Indonesia tries to enhance energy supply security. These measures include diversification of energy sources away from oil, rationalisation of energy pricing, and improvement of energy efficiency.

ENERGY DEMAND DRIVERS

Over the outlook period, GDP is projected to grow at 4.6 percent per year, from US$790 billion in 2002 to US$2,795 billion in 2030. The growth in GDP will be largely attributed to the services sector and will account for about 57 percent of the incremental GDP growth.

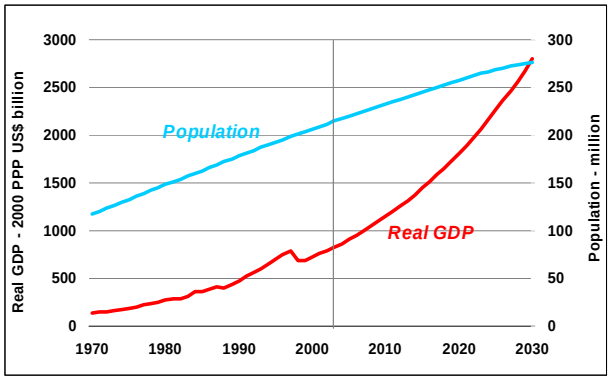
The economy's success in controlling the expansion of population will result in slower growth in population over the outlook period. Population is projected to grow annually at 1.0 percent from 2002 to 2030, slower than the average annual growth rate of 1.6 percent over the last two decades.

Population in Jakarta is expected to exceed 15 million in 2015, making the city one of the world's mega cities. Further urban migration will also increase the population of Surabaya city to more than 5 million. As a result, Indonesia's urbanisation level is projected to increase from a low of 44 percent in 2002 to 68 percent in 2030. Over the outlook period, it is estimated that about 18 cities will have population between 1 and 5 million. Growth of urban population will lead to higher demand for oil in

[48] Department Energy and Mineral Resources (2005a).

transport, and electricity in the residential and commercial sectors.

Figure 38 GDP and Population



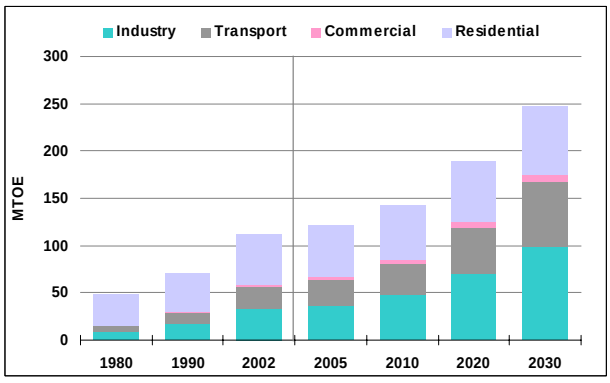
Source: Global Insights (2005)

OUTLOOK

FINAL ENERGY DEMAND

Indonesia's final energy demand is projected to grow at 2.9 percent per year, reaching 247 Mtoe in 2030, more than double that of 2002 at 112 Mtoe. The industry sector will maintain the largest share at 40 percent, followed by residential (29 percent), transport (28 percent), and commercial (3 percent) in 2030.

Figure 39 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 4.0 percent until 2030, lower than the average annual growth of 6.5 percent over the past two decades. The shift in industry structure, from energy-intensive to non-energy-intensive industries[49], will lead to the lower projected growth in energy demand in the sector. Indonesia's primary industries have accounted for 37 percent of the total industrial energy consumption in 2002, while the share is expected to decrease to 19 percent in 2030. By contrast with industry structural change, the share of the machinery and electronics industries in total industry energy demand will increase from 12 percent in 2002 to 19 percent in 2030. In addition to changes in industry structure, higher energy prices as a result of subsidy removal are expected to provide a stimulus for energy efficiency improvements in the long-term. As a result of the aforementioned factors, energy intensity[50] in the industrial sector will decline to be below that of the 2002 level, reaching 128 toe per US$ million in 2030 after initially increasing to 143 toe per US$ million in 2010.

By energy source, natural gas is projected to grow rapidly at 4.2 percent per year reflecting robust demand growth for fertilizers and minerals processing. Natural gas demand will surpass that of oil as the leading fuel, accounting for 34 percent of industrial energy demand in 2030, while the share of oil will decrease from 35 percent in 2002 to 30 percent in 2030. Coal and electricity are also projected to grow robustly at 4.7 percent and 4.4 percent per year respectively. Whereas, renewable energy is projected to grow the slowest at a rate of 3.0 percent per year accounting for 5 percent of total industrial energy demand in 2030. Biomass, which is largely used in cogeneration by the wood, food and palm oil industries, will account for almost all of renewable energy demand.

Transport

Despite the economic slow-down during the Asian financial crisis, transportation energy consumption of Indonesia grew at a robust rate of 6.3 percent per year over the past two decades. Transport energy consumption was mostly driven by the road sub-sector and accounted for about 87 percent of the incremental growth. Gasoline consumption for passenger vehicles and motorcycles

[49] Industrial sector's share to total value of output declined from 60 percent in 1980 to 56 percent in 2003, while that for the service sectors increased from 40 percent to 44 percent. The share of energy-intensive industries within industrial value-added also declined from 66 percent to 46 percent. Over the outlook period, industrial sector's share will decline further to 47 percent in 2030, whereas that for the service sectors will rise to 53 percent, and that the share of energy-intensive industries will decline to 35 percent in 2030.

[50] The amount of energy needed to produce a dollar's worth of industrial sector's value added.

increased two-fold, and diesel for buses and trucks also increased two-fold.

Over the outlook period, transportation energy demand is expected to grow at an annual rate of 3.9 percent. Most of the incremental transportation energy demand growth will come from the road transport sub-sector, accounting for 87 percent of the total transport energy demand by 2030. Continued income growth and development of a vehicle manufacturing industry[51] will result in a substantial increase in the number of passenger vehicles from 3.4 million units in 2002 to 13.9 million units in 2030.[52] GDP growth of 4.6 percent per year will result in an increase in freight transport volumes. As a result of these factors, gasoline demand and diesel demand is projected to increase about three-fold.

The rise in energy demand from road transport is expected to worsen the air quality in major cities.[53] With a view to improving air quality, Indonesia began implementation of the "blue sky programme" in 1996. This programme includes measures to phase out the use of leaded gasoline, and introduce catalytic converters for vehicles. The programme also includes the introduction of LPG vehicles and CNG buses. As a result, over the outlook period, LPG for road transport will increase six-fold and natural gas is projected to increase two-fold. However the combined share of LPG and natural gas in total road transport energy demand would remain small at 1.0 percent.

Because of Indonesia's archipelagic nature, constituting about 17,000 islands, the marine and air sub-sectors will remain important modes of inter-island transport. Over the outlook period, the energy demand of the marine and air transport sub-sectors will increase at an annual rate of 1.0 percent and 5.3 percent respectively, the latter growing faster due to increased passenger and air freight traffic volume.

Residential and Commercial

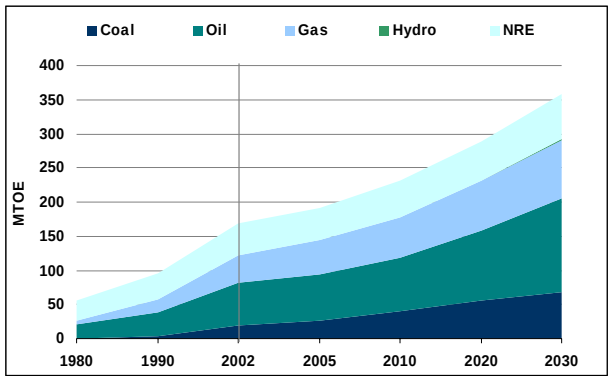
The most significant variables affecting Indonesia's residential energy consumption are growth in income, the number of households and improvement of living standards. Energy demand in the residential sector is expected to grow at 1.1 percent per year, lower than the average annual growth of 2.1 percent over the past two decades. Switching from non-commercial to commercial energy sources explains the projected slow-down of growth in residential energy demand. Despite fuel switching, combustible renewables and waste are projected to maintain the largest share of total residential energy demand at 72 percent in 2030. The share of electricity is projected to increase from 6 percent in 2002 to 13 percent in 2030, growing at an annual rate of 4.3 percent, partly because of the government's effort to increase electrification levels.[54] Kerosene demand will decline at 0.4 percent per year and the share will decrease from 19 percent in 2002 to 12 percent in 2030 as kerosene is replaced by electricity for lighting.

Energy demand in the commercial sector will grow in parallel with the growth in value added for services sector, at 4.0 percent per year through 2030. Electricity will grow at the fastest annual rate of 5.5 percent, and the share in total commercial energy demand will increase from 50 percent in 2002 to 73 percent in 2030. On the other hand, the combined share of kerosene and diesel will decrease from 32 percent in 2002 to 16 percent in 2030.

PRIMARY ENERGY DEMAND

During the outlook period, Indonesia's primary energy demand is expected to more than double from 168 Mtoe in 2002 to 359 Mtoe in 2030. Coal is projected to grow at the fastest rate of 4.7 per year, followed by oil and natural gas at 2.8 percent, hydro at 2.6 percent and renewables at 1.3 percent.

Figure 40 Primary Energy Demand



Source: APERC Analysis (2006)

Coal demand will mainly be driven by electricity generation as Indonesia promotes the construction of

[51] International auto makers are locating their manufacturing and assembly plant base in Indonesia. Companies such as Toyota and Daihatsu have been successful in manufacturing relatively low-priced vehicles such as "Kijang", "Avanza" and "Xenia" of which 80 percent of the parts are produced in Indonesia, and these companies consider Indonesia as one of the manufacturing bases for export to the Southeast Asian economies.

[52] The growth trend for passenger vehicle ownership is slower in the near-term than in longer-term. With the expected removal of subsidies for diesel and gasoline, cost of vehicle ownership – relative to the income level – would be higher in near-term.

[53] In Jakarta, for example, NO_x and particulate levels surpassed that of WHO guidelines by a factor of two.

[54] The electrification of Indonesia will increase from 58 percent in 2004 to 95 percent in 2030.

mine-mouth coal-fired electricity generation plants. As a result, coal demand is expected to increase from 19 Mtoe in 2002 to 68 Mtoe in 2030. A small portion of coal demand is expected to come from the residential sector as the economy promotes the utilisation of coal briquettes in the residential sector for cooking.

Natural gas demand is projected to increase from 40 Mtoe in 2002 to 87 Mtoe in 2030, at an annual growth rate of 2.8 percent. The electricity sector will lead natural gas demand, accounting for 53 percent of the incremental natural gas demand growth. Over the outlook period, natural gas demand will be met by domestic supply – by both pipeline and internal LNG shipments.

Oil demand is projected to increase from 63 Mtoe in 2002 to 136 Mtoe in 2030 as a result of robust transport demand growth, making up 61 percent of the incremental growth. Oil production is expected to decline, at an annual rate of 0.5 percent from 64 Mtoe in 2002 to 55 Mtoe in 2030. Due to demand growth and declining production, the net oil import dependency is projected to reach 60 percent in 2030 from 2 percent net oil export position in 2002.

ELECTRICITY

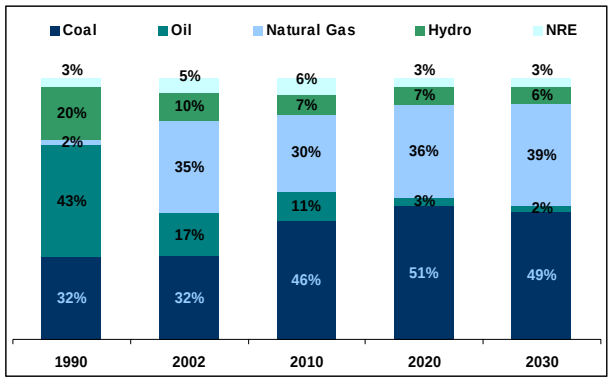
Electricity demand is projected to more than triple, growing annually at 4.6 percent through 2030. By sector, demand in the commercial sector is projected to grow at the fastest rate of 5.5 percent per year, followed by industry at 4.4 percent and residential at 4.3 percent.

In 2004, electrification ratio was low at 58 percent, however, over the outlook period, it is expected that the electrification ratio will increase to 95 percent in 2030. As a result, total installed generation capacity is projected to increase almost four-fold, from 28 GW in 2002 to 108 GW in 2030. Of this total, coal will account for about 54 percent of the new capacity requirements, and natural gas at 40 percent. [55]

In 2030 coal is expected to account for the largest share of the electricity generation mix at 49 percent, followed by natural gas (39 percent), hydro (6 percent), renewables (3 percent) and oil (2 percent).

[55] Over the outlook period, nuclear is not expected to be constructed, however Indonesia considers nuclear as a viable option to ensure electricity supply security.

Figure 41 Electricity Generation Mix



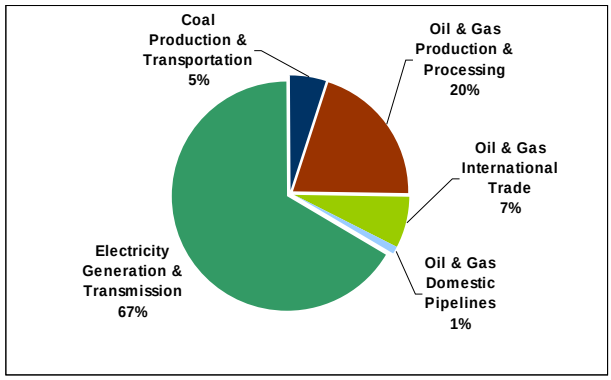
Source: APERC Analysis (2006)

In addition to Indonesia's projected domestic electricity generation, it is envisioned that the economy will import some of its electricity requirements from Sabah, Malaysia through the ASEAN Power Grid Interconnection, initially at 1.5 TWh in 2009 increasing further to 6 TWh by 2014.

INVESTMENT REQUIREMENTS

Indonesia will need a total of between US$219-274 billion in new investment to support the projected growth of energy demand. The majority of this investment will be required in the electricity sector (67 percent), followed by oil and gas production and processing (20 percent), oil and gas international trade (7 percent), coal production and transportation (5 percent) and domestic oil and gas pipeline (1 percent).

Figure 42 Investment Requirements



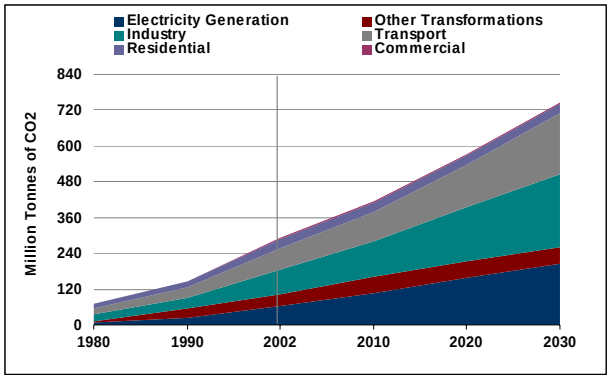
Source: APERC Analysis (2006)

CO_2 EMISSIONS

Total CO_2 emissions from the energy sector are projected to increase from 292 million tonnes of CO_2 in 2002 to 746 million tonnes of CO_2 in 2030. CO_2 emissions for Indonesia are evenly distributed among

the industry, transport and electricity sectors, with each taking about one-third of total CO_2 emissions.

Figure 43 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

ENHANCEMENT OF ENERGY SECURITY

Indonesia is at a turning point from a net oil exporter into a net oil importer. Over the outlook period, oil production is expected to decline at an annual rate of 0.5 percent in parallel with the rising oil demand for transportation sector, resulting in Indonesia's net oil import dependency reaching 60 percent in 2030.

As a means to reduce oil dependency, the government encourages switching from oil to natural gas in the industry sector, and from oil to coal and natural gas in the electricity sector. In addition, the economy promotes the use of bio-fuels in the transportation sector.

On top of the aforementioned fuel switching efforts, the economy has been improving incentives to foster greater opportunities for investment in the development of upstream oil and gas resources. For example in 2003, the government raised the profit share for contractors operating in conventional oil and gas fields. For oil fields, the profit share was raised from 15 percent to 20 or 25 percent, and for gas fields, the profit share was raised from 30 percent to 35 or 40 percent. In addition, Indonesia provides incentives for those contractors that develop marginal fields.[56] As a result of those new incentives, the number of production sharing contracts reached 16 in 2004 compared with only one in 2002.

Aside from the development of domestic resources, Indonesia has pursued oil resource development overseas. For example, Pertamina and Medco Energy have been involved in oil exploration and production activities in Libya, Iraq, the US, Oman and Viet Nam. Although access to oil resources is still limited, the involvement of overseas projects could contribute to future oil supply.

RATIONALISATION OF ENERGY PRICING AND ENERGY EFFICIENCY IMPROVEMENT

Over the last two decades, with the subsidized low price, energy suppliers, including electricity generators, and refineries, could not earn a satisfactory rate of return for energy supply, resulting in the lack of investment to develop infrastructure and to replace obsolete technologies. For example, several regions in Indonesia experienced frequent brownouts or blackouts due to the lack of electricity generation and transmission facilities.

The low domestic energy prices and subsequent lack of incentive for energy efficiency improvement has resulted in Indonesia's high energy intensity in 2002 at 213 toe per US$ million, the highest among the APEC member economies.

The provision of subsidies has created a significant burden on the government budget. In 2004, about IDR 73.6 trillion (US$ 7.9 billion) or 14 percent of government expenditure went to fuel subsidies.

In 2005, Indonesia managed to reduce subsidies for oil products. Indonesia began to set up mechanisms to formulate industrial oil product prices and high grade oil product prices for transportation reflecting price changes in the world oil market. In addition, the economy has formulated new electricity tariff mechanisms to reflect changes in production cost to the end use price. According to Indonesia's Energy Blueprint, the economy plans to remove gasoline and diesel subsidies by 2006 and kerosene by 2007. However, to reduce the impact of energy price increases, Indonesia will continue to provide direct cash subsidies to the poor population.

With tight budgetary condition, the application of market prices in the domestic market is an option for Indonesia to limit government burden of subsidising energy prices. Reflecting increase in the world market energy prices to end-use prices could motivate the efficient use of energy.

IMPLICATIONS

Indonesia is at the turning point of changing from an oil exporter to a net oil importer. Because of the amount of investment needed to secure energy supply, Indonesia would be required to create attractive conditions to promote both domestic and foreign investments by simplifying approval procedures, removing restrictions and establishing

[56] Contractors working in marginal fields are entitled additional 20 percent cost recovery if the rate of return of their investment is lower than 15 percent.

stable and consistent laws and regulation. Indonesia may need to address supply security, exploration of domestic energy resources, promoting investment, and improve energy efficiency through rationalisation of energy prices.

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JAPAN

- *Japan's primary energy demand is expected to grow at an annual rate of 0.5 percent over the outlook period.*
- *The oil dependency of the economy will decrease from 50 percent in 2002 to 42 percent in 2030. Natural gas and nuclear will increase their share to replace oil in the energy mix.*
- *CO_2 emissions in 2010 from energy consumption are projected to be about 10 percent higher than the Kyoto target.*

RECENT ENERGY TRENDS AND ENERGY POLICY

In parallel with Japan's recovery from a decade long recession in the 1990s, energy consumption has increased at 1.4 percent per year between 2001 and 2004, at a slightly faster rate than that of the previous decade of 1.0 percent. In spite of the faster growth, the energy elasticity to GDP was lower at 0.82 in recent years, compared with that of 1.1 over the past decade. The lowering of GDP elasticity is as a result of the introduction of advanced technologies, and improvements in operational efficiency in the energy transformation, transportation and end-use sectors.

Between 2001 and 2004, the trend of energy consumption growth has shown substantial differences by source. Oil declined yearly at 0.4 percent due to the continued fuel switching efforts by the electricity and industry sectors. Natural gas increased by 2.9 percent per year, driven mainly by the industry sector for use in on-site cogeneration systems. Nuclear declined at an annual rate of 4.1 percent due to the suspension of operations for safety inspections in 2003 and 2004.[57] Among the energy sources, coal, the main fuel for electricity generation, has increased at the fastest annual growth rate of 5.7 percent, due partly to the electricity companies' increased coal consumption to make up for the loss from nuclear power generation, and partly to reduce generation costs amid a deregulation of electricity industry.

The increase in energy consumption growth, combined with the rise in the use of coal for electricity generation, has resulted in higher CO_2 emissions over recent years. Between 2001 and 2004, CO_2 emissions from the energy sector have increased annually at 2.0 percent, compared with that of 0.7 percent during the 1990s. Japan has ratified the Kyoto Protocol, and is committed to reduce CO_2 emissions to 6 percent below that of the 1990 emissions level between 2008 and 2012. In 2004, Japan's CO_2 emissions from the energy sector have already surpassed that of its 1990 emissions level by 15 percent.

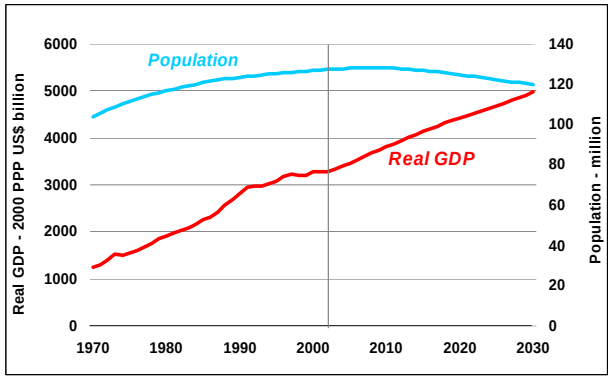
Therefore, meeting the Kyoto target will be a difficult challenge for the economy as a whole. The challenge may be even greater for the electricity industry which is currently undergoing market liberalisation. Rising LNG prices, in parallel with rising crude oil prices in the future will make it difficult for the electricity industry to curb CO_2 emissions as carbon intensive coal has become the preferred option due to its cost competitiveness.

ENERGY DEMAND DRIVERS

Over the outlook period, Japan's economy is expected to grow at an annual rate of 1.5 percent. The near-term growth to 2015 is expected to be fast at 1.8 percent per year, driven by growth in the services sector.

Population is projected to contract by an average rate of 0.2 percent per year (2002-2030), compared with the growth of 0.4 percent between 1980 and 2002. The population started to decline in 2005, and the declining trend is expected to continue towards the end of the outlook period.

Figure 44 GDP and Population



Source: Global Insights (2005)

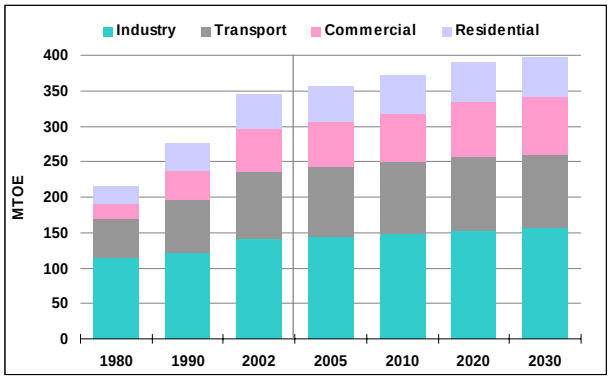
[57] In 2002, Tokyo Electric Power Company (TEPCO) was found to have falsified their safely reports in the later half of 1980s and during 1990. The incident has led to the suspension of operation of about 17 nuclear units for several months starting at the latter half of 2003.

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 0.5 percent per year, compared with annual growth in the previous two decades of 2.2 percent. The commercial sector is expected to grow at the fastest rate of 1.0 per cent per year through 2030, followed by residential at 0.5 percent, industry at 0.4 percent and transport at 0.4 percent.

Figure 45 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 0.4 percent until 2030, lower than the 1.0 percent observed over the past two decades. The shift of industry structure from an energy-intensive to non-energy-intensive structure[58] and the sluggish growth in materials production is expected to lower the projected growth in energy demand in the sector. Japan's business community's strong measures for energy conservation, such as the "Keidanren (Japanese Business Federation) Voluntary Action Plan on Environment" [59] are also expected to contribute to reducing energy demand growth. Consequently, energy intensity [60] in the industrial sector is projected to decline at an average annual rate of 1.1 percent, reaching 102 toe per US$ million in 2030 from 140 toe per US$ million in 2002.

Petroleum products are projected to maintain the largest share of industrial energy demand throughout the outlook period, but with a declining share, from 50 percent in 2002 to 44 percent in 2030. The decline is as a result of the gradual substitution of fuel oil by natural gas and slow growth of naphtha demand. [61] By contrast, natural gas is projected to represent the highest growth rate of 2.1 percent per year, the share increasing from 7 percent in 2002 to 12 percent in 2030. Robust growth in natural gas demand is expected as more industries install modern gas-turbine cogeneration systems (combined heat and electricity) to comply with the CO_2 emissions reduction target. Coal demand is projected to decline by 0.1 percent per year as crude steel production, the main consumer of coking coal, is projected to decline by 0.4 percent over the outlook period. Electricity, the second-largest energy source for the industrial sector, is likely to increase its share from 26 percent in 2002 to 30 percent in 2030 as non-energy-intensive industries such as mechanical and IT industries utilise more electrical equipment. The share of renewable energy is projected to remain fairly constant at 2.0 percent over the outlook period. Biomass, which is largely used in cogeneration, particularly by the paper and pulp industry, will account for almost all of the demand for renewable energy.

Transport

Over the outlook period, energy demand in the transport sector is projected to grow at an annual rate of 0.4 percent per year, compared with the previous two decades at 2.5 percent per year. Near term growth to 2010 is projected to be faster at 1.1 percent, slowing down to 0.2 percent between 2010 and 2020. Due to the decline in population, transport energy demand is expected to reach its peak sometime in 2025 and decline thereafter by an annual rate of 0.1 percent to the end of outlook period.

Energy demand for road transport is projected to increase by an annual rate of 0.2 percent, maintaining the largest share at around 78 percent of the total transport energy demand. Gasoline for passenger vehicles is expected to increase by 0.5 percent per year, compared with that of 2.6 percent in the

[58] Industrial sector's share to total value of output declined from 36 percent in 1980 to 30 percent in 2002, while that for the service sectors increased from 65 percent to 70 percent. Over the outlook period, the share of the industrial sector is projected to decline further to 29 percent in 2030, whereas that for the service sectors will rise to 71 percent, and that the share of energy-intensive-industries within industrial value-added will also decline from 23 percent in 2002 to 22 percent in 2030..

[59] The plan is aimed at reducing CO_2 emissions by industry and transformation sectors below their 1990 levels in 2010 by setting reduction targets in each industry category. The reduction targets in energy consumption through voluntary actions by industries are: iron and steel by 10 percent; chemicals by 10 percent; paper and pulp by 10 percent; and cement by 3 percent.

[60] The amount of energy needed to produce a dollar's worth of industrial sector's value added.

[61] Between 1980 and 2002, production of ethylene increased at an annual rate of 2.5 percent, and Japan is currently posted as the world's second-largest producer of ethylene with a production capacity of about 7.2 million tonnes per year. However, future production of ethylene is projected to increase slowly from the current 7.4 million tonnes to 7.6 million tonnes by 2010, then stay at that level through 2030. This would result in the slow growth for naphtha demand as a feed stock for ethylene production.

previous two decades. The stock of passenger vehicles will reach the highest level of 62 million units in 2013, and then decline at an annual rate of 0.3 percent to the end of the outlook period. Despite declining passenger vehicle stocks, gasoline demand per passenger vehicle is expected to increase slightly by an annual rate of 0.2 percent. Vehicle efficiency improvement will be offset by the increasing share of large-sized vehicles, and reducing share of medium-sized vehicles. Demand of diesel for freight trucks is expected to decline annually at 0.2 percent (2002-2030). Continued improvements in operational efficiency by freight truck owners, combined with slow economic growth towards the end of the outlook period will result in the aforementioned decline in diesel demand.

Residential and Commercial

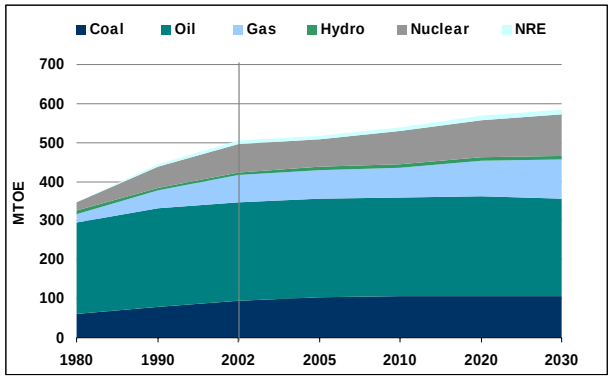
Japan's residential energy demand is expected to grow annually at 0.5 percent, at a slower rate compared with the previous two decades of 3.0 percent per year. Since the energy mix in the residential sector has already been diversified, not much difference is expected from the current situation over the outlook period. Since 1990, electricity has accounted for the largest share in total residential energy demand due to the increase in the household ownership of electric appliances such as air conditioners, refrigerators and televisions. As the total number of households is expected to reach the highest level in 2015 and decline thereafter, electricity demand is projected to grow at 0.6 percent per year, which is a slower rate than the 3.8 percent annual growth rate observed during the past two decades. Among the energy sources, natural gas is expected to grow the fastest at 1.3 percent per year in the total residential energy demand.

Reflecting the slow growth in floor space and implementation of energy efficiency programmes in the commercial sector, energy demand for the commercial sector is expected to grow at an annual rate of 1.0 percent, a significantly slower rate than the previous two decades at 5.0 percent per year. Electricity is projected to grow by 1.5 percent annually, supported by the increase in demand for cooling and lighting in commercial buildings. Natural gas is expected to grow at the fastest rate of 1.8 percent per year, replacing diesel oil as a feedstock for standby generators in commercial buildings.

PRIMARY ENERGY DEMAND

Japan's primary energy demand is projected to grow at an annual rate of 0.5 percent through 2030. New and renewable energy is expected to grow at the fastest rate of 2.1 percent per year. However, the share in total primary energy demand is projected to remain small at around 2.0 percent. Nuclear will be the second fastest growing energy source, at an annual rate of 1.4 percent, followed by natural gas at 1.3 percent, and coal at 0.4 percent. Demand for oil is projected to decline at an annual rate of 0.1 percent through 2030.

Figure 46 Primary Energy Demand

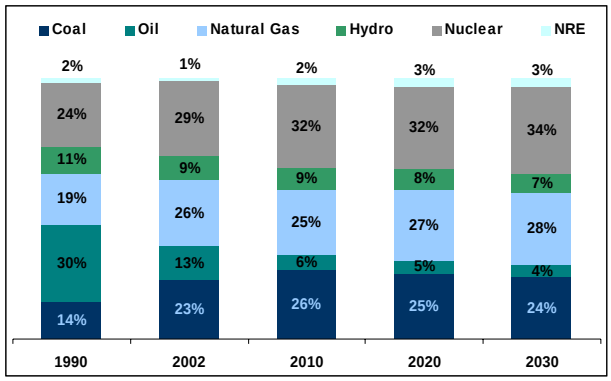


Source: APERC Analysis (2006)

ELECTRICITY

Electricity demand is expected to increase by an annual rate of 0.9 percent over the outlook period. Electricity demand from the commercial sector is expected to show the fastest growth at 1.5 percent per year, followed by industry at 0.9 percent and residential at 0.6 percent.

Figure 47 Electricity Generation Mix



Source: APERC Analysis (2006)

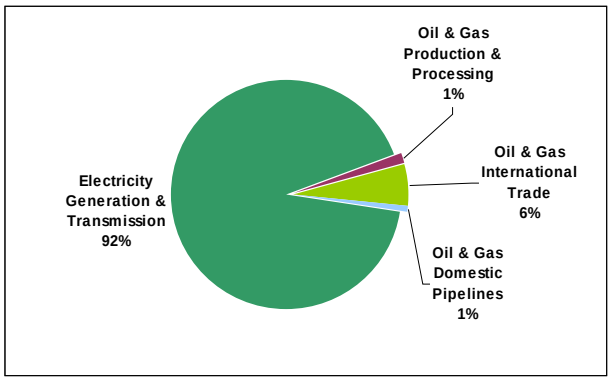
In conjunction with the economy's energy policy goal to reduce energy imports, the share of nuclear in the electricity generation mix is projected to increase from 29 percent in 2002 to 34 percent in 2030 with an estimated addition of 12 GW of installed capacity. The share of coal in 2030 is expected to be around 24 percent, compared with 14 percent in 1990, as electricity companies favour coal over other energy sources due to cost competitiveness. The share of natural gas in the electricity generation mix is expected to increase from 26 percent in 2002 to 28 percent in 2030. Electricity generation from new and

renewable sources is expected to grow the fastest at a rate of 5.2 percent per year, but the share will remain low at around 2 to 3 percent. The share of oil is expected to decline from 13 percent in 2002 to 4 percent in 2030.

INVESTMENT REQUIREMENTS

To meet the projected growth in energy demand, Japan will have to develop energy infrastructure with a total investment of between US$116.5-141.8 billion over the outlook period. The majority of the investment requirements are expected to be allocated to the development of electricity generation and transmission infrastructure, accounting for about 92 percent of total investment requirements in the same period.

Figure 48 Investment Requirements

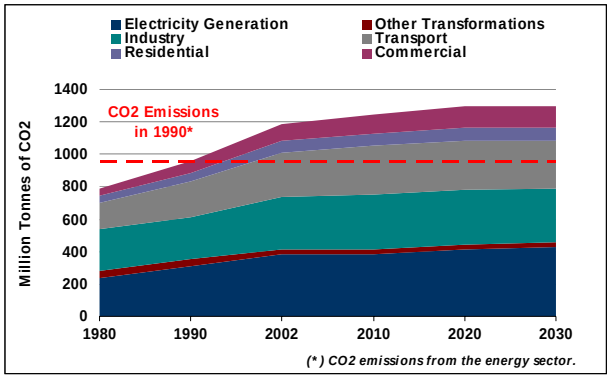


Source: APERC Analysis (2006)

CO_2 EMISSIONS

CO_2 emissions from the energy sector are projected to increase from 1,186 million tonnes of CO_2 in 2002 to 1,294 million tonnes of CO_2 in 2030. The electricity and industry sectors are the biggest contributors, together accounting for 52 percent of total incremental growth in CO_2 emissions between 2002 and 2030.

Figure 49 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

OIL SUPPLY SECURITY

After the two oil shocks in 1973 and 1980, Japan has implemented policy measures to diversify energy sources away from oil, diversify energy import supply sources, and improve energy efficiency to restrain energy demand growth. As a result of these policies, Japan has successfully reduced the share of oil in total primary energy demand from 77 percent in 1973 to 50 percent in 2002. Over the outlook period, the share of oil is projected to decline further to 42 percent by 2030.

Despite oil's declining share in the primary energy mix, dependence on the Middle East is expected to rise as imports from Asia - such as Indonesia and Malaysia - decline. As an option to diversify crude oil supply sources, the government has been negotiating with Russia to import oil from Angarsk. Japan has encouraged local private companies to get involved in upstream oil development projects overseas. To facilitate the establishment of a private internationally competitive upstream exploration and development company, government has undertaken the public listing of INPEX, a formerly government owned company.

DEREGULATION OF THE ENERGY INDUSTRY AND MEETING THE KYOTO TARGET

Japan's energy industry has been undergoing a major transformation since deregulation of the oil industry started in 1985 and the electricity and gas industry in 1995. About 40 percent of the electricity market is open to competition, and about 45 percent of the gas market has been liberalised as of 2006. The oil market has been completely liberalised since 1994. As a result of liberalisations, energy industries are trying to improve their operational efficiency, and find sources that can reduce supply costs.

Coupled with the competitive pressures to reduce costs, the energy industry in Japan is also faced with the difficult challenge of meeting the Kyoto target. The challenge is expected to be greater for the electricity industry as carbon intensive coal has become the fuel of choice in the near-term, due to its cost competitiveness against LNG. Over the outlook period, CO_2 emissions from electricity generation alone are likely to increase by about 30 percent by 2010, compared with that of the 1990 level.

IMPLICATIONS

Japan seeks to simultaneously achieve the energy policy goals of: 1) enhancement of energy security, 2) improvement of economic efficiency of energy

supply and 3) protection of environment. It is a challenging task for Japan's energy industry as these policy goals often contradict each other.

Japan's energy industry may have to find the most cost effective options to diversify energy sources away from the Middle East and to improve the economic efficiency of energy supply. However, the discussion with Russia on the oil supply from Angarsk through pipeline seems primarily driven by the goal to enhance energy supply security rather than the improvement of economic efficiency. Policy makers would have to continue making efforts to place all the options for energy supply sources on the table, and involve stake holders, including energy industries in the neighbouring economies, to harmonise various institutional interests.

In addition, Japan's energy industry is faced with a challenge to meet the Kyoto target. As the marginal cost of emissions reduction in Japan is rising in parallel with increases in energy prices, the energy industry will have to find other options aside from measures adopted in the domestic market. These would include emissions trading, and overseas GHG emissions reduction projects such as Joint Implementation and Clean Development Mechanism.

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KOREA

- *Korea's primary energy demand is expected to grow annually at 2.0 percent, from 200 Mtoe in 2002 to 352 Mtoe in 2030; driven by the growth in the electricity and industry sectors.*
- *The change in industry structure, and energy efficiency improvements will result in the slower growth rate for energy demand compared with the past two decades.*
- *The economy's initiatives to strengthen inter-regional cooperation through electricity and natural gas supply linkages will help Korea to diversify energy supply sources.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Korea's primary energy consumption grew at an average annual rate of 3.2 percent between 2002 and 2005, much slower than that of the last decade at 6.9 percent per year. The sluggish growth in energy consumption is due mainly to the economy's rather slow GDP growth at around 3.9 percent per year over the same period, dampened further by energy efficiency improvements in the industry and transport sectors.

With very limited indigenous energy resources, Korea relies heavily on imports of oil, natural gas and coal. Net imports have more than doubled from 72 Mtoe in 1990 to 190 Mtoe in 2005. In 2005, Korea was the world's fourth-largest importer of oil and the second-largest importer of both coal and liquefied natural gas (LNG).

As a net energy importer, the recent rise in energy prices has raised government concern on energy security issues. High oil and LNG prices have had an impact on the economy, particularly in the industry sector which is dominated by energy-intensive industries like steel, cement, petrochemical and ship building.

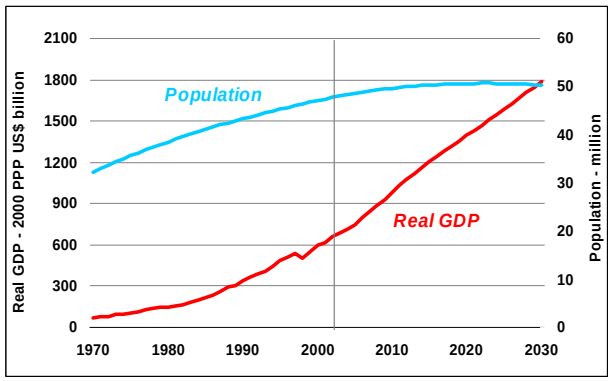
To ultimately reduce the economy's energy import dependency, and to enhance energy supply security, Korea has instituted a number of measures throughout the energy supply chain and end-use sectors. The government supported the expansion of nuclear electricity generation to decrease the dependence on fossil fuels for electricity generation. The industry sector has been required to meet stringent regulations on energy efficiency. Moreover, large-scale energy users, with an annual consumption of more than 0.2 Mtoe, have started developing voluntary agreements on energy savings. In 2005, the government announced that the economy would carry out the Average Fuel Economy (AFE) programme in an effort to improve the deteriorating fuel economy of passenger vehicles. In addition to the enhancement of energy supply security, Korea is aiming to increase energy market efficiency through deregulation, and the establishment of an environmentally friendly energy supply system.

ENERGY DEMAND DRIVERS

Korea's GDP is projected to grow at an annual rate of 3.6 percent over the outlook period – a slower rate than the past two decades at 7.0 percent per year. Non-energy intensive industries such as the Information Technology (IT), electronics, machinery, and service industries, are expected to lead the future economic growth.

Population is projected to contract at 0.2 percent per year over the outlook period, compared with that of 1.0 percent per year during the past two decades. Total population will reach a peak of 50.6 million around 2025, and is expected to decline thereafter.

Figure 50 GDP and Population



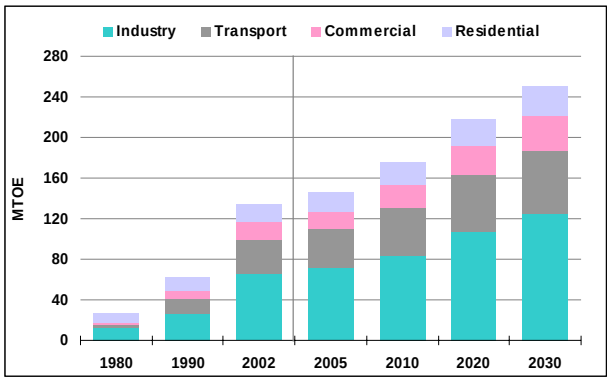
Source: Global Insights (2005)

OUTLOOK

FINAL ENERGY DEMAND

Final energy demand is projected to grow at 2.3 percent per year, much slower compared with the annual growth in the previous two decades of 7.5 percent. Energy demand in the industry sector will maintain the largest share at around 50 percent, followed by transport (25 percent), commercial (14 percent), and residential (11 percent).

Figure 51 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 2.3 percent through 2030, slower than the average growth rate over the past two decades at 7.6 percent per year. The shift from energy-intensive industry to non-energy intensive industry will result in the lower projected growth for industrial energy demand. Over the past two decades, the value added of energy-intensive manufacturing sector has grown more than ten-fold, due to the production capacity expansion in industries such as steel, cement, shipbuilding[62] and petrochemicals. By contrast, future growth of industrial value-added is expected to be led by non-energy-intensive industries such as IT, electronics, machinery and services sector.[63] The impact of the changes in the economy's industrial structure will result in significant improvements in energy intensity, from 273 toe per US$ million in 2002 to 164 toe per US$ million in 2030.

Oil products are projected to maintain the largest share of industrial energy demand through 2030, but the share is expected to decrease from 59 percent in 2002 to 44 percent in 2030. Fuel oil for industrial boilers and naphtha as a feedstock for ethylene production are expected to account for the major share of industrial oil products demand. Increase in natural gas demand for boilers and cogeneration systems are expected to offset the decline in the share of oil products, growing at an annual rate of 5.2 percent. Demand for coal is expected to grow slowly at 2.7 percent per year, compared with 8.5 percent in the previous two decades. The slow growth of crude steel production at an annual rate of 1.5 percent, and increased efforts to improve the energy efficiency of the steel industry[64] will lead to the lower projected growth in coal demand. Electricity, the second-largest energy source for the industrial sector, is projected to grow at 3.2 percent per year, with the share increasing from 20 percent in 2002 to 26 percent in 2030. Heat and renewable energy is also expected to increase rapidly, but the share to total industrial energy demand will reach only 5 percent in 2030. Most of the growth in heat and renewable energy demand is likely to come from combined heat-and-electricity installations at industrial facilities.

Transport

Korea's transport energy consumption is dominated by the road transport sub-sector, representing more than three quarters of the economy's total transport energy consumption in 2002. Over the past two decades, income growth, improvements in living standards, expansion of residential suburbs and development of vehicle manufacturing industries have all contributed to a thirty-fold increase in the stock of vehicles, which have in turn resulted in a ten-fold increase in gasoline and diesel consumption.[65] Managing road transport congestion[66], and air pollution[67] caused by passenger vehicles and freight trucks continues to be a significant challenge for the economy.

Over the outlook period, the road sub-sector is projected to dominate energy demand, accounting for about three quarters of total transport energy demand. Demand for diesel is projected to grow robustly, at an annual rate of 2.4 percent due to the continued popularity of SUVs[68] and increased trade as a result of economic development. By contrast, gasoline demand is projected to grow at a slower rate of 1.7 percent per year through 2030.[69]

[62] Korea is the world's largest shipbuilding economy, accounting for 35 percent of world shipbuilding capacity in 2006.

[63] Over the outlook period, industrial value-added growth of non-energy-intensive industries is expected to grow at 4.4 percent per year, while that for energy-intensive industries is expected to grow at 3.5 percent.

[64] Due to the introduction of advanced technologies, energy use per tonne of crude steel production declined to 0.19 toe per tonne in 2001, while that of the US, Japan, and China was at 0.24 toe, 0.17 toe, and 0.42 toe respectively.

[65] This means that vehicle ownership per 1,000 population increased from 6.5 in 1980 to 204 in 2002.

[66] During the past 10 years, the length of road increased by 1.5 times, while the number of passenger vehicle registrations increased 4 times. The imbalance in growth of road length and vehicle registration has resulted in serious traffic congestion.

[67] Between 1995 and 2000, trucks accounted for 80 percent of total NO_2 emissions in Seoul, which surpassed the WHO air quality guidelines.

[68] Diesel-powered SUVs have become popular because of the lower diesel price compared with gasoline.

[69] The stock of passenger vehicles is projected to increase from 9.7 million in 2002 to 15 million in 2020, growing at an annual rate of 2.4 percent. Thereafter, slower population growth will lead to lower growth in the stock of passenger vehicles, growing at 0.3 percent per year.

The marine sub-sector will maintain the second largest share of total transport energy demand. Marine is projected to remain an important mode of transport for the internal movement of raw materials and finished products.

The air sub-sector is expected to grow at the fastest rate of 3.0 percent. Korea has four international and 175 domestic airports, the largest of which is Incheon airport. Incheon is ranked the 10th largest in the world and the second largest in Asia in terms of passenger handling capacity. With the completion of the second phase of Incheon's capacity expansion in 2007, the airport will serve as an air transport hub in Asia.

Energy demand of the rail sub-sector is expected to increase 1.5 times, while the share of rail in total transport energy demand is projected to decrease from 1.6 percent in 2002 to 1.3 percent in 2030. Rail electricity demand is projected to increase at a rate of 3.7 percent per year as electrification of the rail network proceeds.[70] By contrast, demand for diesel in the rail sub-sector will decline at 1.0 percent per year.

Residential and Commercial

Energy demand in the residential sector is projected to grow at an annual rate of 1.8 percent, compared with that of 5.0 percent per year between 1971 and 2002. Natural gas is projected to maintain the largest share of total residential energy demand increasing from 45 percent in 2002 to 57 percent in 2030 as a result of fuel switching from coal and LPG. In Korea, most households utilise gas for heating, and since 70 percent of households are already connected to the gas supply network, slower growth in natural gas demand is expected over the outlook period compared with the last two decades. Electricity is projected to grow at 2.0 percent per year and account for the second largest share of total residential energy demand at 22 percent in 2030. The growth is lower than the previous two decades due to the slow growth in the number of households, and saturation of electrical appliances.

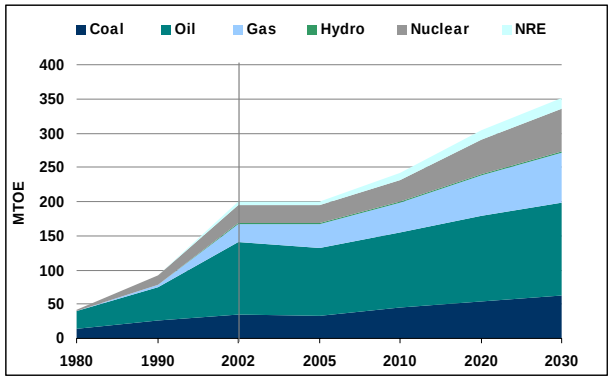
Supported by strong growth in the services sector[71], energy demand in the commercial sector is projected to grow at 2.5 percent per year. Electricity, the main energy source for the commercial sector, is expected to grow at 3.6 percent per year, driven by increasing demand for cooling and lighting in commercial buildings. Demand for gas is expected to grow at the fastest rate of 4.6 percent annually. Gas will continue to replace coal and diesel for boilers in commercial buildings, and the share in total commercial energy demand is expected to increase from 10 percent in 2002 to 17 percent in 2030.

PRIMARY ENERGY DEMAND

Korea's primary energy demand is projected to grow at an annual rate of 2.0 percent through 2030, compared with that of 7.4 percent between 1980 and 2002. The change in industry structure from heavy industry to services, and IT industries, and energy efficiency improvements across the sectors will result in the slower growth rate for energy demand over the outlook period. As a result, GDP to energy elasticity is expected to improve to 0.6 compared with 1.1 over the previous two decades.

Natural gas is projected to grow annually at 3.6 percent, followed by nuclear at 3.2 percent, coal at 2.2 percent, and oil at 0.9 percent. Renewables is projected to grow at an annual rate of 4.2 percent, while the share in total primary energy demand is expected to increase slightly from 3 percent in 2002 to 5 percent in 2030.

Figure 52 Primary Energy Demand



Source: APERC Analysis (2006)

Reducing the economy's oil dependency has been one of the important energy policy goals of Korea. By 2030, the share of oil in total primary energy demand is projected to decrease from 53 percent in 2002 to 39 percent in 2030. Fuel switching by the industry and electricity sectors and slower growth in oil demand for transport, are expected to contribute to reduction in the share of oil in total primary energy demand.

Natural gas demand is projected to increase from 27.4 Mtoe in 2002 to 72.9 Mtoe 2030, due to the fast growth in the industrial sector and expansion of natural gas-fired electricity generation. As a result of this increasing demand, the volume of LNG that is unsecured through long-term contracts is projected to increase, and will account for about 30 percent of demand in 2010, and 70 percent in 2020.

[70] Ministry of Construction and Transport has set a target to electrify 82 percent of total rail system in Korea from 39 percent in 2004.

[71] Value added for the services industry is projected to grow at 3.3 percent per year.

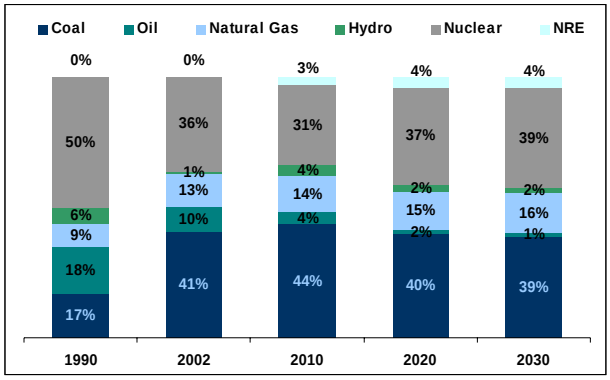
Demand for coal is projected to increase from 34.5 Mtoe in 2002 to 62.8 Mtoe in 2030. The growth is largely attributed to the electricity sector, accounting for 93 percent of the incremental growth between 2002 and 2030.

ELECTRICITY

Electricity demand is projected to grow at 3.2 percent per year over the outlook period. Growth is expected to be faster in the near-term 2002-2015 at an annual growth rate of 4.4 percent.

The electricity generation mix is not expected to change significantly over the outlook period. In 2030, coal and nuclear will maintain the largest combined share of 78 percent, followed by natural gas (16 percent), renewable (4 percent), hydro (2 percent), and oil (1 percent). The share of oil in the electricity generation mix is expected to decline from 10 percent in 2002 to 1 percent in 2030. On the other hand, the share of renewables is projected to increase from near zero in 2002 to 4 percent in 2030.

Figure 53 Electricity Generation Mix

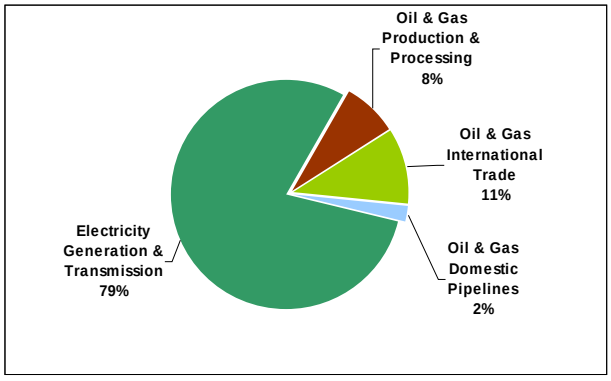


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

Total investment requirement is projected to reach between US$227-276 billion over the outlook period. Of the total investment requirements, 79 percent will be allocated to electricity generation and transmission to cater for Korea's high electricity demand.

Figure 54 Investment Requirements

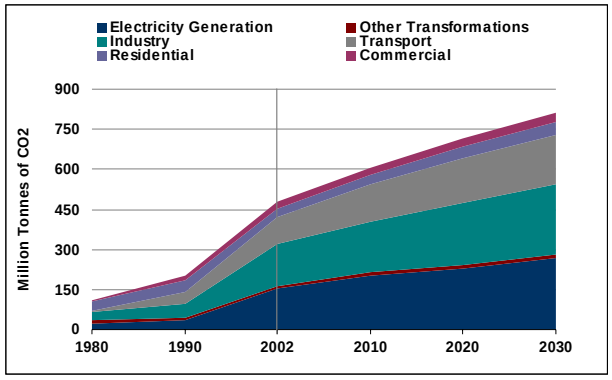


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Despite the increasing share of nuclear, the dominant share of coal in the economy's electricity generation mix over the outlook period is projected to increase CO_2 emissions from 480 million tonnes of CO_2 in 2002 to 881 million tonnes of CO_2 by 2030.

Figure 55 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

GAS AND ELECTRIC POWER GRID INTERCONNECTIONS WITHIN NORTHEAST ASIA

Korea is heavily dependent on Middle East oil and natural gas, at 80 percent and 54 percent respectively in 2003. As such, the economy is highly vulnerable to supply disruptions in the region, not to mention the impacts of rising energy prices. To secure a stable supply of energy to meet increased energy demand over the outlook period, Korea is actively pursuing energy cooperation in Northeast Asia. The northern part of Northeast Asia − Eastern Siberia and the Russian Far East − has been regarded as an energy "treasure house", for which China, Japan and Korea could be good market players. From the perspective of creating a Northeast Asian economic community, possibly including North Korea, the Korean government has added to its to-do list the policy goal of constructing an energy system linked to the Asian Continent.

GHG EMISSIONS REDUCTION

Korea is not included in the Kyoto Protocol, in which a total of 38 economies are required to reduce their emissions of greenhouse gases by 5.2 percent below the 1990 level during the first commitment period. Korea, however, will likely be pressured to join the scheme from 2013 because it is a member of the Organization for Economic Cooperation and Development (OECD) and is the ninth-largest emitter of greenhouse gases in the world. According to an estimate by the Korea Energy Economics Institute (KEEI), if Korea cuts the carbon dioxide

emissions by 5 percent of 1995 level by 2015, it will cost it about 0.78 percent of its gross domestic product. Therefore, it is not easy for Korea to join the mandatory reduction regime, and it is demanding a new kind of reduction method to guarantee more sustainable economic development and to encourage the participation of developing countries.

Various programmes have been listed to cope with rising greenhouse gas emissions. Among these include the government's introduction of emissions trading system in 2006, with efforts to develop a greenhouse gas reduction registry. Other programmes include the nationwide energy saving plan aimed at reducing energy intensity to 8.6 percent below the 2004 level by 2007 and a plan to increase the share of NRE to 5 percent in total primary energy consumption by 2011.

IMPLICATIONS

Primary energy demand in Korea is expected to grow at an annual average rate of 2.0 percent over the outlook period, compared with 7.4 percent per year in the previous two decades. Despite the slow-down in the projected growth rate of energy demand, 77 percent of the energy demand would have to be met by import through 2030, rendering concerns over future energy supply security.

Establishment of trans-boundary energy supply system with the economies in Northeast Asia will serve as an option for Korea to ensure energy supply security and reduce the Middle East dependence on oil and natural gas imports. One of the promising projects is a natural gas pipeline from the Kovykta natural gas deposit of Eastern Siberia through China. Another promising project is the electric power grid interconnections with Russia, China, and North Korea.

To realize these projects, the first step would be for the policy makers of each economy to recognise the potential benefits in the region. In addition, in order to deal with these issues effectively, the region needs to establish a stable international legal framework.

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MALAYSIA

- *Malaysia's primary energy demand is projected to grow at 3.5 percent per year from 56 Mtoe in 2002 to 147 Mtoe in 2030; mainly due to the increase in demand for coal, oil and gas; with coal demand accounting for the highest growth rate at 9.7 percent per year through 2030.*
- *Indigenous oil reserves are projected to be depleted within the outlook period, thus shifting the economy to a net energy importer. Net import dependency will reach 32 percent in 2030 from a net export position of 57 percent in 2002.*
- *Ensuring security of energy supply will be central to Malaysia's National Energy Policy.*
- *To strengthen energy security through regional cooperation, Malaysia is expected to extend full support to inter- and intra-regional trade and bi/multilateral-agreements, in all aspects of the energy supply chain, including among others cross border interconnection efforts like the Trans-ASEAN Gas Pipeline (TAGP) and the ASEAN Power Grid.*

RECENT ENERGY TRENDS AND ENERGY POLICY

In parallel with Malaysia's rapid economic development, final energy consumption grew at a fast rate of 5.6 percent between 2000 and 2005 to reach 38.9 Mtoe in 2005. A substantial portion of the energy consumed was from oil (63 percent) which was mainly utilised in the transport and industrial sectors. Natural gas consumption also increased in a rapid manner to fuel electricity demand. The share of natural gas in total installed electricity generation capacity remains high at 70 percent in 2005, but has fallen slightly from 77 percent in 2000. Despite the government's efforts to increase the share of coal in the electricity generation mix, the share of coal only reached 22 percent in 2005.

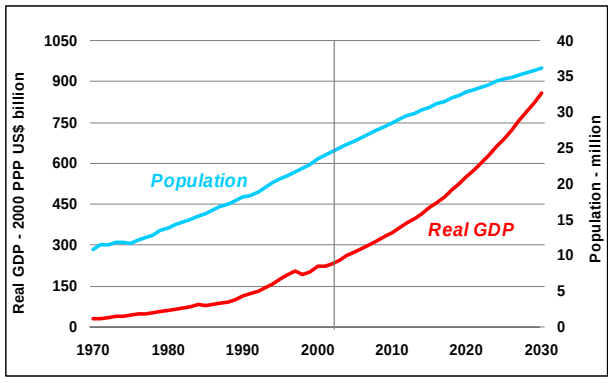
Malaysia is endowed with conventional energy resources such as oil and gas as well as renewables like hydro, biomass and solar energy. The economy is a net energy exporter with 11 percent of export earnings in 2004 derived from crude oil, LNG and petroleum products export. To develop the economy's oil and gas reserves in a sustainable manner, the government formulated the National Depletion Policy in 1980 that fixed the maximum daily oil and gas production levels. At 2005 production levels, proven oil reserves are expected to last another 19 years while natural gas reserves are expected to last for about 33 years.

Taking into account the growing energy consumption and domestic energy supply constraints, Malaysia has set sustainable development and diversification of energy sources, as the economy's main energy policy goals. The Five-Fuel Strategy recognises renewable energy resources as the economy's fifth fuel after oil, coal, natural gas and hydro. The 9th five-year plan (2006-2010) emphasises the security, reliability and cost-effectiveness of energy supply, while focusing on the sustainable development of the energy sector. The introduction of biodiesel for the transport sector in 2005 is one of the positive steps that the government has undertaken to achieve sustainable energy development through diversification of fuel sources.

ENERGY DEMAND DRIVERS

Malaysia's economy is expected to grow strongly over the outlook period with an annual average growth rate projected at 4.8 percent. The strongest growth will be from the industry (mainly the manufacturing sector) and the services sectors, attributing shares of 54 and 46 percent to total GDP in 2030 respectively.

Figure 56 GDP and Population



Source: Global Insights (2005)

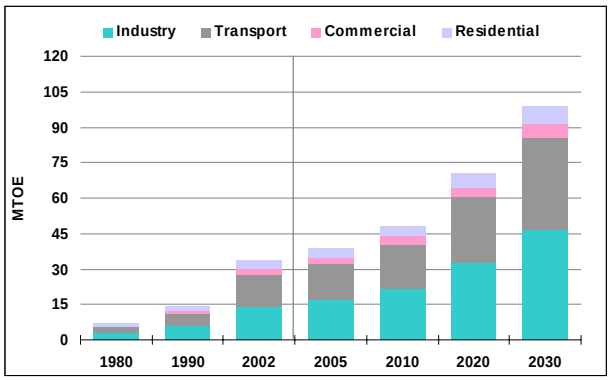
UN Habitat projects that the share of Malaysia's urban population will reach 78 percent in 2030 from 63 percent 2002. This factor combined with high per capita GDP growth of 3.4 percent per annum over the outlook period will lead to a change in lifestyle, where energy consumption will be based mostly on commercial energy sources, rather than traditional biomass sources. This will naturally cause a substantial growth in energy demand for the transport, commercial and residential sectors.

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 3.9 percent per year, reaching 98.7 Mtoe in 2030, nearly three times the 2002 level. The industry sector will have the highest growth rate of 4.3 percent, followed by transport at 3.9 percent, residential at 3.1 percent and commercial at 2.7 percent.

Figure 57 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 4.3 percent until 2030, lower than its average annual growth of 7.5 percent over the past two decades. The shift in industry structure, from energy-intensive to non-energy-intensive industries, as well as improvements in energy efficiency will lead to the lower projected growth in energy demand. Consequently, over the outlook period, energy intensity in the industrial sector is expected to fall at an annual rate of 0.8 percent, reaching 105 toe per US$ million in 2030 from 132 toe per US$ million in 2002. The share of oil in industrial energy demand is projected to contract to 21 percent in 2030 from 35 percent in 2002; as the government promotes diversification of fuel sources. By contrast, natural gas with its large reserves and robust demand for petrochemical feedstock is projected to grow at 5.0 percent per year. Natural gas demand will surpass that of oil as the leading fuel, and will account for 43 percent of industrial energy demand in 2030. Renewable energy is projected to grow modestly at 2.7 percent per year; however, its share to total industrial energy demand will remain at less than 1 percent in 2030. Biomass, which is largely used in cogeneration by palm oil industries, will account for almost all of the demand for renewable fuels.

Transport

The transportation sector of Malaysia is heavily reliant on the road transport sub-sector. In 2002 for example, energy demand for road transport represented 86 percent of the total transport energy demand. Urban transport such as in Kuala Lumpur is heavily dependent on passenger vehicles, since rail infrastructure has not yet been well developed to connect the city centre with the residential suburbs. Inter-city passenger and freight movement depends on road transport, because of the limited availability of rail transport. Passenger vehicle ownership has been promoted as Malaysia considers the auto manufacturing industry as an important driver for economic development. As a result, Malaysia has a relatively high level of passenger vehicle ownership of about 180 per 1,000 population in 2002.

Energy demand in road transport is projected to grow at an annual rate of 3.5 percent. By fuel type, the trend of growth will show significant differences, with gasoline growing at 2.9 percent per year, diesel at 4.2 percent per year, and natural gas at 9.2 percent per year. The slower growth rate for gasoline, mainly for passenger vehicles, reflects several factors, such as a slow down in population growth towards the end of the outlook period, government measures to develop alternative modes of transport such as rail, and improvements in efficiency for passenger vehicles. By contrast, diesel demand for freight trucks will be largely driven by the constant growth in manufacturing and construction. Natural gas represents the fastest growth in road transport, as Malaysia plans to mitigate road induced air quality problems through converting diesel-powered buses to CNG, and promoting natural gas passenger vehicles. However, the natural gas share in the total road transportation energy demand will remain small at around 1 percent throughout the outlook period.

Energy demand for air transport is expected to grow at the fastest growth rate of 5.8 percent per year. Malaysia aims to become a regional hub for air transport, and is actively inviting international air carriers by providing landing tax incentives for a number of years. Along with integration of economic activities among ASEAN economies, Malaysia expects to increase the volume of international air travel.

Residential and Commercial

Malaysia's residential energy demand is projected to grow at 3.1 percent per year throughout the outlook period. The promotion of energy conservation and implementation of other environmental protection measures explain the slow growth in total residential energy demand. In 2030,

electricity, biomass and LPG will contribute 57 percent, 24 percent and 17 percent respectively to the energy mix. Demand for electricity is expected to grow at an annual rate of 4.9 percent, which is slower compared with the 5.8 percent annual growth rate between 1997 and 2002; mainly as a result of the increasing efficiency of household appliances, such as refrigerators and air-conditioners. Biomass, a dominant fuel in rural areas mainly for cooking, is expected to grow at 0.9 percent annually over the outlook period. On the other hand, the demand for commercial energy sources, for example LPG, will also increase by 2.7 percent per year until 2030; slowly replacing biomass for cooking and water heating. LPG will however face some competition with natural gas in the future.

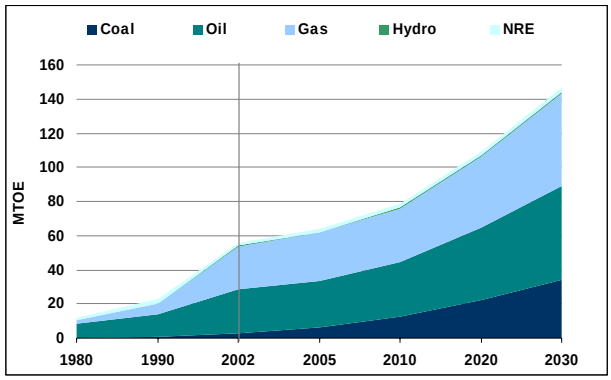
The main drivers influencing energy demand in the commercial sector is economic growth and weather condition. Owing to Malaysia's predominantly humid weather conditions, about 40 percent of total energy demand in the commercial sector will be required for space cooling. As with the residential sector, the government has taken initiatives to reduce the energy intensity of commercial buildings and office equipment. As a result, energy demand growth in the commercial sector will slow down to 2.7 percent annually while the value added for the services industry will grow at 4.7 percent per year. Over the outlook period, the energy mix in the commercial sector will not show any significant change, with electricity accounting for 68 percent, LPG (17 percent), heavy fuel oil (12 percent) and natural gas (3 percent) in 2030. Driven by the increasing demand for cooling and lighting in commercial buildings, electricity is expected to grow at an annual rate of 2.7 percent. LPG demand is projected to grow at 2.8 percent per year while heavy fuel oil demand will grow at 1.9 percent annually from 2002 and 2030. Natural gas demand is expected to grow at the fastest annual growth rate of 10.1 percent, although it will increase from a relatively small absolute value in 2002.

PRIMARY ENERGY DEMAND

Malaysia's primary energy demand is projected to grow at an annual rate of 3.5 percent, to reach 146.7 Mtoe in 2030, a 2.6-fold increase from 2002.

Among the fossil fuels, coal is projected to grow at the fastest rate of 9.7 percent per year, followed by natural gas at 2.9 percent and oil at 2.7 percent. Coal demand will increase substantially to meet the rising electricity demand, accounting for 93 percent of the total incremental coal demand (31.2 Mtoe). This is in line with Malaysia's target to increase the share of coal in the electricity generation sector. Malaysia is a net importer of coal and imports will increase about 14 times from 2002 to 2030 reaching 33.4 Mtoe in 2030.

Figure 58 Primary Energy Demand



Source: APERC Analysis (2006)

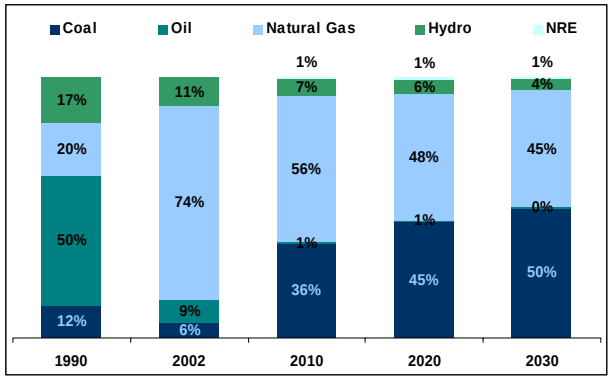
Growth in natural gas demand will continue at a steady pace with increasing natural gas demand in the industry sector, which is projected to account for 37 percent of total primary energy demand in 2030.

The share of oil is projected to decline from 47 percent in 2002 to 38 percent in 2030. Over the outlook period, oil demand in the transport sector will grow at 3.9 percent reaching 39.0 Mtoe in 2030, translating to 71 percent of total primary energy demand in the same period.

ELECTRICITY

The electricity demand of Malaysia will increase by 4.7 percent per year over the outlook period, to reach 274 TWh in 2030. The growth in electricity demand is heavily influenced by strong demand from the industrial sector, which is projected to increase at 5.4 percent annually over the outlook period. Electricity demand for the residential sector will also experience strong growth of 4.9 percent per year due to improving living standards. Per capita electricity demand is projected to more than double from 2002 to reach 7,571 kWh/person in 2030, higher than that of the APEC region average at 6,833 kWh/person.

Figure 59 Electricity Generation Mix



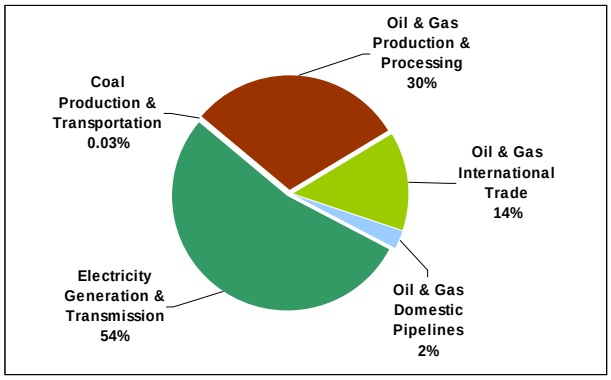
Source: APERC Analysis (2006)

Throughout the outlook period, natural gas is expected to be gradually replaced by coal in the electricity generation mix. Consequently, the share of natural gas in the electricity generation fuel mix will be reduced from 74 percent in 2002 to 45 percent in 2030, while the share of coal will increase from 6 percent in 2002 to 50 percent in 2030.

INVESTMENT REQUIREMENTS

The energy industry of Malaysia will need a total investment of between US$107-135 billion during the outlook period. The majority of the investment will be required for electricity generation and transmission (US$59-72 billion) and oil and gas production (US$28-41 billion). These reflect the fast growth in the need for electricity in improving living standards and fuels for industry and transportation.

Figure 60 Investment Requirements

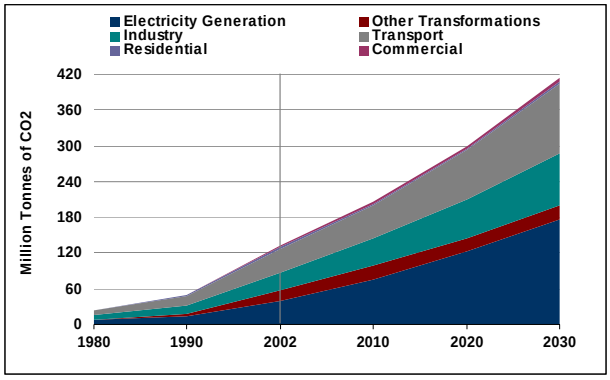


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Over the outlook period, CO_2 emissions from the energy sector are projected to grow at 4.2 percent per annum, reaching 414 million tonnes of CO_2 in 2030, a three-fold increase over 2002. The electricity sector will be the biggest contributor to the incremental growth in CO_2 emissions at 49 percent, followed by the transport sector at 28 percent and the industry sector at 20 percent.

Figure 61 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

LONG-TERM ENERGY SECURITY

Despite government efforts to preserve declining energy reserves, Malaysia will become a net energy importer in the next 28 years. Net import dependency will increase from minus 57 percent (net energy export position) in 2002 to 32 percent in 2030. The increase in the share of coal in electricity generation will result in a substantial increase in coal imports, with import dependency rising from 2.4 Mtoe in 2002 to 33.4 Mtoe in 2030. The projected flat domestic production of natural gas together with increasing demand over the outlook period would reduce Malaysia's natural gas export capability, thereby reducing the net export position of natural gas from 79 percent in 2002 to 7 percent in 2030. Despite the reduction, Malaysia will remain a net exporter of natural gas over the outlook period. In the case of oil, import dependency is expected to reach 32 percent in 2030 from a net exporting position of 54 percent in 2002, due to the strong growth of demand in the transport and industrial sectors.

To boost oil and natural gas reserves, Malaysia has been intensifying the exploration of deepwater and extra-deep water areas. For example in 2005, intensive exploration activity resulted in the discovery of 1,084.7 million barrels of oil equivalent (mmboe) of oil and natural gas reserves of which 70 percent are located in deepwater areas. To further improve energy supply security, Malaysia has ventured into energy-related industries and services abroad. For example PETRONAS has invested a total of RM29 billion in downstream and upstream activities in 35 economies and Tenaga Nasional Berhad (TNB) has also invested in the extraction of coal in Kalimantan, Indonesia.

In addition, the recent introduction of biodiesel as an alternative fuel for transportation will assist the economy in reducing diesel import. The utilisation of biodiesel in Malaysia, which is targeted to be enforced by 2008, is estimated to reduce diesel imports by 500,000 tonnes a year or 10 percent by blending 5 percent biofuel to diesel at pumps.

DEVELOPMENT OF A SUSTAINABLE TRANSPORTATION SYSTEM

The heavy reliance on passenger vehicles due to insufficient public transport infrastructure will result in strong demand for oil in the transport sector. As Malaysia will greatly rely on oil imports, with a net import dependency of 32 percent in 2030, there is an urgent need for the economy to improve its public

transport system subsequently reducing oil consumption in the transport sector.

NATURAL GAS DISTRIBUTION SYSTEM

The use of natural gas in sectors other than the electricity sector has been promoted as part of the government strategy to diversify energy sources. Over the outlook period, the share of natural gas in total final energy demand will grow at 5.1 percent per year mainly due to strong demand growth in the industry sector, as a result of domestic availability and competitive price. However, in order to utilise natural gas in the industrial sector more extensively a comprehensive pipeline system will be required. The Natural Gas Distribution System (NGDS) was expanded from 455 km in 2000 to 1,365 km in 2005. The NGDS network will be further expanded to a total of 2,005 km in 2010 with an estimated investment requirement of US$168 million[72]. The network is projected to supply 6.9 Mtoe of natural gas in 2010. However, as natural gas demand is projected to grow strongly and reach 20.4 Mtoe in 2030, the domestic gas pipeline network will need to be expanded further over the outlook period at an estimated cost of US$2-3 billion.[73]

IMPLICATIONS

Malaysia's energy policy dates as far back as the 1970s and since then the economy had been in the forefront for the effective management of its energy resources, efficient utilisation and protection of the environment. Programmes and policies have been laid out to effectively institute the economy's energy policies and programmes.

The pressing concern that Malaysia needs to tackle is energy supply security as limited domestic energy resources coupled with increasing energy demand will reduce the economy's export capability and increase dependence on imported energy sources. One approach to reducing dependence on fossil fuels is to exploit the economy's abundant renewable sources such as solar, mini hydro, and biomass from palm oil industry. However, to boost the development of the renewables, review of current renewable energy development mechanisms, such as incentives and financing mechanisms, should be undertaken to identify barriers to the implementation of projects. In addition, the Clean Development Mechanism (CDM) could be utilised to increase the viability of renewable projects, by trading Certified Emission Reduction credits with Annex B countries.

In an effort to increase energy security, Malaysia should actively pursue a strategy of regional cooperation with neighbouring economies (for example, Brunei Darussalam), through which possible bilateral/inter-regional interconnection agreements, (for example the Trans-ASEAN Gas Pipeline) could bring the much needed natural gas and oil to the economy.

Another initiative that could be further promoted is the ASEAN Power Grid Interconnection Initiative. As at 2003, one link between Malaysia and Thailand was in operation. However, to enhance the regional electricity transmission network, additional links with neighbouring economies (such as Indonesia and Singapore) could be instigated to further strengthen energy security.

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[72] Economic Planning Unit (2005)

[73] Estimate by APERC.

MEXICO

- *Mexico's primary energy demand will grow annually at 2.3 percent, driven mainly by increased demand for oil and natural gas in the transport and industrial sectors.*
- *Steady demand growth and depleting energy reserves will decrease the economy's net energy export position from 59 percent in 2002 to 9 percent in 2030.*
- *Continued reforms in the regulatory policies of the energy sector may contribute to improvement in the economy's domestic supply potential.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Mexico's final energy consumption has increased from 91.6 Mtoe in 2002 to 98.3 Mtoe in 2005 at an average annual growth rate of 2.4 percent, as a result of strong industry expansion and improvement in living standards. The transport sector accounted for the largest share in total energy consumption at 65 percent, followed by industry at 20 percent. Oil, the primary energy source, has accounted for two-thirds of total final energy consumption over the period 2002 to 2005.

The economy has indigenous energy resources of oil, natural gas and coal. Mexico's crude oil requirements have historically been met by domestic production, however, as the economy's demand for petroleum products continued to grow, the economy's refinery utilisation ratio reached 97 percent, promoting the importation of petroleum products to meet domestic demand – 15.7 million tonnes of petroleum products were imported and 5.2 million tonnes were exported in 2005. In the case of natural gas, 35.6 Mtoe was produced domestically in 2005, however, in the north-western area 9.0 Mtoe was imported from the US since there is currently no domestic pipeline infrastructure. Similarly, 1.2 Mtoe of coal was imported in 2005 – the coal import dependency of the economy being 20 percent.

Mexico is one of the world's major non-OPEC oil producing economies and exports of crude oil increased from 97.9 million tonnes in 2002 to 102.8 million tonnes in 2005, of which approximately 80 percent was exported to APEC economies, predominantly the US.

However, like any other finite resource, oil reserves are depleting gradually. As a result of early depletion of oil reserves, the government has been prompted to intensify investments in the upstream oil sector, some examples of which are the development of the Chicontepec Oil and Marine Building Programmes in the Gulf of Mexico.

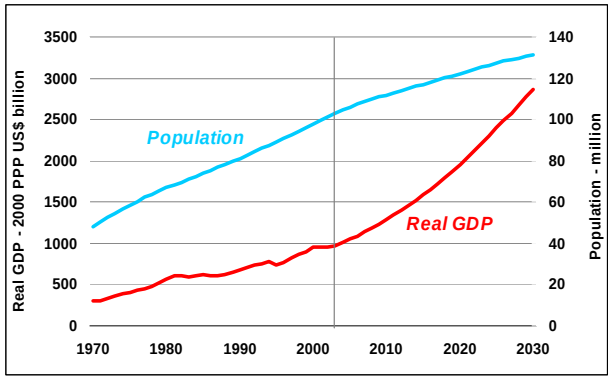
The economy also has plans to restructure the energy sector and diversify energy source away from oil through the utilisation of coal and renewables.

To ensure entry of investors and expand investments in the energy exploration and development, the government has made modifications to the legal framework and introduced the Energy Sector Program 2001-2006, aimed at liberalising energy markets to augment investment capacity, foster competition in the energy market, and enhance energy quality and supply.

ENERGY DEMAND DRIVERS

Mexico's economy is expected to grow at an average annual rate of 4.0 percent over the outlook period. Industry is the second largest energy consumer in Mexico after transportation and is projected to be supported by strong industrial GDP annual growth of 3.7 percent despite the narrowing gap in energy conservation due to the saturation of modern technologies within the industry sector through the North American Free Trade Agreement (NAFTA).

Figure 62 GDP and Population



Source: Global Insights (2005)

Population is expected to grow annually at 0.9 percent, lower than growth rate of 1.9 percent over the previous two decades with total population increasing from 101 million in 2002 to 131 million in 2030.

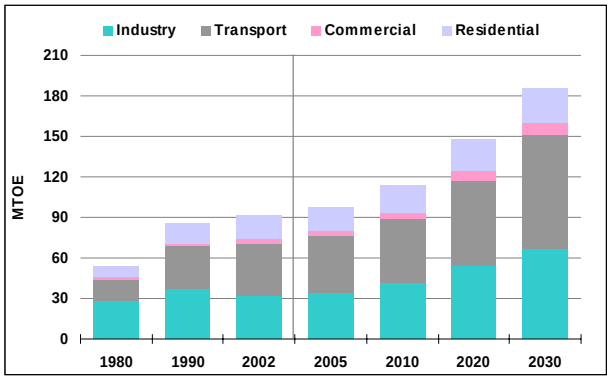
Over the outlook period, rising income and improvement in living standards will increase the proportion of urban dwellers, projected to increase from 75 percent in 2002 to 83 percent in 2030.

OUTLOOK

FINAL ENERGY DEMAND

Mexico's final energy demand is expected to grow at 2.5 percent per year over the outlook period, which is similar to the annual growth in the previous two decades of 2.5 percent. The transport sector is projected to account for the largest share at 46 percent, followed by industry (36 percent), residential (14 percent), and commercial (4 percent).

Figure 63 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 2.7 percent until 2030, faster than its average annual growth of 0.6 percent over the past two decades. Strong expansion in the industry sector of 3.7 percent per year and emphasis on exports to North America will lead to the faster projected growth in energy demand. Since 1990, energy efficiency improvements (for example increased use of continuous casting in steel making) and structural changes in Mexico's industry have played an important role in reducing industrial energy consumption. From 1990-2002, industrial energy consumption in Mexico fell at an average rate of 1.2 percent per year, conversely the value-added of industrial sector grew by 2.5 percent. The decoupling of energy consumption and income in the industrial sector has resulted mainly from the drastic reduction in energy intensity of Mexico's industry, particularly in petrochemicals, iron and steel, sugar, cement, and paper and pulp production. [74] Further energy efficiency improvements and changes in the industrial structure are expected to continue to reduce energy intensity at a moderate pace of 1.0 percent per year, reaching 100 toe per US$ million in 2030 from 132 toe per US$ million in 2002.

Over the outlook period, electricity is projected to account for the highest growth in industrial energy demand, increasing at an average annual rate of 3.8 percent. Electricity demand will surpass that of petroleum products as the leading energy source, accounting for 40 percent of industrial energy demand in 2030. The additional demand for electricity is expected to be met by an influx of independent power producers (IPPs) in the manufacturing sector. By contrast, the demand for petroleum products is projected to grow slowly at 2.0 percent per year with a decreasing share, from 37 percent in 2002 to 31 percent in 2030, following the historical declining trend for fuel oil. The share of natural gas is projected to remain fairly constant at 27 percent over the outlook period. The switch to natural gas in the industrial sector will be driven by stricter environmental regulations that discourage the use of fuel oil and coal. Coal demand is projected to decline at 1.9 percent per year as energy efficiency improvements continue to be implemented in the iron and steel industry. Industrial coal consumption decreased at 3.5 percent per year between 1990 and 2002.[75] Renewable energy demand in industry is also projected to decline at 0.8 percent per year, mainly because of reduced demand for biomass. Biomass, in the form of sugarcane bagasse, is experiencing supply shortages as the sugar industry is faced with increasing international competition from fructose imports. Sugarcane bagasse is gradually being replaced by high-quality modern fuels.

Transport

Mexico's transport energy demand is dominated by the road transport sub-sector, accounting for as high as 91 percent of total transportation energy demand in 2002. Due to the absence of a mass transport railway system, urban dwellers have to rely on road transport including private vehicles, buses and taxis. Integration to the North American economy as a result of the NAFTA in 1994 has lead to a substantial increase in diesel requirements for

[74] Aguayo and Gallagher (2005)

[75] According to Ozawa et al. (2002), the reduction of coal use would be explained by structural changes and energy efficiency improvement of iron and steel industry: the closing of inefficient open hearth furnace by 1992; the increased use of the continuous casting (from 10 percent in 1970 to 85 percent in 1996); the implementation of new technologies for direct iron production; and the increased utilisation of coke oven and blast furnace gases for on-site electricity generation. In addition, Mexico has a relatively high share of electric arc furnace at about 60 percent of crude steel production, compared with some 40 percent in the US, 45 percent in Korea, and 20 percent in China.

freight trucks. Development of an automobile industry has reduced the price of passenger vehicles, and spurred the growth of vehicle ownership.

Over the outlook period, the transportation energy demand of Mexico is projected to grow at an annual rate of 2.8 percent. The projected growth would come from road transport, which will account for about 92 percent of the incremental growth in total transport energy demand, with the remainder from air transport representing around 8 percent. With the continued growth, per capita transportation energy demand is projected to grow from 0.38 toe in 2002 to 0.64 toe in 2030, lower than the APEC average of 0.42 toe in 2002 and 0.67 toe at 2030.

By fuel type, gasoline demand is expected to continue to grow robustly at an annual rate of 2.6 percent a faster rate than the previous two decades at 2.3 percent per year. Mexico's integration to the economic activities of North America will further boost the requirements for freight transport, which will in turn result in diesel demand growing at 2.7 percent over the outlook period. Jet kerosene demand for air transport will increase at an annual rate of 3.3 percent – a faster rate than the previous two decades at 2.7 percent per year. Again, integration to the North American market will spur the growth of air transport for both passenger and freight volumes.

Residential and Commercial

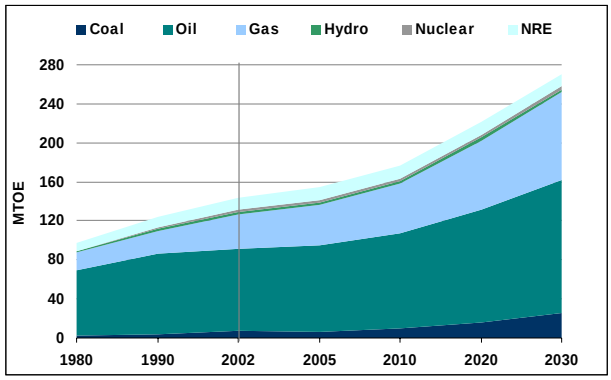
Mexico's residential energy demand is driven by increasing income, size of household and ownership of appliances, level of electrification and differences in energy services between urban and rural areas. The energy demand of the residential sector is projected to grow at 1.4 percent annually over the outlook period. Demand for natural gas is expected to grow at the fastest rate of 6.0 percent per year, with the share increasing from 3 percent in 2002 to 12 percent in 2030. This is as a result of government efforts to substitute oil as well as the replacement of LPG with natural gas. By contrast, the share of LPG will decrease from 42 percent in 2002 to 37 percent in 2030, but will maintain the largest share throughout the outlook period. However the demand for LPG is expected to grow at an annual rate of 0.9 percent, which is slower compared with the 5.0 percent annual growth rate in the past three decades. Electricity demand is expected to grow at the same rate as that of electrification at 3.0 percent per year, with the share of electricity increasing from 19 percent in 2002 to 29 percent in 2030, to account for the second largest share in total residential energy demand. The replacement of biomass with commercial fuels because of increasing environmental and health concerns, will result in a decrease in the share of combustible renewables (mostly fuel wood), and will account for a 21 percent share of total residential energy demand in 2030. As fuel wood is never replaced entirely, even in households that have been using LPG for many years, the demand is projected to decline gradually at a rate of 0.4 percent annually over the outlook period.

Over the outlook period, commercial energy demand is expected to grow at 3.0 percent annually, moving in line with the value added for the services industry growth of 3.9 percent per year. As in the residential sector, natural gas demand is expected to grow the fastest, making up about 14 percent of total commercial energy demand in 2030. Demand for natural gas is expected to grow at 6.0 percent annually throughout the outlook period. Conversely, the share of LPG in total commercial energy demand is projected to decline from 47 percent in 2002 to 35 percent in 2030 as LPG will be replaced by natural gas and electricity. Electricity is expected to account for the largest share of total commercial energy demand at 44 percent after 2014.

PRIMARY ENERGY DEMAND

Despite an almost two-fold increase in primary energy demand, oil will maintain the dominant share over the outlook period. However, the total share will decline from 58 percent in 2002 to 51 percent by 2030.

Figure 64 Primary Energy Demand



Source: APERC Analysis (2006)

Major growth in demand for coal and natural gas is expected at 4.2 and 3.3 percent respectively. The increasing share of coal will be due largely to the government's policy of fuel diversification in electricity generation, to reduce the economy's high reliance on natural gas. Despite having considerable natural gas reserves, the demand for natural gas will have to be met by imports. Therefore important investments will have to be made to explore and develop new natural gas fields. Nuclear is expected

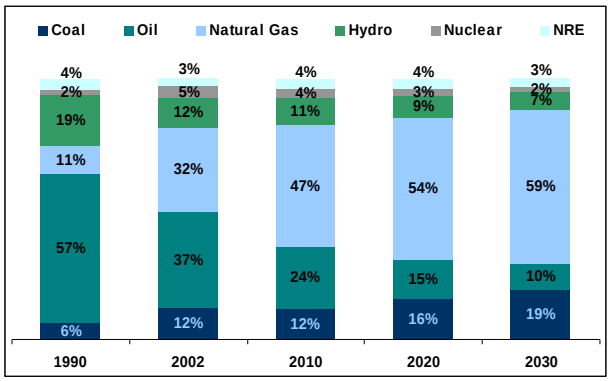
to maintain the current level over the outlook period. The share of renewables in primary energy demand is projected to decrease from 8 percent in 2002 to 5 percent in 2030 as a result of the substitution of biomass for other forms of commercial energy and difficulties in financing renewable energy projects.

ELECTRICITY

Electricity demand is projected to grow at 3.6 percent over the outlook period, with the share of gas and coal in the electricity generation mix expected to increase. Electricity generation is projected to reach 505 TWh in 2030 with 59 percent of electricity generated from gas, 19 percent from coal, 10 percent from petroleum, 7 percent from hydro, and 3 percent from new and renewable energy. No new nuclear capacity will be added during the outlook period thereby reducing the share of nuclear from 5 percent in 2002 to 2 percent in 2030.

The share of oil-fired electricity generating plants is projected to decrease to 12 percent of total installed capacity in 2030 from 37 percent in 2002. In contrast, the share of natural gas will increase from 25 percent in 2002 to 52 percent in 2030. Likewise, the share of coal will increase by 8 percent over the same period. New and renewable energy will grow at 4.6 percent annually between 2002 and 2030, with wind and biomass-based electricity generation projected to respectively reach 2.2 TWh and 7.5 TWh in 2030 from 4.4 MWh and 470 MWh in 2002.

Figure 65 Electricity Generation Mix

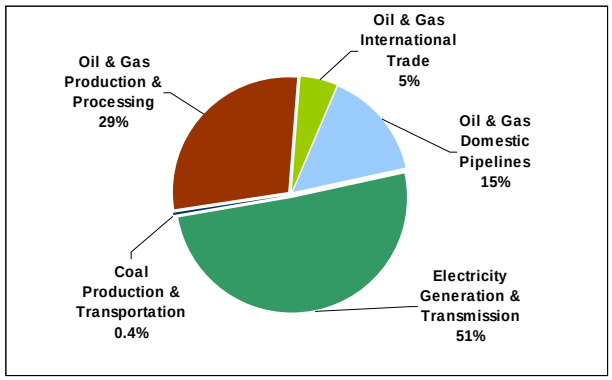


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

The investment required to finance the economy's future energy infrastructure development over the outlook period is projected to be between US$172-228 billion. The majority of which will be used for the build up of electricity generation and power grids expansion, and also for domestic oil and gas industries developments.

Figure 66 Investment Requirements

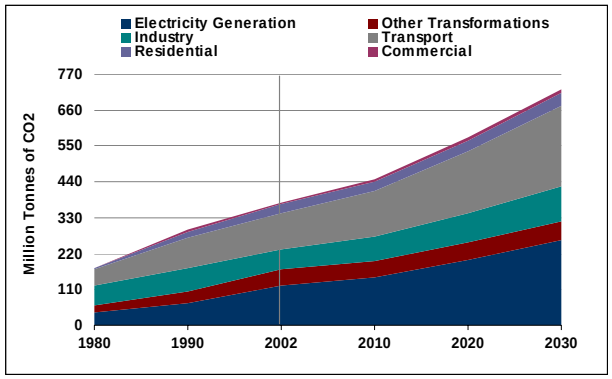


Source: APERC Analysis (2006)

CO_2 EMISSIONS

The continued dominance on fossil fuels in the economy's electricity generation mix and the growth in petroleum demand of the transport sector will generate a total of 724.1 Million tonnes of CO_2 in 2030.

Figure 67 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

UPSTREAM OIL INDUSTRY DEVELOPMENT

Mexico's proven oil reserves will eventually deplete as indicated by the low reserves to production ratios observed in the past decade[76], which will subsequently decrease oil exports over the outlook period. Therefore, a strong need for additional investment in exploration and development of new acreage to maintain the economy's net oil export position is required. A major barrier however is the economy's constitution which restricts the exploitation of natural resources to the national oil company that has in turn limited both foreign and private sector participation in the industry. To

[76] PEMEX reports Mexico's oil reserve to production (R/P) ratio at 38 years, while the BP Statistical Review of World Energy 2006 puts the R/P ratio at 10.0 years.

address this concern, Mexico aimed to reform the energy sector through amendments to the constitution, which would allow private and foreign participation in the oil industry, including natural gas. However, the plan was deferred due to insufficient congressional support to make the necessary changes.

NEED FOR A LONG-TERM ENERGY POLICY

The fuel choice dilemma for new thermal power plants should be addressed in parallel with the long-term national energy strategy. Therefore the establishment of a complex energy strategy is necessary to overcome hurdles for future energy supply and environmental protection which could benefit the Mexican economy and the society as a whole.

In addition, Mexico's projected high demand for natural gas and decreasing supply of pipeline gas from the US would precipitate the need to secure future natural gas supplies through the establishment of LNG import facilities.

Likewise, to address the growing projected demand for steam coal for electricity generation could be addressed by increasing both domestic coal production and coal imports.

Most Mexican cities have air pollution problems and the land transportation sector is the main contributor to this problem.

IMPLICATIONS

Growing energy import dependence will complicate the economy's position in the global energy market. Mexico will become a significant importer of LNG and coal in the APEC region. However, decreasing oil exports, will add to the overall call on oil and natural gas in North America.

In the long-term, the government's dependence on oil revenues will prove to be a major concern, particularly if revenues cannot keep up with increased spending in health, education, and infrastructure, that is necessary to maintain and improve Mexico's standard of living, as currently non-oil related fiscal revenue makes up only about 12 percent of Mexico's GDP.

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NEW ZEALAND

- *New Zealand's primary energy demand will grow annually at 1.8 percent from 18.8 Mtoe in 2002 to 30.6 Mtoe in 2030; buoyed mainly by high demand growth in coal and renewables.*
- *The economies high dependence on hydro for electricity generation and depleting natural gas reserves; thereby increasing the use of coal for electricity generation may raise concerns over the outlook period.*
- *CO_2 emissions from the energy sector are projected to reach 36.9 million tonnes of CO_2 in 2010 – about 75 percent higher than the 1990 level.*

RECENT ENERGY TRENDS AND ENERGY POLICY

On the back of robust economic growth from 2000 to 2004, New Zealand's total primary energy consumption has increased by an average annual growth of 0.4 percent. Oil consumption in particular has increased substantially, accounting for 52 percent of the total incremental growth in energy consumption. This is primarily because of expanding trade/freight by road transport and the expansion of passenger vehicle use due to the lack of efficient public transport networks. Natural gas was mainly consumed in the industry and electricity sectors. With reduced natural gas production, the electricity sector has shifted from the utilisation of natural gas to coal and wind; substantially increasing coal consumption in the electricity sector from 0.23 Mtoe in 2000 to 1.02 Mtoe in 2004.

Historically, most of the economy's energy supply has been met through domestic production, except oil. However natural gas production has fallen in recent years from a peak of 6.3 Mtoe in 2001 to 4.1 Mtoe in 2004 – a drop of approximately 35 percent – as production from the Maui gas field draws to a close. The economy produces both steaming and coking coals, of which the majority of coking is exported while steaming coal is utilised domestically for electricity generation. Oil on the other hand is mostly imported and the economy's oil imports have increased from 5.3 Mtoe in 2000 to 6.2 Mtoe in 2004, representing an import dependency of 87 percent in 2004.

The decline in natural gas production from the Maui gas field has prompted New Zealand to: 1) intensify exploration of natural gas; as many areas of New Zealand remain relatively under-explored and the probability of finding hydrocarbon structures of the same size or greater than that of the Maui field still remains high, and 2) adopt an aggressive Petroleum Strategy to promote the development and security of natural gas supply through importation of LNG or CNG. Other countermeasures that have been undertaken to offset the reduction in domestic production of natural gas include policies to increase investment in the upstream sector through the introduction of various incentives and tax breaks.

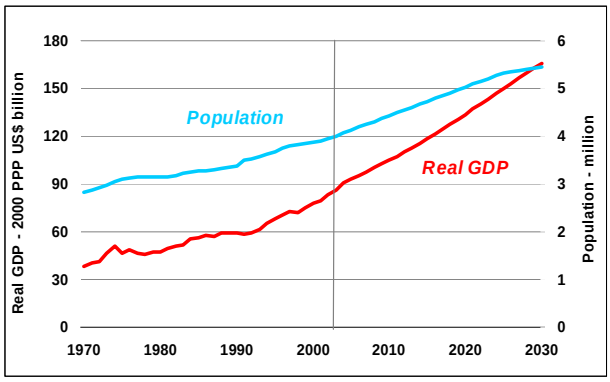
The government is currently in the process of developing a national energy strategy which will involve a broad re-examination of New Zealand's current energy policies with an emphasis on energy efficiency as a method to reduce growth in energy demand. This strategy will be based on the tenets of sustainable development through the Sustainable Development Programme of Action (SDPOA), which calls on government agencies to take a wider, more integrated approach to policy development with the three desired outcomes being: 1) energy use in New Zealand becomes more efficient and less wasteful, 2) renewable sources of energy are developed and maximised, and 3) New Zealand consumers have a secure supply of electricity. In addition, in 2002 New Zealand ratified the Kyoto Protocol under which the economy is obligated to reduce CO_2 emissions to that of the 1990 level. To this end, policies/strategies are currently being undertaken through which the mandated reduction target can be achieved.

ENERGY DEMAND DRIVERS

The New Zealand economy is projected to grow annually at a modest rate of 2.5 percent over the outlook period, which will result in an approximate doubling of total GDP by 2030. While New Zealand is to all intents and purposes an agriculturally based economy, continued expansion of the services sector will contribute the most to economic growth, with the GDP in services sector making up approximately 80 percent of total GDP in 2030.

Population is projected to grow robustly at 1.2 percent per year over the outlook period, compared with the previous three decades of 1.0 percent. The projected growth will result in a 20 percent increase over the 2002 level reaching 5.44 million in 2030.

Figure 68 GDP and Population



Source: Global Insights (2005)

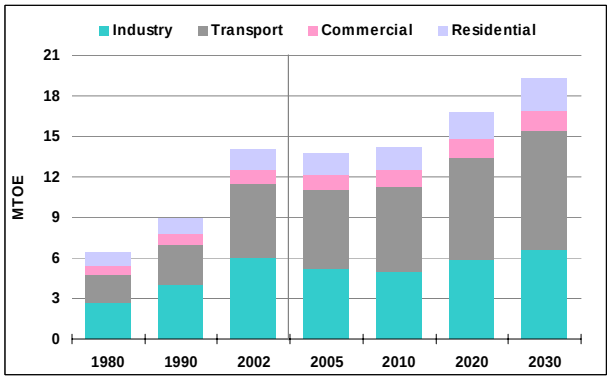
New Zealand is by world standards a fairly urbanized economy with the urban population expected to reach 89 percent in 2030 from 86 percent in 2002. What is peculiar to New Zealand however is that this urbanisation is very unbalanced with the majority of people concentrated in, Auckland City – New Zealand's largest urban region – which continues to grow dramatically. In 2005, more than 25 percent of the economy's population live in this region and the trend is expected to continue with the projected population to reach one third of total population by 2030.

OUTLOOK

FINAL ENERGY DEMAND

Final energy demand is expected to grow at 1.2 percent per year over the outlook period, slower than the annual growth of 3.6 percent in the previous two decades. The transport sector is projected to account for the largest share at 46 percent, followed by industrial (34 percent), residential (12 percent), and commercial (8 percent).

Figure 69 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 0.4 percent until 2030, much lower than the average annual growth of 3.7 percent over the past two decades. The low projected increase in industrial energy demand is attributed to the large decrease in natural gas utilisation resulting from the closure of Methanex's gas-to-methanol plants.[77] These plants were partly responsible for the historical growth in natural gas consumption which grew at an average of 10.8 percent over the period 1980 to 2002. As a result of these closures, the share of industrial energy demand to total final energy demand is expected to fall from 43 percent in 2002 to 34 percent in 2030. Energy intensity [78] in the industrial sector is also expected to decline at an average annual rate of 2.3 percent, improving from 310 toe per US$ million in 2002 to 161 toe per US$ million in 2030.

The individual shares of energy sources to total industrial energy demand is projected to change significantly over the outlook period. The share of natural gas is projected to decrease from 42 percent in 2002 to 14 percent in 2030 while the share of oil and coal will increase respectively at 1.5 percent and 0.8 percent per year. Renewables, the second fastest-growing energy source, is projected to grow at an average annual rate of 1.6 percent, accounting for 20 percent of total industrial energy demand in 2030. Among the renewable energy sources, biomass is expected to lead the growth which is largely utilised in cogeneration, particularly by the forestry industry.[79]

Electricity is projected to increase from 1.3 Mtoe in 2002 to 2.6 Mtoe in 2030, accounting for the fastest growth in industrial energy demand at an average annual rate of 2.5 percent. Electricity demand will surpass that of natural gas as the leading energy source, accounting for 39 percent of industrial energy demand in 2030, as more new and efficient electrical equipment is utilised within the manufacturing sector.

[77] Methanex is the largest petrochemical producer in New Zealand operating two plants with a combined capacity of 2.4 million tonnes of methanol per annum; however, due to the shortage of gas on the New Zealand market the 1.87 million tonne Motunui plant ceased operations in November 2004. The smaller 530,000 tonne per annum Waitara Valley plant was idled in the fourth quarter of 2005, but has managed to secure sufficient gas to continue operations up until the end of the second quarter of 2006.

[78] The amount of energy needed to produce a dollar's worth of industrial sector's value added

[79] Ministry of Economic Development (2003) assumes robust forest industry growth, with the harvest rate increasing from 19 million m^3 in 2001 to 33 million m^3 in 2025, and the total amount processed increasing from 13 million m^3 in 2001 to 19 million m^3 in 2025.

Transport

Transportation energy consumption in New Zealand is dominated by road transport sub-sector, accounting for about 84 percent in 2002. Given the low population density, sprawling sub-urban areas, and an insufficient mass transit system that connects city centre and residential suburbs, commuters have to rely on gasoline powered passenger vehicles. Inter-city transport for both the passenger and freight sub-sectors depend mainly on road transport as cities in the economy are connected by toll-free highway systems. To support the mobility of passengers, New Zealand's vehicle ownership per 1,000 population is relatively high, at 541 per 1000 population – the third highest in the APEC region after the US and Canada.

Over the outlook period, the transportation energy demand of New Zealand is projected to grow at an annual rate of 1.7 percent. The major growth is expected to come from road transport sub-sector accounting for about 78 percent, with the remainder from air transport sub-sector at 22 percent. With the steady growth in the road and air sub-sectors, per capita energy demand in the transport sector is projected to reach 1.6 toe in 2030 – the fourth largest after the US, Canada and Australia.

By fuel type, jet kerosene demand for international air transport is projected to grow at the fastest rate of 2.6 percent per year. The projected growth will be mainly due to New Zealand's reaching bilateral and multilateral agreements with neighbouring economies such as Australia and Singapore, boosting international air travel.

Diesel demand for freight trucks is expected to grow at 1.8 percent per year. Since the deregulation of the freight transport sub-sector in the 1990s, diesel consumption has experienced robust growth of 10.8 percent over the last decade. However, over the outlook period, the growth rate in diesel demand is expected to stabilise at 1.8 percent. On the other hand, gasoline demand for passenger vehicles is projected to grow at an annual rate of 1.4 percent – a slower rate than the past three decades at 1.9 percent per year, as a result of the saturation in vehicle ownership.

Residential and Commercial

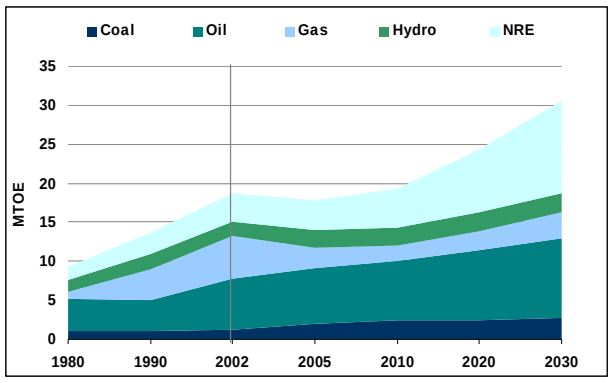
Energy demand in the residential sector is expected to grow at 1.8 percent per year over the outlook period. With urban migration to Auckland, electricity demand will grow the fastest at an annual rate of 2.0 percent, with the share of electricity to total residential energy demand increasing from 69 percent in 2002 to 74 percent 2030. Natural gas is projected to maintain the second largest share to total residential energy demand accounting for 12 percent in 2030, growing at 1.9 percent annually, slower than the previous two decades, due to the lower growth in the number of households connecting to the gas pipeline system. Demand for renewables and waste is also expected to grow at 0.6 percent per year, with the share to total residential energy demand accounting for 11 percent in 2030.

Although the value added for services sector will continue to grow robustly at 2.9 percent per year during the outlook period, energy demand in the commercial sector is projected to grow moderately at an annual rate of 1.2 percent, influenced by initiatives to increase the energy efficiency of the sector. Electricity is expected to maintain the largest share of total commercial energy demand, accounting for 59 percent in 2030, and grow at 1.3 percent per year. Likewise, natural gas demand is expected to grow at 1.8 percent per year until 2030, with the share of natural gas increasing from 26 percent in 2002 to 30 percent in 2030. By contrast, the share of coal is expected to decrease from 10 percent in 2002 to 5 percent in 2030, declining at a rate of 1.2 percent per year.

PRIMARY ENERGY DEMAND

New Zealand's primary energy demand is projected to grow at an annual rate of 1.8 percent – a slower rate than the previous two decades at 3.3 percent per year. [80]

Figure 70 Primary Energy Demand



Source: APERC Analysis (2006)

Among the fossil fuels, coal will grow at the fastest rate of 2.9 percent per year, followed by oil at 1.6 percent, while gas is projected to decrease at 1.8 percent over the outlook period. However, the highest growth will be in renewables, growing at 4.3

[80] Note that the growth rate for primary energy demand is much higher than that of final energy demand primarily as a result of geothermal generation. With low efficiency (10-15 percent) the amount of energy from geothermal supplied as electricity (final energy) is low compared with amount used in the process (primary energy).

percent per year to reach 39 percent of total primary energy demand in 2030.

Coal demand will be largely driven by the electricity sector, accounting for approximately 14 percent of the total incremental growth of input fuel to electricity. The capacity of coal-fired electricity generation is projected to triple over the outlook period.

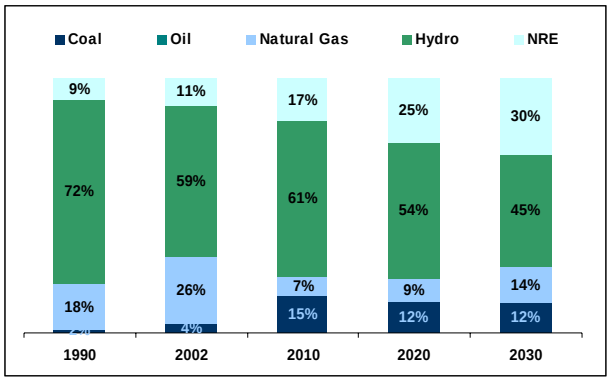
The transportation sector will be the largest single contributor to incremental oil demand growth accounting for 92 percent of the total. Since New Zealand has only very limited domestic oil resources and production is declining, the majority of oil supply will continue to be imported. In addition there is only one domestic refinery in New Zealand, which can only produce enough petroleum products to meet 70 percent of the economy's domestic demand, therefore net oil import dependency is projected to increase from 80 percent in 2002 to 90 percent in 2030.

The direct use of renewable resources which include biogas, industrial waste, wood, solar, and geothermal will continue to play an important role in New Zealand's primary energy mix over the outlook period and reach 11.8 Mtoe in 2030.

ELECTRICITY

Over the outlook period, the electricity demand of New Zealand is projected to grow at 2.1 percent per year.

Figure 71 Electricity Generation Mix



Source: APERC Analysis (2006)

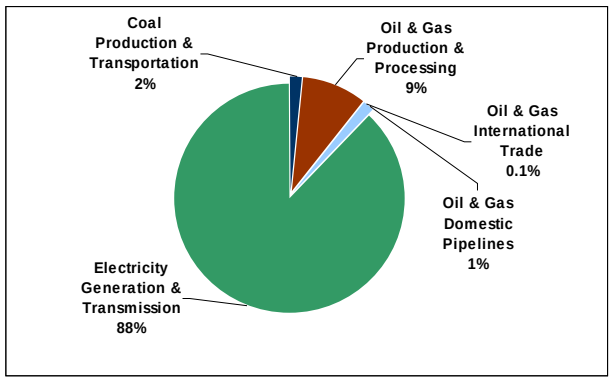
Hydro will maintain the dominant share of 45 percent in the electricity generation mix; however, this is much lower than the 2002 level of 59 percent. Diversification away from hydro will be achieved through increasing the share of other renewables, such as wind and geothermal which will increase their share to 12 and 11 percent respectively by 2030. Overall electricity from renewable sources is projected to account for 75 percent of the electricity generation mix in 2030.

For electricity generation from fossil fuels, natural gas will be a major fuel at 14 percent in 2030. However, the role of coal will become more important as domestic natural gas resources are depleted and emphasis is placed on the use of domestically produced coal.

INVESTMENT REQUIREMENTS

The total investment necessary to support New Zealand's energy infrastructure requirements will reach a total of between US$15-18 billion by 2030. A large part of the investment will be needed for the construction of new and additional electricity generation and transmission facilities reaching about US$13-16 billion by 2030.

Figure 72 Investment Requirements

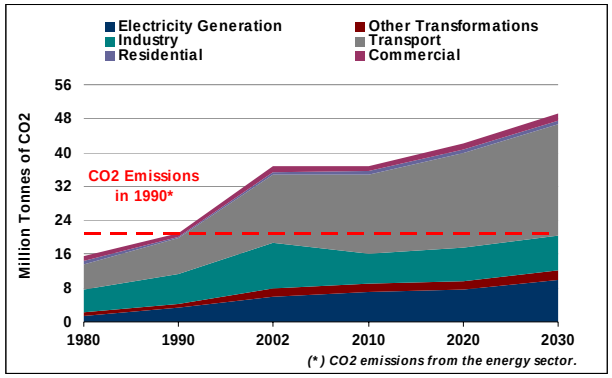


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Over the outlook period New Zealand's total CO_2 emissions from the energy sector are projected to reach 49 million tonnes of CO_2, which is 2.3 times higher than the 1990 level, which will make reductions under the Kyoto Protocol difficult for New Zealand to achieve.

Figure 73 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

By sector, the transportation sector is expected to account for the largest share at 53 percent of total CO_2 emissions or 26 million tonnes of CO_2, followed

by the electricity sector at 20 percent emitting 10 million tonnes of CO_2.

MAJOR ISSUES

SECURITY OF ELECTRICITY SUPPLY

New Zealand is highly dependent on hydro for electricity generation. In 2004, 65 percent of the total electricity generated was supplied from hydro compared with the APEC average at 14 percent in 2002. The heavy reliance on hydro has led to problems in recent years when the storage capacity of hydro reservoirs reached critically low levels. The lack of incentives in the previous market for electricity generators to invest in new generation capacity, which would provide sufficient supply security in very dry years, has prompted government to establish the Electricity Commission in 2003. The Commission is responsible for managing the electricity sector so that electricity demand can be met in a 1-in-60 dry year[81], without the need for emergency conservation campaigns like the voluntary "electricity savings" campaign "Target 10%"[82] that was run in 2001 and 2003.

The economy is also faced with the expected high growth in electricity demand in the Greater Auckland region, which requires added generating and transmission capacity. The electricity demand of the Greater Auckland region is projected to grow by an average 3.8 percent per year to reach an equivalent electricity generation capacity of 3,356 MW in 2025[83], compared with the economy average annual rate of 2.2 percent. The main reason for Auckland's faster growth compared with the economy average is growth in population due to internal migration and immigration. [84] In addition, much of the infrastructure serving this region was built in the 1950's and 60's and is in need of upgrading with the main transmission lines fast approaching capacity loading.[85]

MEETING THE KYOTO PROTOCOL TARGETS

In December 2002 the New Zealand government ratified the Kyoto Protocol, under which the economy was obligated to reduce its CO_2 emissions to the 1990 levels over the period 2008-2012. However, as a result of very robust economic growth over the past five years, greenhouse gas emissions have increased markedly. Although New Zealand's greenhouse gas emissions are only growing at around half the rate of GDP growth, the increase is still significant.

In the latest Greenhouse Gas Inventory for the year 2003, New Zealand's CO_2 emissions came from the following sources: Agriculture 49 percent [86], energy 43 percent and other (industrial processes etc) 5 percent. Within the energy sector, transportation is the largest contributor at 45 percent with emissions having increased by 65 percent over 1990 levels. Carbon intensity improvement in the transport sector is thus seen as the best way for New Zealand to meet its Kyoto Protocol target, but given the lack of public transportation options and the current high energy intensity of this sector, reduction could be difficult to achieve.

The next largest contributor is thermal electricity generation at 25 percent, with emissions having increased by 60 percent over 1990 levels. However, with the depletion of the Maui gas field the mix between coal-fired and gas-fired generation is shifting. For the 2005 March year end, coal provided 38 percent of thermal generation compared with 25 percent in 2004, therefore it is expected that emissions from this sector will increase over the coming years. To reduce emissions from electricity generation the government is promoting the installation/expansion of renewable sources; however, there are more thermal than renewable options to meet increasing demand for electricity under current economic/technological conditions.

IMPLICATIONS

The economy's energy supply and demand structure is likely to change over the outlook period from one where the majority of energy resources are domestically produced to another where a greater proportion of energy resources are imported from international markets. This coupled with New Zealand's commitment to reduce CO_2 emissions under the Kyoto Protocol will have profound implications for the development of the electricity sector in particular.

[81] The amount of hydro storage required to sustain a 1 in 60 year low inflow sequence with all non-hydro electricity supply fully committed.

[82] The aim of the campaign was to reduce electricity consumption by 10 percent.

[83] Transpower (2005)

[84] In 2002 roughly 25 percent of New Zealand's population lived in the greater Auckland region with this share expected to increase to more than one third by 2030.

[85] In 1998 a power failure in Auckland greater reduced electricity supply in the central business district for a number of weeks.

[86] Agriculture is the principal industry of New Zealand and 31.3 percent of New Zealand's total CO_2-eq emissions come from methane produced as a by-product of enteric fermentation of domestic farm animals (cattle, sheep etc), which are not easy to reduce.

A balanced approach to the development of the electricity sector will have to be taken into consideration where all available resources are considered, including domestically produced coal. Government incentives and promotion of clean coal technologies, further research and development of CO_2 capture and sequestration technologies in addition to informed debate on the merits as well as demerits of each energy resource will become more necessary. Failure to look at all possible options – including coal and LNG – could lead to an unbalanced electricity system, which could impact on the economic health of New Zealand.

The introduction and promotion of biofuels in New Zealand would contribute substantially to the reduction of carbon intensity in the transport sector; however, a truly integrated and efficient mass transit rail system within the Auckland region would also contribute significantly to the reduction of carbon emissions in addition to lower point source air pollution, therefore, development and promotion of mass transit systems is one method in which energy efficiency could be greatly enhanced over the outlook period.

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PAPUA NEW GUINEA

- *Papua New Guinea's total primary energy demand is projected to increase from 1.4 Mtoe in 2002 to 3.8 Mtoe by 2030, driven mainly by robust oil demand growth for industry.*
- *The slow rate of oil discovery, depleting reserves and high oil demand growth will make Papua New Guinea a net oil importer after 2015.*
- *The expansion of export markets for oil and natural gas will initiate fuel diversification efforts in the electricity sector.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Papua New Guinea's energy consumption is one of the smallest in the APEC region, at 1.4 Mtoe in 2002. Energy consumption grew robustly at 4.7 percent per year between 2002 and 2005. High rate of industrialisation, growth in infrastructure and improved living conditions have been the key factors for the rising energy consumption over the past years. Oil consumption for new mines has exhibited the fastest growth and accounted for 5.3 percent of the total energy consumption over the past three years.

To support the economy's growing energy needs, Papua New Guinea has intensified the exploration, development and exploitation of indigenous oil and gas resources (both offshore and onshore). As a result, a small new oil field at the South East Mananda has commenced operation and is producing at about 7,000 barrels of oil per day augmenting the economy's low oil production output.

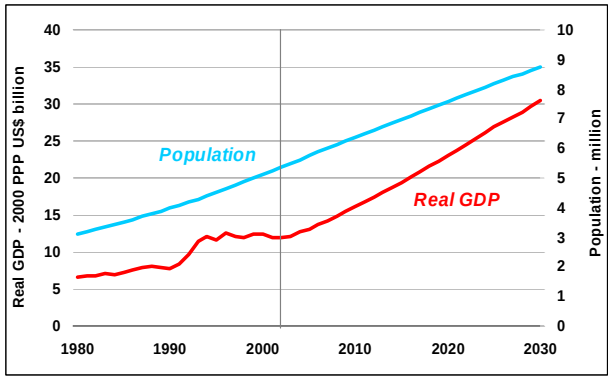
Much of the growth in energy consumption has been from petroleum products and is being met by imports. However, with the commissioning of the first oil refinery in 2004, all petroleum product imports (excluding LPG) have now been replaced by domestic production from the new refinery.

The growing awareness on oil dependency amid depleting reserves has prompted the economy to seek other alternative energy sources. Papua New Guinea has initiated the PNG National Energy Policy Statement and Guidelines document which will among others set the economy's future policy direction on energy.

ENERGY DEMAND DRIVERS

Papua New Guinea's economic performance since the 1990s has generally been weak. Over the last two decades GDP achieved modest growth of 2.6 percent, with GDP per capita increasing only at 0.1 percent annually. Papua New Guinea's export-oriented economy and capital intensive mineral sectors would however be the major area of growth, generating export revenues, particularly from oil and gas. With the strong growth in the industrial sector, the economy is expected to grow annually at 3.4 percent from 2002 to 2030. Expansion and development of infrastructure (in agriculture, mining, and industry) would require sustained growth in energy demand in the same period.

Figure 74 GDP and Population



Source: Global Insights (2005)

High population growth has constrained the economy's development for nearly two decades. Half of the people in Papua New Guinea are still poor and living below the poverty line. Over the outlook period, population is expected to moderately grow at 1.8 percent per year as living conditions improve.

Population is expected to increase from 5.4 million in 2002 to 8.8 million by 2030. Increased agricultural and industrial activities, particularly in mining, oil, and gas exports are expected to generate new and additional jobs, improve living standards and encourage urban migration and movement of people away from rural areas. Urbanisation therefore is expected to increase from 13 percent in 2002 to 20 percent in 2030, and grow at an annual rate of 1.6 percent until 2030, faster than the previous decades of 0.1 percent.

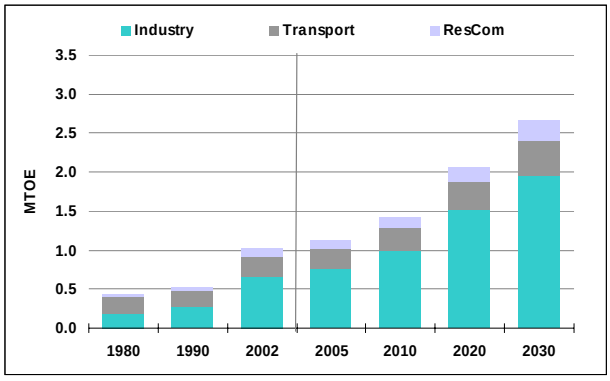
OUTLOOK

FINAL ENERGY DEMAND

Final energy demand is projected to grow annually at 3.5 percent from 1.0 Mtoe in 2002 to 2.7

Mtoe in 2030. The growth is mainly from the industry sector, which will grow from 0.7 Mtoe in 2002 to 1.95 Mtoe in 2030 and will account for 74 percent of the total energy demand, followed by transport (15 percent), and residential and commercial sectors (11 percent).

Figure 75 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 4.0 percent during the outlook period. The robust growth in industrial value-added of 4.0 percent per year, is due to the increased government promotion of local manufacturing industries, which is expected to contribute significantly to this projected growth in energy consumption. With the commissioning of the first oil refinery in 2004, the oil refining industry is expected to play an important role in the economy.

Transport

Energy demand in the transport sector is projected to increase from 0.27 Mtoe in 2002 to 0.44 Mtoe in 2030, growing at an annual rate of 1.7 percent. Despite the steady growth, per capita transportation energy demand will not show much difference through 2030. Underdeveloped road transport infrastructure has placed limitations on the mobility of road transport.

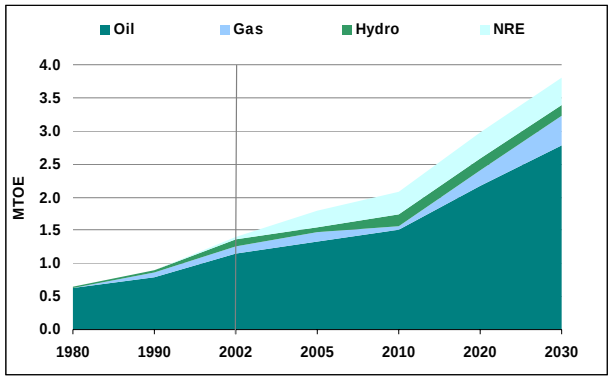
Residential and Commercial

Along with moderate population and income growth and gradual expansion of the industry base[87], energy demand in the residential and commercial sectors[88] is expected to grow at 3.6 percent per year throughout the outlook period, slower in comparison with the previous decade of 5.8 percent. Electricity is the dominant energy source in the residential and commercial sectors and is projected to grow at 4.6 percent annually, driven by moderate spending by consumers as income increases. The share of electricity in the total residential and commercial sectors is expected to increase from 62 percent in 2002 to 80 percent in 2030. Demand for petroleum products is expected to increase by 1.3 percent annually and account for 20 percent of the total residential and commercial energy demand in 2030.

PRIMARY ENERGY DEMAND

Total primary energy demand is projected to grow by 3.6 percent annually over the outlook period. Oil will grow at 3.2 percent and will maintain the dominant share of total primary energy demand at 73 percent by 2030. Oil demand will increase from 1.2 Mtoe in 2002 to 2.8 Mtoe in 2030.

Figure 76 Primary Energy Demand



Source: APERC Analysis (2006)

Oil will maintain the largest share in total primary energy demand and the greatest share of the demand will be concentrated in the industry sector, followed by electricity and transport. The demand for natural gas will be driven by the electricity generation sub-sector.

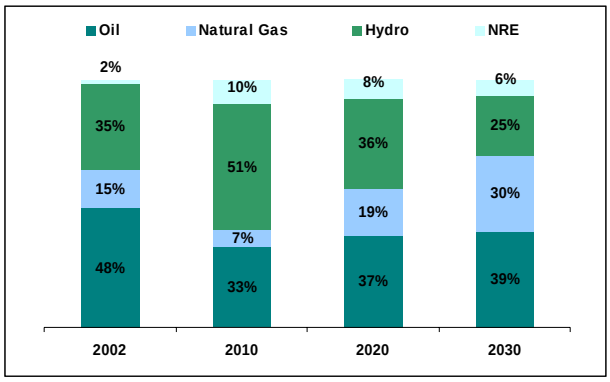
ELECTRICITY

Electricity demand is expected to double from 3.0 TWh in 2002 to 7.8 TWh in 2030 driven mainly by the industry and residential sectors. Electricity demand will be supplemented by hydro, natural gas (starting in 2010) and geothermal electricity generation. In 2030, oil will dominate the electricity generation mix at 39 percent, followed by natural gas (30 percent), hydro (25 percent) and renewables (6 percent).

[87] The PNG government plans to promote small to medium scale enterprises to strengthen the economy as a drive towards the government goal of 5 percent GDP growth in the medium term.

[88] Due to a lack of disaggregated national data for the residential and commercial sectors, energy demand for the two sectors will be combined over the outlook period.

Figure 77 Electricity Generation Mix

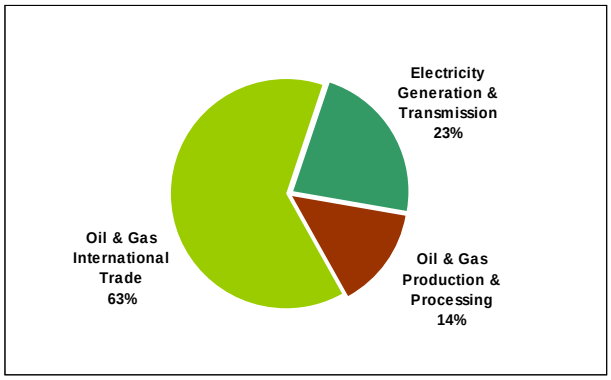


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

Over the outlook period, the total investment requirements necessary to support the economy's energy infrastructure development are expected to reach between US$7.98-9.06 billion in 2030. Investment in oil and gas international trade will have the largest share of 63 percent followed by electricity generation and transmission (23 percent) and oil and gas production and processing (14 percent).

Figure 78 Investment Requirements

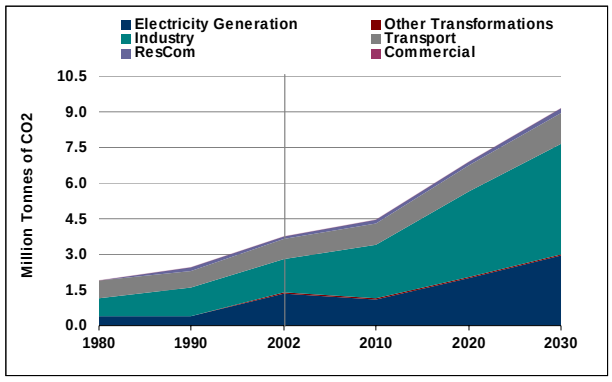


Source: APERC Analysis (2006)

CO_2 EMISSIONS

CO_2 emissions from the energy sector are projected to reach 9.1 million tonnes of CO_2 in the outlook period which is 2.4 times higher than the absolute levels in 2002. The biggest volume of CO_2 emissions will come from the industrial sector. In comparison with other APEC member economies, the increase in CO_2 emissions will still be minimal.

Figure 79 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

Unless new investments in oil exploration are realised, Papua New Guinea's oil reserves will be reduced with the economy becoming a net oil importer after 2015.

In Papua New Guinea's bid to generate the much needed revenues, the economy will build the first natural gas pipeline to Australia. Natural gas export to Australia is expected to commence operation in 2009.

The government has passed amendments to the Oil and Gas Act to fast track the PNG gas pipeline project to export gas to Australia from 2009. The amendment includes licensing provisions which will have a life span of 25-30 years to ensure that the tenure of the petroleum development and pipeline licenses are secured over the life of the project. The "security of tenure" was a fundamental requirement for both investors and lenders to the PNG pipeline gas project.

New fiscal incentives were offered to oil companies which include a reduction in income tax from 50 to 30 percent and removal of the Additional Profit Tax (APT). This incentive is already attracting new investors who are now undertaking exploration activities for oil and gas.

In addition, the government will release the National Energy Policy Statement and Guidelines document in early 2007 in order to clarify policy direction of the energy sector, and to improve investors' confidence, not only in oil and natural gas explorations, but also in infrastructure development.

IMPLICATIONS

Fresh initiatives and incentives offered by the government have attracted modest investments in the energy sector. Perhaps it is the economy's rugged terrain that has increased infrastructure costs and

which has hampered exploitation of resources. In addition, sensitive customary land tenure systems, near uncertain political instability, social conflicts and non transparent and poor governance have all contributed to lukewarm investors' interest. In this regard, the release of the National Energy Policy Statement and Guidelines document will be a good start to clarify the economy's energy policy goal and priorities in the energy sector development and to increase investors' confidence.

Although Papua New Guinea's dependence on imported oil will be inevitable in the next 10 years, it might help to study the optimum use of other indigenous resources like hydro and geothermal for electricity generation. Careful analysis and optimisation modelling of the economy's electricity generation requirements may lean towards coal as an alternative resource (from Indonesia and Australia), rather than using its high valued natural gas for its own electricity generation.

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PERU

- *Peru is projected to be one of the fastest growing economies in the APEC region with GDP growing at 4.1 percent annually over the outlook period; buoyed mainly by increased trade and industrial growth (mining).*
- *Primary energy demand is projected to grow two-fold, at 2.7 percent annually from 12.7 Mtoe in 2002 to 26.7 Mtoe in 2030; with oil for the transportation sector and natural gas for electricity generation expected contribute the most to the increasing demand.*
- *Energy supply security, diversification of energy supply, lag in energy infrastructure development, and environmental protection remain as the major areas of concern.*
- *Between US$29-38 billion in investment will be needed in new infrastructure to support Peru's energy demand growth.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Peru's primary energy consumption grew robustly at 6.1 percent between 2003 and 2004. Natural gas consumption, accounted for the largest share at 83 percent of the total incremental energy consumption growth over the period 2004 to 2005, as a result of strong expansion in the industrial sector, especially the export-oriented minerals mining and processing industries, fishing and agricultural sectors taking advantage of high commodity prices on international markets and fuel switching in the electricity sector from fuel oil to natural gas.

Peru is a net energy importer, mostly for oil and natural gas. An important energy resource is the Camisea gas field which has reduced the economy's oil import dependence over the last two years. Since August 2004 the field has substantially increased the domestic natural gas supply and allowed a large degree of fuel switching from oil to natural gas in the industrial and electricity sectors.

The high growth in energy consumption and constraints in domestic energy supply prompted the economy to diversify the energy supply mix, shifting from oil to natural gas. The economy also has improved electrification level to 77 percent in 2005, and plans to increase this further to 90 percent in 2010.

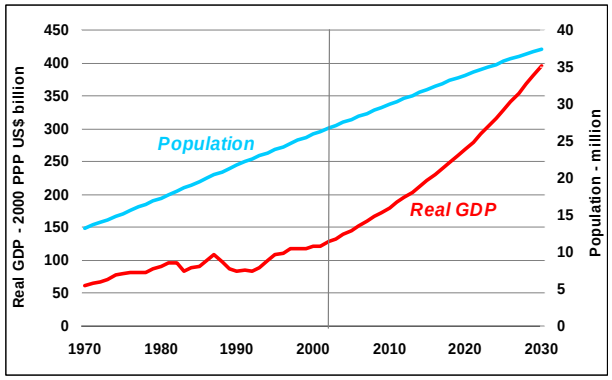
Peru's high dependence on hydro for electricity generation has also become a problem in last five years as a result of changes in rainfall distribution patterns due to the climatic conditions La Niña and El Niño. To address this problem Peru has recently established an energy policy aimed at increasing the use of natural gas for the industry and electricity sectors, while advocating improvement of energy efficiency and regulating energy development such that protection of the environment is achieved.

ENERGY DEMAND DRIVERS

Peru's high economic growth of 4.1 percent over the outlook period (one of the fastest in the APEC region) is expected to underpin the economy's energy demand growth. Increasing population at a rate of 1.2 percent per year until 2030 will most likely contribute to further growth in the energy demand.

Further growth in the mining sector is projected with such prospects as Las Bambas, Michiquillay, La Granja, San Antonio de Poto, Galeno, and Pashpap among others which are expected to begin production over the outlook period. In addition the signing of the US-Peru free trade agreement in 2006 will not only increase trade flows and volumes, but also expand Peru's export market. Despite the potential growth, there are risks surrounding the development of Peru's economy. In the short to medium term, possible changes in the economy's leadership will remain a major constraint for investors concerned about the risk of changing government policies.

Figure 80 GDP and Population



Source: APERC Analysis (2006)

Peru is an increasingly urbanised economy with most of the population living in cities. According to the Peruvian National Statistical Institute, 74 percent of the population lived in cities in 2004 and this is expected to reach 81 percent by 2025. This growth

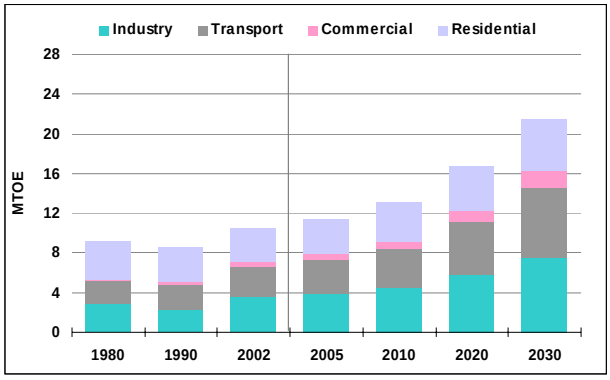
has resulted from internal migration prompted by economic expansion associated with the growth of coastal cities.

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 2.6 percent per year, compared with annual growth in the previous two decades of 0.6 percent. The industry sector will maintain the largest share at 35 percent, followed by transport (33 percent), residential (24 percent) and commercial (8 percent).

Figure 81 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Industry is the largest energy consumer in Peru, with the extraction of non-ferrous metals taking the largest share. Peru is the world's third largest copper producer and the second largest silver producer. Additionally with the commissioning of the Antamina Project (the third largest mining operation in the world), greater levels of zinc and silver production have been observed.[89]

Peru's industrial energy demand is projected to grow at an average annual rate of 2.7 percent until 2030, faster than its average annual growth of 1.0 percent over the past two decades. More than half of the energy required in the industrial sector will be used by heavy industry such as mining, chemicals, metals, non-metallic minerals, quarrying and fishing.

Petroleum products are projected to grow robustly at 1.7 percent per year, accounting for 41 percent of the total industrial energy consumption in 2030. Diesel demand for mining and quarrying, construction, agriculture and the fishing industry is also projected to contribute to the growth in industrial oil demand.

Natural gas is projected to grow rapidly at 9.8 percent per year over the outlook period. Despite its relatively fast growth, the share of natural gas to total industrial energy demand will reach only 1 percent in 2030. Currently, industrial gas use is limited to heat and electricity generation.

Over the outlook period, electricity is projected to grow at an annual rate of 3.2 percent. Mining would account for the largest proportion of the growth in electricity demand.

Transport

Throughout the outlook period, the road transport sub-sector is projected to maintain the largest share in total transportation energy demand. Diesel will be the main fuel which will increase more than two-fold, while gasoline is expected to grow by almost two-fold boosted by the number of ownership to passenger vehicles due to continued income growth over the outlook period.

Government effort to build mass transport systems, starting in Metro Lima will have a significant impact on modal shifts, and the flow of goods and services. Some of the factors which are expected to contribute to the growth in this sector are, rising income and urban migration.

Another effort promoted by the government is the increased use of compressed natural gas (CNG) in buses and passenger vehicles in Lima city, because CNG has become cost competitive with oil due to increasing domestic natural gas production which is exempted from taxes. Also in 2005 the first CNG powered train started operating between Lima and Huancayo.

Residential and Commercial

Over the outlook period, energy demand in the residential sector is projected to increase at an annual rate of 1.5 percent compared with a decreasing rate of 0.7 percent annually in the previous two decades. Electricity demand is projected to grow at an annual rate of 4.2 percent, increasing the share of electricity in total residential demand from 11 percent in 2002 to 24 percent in 2030. Petroleum products in the residential sector are projected to rise at an annual rate of 1.9 percent raising the share of petroleum in total residential demand from 31 percent in 2002 to 34 percent in 2030. LPG is expected to continue to replace biomass for cooking and heating in the residential sector. LPG is the dominant petroleum product consumed in the residential sector and is projected to grow by 3.0 percent throughout the

[89] The start-up of Compañía Minera Antamina S.A. represents the most significant investment in the history of Peruvian mining (approximately US$2.26 billion) and shortly after initiating operations, Antamina swiftly became one of the leading national producers of copper and zinc concentrates.

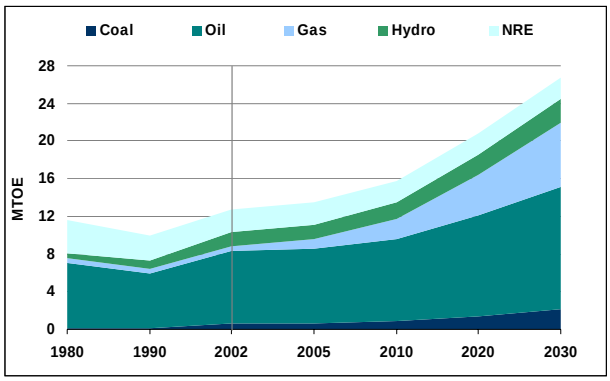
outlook period. Due to the implementation of the rural electrification program, biomass is expected to decline at 0.3 percent pear year until 2030, with the share of biomass decreasing from 58 percent in 2002 to 35 percent in 2030.

The energy demand of the commercial sector is projected to grow annually at 4.5 percent over the outlook period as a result of growth in the value added for services industry. Demand for electricity, the main energy source for the commercial sector, is expected to grow at 5.9 percent per year with the increase in demand for cooling and lighting in commercial buildings, as well as for office equipment use during the outlook period. Electricity will maintain the largest share in the commercial sector from 58 percent in 2002 to 82 percent in 2030. On the other hand, demand for petroleum products are projected to grow by an annual growth rate of 1.3 percent – a slower rate than the previous two decades at 7.9 percent per year.

PRIMARY ENERGY DEMAND

Peru's primary energy demand is projected to grow at an annual rate of 2.7 percent over the outlook period, faster than the previous two decades at about 0.4 percent. Among the fossil fuels, natural gas will grow the fastest rate at 9.8 percent per year, followed by coal at 4.4 percent and oil at 1.9 percent.

Figure 82 Primary Energy Demand



Source: APERC Analysis (2006)

The transport and industry sectors will account for 52 percent and 25 percent respectively of the total incremental oil demand growth between 2002 and 2030. With the rising demand and decline in domestic production, Peru's net oil import dependency is projected to increase from 36 percent in 2002 to 58 percent in 2030. Recognising the economy's vulnerability to outside shocks, Peru has been trying to secure oil supply by intensifying exploration and development efforts in the upstream oil and gas sectors and promoting investment activities in forest areas.

Aside from investment in upstream projects, Peru has also started to promote replacement of oil for natural gas in an effort to change the overall energy mix. Through the "Plan Nacional de Transformación de la Matriz Energética", the Peruvian government plans to promote greater usage of natural gas and targets 25 percent of total primary energy demand in 2030 to come from natural gas, up from 4 percent in 2002.

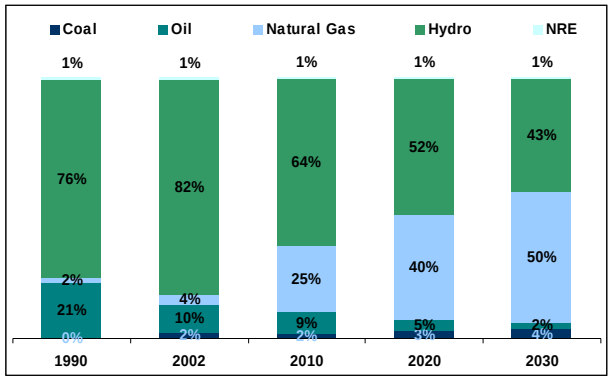
ELECTRICITY

Peru's electricity demand is expected to increase by 4.0 percent per year over the outlook period, to almost triple that of 2002. Despite substantial growth, per capita electricity demand will reach 1,632 kWh in 2030 less than one-fifth of that of the APEC average.

To meet the increasing electricity demand, Peru will continue to rely on natural gas as the most cost competitive option among all other fuel types. Peru is expected to increase the installed capacity of natural gas-fired electricity generation from 0.3 GW in 2002 to 6.0 GW in 2030.

By 2025 hydro is projected to maintain the dominant share in the electricity generation mix. However, from 2026 natural gas will surpass hydro and reach 44 percent in 2030, compared with hydro's 37 percent share in the same year. In Peru's short term electricity plan the government will continue to construct hydro power plants. However, over the outlook period, the construction of combined cycle gas-fired power plants will be promoted which should result in lower electricity tariffs.

Figure 83 Electricity Generation Mix



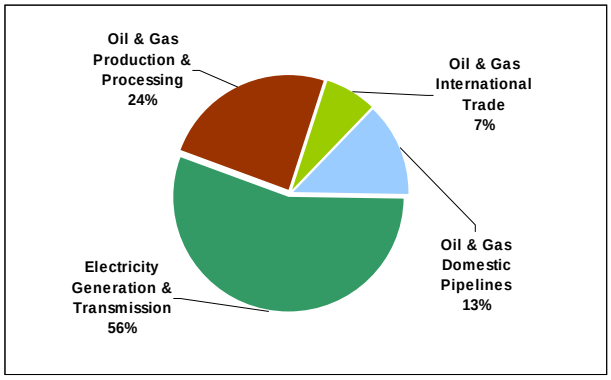
Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

Total investment requirements are projected to reach between US$29-38 billion. Investment in electricity generation and transmission will have the largest share of 56 percent, followed by oil and gas production and processing (24 percent), oil and gas

domestic pipeline (13 percent), and oil and gas international trade (7 percent).

Figure 84 Investment Requirements

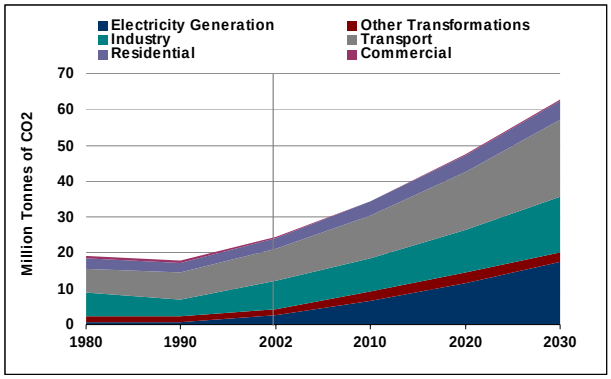


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Total CO_2 emissions from the energy sector will reach 62.9 million tonnes of CO_2 in 2030 which is about 3.5 times that of the 1990 CO_2 emissions level. The growing share of natural gas in the economy's electricity generation mix would slightly reduce total CO_2 emissions and will account for almost 26 percent of total CO_2 emissions while the transport sector will account for 37 percent of CO_2 emissions in 2030.

Figure 85 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

DEVELOPMENT OF THE NATURAL GAS MARKET

Peru has substantial reserves of natural gas. However, the development of a domestic natural gas market has been very slow. Plans to extend natural gas pipeline to other cities have not been realised because of lack of investment.

The government has also been promoting the utilisation of natural gas to replace oil in the energy mix and reduce oil dependency, but with increasing energy imports, combined with depleting domestic resources, concerns for energy supply security have become a very serious concern. Other factors include delay in the development and construction of the Camisea LNG export facilities, expected to be completed in 2009.

ELECTRICITY SUPPLY INFRASTRUCTURE DEVELOPMENT AND REGULATORY REFORM

Driven by economic development, Peru's electricity demand is projected to experience a three-fold increase from 22 TWh in 2002 to 66 TWh in 2030. As a result, the Peruvian electricity sector will have to invest US$16.2-20.7 billion in electricity generation and transmission facilities to meet this expected demand.

Reforms have been undertaken to increase electricity supply security, facilitate investments by the private sector and to improve operational efficiency of the electricity industry. Restructuring of the electricity industry has been carried out since 1992.

REFINERY MODERNIZATION

Since 2004, Peru's state oil company Petroperu has tried to hold international tenders to upgrade its 62,000 b/d North Coast Talara refinery. Petroperu was expected to meet the fuel standards recommended by the World Bank for South American Countries by 2005 but this has been delayed.

A law has been passed which mandates that the sulphur content in diesel fuel in Peru be reduced from the current 5,000 - 10,000 ppm (0.5 – 1 percent) to 50 ppm (0.005 percent) by January 2010. For imported diesel the current sulphur limit is 2,500 ppm. To reduce the sulphur content to 50 ppm will require substantial investment in Peru's refineries. The Ministry of Energy and Mines has indicated that for the two largest refineries, US$ 300 million will have to be invested in each to satisfy the new sulphur standards to be introduced from 2010. These investments will also slightly increase the production capacity, in turn reducing the operating costs, although the degree to which these costs can be reduced is currently unknown. This is a challenging task, given the relatively short timeframe in which the refineries' need to carry out the necessary investments. Thus, it is unlikely that the refiners will be able to deliver the required low sulphur diesel by 2010.

IMPLICATIONS

Growth in the Peruvian economy will translate into substantial growth in Peru's energy demand. Energy supply will be supported by domestic natural gas from the Camisea project and provision made for the development of an LNG terminal for natural gas exports. The biggest challenge therefore is to find a way to sustain growth in the coming years and balance growing energy needs with the economy's strong commitment to protect the environment.

In the electricity sector, elimination of barriers in the transmission network to decongest the system, including: a) enhancing the current development of insufficiently transmission network that culminates in the separation of the system into islands; and b) the improvement of the regulatory framework to reduce transaction costs and facilitate the entrance of new participants. The new regulatory framework should be capable of facilitating investment in new transmission capacity and be profitable for the investors, while also permitting complete access to the system for all users from generation companies through to distribution utilities.

Cross-border energy projects could also provide options to enhance the security of energy supply, through the utilisation of regional cooperation to construct electricity and pipeline interconnections. The establishment of a framework capable of facilitating legislative and technical coordination – similar to the electricity interconnection and trade agreement that was successfully opened between Peru and Ecuador in 2005 – is one method through which Peru could cooperate with neighbouring economies.

The resolution of issues and controversies in relation to maritime borders between Chile and Peru and access to the continental shelf of Bolivia could have very a big impact on regional energy security. Once resolved through regional energy integration; for example through the establishment of an "energy ring" among the neighbouring Latin American economies (Chile, Argentina, Bolivia, Brazil, Paraguay, Uruguay, Bolivia and Peru), energy supply stability could be achieved.

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PHILIPPINES

- *The Philippines' primary energy demand is projected to more than double from 44Mtoe in 2002 to 111Mtoe in 2030, growing annually at 3.4 percent; buoyed mainly by high growth in the demand for petroleum products in the transport sector.*
- *Robust economic growth stimulated by increasing population and demographic changes will further expand the economy's energy demand.*
- *The economy will remain a net energy importer despite efforts to expand the energy resource supply base with renewable energy technologies and alternative fuels.*
- *Between US$68-87 billion in new investment will be required to finance the economy's projected expansion of energy infrastructure; 69 percent or US$61 billion of which will be allocated to the electricity sector.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Over the last two decades, the Philippines' total primary energy consumption increased annually at 3.5 percent. Between 2002 and 2004, oil accounted the largest share at 38 percent, mainly from the transport sector, increasing at 7.2 percent annually over the same period. Industrial energy consumption has also increased due to renewed interests in metal mining as a result of rising international metal prices. The continued expansion of industrial activities between 2002 and 2004 has increased the aggregate consumption of oil, coal and electricity by as much as 1.0 percent per year. Heightened economic activities as a result of improved income, living standards, and increased personal consumption and spending have subsequently contributed to the high energy consumption growth in the commercial sector.[90]

The economy has moderate reserves[91] of oil, natural gas and coal and supplies half of the total domestic energy requirements. Increasing energy consumption has exerted pressure on the economy's indigenous energy production, particularly for oil, natural gas and coal. Coal production increased and reached the highest level of 2 million tonnes[92] in 2004, supplied mostly by the Semirara Coal Corporation. Natural gas production likewise increased from 376 MMCF in 2000 to 94,803 MMCF in 2003, while oil production (from condensate) increased more than six times from 0.3 million barrels in 2000 to 4.86 million barrels in 2003 when the Malampaya oil and gas field started commercial operation in 2001. As a result of these developments, imports have been reduced and the economy's energy self-sufficiency has improved from 50.2 percent in 2002 to 51.9 percent in 2004.

Despite increases in indigenous energy production and improvement in self-sufficiency, rising demand for oil and coal have continued to increase the economy's import dependence thus prompting government to pursue further improvement in policy measures and programmes. Aside from the regular programmes included in the Philippine Energy Plan, the government has initiated legislative measures that would guarantee reduction of import dependence through aggressive promotion for exploration and development of indigenous energy resources, enhanced utilisation of natural gas, continued reforms in the electricity sector, energy efficiency improvements, promotion of alternative fuels in the transport sector and fiscal reforms. These measures are aimed at ensuring adequate, reliable and affordable supply of energy to the economy, with the highest regard on environment and sustainable development. With the government programmes and institutional changes in place, the government hopes to achieve a greater degree of energy self sufficiency over the outlook period.

ENERGY DEMAND DRIVERS

GDP grew steadily at 2.4 percent over the last two decades and is expected to maintain a growth rate of 4.1 percent over the outlook period. The service sector is expected to lead the economy's GDP growth accounting for 60 percent of the total incremental growth of GDP between 2002 and 2030.

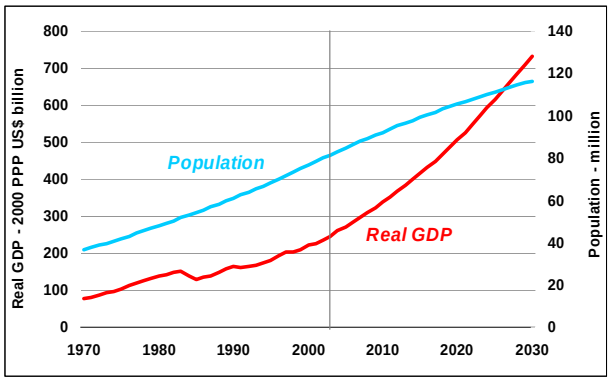
[90] Despite the strong economic growth, the uptrend in GDP growth suffered a slight decline, mainly as a result of heightened oil prices and government's decision to cut back on public services and infrastructure spending to reduce the economy's budget deficit. The slump however was later revived by increased remittances from Filipinos working overseas - now reaching over US$11.6 billion representing 13.5 percent of GDP in 2004 (World Bank).

[91] In 2002, proven oil reserves were estimated at 24 MCM, natural gas at 107 BCM, and coal 399 million tonnes. The Philippines is also the world's second largest geothermal energy producer for electricity generation, next to the US.

[92] Average annual coal production over the last two decades was only 1.2 million tonnes.

Despite government's efforts to limit population increase, population is expected to continue growing at a moderate rate of 1.4 percent over the outlook period. Social and economic opportunities in the Philippines, for the last two decades have been concentrated in Metro Manila or the National Capital Region (NCR) and this trend of internal migration is expected to continue over the outlook period. Based on UN Habitat statistics, the economy's urbanisation level will increase from 60 percent in 2002 to 76 percent in 2030. [93]

Figure 86 GDP and Population



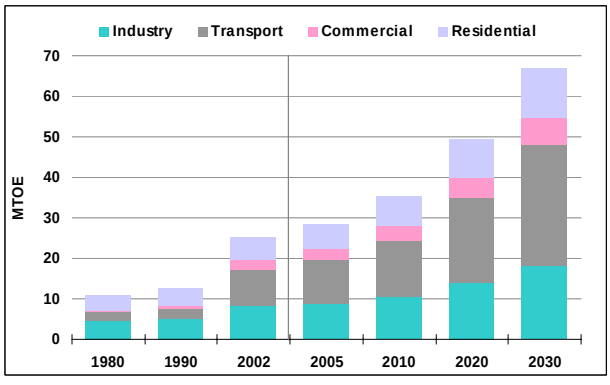
Source: Global Insights (2005)

OUTLOOK

FINAL ENERGY DEMAND

The Philippines' total final energy demand is projected to grow more than two-fold from 25.2 Mtoe in 2002 to 67.1 Mtoe in 2030, at an average annual rate of 3.6 percent. The transport sector will account for the major share at 44 percent, followed by industrial (27 percent), residential (19 percent) and commercial (10 percent).

Figure 87 Final Energy Demand



Source: APERC Analysis (2006)

[93] In contrast, the government has initiated plans to decentralize the economy by establishing growth centres/regions, through which rural areas are developed into urban centres to discourage internal migration to the major urban cities.

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 2.9 percent until 2030, an increase from the average annual growth of 2.5 percent over the past two decades. The higher industrial value-added growth at 4.4 percent per year will result in the slightly higher growth in energy demand of the sector. Expected developments in the energy-intensive mining industry, due to the increased investor confidence following the Supreme Court ruling on the Mining Act of 1995, will also contribute to the faster growth in demand. Major developments in the mining industry include the commercial operation of the Malampaya gas field and the start up of gold, copper and nickel mining operations nationwide. The economy also expects to see robust growth in the petrochemical industry, which is expected to grow at 4.0 percent per year over the outlook period.

The share of renewable energy is projected to remain the largest, but will contract from 48 percent in 2002 to 33 percent in 2030. The share of bagasse, which is largely used in cogeneration in the sugar industry, is expected to decrease as it is gradually replaced by commercial fuels. The share of oil is also projected to decrease from 25 percent in 2002 to 22 percent in 2030, as oil is replaced by other fuels. The demand for natural gas, which is expected to begin in 2007, is projected to grow at an annual rate of 6.3 percent over the outlook period. With the completion and operation of the Batangas-Manila natural gas pipeline in 2007, industries along the pipeline route are expected to source their fuel requirements from the pipeline, consequently replacing fuel oil. As a result of these new connections, natural gas is expected to account for about 8 percent of the total industrial energy demand in 2030. Electricity, on the other hand, is projected to grow at the fastest rate of 4.7 percent per year, as more industries utilize electrical equipment. The share will increase from 16 percent in 2002 to 27 percent in 2030.

Transport

Energy demand in the transport sector is characterised by a heavy reliance on the road transport sub-sector, which accounts for 90 percent of total passenger and 50 percent of freight movement. In urban areas such as Metro Manila, reliance on road transport is high due to the growing number of passenger vehicles, the most popular of which are the 'FX' taxis and passenger 'jeepneys'. Road transport accounts for most of the inter-city travel between Manila and the various provinces in Luzon, including the islands of Visayas and

Mindanao as these islands are linked by provincial highways and bridges which cut travel time by almost half compared with that of marine transport. Traditionally, inter-island travel is undertaken through roll-on-roll-off (RORO) vessels which virtually connect all the islands in the archipelago.

Over the outlook period, road transport energy demand is expected to grow at an annual rate of 4.6 percent, and account for 90 percent of total transport energy demand in 2030. The growth is mainly as a result of the planned decongestion of Metro Manila to distribute economic development and provide new opportunities for growth in other regions. Likewise, increasing income, at an annual rate of 2.8 percent, is projected to contribute to the annual incremental growth in passenger vehicle stocks at 88 thousand vehicles per year. This will translate to a substantial growth in gasoline demand, growing at 4.0 percent per year. Likewise, energy demand for freight transport is expected to grow substantially as a result of increased industrial activity. The amount of freight traffic is projected to increase, in turn driving the demand for diesel at an annual rate of 5.0 percent through 2030.

Residential and Commercial

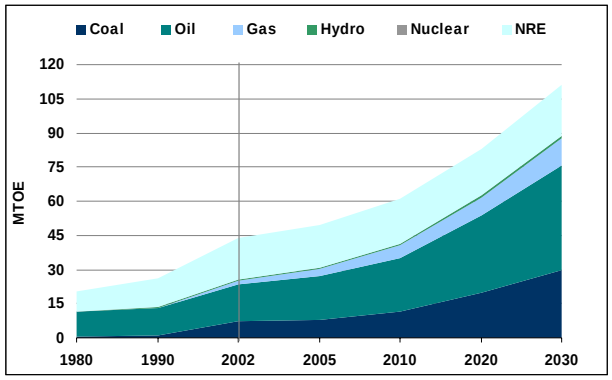
With the increase in population and income growth, energy demand in the residential sector is projected to grow at 2.9 percent per year, faster than that of 1.9 percent over the past two decades. In 2002, the Philippines' residential energy consumption was dominated by biomass (from rice and coconut residues, and wood waste) at 58 percent. However due to the expanded access to electricity and the availability of commercial fuels, the share of biomass in total residential energy demand is projected to decrease from 58 percent in 2002 to 28 percent in 2030. Consequently, limited growth in biomass is expected at a modest rate of 0.2 percent due to the continued use in rural areas as a fuel for cooking. Electricity on the other hand is projected to grow the fastest at 6.5 percent per year and will account for the largest share in total residential energy demand at 56 percent in 2030. As an alternative to kerosene and biomass for cooking, LPG is expected to grow at an annual rate of 3.3 percent and will account for about 14 percent of the total residential energy demand in 2030.

Over the outlook period, commercial energy demand is expected to grow at 3.7 percent per year, mainly as a result of expanded use of electricity in the sector, accounting for 60 percent of the total commercial demand growth. Due to the increasing demand for cooling and lighting in commercial buildings, the share of electricity is expected to increase from 35 percent in 2002 to 60 percent in 2030, growing at an annual rate of 5.7 percent. LPG is expected to account for the second largest share in total commercial energy demand but with a decreasing share from 20 percent in 2002 to 19 percent in 2030, at an annual rate of 3.4 percent. As a result of the substitution with the aforementioned energy sources, the combined share of diesel and heavy fuel oil is expected to decrease from 44 percent in 2002 to 21 percent in 2030.

PRIMARY ENERGY DEMAND

Oil is expected to dominate the economy's primary energy demand at 41 percent, followed by coal at 27 percent and renewables (mostly from biomass) at 20 percent.

Figure 88 Primary Energy Demand



Source: APERC Analysis (2006)

The economy's energy import dependence is expected to increase from 51 percent in 2002 to 68 percent in 2030, importing most of oil and coal requirements for the transport and electricity sectors.

The increasing share of coal will be attributed to the expected growth in the cement industry and the electricity sector. The share of biomass on the other hand is expected to decrease from 42 percent in 2002 to 20 percent in 2030 because of the continuing shift to electricity and LPG for cooking in the residential sector.

Due to the environmental reason, the electricity sector will increase use of natural gas from 1.8 Mtoe in 2002 to 11.8 Mtoe in 2030, growing at an annual rate of 6.5 percent through 2030. The industry sector will also increase the use of natural gas from 0.6 Mtoe in 2002 to 1.4 Mtoe in 2030 as a chemical feedstock.

ELECTRICITY

Electricity demand is projected to grow annually at 5.7 percent over the outlook period. The fastest growth in electricity demand is expected in the residential sector, increasing annually at 6.5 percent, followed by commercial at 5.7 percent and industry at

4.7 percent by 2030. Despite government efforts to expand the economy's mass transport system, contribution to electricity demand in the transport sector will be negligible over the outlook period.

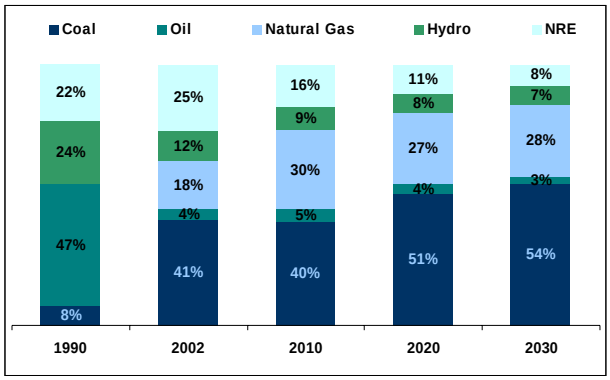
The economy's electricity generation mix has historically been dominated by oil which accounted for 47 percent in 1990, followed by hydro (24 percent), renewables (22 percent) and coal (8 percent).

Over the outlook period, significant changes are expected particularly with the entry of natural gas which will account for an increasing share from 18 percent in 2002 to 28 percent in 2030.

Due to coal's abundance in both domestic and regional supply, and cost competitive advantage over other fossil fuels, coal is projected to account for the largest share in electricity generation mix and will increase from 41 percent in 2002 to 54 percent in 2030, at an annual growth rate of 6.2 percent.

Despite the aggressive promotion of renewables for electricity generation and increased capacity, the share of renewables in the electricity generation mix is projected to decrease from 25 percent in 2002 to 8 percent in 2030, at 0.8 percent per year.

Figure 89 Electricity Generation Mix

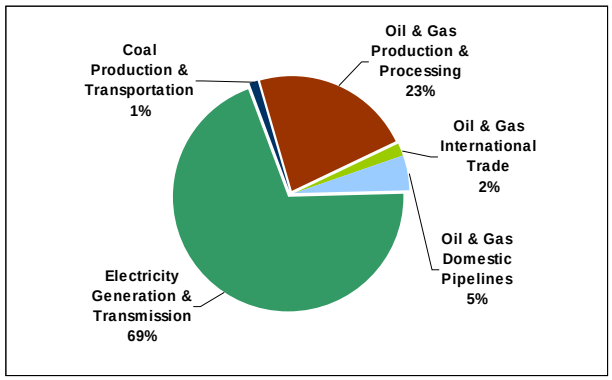


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

The projected growth in energy demand will require the development of energy supply, transformation, transport, and downstream energy infrastructure at an estimated cost of between US$68-87 billion by 2030. Major investment is expected in electricity generation and transformation reaching as high as US$61 billion in the same period.

Figure 90 Investment Requirements

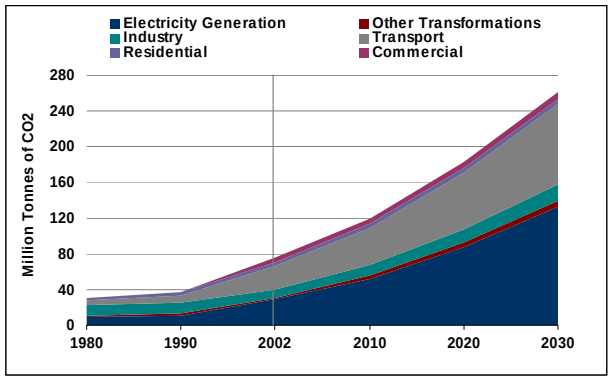


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Measures to move away from fossil fuels, improvement in energy efficiency and conservation, and other emission reduction programmes would contribute to the slower growth in CO_2 emissions despite the economy's robust energy demand growth. Over the outlook period, CO_2 emissions are expected to grow at 4.6 percent per year and will reach a total of 262 million tonnes of CO_2 in 2030.

Figure 91 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

REDUCING IMPORT DEPENDENCY

Despite government efforts to expand the economy's domestic energy production, the Philippines is still expected to remain a net energy importer over the outlook period.

Since the economy's oil imports are mostly utilised in the transport sector, reducing oil dependence in the sector will remain the biggest challenge. To this end, the economy has aggressively introduced and promoted the use of biofuels such as coco methyl ester (CME), ethanol, gasohol, alcogas and LPG for transport. The success of the programme however hinges on the economic viability of establishing new production facilities, increasing

biofuel feedstocks, and the issuance of necessary incentives to attract prospective investors.

IMPLICATIONS

ENERGY SECURITY

The Philippines has been very active in promoting investments in the upstream and downstream energy sectors. The Public Contracting Rounds which the economy has initiated starting in 2003 has generated more areas in oil, natural gas and geothermal for new investments. New service contracts have also been awarded which would expect further increases in future supply for oil, natural gas and geothermal. The success of this programme together with other legislative measures expects to help improve the economy's self sufficiency or import dependency in the next 30 years.

However, despite these efforts, the economy still lags behind other APEC member economies in terms of foreign capital flow. The business sector still considers the slow privatisation process in the electricity sector, delays in the economy's fiscal and political reforms, including the slow process of legislative approval of important energy measures, as contributory factors to the lack of investor interests. The lack of appropriate energy infrastructure will contribute the biggest bottleneck in terms of delivery of energy to all economic sectors.

The economy may also have to rethink the role of natural gas in the economy's electricity generation mix as the primary fuel with due consideration on the current and projected resource potential and the necessary infrastructure development against that of coal, which is a more abundant and cost competitive energy resource.

The Philippines has foreseen the need to forge ties with international communities especially with the ASEAN on the posing threat of global energy supply shortages. The economy is an active member of the APEC, ASEAN, Asian Cooperation Dialogue (ACD), as well as other bilateral undertakings which translated into numerous agreements, MOUs and joint cooperation with other economies. For example, an MOU was signed in 2005 between the Philippines and Indonesia to cooperate in the long-term coal, oil and gas supply, including geothermal development. Maintaining cooperation and facilitation of trade could guarantee the security of supply across regions.

ALTERNATIVE FUELS

The economy is aggressively promoting the development of alternative fuels from indigenous agricultural wastes. The main problem however the economy may face in the future is the conflict between energy security and food security. If left unchecked, feedstock for ethanol and coco methyl ester will compete with the current demand for sugar and coconut products (both important export commodities) and might result again to unwarranted imports and increased prices.

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RUSSIA

- *Russia's primary energy demand is projected to grow at 0.7 percent per year over the outlook period; buoyed mainly by increasing demand for oil and gas in the industry and transport sectors.*
- *Significant energy conservation and economic restructuring efforts would help reduce the economy's very high energy intensity.*
- *Amendments to energy-related laws, regulations, and codes will stabilise the institutional framework and strengthen investor confidence; therefore facilitating the smooth inflow of investment into the energy sector.*
- *As a major world energy exporter, Russia is expected to strengthen regional energy trade and cooperation with both Northeast Asian and American neighbours, while maintaining a strong position in the traditional European market.*
- *Tapping hydrocarbon resources in the north of West Siberia, East Siberia and the continental shelves of the Arctic and Pacific Ocean's should augment depleting reserves from traditional oil and gas fields in other provinces.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Russia is the world's third largest energy consumer. Primary energy consumption has grown robustly over the last five years at 2.5 percent while GDP growth reached 7.1 percent in 2004, surpassing the average growth rates of the other G8 economies. In 2005, natural gas accounted for the largest share of primary energy consumption at 56 percent, followed by oil at 18 percent, and coal at 16 percent. Due to the extremely cold climate across the economy, the most important use of natural gas is space heating.

Russia meets all of its energy requirements by domestic production, having the world's largest natural gas reserves, the second largest coal reserves and the eighth largest oil reserves. However, with depleting oil and gas reserves in the economy's traditional oil and gas bearing provinces, the economy has been prompted to explore for new acreage.

Russia is the world's largest exporter of primary energy. In 2004, Russia exported a total of 520 Mtoe, of which 330 Mtoe was oil, 168 Mtoe was natural gas and 22 Mtoe was coal.[94] Energy exports have been the major driver for Russia's economic growth, accounting for 25 percent of GDP and 65 percent of export revenues.

As a result of Russia's increasing energy consumption over the past decade and the need to reduce the economy's energy intensity while sustaining Russia's export position, the Federal Government approved the "Energy Strategy of Russia to 2020", in August 2003, outlining the economy's long-term energy policy.

Important features of the policy include: a) greater emphasis on energy efficiency through economic re-structuring and demand-side management; b) establishment of market-based energy pricing mechanisms; c) exploration and development of new oil and gas bearing provinces and modernization/expansion of export facilities; d) diversification of export markets; e) development and construction of new generation nuclear technologies, particularly closed nuclear fuel cycle; and f) refurbishment of gas-fired power plants with combined-cycle technologies.

The Federal Government has also recognised the importance of improving the economy's institutional framework through amendments to the Sub-soil law, tax codes and industry regulations to promote further investment in the energy sector.

ENERGY DEMAND DRIVERS

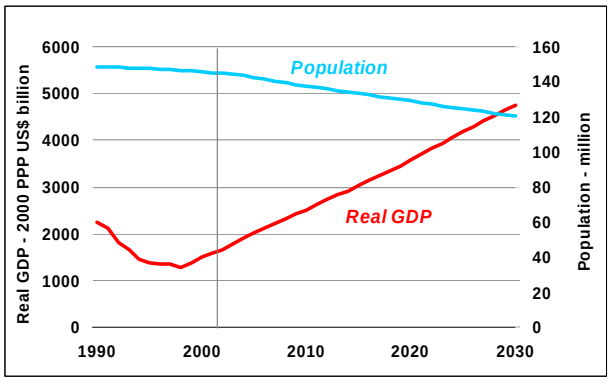
Russia's energy consumption is mainly driven by increasing economic activity, boosted in part by high world energy prices. GDP has grown steadily at an average annual rate of 5.1 percent since economic recovery started in 1999 as a result of the re-valuation of the national currency in 1998; later supported by soaring world energy prices starting in 2000.

Over the outlook period, GDP is expected to continue to grow, although at a slower pace increasing at an average annual rate of 3.8 percent.

By contrast, Russia's total population is expected to decline from 145 million in 2002 to 121 million in 2030 and will have a major impact in both the residential and commercial sectors, as standard of living improves across the economy. The urbanisation level is expected to increase from 73 percent to 78 percent, over the same period.

[94] BP (2005)

Figure 92 GDP and Population



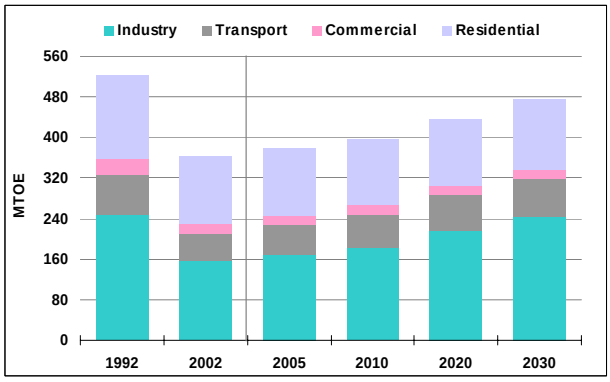
Source: Global Insights (2005)

OUTLOOK

FINAL ENERGY DEMAND

Final energy demand is expected to grow at 1.0 percent per year over the outlook period, compared with the negative growth rate of 3.5 percent in the previous decade. The industrial sector is projected to account for the largest share at 51 percent, followed by residential (29 percent), transport (16 percent), and commercial (4 percent).

Figure 93 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Industrial energy consumption fell sharply in the early 1990s following the dissolution of the Soviet Union, however demand is projected to recover and grow at an average annual rate of 1.6 percent until 2030. The growth rate will be less than half the growth of industrial sector's value-added, at 4.1 percent per year during the same period, resulting in a substantial decline in energy intensity[95] at an average annual rate of 2.4 percent. The expected technological retrofitting of industrial facilities and the effects of subsidy cuts on energy prices would contribute to the decline in industrial energy intensity. Many of the economy's industrial facilities are antiquated and technologically obsolete. National statistics show that in 2002, the average age of industrial facilities and equipment was 20 years. [96] The replacement of these facilities is crucial for the development of Russia's industry and through the introduction of advanced technologies, energy savings could be realised. Moreover, higher energy prices are expected to provide the major stimulus for energy efficiency improvements in the long term. Therefore, by 2030 industrial energy demand is expected to reach only to a similar level in 1992 despite the substantial increase in industrial activities.

Over the outlook period, a significant change in the fuel mix is expected. Natural gas is projected to represent the highest growth of 2.4 percent per year, and will account for 34 percent of industrial energy demand in 2030. In addition, oil and electricity are projected to grow robustly at 2.2 percent and 2.1 percent per year, respectively. The increasing share of gas, electricity and oil in industrial energy demand is as a result of manufacturer's increasing on-site heat generation. Demand for refinery gas as a feedstock for ethylene is projected to grow at 4.2 percent per year reflecting the rapid growth of ethylene production of 4.5 percent per year.

Transport

Russia's transport energy consumption has been declining from 1992 to 2002 at an annual rate of 3.7 percent. Economic downturn has reduced the volume of passenger travel by about 30 percent and freight traffic by about 20 percent. Lack of modern transportation infrastructure, including highways and ports, has been the bottleneck for inter-city passenger travel and logistics activities.

With the projected economic growth and subsequent increases in energy demand of 1.3 percent per year, substantial increase in passenger travel and freight traffic are expected; driving further growth in transport energy demand. Rising income and development of vehicle manufacturing industries will gradually increase passenger vehicle ownership from around 148 per 1,000 populations in 2002 to about 450 per 1,000 populations in 2030.

Energy demand in road transport will maintain the largest share at around 70 percent, and is expected to grow at an annual rate of 3.0 percent over the outlook period. In urban areas, the improvement in living standards and increased

[95] The amount of energy needed to produce a dollar's worth of industrial sector's value added.

[96] GKS (2004)

vehicle production will facilitate the shift from public transportation systems to passenger vehicle utilisation for commuting, thereby resulting in a two-fold increase in gasoline demand. Economic recovery will increase the distance of freight movement. With the expected increase in road freight traffic, the government is planning to upgrade the existing highway networks and developing new ones. Over the outlook period, trucks are expected to replace a substantial portion of rail for freight movement as export of manufactured products to neighbouring European countries continues to grow in the future.

With the steady growth of all transport sub-sectors, per capita transportation energy demand will grow from 0.37 toe in 2002 to 0.63 toe in 2030.

Residential and Commercial

Energy consumption in the residential and commercial sectors in 2002 accounted for 33 percent of total final energy consumption, half of which was heat. However, the energy efficiency of heat generation is low. The government planned to improve the efficiency of heat generators, district-heating systems, and the insulation of apartment and office buildings. A structure shift in design and type of construction for buildings is expected over the outlook period; meaning more energy-efficient apartment and office buildings. The synergistic effect of the government's energy efficiency programs and decline in population will result in limited energy demand growth, mainly driven by the additional space heating and lighting requirement for new buildings, particularly in the residential sector.

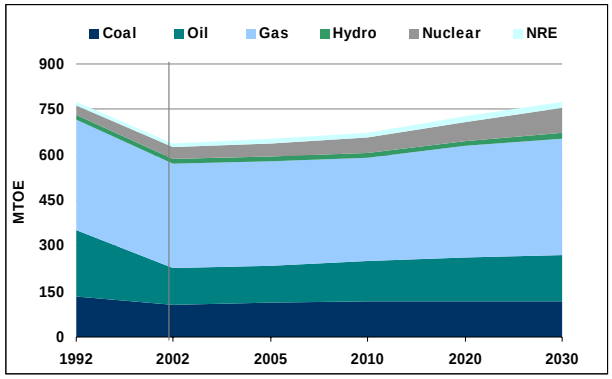
Russia's residential energy demand is expected to grow slowly at 0.1 percent per year over the outlook period. The negligible growth in total residential energy demand would result from the decrease in both centralised heat and coal for small boilers, being compensated by the increase in more efficient natural gas, electricity and petroleum products. With energy efficiency improvements in housing, demand for heat energy is projected to decline by 0.6 percent annually, with the share in total residential energy demand declining to 41 percent in 2030 from 50 percent in 2002. Natural gas is projected to maintain the second largest share in total residential energy demand, accounting for 38 percent in 2030. By replacing coal by natural gas, natural gas demand is expected to grow at 0.8 percent per year, which is faster than the historical growth of 0.4 percent between 1992 and 2002. Consistent with income growth and improving living standards, electricity is expected to grow at 1.0 percent per year throughout the outlook period and the share will increase to 12 percent in 2030 from 9 percent in 2002.

With efficiency gains, energy demand in the commercial sector is projected to decline at an average annual rate of 0.3 percent. The decline is mainly due to the decrease in heat demand, the share of which is expected to decrease from 52 percent in 2002 to 26 percent in 2030 in total commercial energy demand. Heat demand is projected to decline at an annual rate of 2.7 percent. Consistent with the value added for services industry growth, electricity demand is expected to grow at 2.2 percent per year over the outlook period. Consequently the share of electricity is projected to increase from 29 percent in 2002 to 57 percent in 2030, accounting for the largest share of total commercial energy demand. By fuel type, natural gas demand is projected to decline at 0.8 percent per year, slower compared with the 11.4 percent annual decline observed between 1992 and 2002. As a result, natural gas is expected to meet 10 percent of total commercial energy demand in 2030, compared with 12 percent in 2002. LPG is projected to continue to replace coal and compete with natural gas in the commercial sector. Subsequently, LPG demand is projected to grow slowly at 0.1 percent annually and account for a 5 percent share of total commercial demand in 2030.

PRIMARY ENERGY DEMAND

The projected decoupling of economic growth and energy demand will result in modest annual growth in total primary energy demand of 0.7 percent, reaching 769 Mtoe in 2030. Nuclear is expected to grow the fastest at 2.8 percent per year, followed by renewables at 1.8 percent per year. Coal and natural gas are both expected to grow slowly at 0.4 percent per year.

Figure 94 Primary Energy Demand



Source: APERC Analysis (2006)

The high growth in nuclear energy is a result of the proposed policy to accelerate the build up of the nuclear industry, which includes the construction of

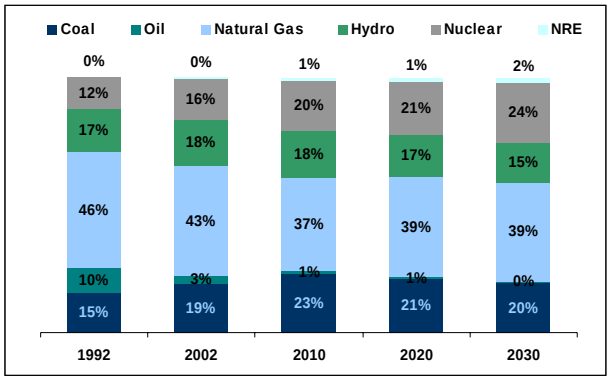
new generation reactors and the utilisation of closed nuclear fuel cycle. The unfavourable distribution of vast untapped hydro resources in East Siberia and the Russian Far East to electricity load centres in the European part of the economy will result in a relatively low 0.7 percent growth for hydro energy development. Although starting from a low base renewable energy will grow and account for the second highest average annual growth rate compared with other fuels, due to rapid development of biomass for heat generation, small hydro and wind energy for electricity generation.

Oil demand will increase at 0.8 percent per year over the outlook period driven by the high growth in demand for motor fuels and rapid industrial development, although its share in electricity and heat generation will decline. The increasing demand for natural gas and coal is mainly for electricity generation.

ELECTRICITY

Electricity demand is projected to grow at 1.9 percent, requiring the economy to increase installed generation capacity from 223 GW in 2002 to 352 GW by 2030. Natural gas would be the main input fuel for electricity generation with a share of 39 percent, followed by nuclear (24 percent), coal (20 percent), and hydro (15 percent). Electricity generation from renewables is expected to increase robustly at an average annual growth rate of 7.4 percent for the next 28 years; despite the share in electricity generation would remain relatively small at 2 percent in 2030. Oil will be the major fuel for remote on-site electricity generation in isolated areas, in particular for northern regions and the Russian Far East.

Figure 95 Electricity Generation Mix

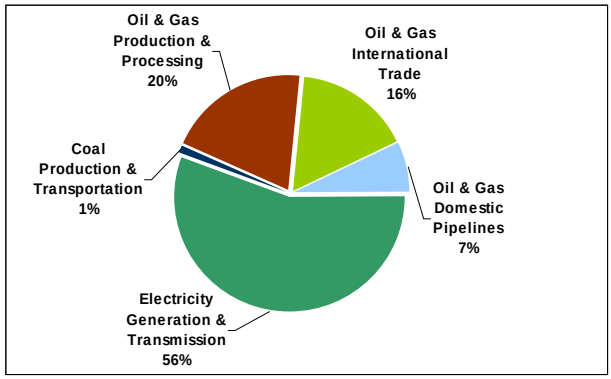


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

Total investment required over the outlook period is estimated between US$709-923 billion. Of this, expansion of electricity generation capacity and transmission would require investments of US$405-513 billion. In addition, between US$295-401 billion will be needed for oil and natural gas exploration, production and infrastructure development through 2030.

Figure 96 Investment Requirements

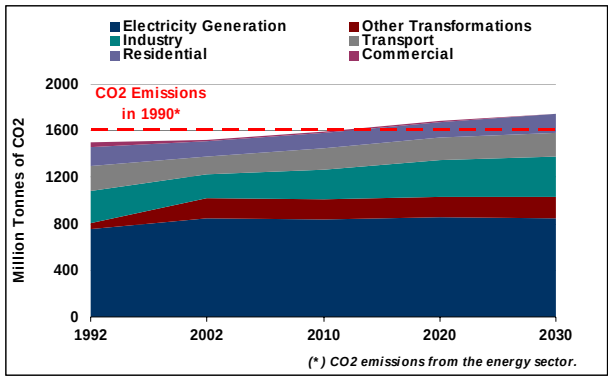


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Over the outlook period Russia's total CO_2 emissions from the energy sector are projected to reach 1,749 million tonnes of CO_2, which is 9 percent higher than the 1990 level. The CO_2 emissions from the electricity sector are projected to contribute 48 percent of the total emissions or 843 million tonnes of CO_2.

Figure 97 CO_2 Emissions by Sector



Source: APERC Analysis (2006)[97]

MAJOR ISSUES

REDUCTION OF ENERGY INTENSITY

Russia is the world's third largest energy consumer, due partly to the antiquated and

[97] In the case of Russia, the historical IEA data from 1992 to 2002 combines the CO_2 emissions from electricity and heat generation into one sector. However, the outlook has disaggregated these into two sectors, namely; electricity generation and other transformations, which explains the sharp increase in other transformations sector.

technologically obsolete industrial and energy supply infrastructure. Over the last decade, few investments have been made to improve the economy's industries, which has given rise to Russia's industrial energy intensity increasing from 352 toe per US$ million in 1992 to 381 toe per US$ million in 2002, which corresponds to an annual growth rate of 0.8 percent. In addition, over the same period, electricity and heat supply systems have not been upgraded and are in critical need of modernization. Areas for modernization include refurbishment of electricity/heat generation facilities to improve energy efficiency, retrofitting of existing gas-fired power plants with combined-cycle gas turbine technology, implementation of clean coal technologies, and replacement of obsolete equipment on transmission networks and district heating systems.

Deregulation of gas prices is another critical issue for energy conservation and economic development. This will improve the economics of energy conservation by removing the energy waste potential partly encouraged by state-controlled low gas prices. Energy intensive industries, electricity generation and heat production have been subsidised by gas producers to the detriment of gas exploration and extraction development. Establishing fair energy pricing practices and eliminating subsidies and cross subsidies are critical for radical energy efficiency improvement and for attracting investments for energy infrastructure rehabilitation and construction.

The current Russian refining industry has the lowest yield of light products among APEC member economies, except for Mexico. Refinery refurbishing is urgent to meet strengthening fuel quality standards in Russia.

EXPANSION OF EXPORT FACILITIES AND OUTLETS

Upgrading and construction of advanced oil and natural gas production facilities – for example enhanced oil recovery – and exploration of new frontier areas are necessary to meet domestic demand as well as maintaining and increasing export capacity. Potential frontier areas under consideration are the natural gas fields in the Yamal peninsula, oil and natural gas bearing provinces in East Siberia and offshore areas in the Pacific and Arctic Oceans.

The expansion of export infrastructure and diversification of export destinations could contribute to the security of oil and natural gas markets. More than 90 percent of Russia's oil and gas production is currently exported to European economies. Therefore, the expansion of export infrastructure will lead to a significant increase in exports to the Asia-Pacific and North America regions.

NUCLEAR INDUSTRY DEVELOPMENT

With advanced nuclear technology, Russia has a huge potential for utilisation of nuclear energy. The economy's national energy strategy has included: a) provision for the development of a nuclear fuel cycle that utilizes spent nuclear fuel to generate electricity, to meet the economy's growing electricity demand, and b) the export of nuclear-based technologies and associated services. However, nuclear electricity generation is likely to encounter challenges pertaining to public acceptance and international nuclear safety concerns, among others, just as in other economies.

IMPLICATIONS

In order to meet the growing domestic demand and maintain its position as the world number one energy exporter, Russia has to invest heavily in oil and gas exploration and development in new frontier areas.

The favourable combination of vast energy resources and access to the world's main energy markets provide a perfect opportunity for domestic and international businesses to invest in Russia, but a large amount of investment capital is required over the outlook period. Therefore, in order for these investments to be realised, it is critical that the government and the business sector ensure that funds are properly managed through amendment of the economy's laws and regulations.

Stable laws, tax codes and regulatory frameworks would help modernise Russia's energy industry and by facilitating smooth inflow of investment capital into the economy.

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SINGAPORE

- *Singapore's primary energy demand is projected to grow at 2.8 percent annually between 2002 and 2030, spurred by increased demand for gas in electricity generation. Gas demand in the electricity sector is expected to increase to 14.5 Mtoe in 2030 from 2.9 Mtoe in 2002.*
- *Expansion of the refining industry will sustain oil demand growth in the next 28 years and help maintain the economy's role as an oil trading hub. Likewise, the strategy to diversify natural gas supply and plans to be a trading hub for natural gas will increase natural gas demand.*
- *The absence of indigenous energy resources, high dependence on imported oil for transport fuels and oil product trade will push the economy into developing new energy efficiency and conservation measures.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Singapore's primary energy consumption increased from 35.0 Mtoe in 2000 to 44.1 Mtoe in 2004, primarily from oil and gas spurred by the resilient growth in the industry and transport sectors.[98] The energy mix has seen a major shift in recent years. As a result of switching from oil to natural gas in electricity generation, Singapore has dramatically increased the consumption of natural gas since 2001 when the economy started importing natural gas from Indonesia. From 2000 to 2004, the share of natural gas in primary energy consumption increased from 5 percent to 20 percent. By contrast, the share of oil in total primary energy consumption decreased from 95 percent to 80 percent over the same period.

Not having its own energy resources, Singapore relies entirely on imported oil and gas to meet the economy's growing energy requirements. More than half of Singapore's oil import was re-exported, while the other half was retained for domestic use.

Singapore is the third largest refining centre in the world after the US Gulf Coast, and Rotterdam, and the primary refined products trading hub in Southeast Asia. Singapore also serves as the world's top bunkering port due to the economy's strategic location at the entrance to the Strait of Malacca.

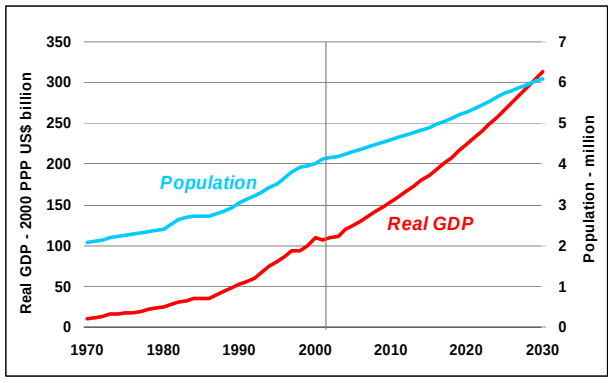
To ensure supply security, Singapore is seeking to diversify natural gas supply sources. The economy has undertaken a study to investigate the feasibility of importing liquefied natural gas (LNG) and the construction of LNG receiving terminal by 2012.

Most of the industrial activities in Singapore – refining and petrochemicals – use oil as the feedstock and are fairly carbon intensive. Therefore, as a means to minimise the burden to the environment resulting from the utilisation of oil, Singapore has recently initiated the "Singapore Green Plan 2012", which anticipates reducing CO_2 emissions by at least 25 percent of the 1990 level by 2012. The Plan outlines strategies to achieve the target through greater energy efficiency improvement, use of cleaner energy sources in the industry, commercial, and transport sectors. Some of the measures adopted include: 1) voluntary energy-efficiency labelling for appliances and buildings, 2) fuel switching in electricity generation, and 3) introduction of "green vehicles" (such as hybrid, and CNG).

ENERGY DEMAND DRIVERS

Singapore's GDP is expected to grow at an annual growth rate of 3.8 percent over the outlook period. The growth will continue to be led by the services and industrial sectors.

Figure 98 GDP and Population



Source: Global Insights (2005)

Over the outlook period, Singapore's population is projected to grow at a slower rate of 1.4 percent per year, compared with the 2.5 percent growth in the past two decades. The slower rate of growth reflects the economy's low fertility rate, which has been declining over for the last two decades. Population is expected to increase from 4.2 million in 2002 to 6.1 million in 2030.

[98] BP (2005)

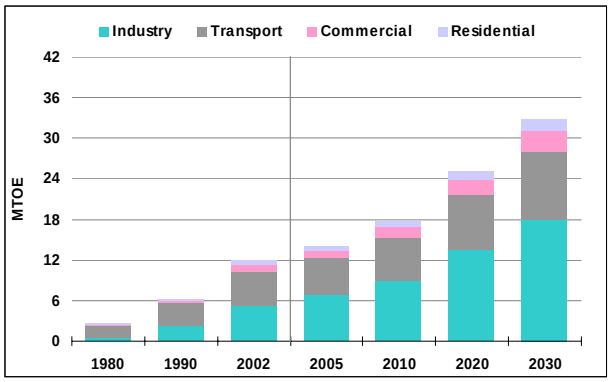
Singapore being a small island economy is highly urbanised and will remain so over the outlook period at 100 percent.

OUTLOOK

FINAL ENERGY DEMAND

Singapore's total final energy demand is projected to grow at an annual rate of 3.7 percent from 12 Mtoe in 2002 to 33 Mtoe in 2030. Industry sector will maintain the largest share at 55 percent, followed by transport (30 percent), commercial (10 percent), and residential (5 percent). The commercial sector and the transport sector are both expected to grow fast at 4.4 percent per year during the outlook period.

Figure 99 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 4.4 percent until 2030. The robust growth will be mainly driven by planned developments in the energy-intensive petrochemical industry, which accounted for about 29 percent of the total manufacturing value added in 2002, and 81 percent of total industrial energy demand. Singapore plans to remain the leading refining centre and refined products trading hub in Asia. Recent developments in the petrochemical industry include the start-up of the second naphtha cracker plant by Petrochemical Corporation of Singapore and a US$200 million synthetic gas plant by Messer and Texaco on Jurong Island. In addition, ExxonMobil has proposed to expand existing ethylene cracking production capacity to more than 900,000 tonnes per day by 2006. Royal Dutch Shell also plans to set up a new naphtha cracker facility with a production capacity of 900,000 tonnes per day in 2009. As a result of these capacity expansions, demand for naphtha is projected to grow at an average annual rate of 4.9 percent and account for 85 percent of total industrial energy demand in 2030. Due to the capacity expansions of energy intensive petrochemical industry, energy intensity[99] in the industrial sector is expected to increase at an average annual rate of 0.3 percent from 137 toe per US$ million in 2002 to 150 toe per US$ million in 2030.[100]

Transport

Given the small land area (650 km^2) and high population density (at 6,425 persons/km^2), Singapore has been developing a comprehensive road transport system that can efficiently handle both freight and passenger transport. In particular, Singapore has been striving to reduce dependence on passenger vehicle and encourage the use of public transport. With the implementation of various economic instruments such as mandatory acquisition of a certificate for passenger vehicle ownership, and electronic road pricing on congested roads, Singapore has successfully slowed the growth in the number of passenger vehicles and consequently gasoline consumption.

Over the outlook period, energy demand for road transport sub-sector is expected to grow at an annual rate of 2.2 percent. Gasoline demand for passenger vehicles will grow by 1.8 percent annually, a slower rate than the previous three decades at 3.8 percent per year. As a result of the implementation of various economic instruments which limit passenger vehicle ownership, the number of vehicles per 1,000 population will not show any significant change from the 2002 level, remaining at around 102 per 1,000 population. Diesel demand for trucks is projected to grow annually at the steady rate of 2.4 percent since trucks are favoured as the main mode of freight transport for high value added manufacturing and petrochemical products.

Singapore's Changi international airport serves as a regional air transport hub and ranks as the second largest in Asia in terms of passenger handling capacity. In anticipation of the increasing number of passengers and volume of freight air transport, Singapore has been continuously upgrading airport facilities and promoting bilateral agreements with neighbouring economies on "open sky" initiatives that will facilitate the free flow of passengers and freight transport. As a result, the demand for jet kerosene, the primary fuel for air transport, is projected to grow robustly, more than doubling from 2.9 Mtoe in 2002 to 6.2 Mtoe in 2030.

[99] The amount of energy needed to produce a dollar's worth of industrial sector's value added

[100] Between 1980 and 2002, energy intensity in Singapore's industrial sector increased at an annual average rate of 5.9 percent as a result of drastic expansion of petrochemical industries.

Residential and Commercial

Singapore is a highly urbanised economy and utilises mainly electricity and gas in the residential and commercial sectors for space cooling and cooking.

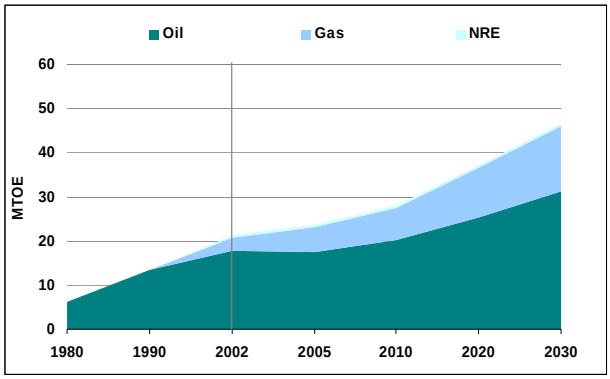
Energy demand in the residential sector is projected to grow at an annual rate of 3.7 percent over the outlook period, slower than the average annual growth rate of 5.4 percent over the past two decades. Demand for electricity, the major energy source in the residential sector, is expected to increase at 3.7 percent per year and account for 92 percent in 2030. Gas demand, on the other hand, is projected to grow at an annual rate of 3.1 percent and account for 8 percent of total residential energy demand in 2030.

Electricity is the only energy source utilised in the commercial sector. Over the outlook period, electricity demand is expected to increase at an annual rate of 4.4 percent, lower than the average annual growth rate of 8.1 percent in the past two decades. Faster growth in electricity demand is expected as a result of strong growth in the service sector, supported by the government's policy to maintain Singapore's position as Southeast Asia's financial and high-tech hub.

PRIMARY ENERGY DEMAND

Primary energy demand is projected to grow at an annual rate of 2.8 percent, from 21 Mtoe in 2002 to 47 Mtoe in 2030. Natural gas will grow the fastest rate at 5.8 percent per year, followed by oil at 2.1 percent during the same period.

Figure 100 Primary Energy Demand



Source: APERC Analysis (2006)

Demand for natural gas is projected to increase dramatically from 3.1 Mtoe in 2002 to 14.7 Mtoe in 2030. Natural gas demand will be largely driven by the electricity sector, accounting for almost all of the total incremental growth up to 2030. Singapore continues to shift from oil to natural gas in the electricity generation to reduce the economy's oil dependency. In 2002, all of the natural gas consumed was met by imports from Malaysia and Indonesia through pipelines. Over the outlook period, to enhance the security of natural gas supply, Singapore is considering diversifying its sources for natural gas. By 2030, 40 percent of natural gas demand is expected to be met through LNG imports.

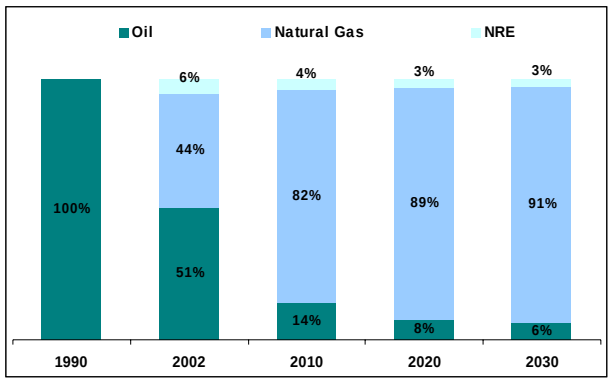
Oil demand will be boosted by the industry and transportation sectors, which will respectively account for 61 percent and 39 percent of total oil demand growth. Oil demand is projected to increase from 17.7 Mtoe to 31.3 Mtoe in 2030. To meet the projected oil demand growth, Singapore has been working to increase trade relations with the Middle East to guarantee against supply disruptions of crude oil. In addition, the expansion of independent storage facilities is underway as a means to increase the economy's strategic reserves and protect against supply disruptions of crude oil.

ELECTRICITY

The electricity demand of Singapore is projected to increase at 3.8 percent per year over the outlook period. By 2030, installed generating capacity is expected to increase from 8 GW in 2002 to 18 GW.

The share of natural gas in the electricity generation mix is expected to increase from 44 percent in 2002 to 91 percent in 2030. Subsequently the share of oil is expected to significantly decrease from 51 percent in 2002 to 6 percent in 2030. Biomass from the waste-to-energy facilities will account for a small share at around 3 percent in 2030.

Figure 101 Electricity Generation Mix



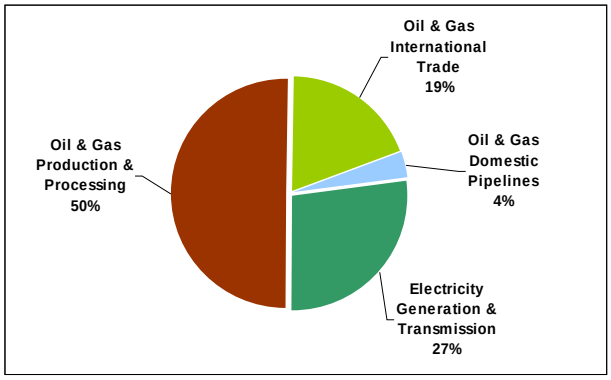
Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

The total investments needed to develop Singapore's energy infrastructure will reach a total of US$ 31-42 billion by 2030. To maintain the economy's leading position in the refining sector and export hub would require additional investment of between US$20-29 billion. The construction of new electricity generation capacity and transmission

facilities will require substantial investments accounting for between US$9-11 billion by 2030.

Figure 102 Investment Requirements

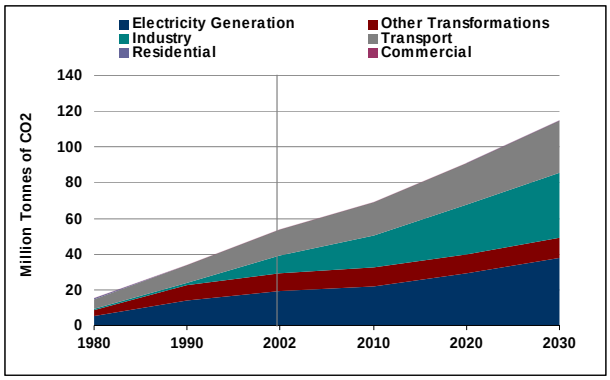


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Over the outlook period, Singapore's total CO_2 emissions from the energy sector are projected to increase from 54 million tonnes of CO_2 in 2002 to 115 million tonnes of CO_2 in 2030. The share of CO_2 emissions is roughly distributed among the electricity, industry, and transportation sectors, each of which accounts for approximately 30 percent of the total CO_2 emissions in 2030.

Figure 103 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

MAINTAINING THE ECONOMY'S LEADING POSITION IN REFINING

Singapore is highly dependent on oil as the major energy source. Strategic location at the entrance to the Straits of Malacca, sound financial system, accessibility to infrastructure, transparent legal system and skilled workforce have established the economy as one of the top three oil trading and refining hubs in the world. However, to maintain the leading position will remain a major challenge for Singapore as regional rivals increasingly improve their export market volumes. Refineries in India, Malaysia, and Thailand have all recently increased oil products export capacity and have been exerting competitive pressure on Singapore in the international and regional oil products market. Moreover, the trend towards cleaner fuels in Asia marketplace will pose a major challenge to an export oriented refinery. A substantial investment will be needed to upgrade existing facilities or to build new ancillary units. In addition, a more complex logistical support would be required to enable the segregation and handling of different grades of refined products.

One advantage the economy has over its rivals is that the oil industry in Singapore is the least governed among other sectors, which means the industry is conducting business in a totally free-market environment. Incentives have also been provided in favour of the industry. Some examples include low corporate tax and absence of legal oil reserve requirement.

SECURITY OF NATURAL GAS SUPPLY

Singapore promotes the utilisation of natural gas as a means to diversify energy sources away from oil and has been working on ways to make the economy a regional gas trader. The economy has initially set a target of increasing the share of natural gas in the electricity generation mix to 60 percent by 2012, but was consequently met in 2003 way ahead of schedule.

Singapore also plans to diversify the sources of its natural gas imports. The supply disruption of natural gas in 2003 from Indonesia has raised concerns about the security of natural gas supply. The incident has culminated in the government deciding to conduct a study on the viability of building an LNG receiving terminal to reduce dependence on pipeline natural gas. The success of the plan however will depend on LNG's competitiveness with pipeline natural gas and the ability of Singapore to use LNG facilities as a buffer stock of gas.

IMPLICATIONS

To maintain the economy's position as the major oil products exporter in Asia, Singapore has been providing incentives to oil companies to solicit more investment in the refining and petrochemical businesses. The leading oil products export position may however be challenged by other refineries in the region for example, China, Korea and India. Constant vigilance will need to be exercised such that Singapore constantly remains one step ahead of its competitors into the future.

In endeavouring to diversify the economy's import dependence away from oil, Singapore has

instead stressed the promotion of natural gas utilisation. The construction of an LNG receiving terminal will depend on the competitiveness of LNG with pipeline natural gas and whether regulation towards an integrated multinational regional natural gas market is realised.

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CHINESE TAIPEI

- *Chinese Taipei's primary energy demand is projected to grow at 2.4 percent annually; owed mainly to growth in the industry and transport sectors; high dependence on energy intensive industries has made it difficult for the economy to decouple energy consumption from economic growth.*
- *Chinese Taipei is expected to expand the utilisation of renewables and import more coal and natural gas as a result of the constraints placed on the economy by the Non-Nuclear Homeland policy.*
- *Energy security (high dependence on oil imports), lack of investment in infrastructure development to meet high energy demand, increasing CO_2 emissions, and the quest for alternative fuels to replace nuclear will remain the economy's major areas of concern over the outlook period.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Chinese Taipei's primary energy consumption grew annually at 5.9 percent, from 83.1 Mtoe in 2000 to 98.6 Mtoe in 2003, mainly as a result of increased consumption of natural gas and coal in the electricity sector. Natural gas consumption increased from 5.5 Mtoe in 2000 to 7.2 Mtoe in 2003 and likewise coal consumption increased from 29.4 Mtoe in 2000 to 36.1 Mtoe in 2003.

Chinese Taipei is a net importer of fossil energy with an import dependency of 98 percent in 2004. With scarce indigenous energy resources, the economy is only able to produce natural gas, which accounts for less than 10 percent of the economy's total natural gas consumption.

Before the completion of the Formosa Petrochemical Corporation's refinery in 2000, Chinese Taipei had imported a significant amount of refined petroleum products. However with the expansion and upgrade of its refining capacity, the economy has been transformed into a net exporter of petroleum products.

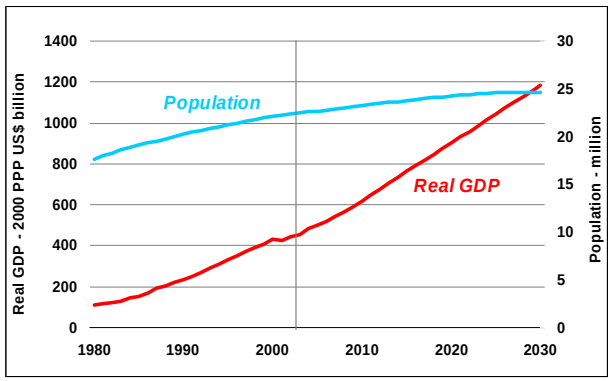
In order to supply natural gas to the Taiwan Power Company's Datan Power Station, the economy is set to construct an LNG receiving terminal in Taichung. Chinese Taipei has allowed independent power producers (IPP) to participate in power plant investment. Eight IPP projects have been completed as of 2004. In 2001, Chinese Taipei set up the ultimate goal of establishing a "Non-Nuclear Homeland Policy" and declared the construction of two advanced light water reactors to be commissioned in 2009 as the last nuclear power plants permitted in the economy.

The Energy Commission, which was established in 1979 under the Ministry of Economic Affairs (MOEA), was legalised and became the Bureau of Energy when the Constituent Act of the Bureau of Energy was promulgated in 2004. The Bureau currently takes the responsibility of formulating and implementing national energy policy. The "Renewable Energy Development Law", "Petroleum Administration Law", "Natural Gas Business Law", and "Electricity Act" are to be set up to create a better energy business environment in the future.

ENERGY DEMAND DRIVERS

Chinese Taipei's GDP is projected to grow annually at 3.6 percent over the outlook period to reach US$1,184 billion in 2030, compared with growth of 6.5 percent per year from 1980 to 2002. The services sector will account for the largest share of GDP at 66.3 percent, followed by the industrial sector (32.9 percent) and the agricultural sector (0.8 percent) in 2030.

Figure 104 GDP and Population



Source: Global Insights (2005)

The population of Chinese Taipei is expected to increase at a slow rate of 0.3 percent annually, from 22 million in 2002 to 25 million in 2030. Due to changes in lifestyle, the urbanisation level is expected to experience a declining trend from 79 percent in 2002 to 76 percent in 2030 as people move from urban to rural areas. [101]

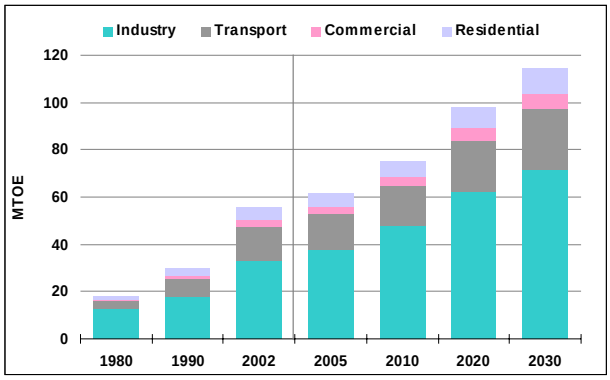
[101] APERC estimate

OUTLOOK

FINAL ENERGY DEMAND

Total final energy demand is projected to grow at 2.6 percent annually from 55.5 Mtoe in 2002 to 114.4 Mtoe through 2030. The industrial sector will account for the largest share at 63 percent, followed by transport (22 percent), residential (9 percent) and commercial (6 percent). Demand for electricity is projected to increase at 3.5 percent annually.

Figure 105 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industry sector is projected to grow at an average annual rate of 2.8 percent, lower than the average annual growth of 4.6 percent over the past two decades. The shift in structure of the industry sector, from energy-intensive to non-energy-intensive industries[102], as well as improvements in energy efficiency will lead to the lower projected growth in energy demand in the sector. Currently, Chinese Taipei's main industries are electronics and petrochemicals. The petrochemical industry accounts for 53 percent of total industrial energy demand, thus making the industrial sector highly energy-intensive. Faster projected growth in the electronics and IT industries compared with the petrochemical industry [103] will result in the comparatively lower growth rate for industrial energy demand, particularly in the latter part of the outlook period. Consequently, energy intensity [104] in the industrial sector is expected to decline at an average annual rate of 0.9 percent, reaching 188 toe per US$ million in 2030 from 240 toe per US$ million in 2002.[105]

By fuel, petroleum products are projected to maintain the largest share throughout the outlook period, although declining slightly to 51 percent in 2030 from 53 percent in 2002. Demand for naphtha as a feedstock for ethylene production is projected to lead the growth in industrial oil demand.[106] The share of electricity is likely to increase from 24 percent in 2002 to 31 percent in 2030 as further use of new and high-tech precision equipment would result in greater demand for electricity. In addition coal is expected to increase slowly at 1.9 percent per year, compared with 5.5 percent growth in the previous two decades, as a result of a slowdown in crude steel production.[107] On the other hand, the share of natural gas is projected to remain constant at 2 percent.

Transport

During the past decade, Chinese Taipei's transportation energy consumption has grown at an annual rate of 6.5 percent – an almost one to one ratio with the annual growth of GDP. Along with economic development, improvement in living standards, and upgrades in transportation infrastructure, energy consumption of all the transport sub-sectors has exhibited substantial annual growth. For example, air transport registered the fastest growth at 8.0 percent, followed by road at 4.9 percent, rail at 4.5 percent, and marine at 2.6 percent between 1990 and 2002. With growth in all sub-sectors, the economy's per capita transport energy consumption has increased from 0.37 toe per person in 1990 to 0.6 toe per person in 2002.

Over the outlook period, transport energy demand is expected to grow at about 2.2 percent per year. Growth will be mostly driven by the energy demand for air transport, which accounts for 63 percent of total incremental growth. Exports of high value added manufacturing products, and increase of direct air travel between Chinese Taipei and Mainland China will spur the growth in energy demand for air transport. To accommodate the expected rise in air

[102] As a result of expansion of petrochemical and metallurgy industries, the share of energy-intensive industries to industrial value-added increased from 27.7 percent in 1980 to 33 percent in 2002. Over the outlook period, this share is projected to decline to 30.1 percent in 2030 as Chinese Taipei develops non-energy-intensive industries such as electronics and IT.

[103] The electronics and machinery industries are expected to grow at 4.7 percent per year over the period to 2030, while petrochemical industries are expected to grow at 3.5 percent.

[104] The amount of energy needed to produce a dollar's worth of industrial sector's value added.

[105] Over the last two decades, energy intensity in Chinese Taipei's industrial sector followed a U-shaped curve, falling until 1993 to reach 157 toe per US$ million and gradually increasing thereafter to 240 toe per US$ million in 2002.

[106] Over the outlook period, industrial naphtha demand is projected to grow at 3.5 percent per year reflecting the robust growth in ethylene production growing at 3.7 percent.

[107] It is assumed that the production of crude steel will grow slowly at 2.5 percent per year over the period to 2030, compared with 7.9 percent between 1980 and 2002.

transport for both the passenger and freight sub-sectors, Chinese Taipei is considering the construction of a new airport close to the centre of Taipei, and expansion of freight handling capacity at Kaoshiung airport.

Energy demand for road transport is projected to grow by 1.1 percent per year, slower than the rate observed historically. As Chinese Taipei's population is expected to peak sometime in 2025, it is projected that the number of passenger vehicles would only grow moderately. Mass transit rail-systems are expected to gradually replace demand for buses and passenger vehicles for city travel, just as high-speed railway system will continue to replace the demand for passenger vehicles for inter-city travel. Subsequently, gasoline demand is expected to grow annually at 2.0 percent during the first half of the outlook period, but slow down to 0.6 percent per year thereafter. By contrast, diesel demand for freight trucks is expected to grow at a constant rate of 1.0 percent per year, due to the growth of high value added manufacturing products, and the expansion of petrochemical industries favouring trucks as the main mode of transport.

Residential and Commercial

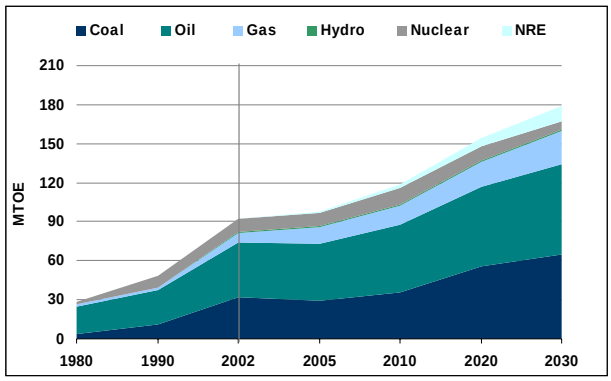
Consistent with the income growth and the improvement in living standards, the energy demand of the residential sector is expected to grow at 2.6 percent per year over the outlook period. The main energy source for the residential sector in Chinese Taipei is electricity, growing at 3.2 percent per year to account for 74 percent of total energy demand in 2030, due to the high ownership level of electric appliances. Demand for LPG is projected to grow slowly at 0.8 percent annually and account for the second largest share at 15 percent in 2030 from 25 percent in 2002, mainly in areas not covered by the natural gas pipeline network.[108] By contrast, natural gas is projected to grow at an annual rate of 2.2 percent as LPG is replaced.

Chinese Taipei's commercial energy demand is mainly driven by annual growth of 2.9 percent in the services sub-sector, much slower compared with the 8.5 percent annual growth rate in the past three decades. As in the residential sector, electricity is the main energy source for the commercial sector. During the outlook period, demand for electricity is expected to grow at the fastest rate of 3.4 percent per year, as a result of the increase in demand for cooling and lighting in commercial buildings. Similarly, natural gas demand is projected to increase at 2.7 percent annually, maintaining a share of around 6 percent throughout the outlook period. Petroleum products are expected to grow at a slow rate of 0.6 percent annually, with the share in total commercial energy demand declining from 21 percent in 2002 to 11 percent in 2030.

PRIMARY ENERGY DEMAND

Total primary energy demand is projected to grow at an annual rate of 2.4 percent, from 92.4 Mtoe in 2002 to 178.6 Mtoe in 2030. Oil will remain the dominant fuel at 39 percent, followed closely by coal (36 percent), natural gas (14 percent), NRE (7 percent) and nuclear (4 percent) in 2030.

Figure 106 Primary Energy Demand



Source: APERC Analysis (2006)

Among the fossil fuels, oil will grow from 41.6 Mtoe in 2002 to 69.6 Mtoe in 2030, with an annual growth rate of 1.9 percent. Growth will be spearheaded by the anticipated construction of a new 300,000 b/d refinery in Yunlin by the Chinese Petroleum Corporation by 2014. Coal will remain a major fuel input for electricity generation, accounting for the largest share in electricity generation at 59 percent. Natural gas demand is projected to grow annually at 4.5 percent to reach 25.2 Mtoe in 2030 as a result of increased utilisation of natural gas for electricity generation. To meet supply, Chinese Taipei plans the construction of additional LNG receiving terminals.

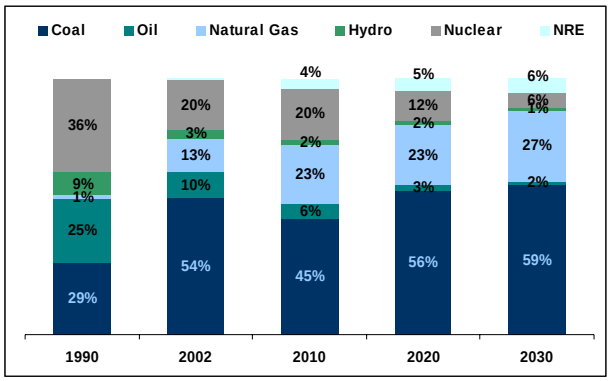
The share of NRE, which includes biomass, bagasse, wind, solar, and geothermal, in the economy's primary energy mix is projected to increase significantly from 0 percent in 2002 to 7 percent in 2030. On the other hand, the share of nuclear will remain stagnant at 11 percent from 2002 to 11 percent in 2010 and decline thereafter; reaching 4 percent by 2030, due to Chinese Taipei's Non-Nuclear Homeland policy.

[108] In 2001, the percentage of households connected to the natural gas pipeline network was 20 percent. Those not connected used bottled LPG, which is primarily used for cooking and water heating. By 2030, it is projected that the percentage of households connected to the network would reach almost 60 percent.

ELECTRICITY

In 2030, total installed capacity will reach 86 GW, the majority of which will be thermal at 81 percent – consisting of coal (51 percent), natural gas (28 percent) and oil (2 percent) – followed by hydro (7 percent), NRE (7 percent), and nuclear (4 percent).

Figure 107 Electricity Generation Mix



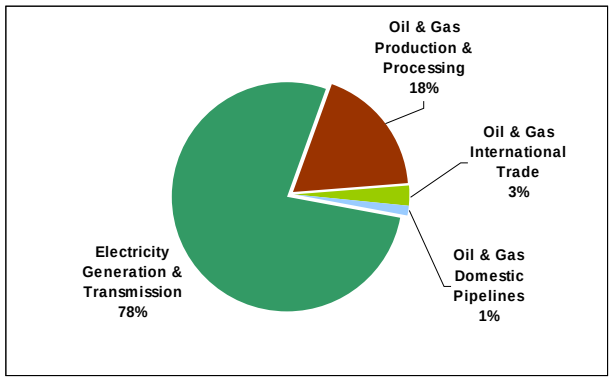
Source: APERC Analysis (2006)

Total electricity generation is projected to increase from 199 TWh in 2002 to 438 TWh in 2030, with an annual growth rate of 2.8 percent. Due to cost competitiveness, the share of coal will increase from 54 percent in 2002 to 59 percent in 2030. Oil will be replaced by natural gas, the share of which is projected to decrease from 10 percent in 2002 to 2 percent in 2030. Likewise, the share of nuclear will decrease from 20 percent in 2002 to 6 percent in 2030 as units reach retirement age and are decommissioned. However, the share of natural gas will increase significantly from 13 percent in 2002 to 27 percent in 2030, in part due to environmental considerations. The share of hydro is projected to be the smallest, decreasing from 3 percent in 2002 to 1 percent in 2030, due the concern of perceived negative impacts to the environment. Nevertheless, as a result of government policy to promote the development of renewables, the share of renewables will increase from 0 percent in 2002 to 6 percent in 2030.

INVESTMENT REQUIREMENTS

The total investments necessary to finance Chinese Taipei's energy infrastructure requirements are expected to reach between US$ 104-125 billion by 2030. The majority of the investment, US$ 83-97 billion will be required for electricity generation and transmission. Investments in more coal and natural gas-fired power plants will be required to replace oil and nuclear power plants. New refinery capacity, transport and distribution facilities, including storage and LNG terminals will make up the downstream oil and gas investment requirements at between US$ 21-28 billion.

Figure 108 Investment Requirements

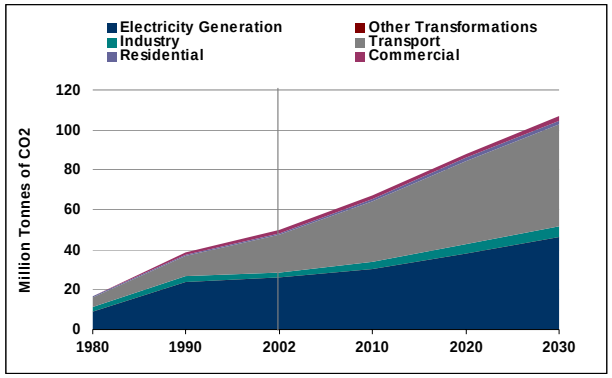


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Total CO_2 emissions from the energy sector are projected to increase from 266 million tonnes of CO_2 in 2002 to 515 million tonnes of CO_2 in 2030. The increase is mainly driven by the continued use of coal in electricity generation, despite the offset from decreasing oil utilisation and increasing the use of less carbon intensive natural gas, renewables and hydro.

Figure 109 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

NON-NUCLEAR HOMELAND POLICY

Notwithstanding the government policy to discontinue utilisation of nuclear for electricity generation, the economy will start the commercial operation of two new advanced light water reactors in 2009, the last nuclear power plants to be built within the economy.

Over the outlook period, the nuclear capacity will reach a peak of 7,844 MW in 2010, and as older plans decommissioned the capacity will gradually decrease to 3,651 MW in 2030. Therefore, the share of nuclear in the electricity generation mix will decline significantly, from 20 percent in 2002 to 6 percent in 2030. Subsequently, to meet future demand for electricity, the share of other fuels will have to

increase. For example, the share of renewables is expected to increase from 0 percent in 2002 to 6 percent in 2030.

REDUCING THE ECONOMY'S HIGH ENERGY INTENSITY

The energy intensity of Chinese Taipei is currently relatively high compared with other industrialised APEC economies with limited energy resources such as Japan, mainly as a result of the economy's high reliance on heavy industry to support economic growth. Therefore to decouple the energy demand from economic growth will remain a major challenge in the future.

ENHANCEMENT OF ENERGY SECURITY

Over the outlook period, due to the economy's lack of indigenous energy resources, Chinese Taipei is expected to remain an energy importer, importing almost all of the economy's oil requirements. To minimize the impact of oil supply disruptions, Chinese Taipei maintains an oil stockpile of no less than 90 days supply. The economy has also tried to diversify its energy supply mix by switching from oil to natural gas, coal and renewable energy. In addition, it has started to secure international joint venture agreements to acquire captive supply sources.

To ensure the continued supply of domestically produced petroleum products, Chinese Taipei is expected to construct a new refinery in 2015, replacing an existing refinery that is due to be phased-out.

An LNG facility is also expected to be constructed, starting operation in 2008, in anticipation of the growth in demand for natural gas for electricity generation.

IMPLICATIONS

With limited domestic energy resources, the security of energy supply is one of the most important issues in energy policy. The Non-Nuclear Homeland policy which limits the utilisation of nuclear energy also puts additional constraint on the economy in terms of diversification of energy supply sources. This implies that to meet increasing energy demand, Chinese Taipei will have to look to alternative energy sources to replace nuclear energy, with coal and natural gas, both higher emitters of CO_2 emissions being the most likely energy sources utilised. The planning for optimal energy mix among fossil fuels and renewables poses a great challenge for the future energy industry development.

To decouple energy consumption and GDP growth, the service sector needs to be promoted/expanded and changes in the structure of the industry sector to a structure that is less energy intensive should be addressed. For example, promoting knowledge-based industries such as the Green Silicon Island proposal could be one way to reduce energy intensity and foster a less energy intensive economy.

Nevertheless, energy will continue to be an essential element of economic activities and the stability of energy supply will continue to be an important aspect of government policy. The establishment of international stockpiling through regional cooperation could be an important way of stabilising domestic energy supply, as could the acquisition of equity in international energy resource developments by the national oil company be another method through which stability of energy supply could be strengthened.

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THAILAND

- *Thailand's primary energy demand is projected to grow at 4.6 percent annually over the next 28 years; mainly from increased demand for oil in the transport and industrial sectors.*
- *Reducing the economy's high reliance on natural gas for electricity generation will be a major challenge, just as increasing the use of coal to replace natural gas. In addition to increasing domestic oil and natural gas reserves and diversification of alternative energy sources, Thailand aims to enhance energy conservation measures to reduce energy demand in all sectors.*
- *Another way to secure Thailand's electricity supply is through power interconnection with either LaoPDR, Cambodia, and Viet Nam, through the Greater Mekong Sub Region Initiatives; of which a number of hurdles still need to be overcome (for example, lack of transmission facilities to effect transfers, regulatory protocols, cross-border tariffs, etc.)*
- *Investment of between US$168 and 211 billion is required over the outlook period to construct the necessary infrastructure to meet Thailand's projected energy demand.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Thailand's primary energy consumption has started to return to the levels of the pre-1997 economic crisis period, substantially increasing at a rate of 6.0 percent per year during 2000-2005, a slightly slower rate than that of the previous decade of 7.0 percent. Modest economic recovery, relatively stable and low petroleum prices, together with the growing number of passenger vehicles each year, have contributed to the economy's growth in total oil consumption at 5.0 percent per year in 2000-2005. In addition, the growth of energy consumption was fuelled by robust consumption for natural gas for electricity generation and to a lesser extent, for industries, at a rate of 8.0 percent. About 70 percent of Thailand's electricity is generated through natural gas, reflecting the economy's heavy dependence on natural gas for electricity generation.

Due to the economy's limited indigenous energy resources, Thailand relies heavily on energy imports, importing 64 percent of total energy consumption in 2005 mainly in the form of oil. Domestic procurement, however, have been accelerated to cope with the increasing consumption. Crude oil production increased 15 percent yearly from 62 thousand b/d in 2001 to 114 thousand b/d in 2005, which supplied only 10 percent of economy's total crude oil consumption. Natural gas production has also increased at a rate of 5.0 percent per year from 1,900 mmscfd in 2001 to 2,292 mmscfd in 2005. About 30 percent of total natural gas consumption is met by imports from neighbouring economies, like Myanmar.

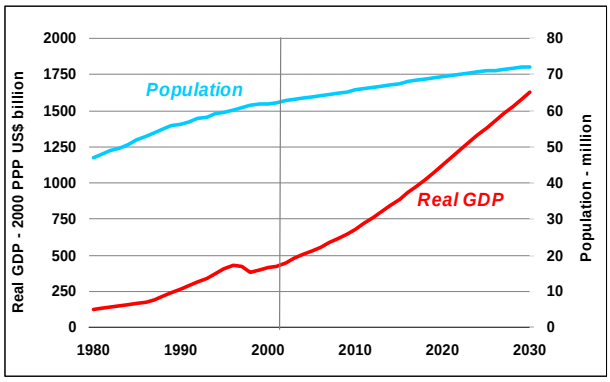
With a view to reducing dependency on imported energy and strengthening energy supply security, the government formulated the "National Energy Strategy" in 2005 with the aim to reduce energy consumption by 13 and 20 percent in 2008 and 2009 respectively. Under this strategy, finding alternative energy and devising new technology for energy conservation are the top priority in the energy master plan. For example in the transportation sector alone, oil consumption is targeted to be cut by as much as 25 percent in 2009 and in 2008, about 180,000 vehicles powered by compressed natural gas is to be deployed in a bid to reduce gasoline and diesel consumption by 10 percent. Gasohol, or the so-called "E-10", is aimed to be utilised nationwide as a replacement for gasoline by 2008. Moreover, in the industrial sector, energy consumption is targeted to be reduced by as much as 20 percent through efficiency improvements by 2008. Factories inside the industrial estates are encouraged to switch to natural gas either through pipeline or liquefied natural gas or compressed natural gas. A joint public and private committee has also been established to boost energy conservation in various industries.

Government is also looking at the possibility of solving energy problems through the development of logistic system, which includes oil transport through pipelines, the improvement of mass transit system and freight transport by switching the mode of transport from cars and light trucks to the railway and waterway systems.

ENERGY DEMAND DRIVERS

Thailand's economy is projected to grow robustly at 4.7 percent over the outlook period, mainly as a result of increased export trading. The manufacturing and services sectors will remain the major contributors to GDP.

Figure 110 GDP and Population



Source: Global Insights (2005)

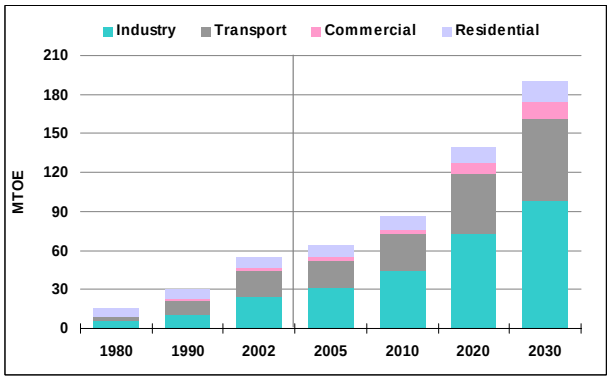
Soaring oil prices, conflict in the three southernmost provinces, as well as the avian flu outbreak in some poultry farms will have a lingering effect on the economy's growth in the short- to medium-term. Over the outlook period, Thailand's population is projected to grow at a modest rate of 0.5 percent pear year, mainly as a result of the success in the population planning policy implemented during the past three decades.

OUTLOOK

FINAL ENERGY DEMAND

Thailand's total final energy demand is projected to grow at 4.5 percent per year, slower than the 6.0 percent annual growth in the last two decades. The total final energy demand will increase from 55 Mtoe to 190 Mtoe in 2030, the largest share of which will come from the industry sector (52 percent) followed by transportation (33 percent), residential (8 percent), and commercial (7 percent).

Figure 111 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Industrial energy demand is projected to grow at an average annual rate of 5.0 percent, lower than the average annual growth rate of 7.5 percent over the past two decades. The government's strong measures to improve energy efficiency and the shift of the industrial structure from energy-intensive to non-energy-intensive industries is expected to lower the projected growth in energy demand of the industrial sector. Over the outlook period, energy demand is expected to grow at almost the same level as the growth in industrial value added through 2020. This indicates the industrial value-added elasticity of energy demand will be around 1.0 between 2002 and 2020, while the elasticity will be reduced to less than 1.0 between 2020 and 2030. By fuel type, oil is projected to maintain the largest share throughout the outlook period, but will decline from 42 percent in 2002 to 32 percent in 2030. The gradual substitution of fuel oil with natural gas and the slow growth in diesel demand will result in the decline in the share of oil. On the other hand, natural gas is projected to grow at the fastest rate of 7.3 percent, slower than that of the rapid growth of 17.0 percent per year from 1990 to 2002. Natural gas is expected to be used as a feedstock for petrochemical production, as well as to replace fuel oil for boilers in the manufacturing sector.

Transport

Between 1990 and 2002, Thailand's transportation energy consumption has increased two-fold, mostly as a result of the increase in road transport. The number of passenger vehicles has grown at an annual rate of 10.4 percent, and the number of freight trucks has grown at an annual rate of 6.3 percent.

Over the outlook period, road transport is projected to continue to lead the growth in transportation energy demand, accounting for 90 percent of the incremental increase. The economy's continued income growth, at an annual rate of 4.2 percent, and the development of vehicle manufacturing industries is expected to increase the stock of passenger vehicles from 6.3 million in 2002 to 11.9 million in 2030. The increase in manufacturing, robust construction activities and further development in the agricultural sector will favour the use of trucks as the main mode of freight transport. As a result of these developments, it is projected that gasoline for passenger vehicles will increase three-fold, while diesel for minivans, trucks and farm vehicles will increase four-fold.

As a result of the rising gasoline and diesel demand and the worsening air quality problem, the government plans to implement several policy measures including the application of Euro IV emission standards from 2010. The government aims to introduce CNG vehicles; however the shares of alternative fuels such as natural gas and ethanol

will not grow substantially, and will account for only 1.0 percent of energy utilisation in road transport in 2030.

Residential and Commercial

The residential and commercial sectors currently do not have any direct use for natural gas and therefore will remain so in the future.

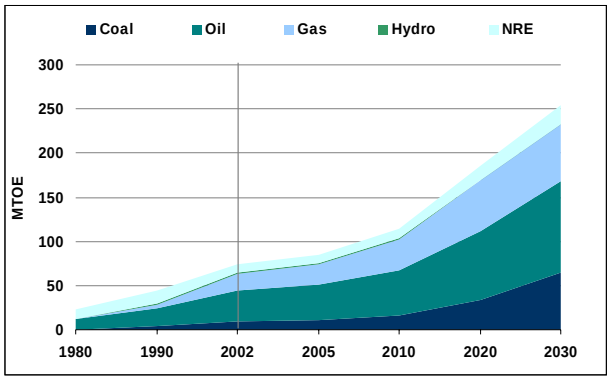
Thailand's residential energy demand is projected to increase at an annual rate of 2.0 percent over the outlook period, slightly higher than that of the 1.8 percent average annual rate in the past two decades. Along with income growth and improvement in people's living standards, electricity is expected to grow the fastest at an annual rate of 5.0 percent. Electricity will surpass combustible renewables and waste to become the biggest source of energy in the residential sector after 2020, with the share of electricity in the total residential energy demand increasing from 22 percent in 2002 to about 49 percent in 2030. Demand for petroleum products (kerosene and LPG for cooking) is projected to grow at 1.7 percent, from 1.7 Mtoe in 2002 to 2.8 Mtoe in 2030.

Strong economic growth will drive the commercial sector's electricity demand, to grow annually at the fastest rate at 5.7 percent, from 2.7 Mtoe in 2002 to 13 Mtoe in 2030.

PRIMARY ENERGY DEMAND

Total primary energy demand is projected to grow at an annual rate of 4.6 percent over the outlook period, from 74 Mtoe in 2002 to 258 Mtoe in 2030. Among the fossil fuels, coal is projected to grow at the fastest rate of 7.0 percent per year, followed by natural gas at 4.5 percent and oil at 3.9 percent.

Figure 112 Primary Energy Demand



Source: APERC Analysis (2006)

Coal is mainly utilised for electricity generation accounting for 70 percent of the incremental growth in primary energy demand. The share of coal is projected to increase to 25 percent in 2030 from only 13 percent in 2002. Due to the low quality of Thailand's indigenous coal resources, the economy will have to import 91 percent of the total coal requirements in 2030.

Natural gas demand is projected to be largely driven by electricity generation and will account for more than 70 percent of the total incremental demand growth. The share of natural gas will decline from 34 percent in 2015 to 25 percent in 2030, as it is replaced by coal in electricity generation.

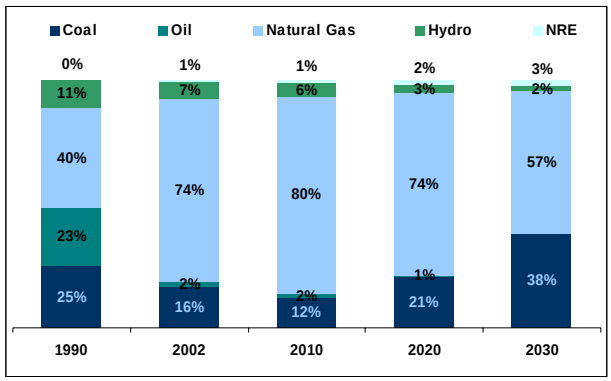
Oil demand is projected to grow annually at 3.9 percent, from 35 Mtoe in 2002 to 103 Mtoe in 2030, mainly driven by the transport and industry sectors. Net oil import dependency is projected to increase from 89 percent in 2002 to 94 percent in 2030 as a result of increasing demand and declining domestic oil production. Various alternative fuels have recently been introduced to further reduce oil demand.

ELECTRICITY

The economy's electricity generation is projected to increase annually at 5.5 percent, from 111 TWh in 2002 to 504 TWh in 2030, less than half the growth rate of 14.1 percent observed before the financial crisis in 1997.

Throughout the outlook period, natural gas will maintain the dominant share in the electricity generation mix but the share will decline from 74 percent in 2002 to 57 percent by 2030.

Figure 113 Electricity Generation Mix



Source: APERC Analysis (2006)

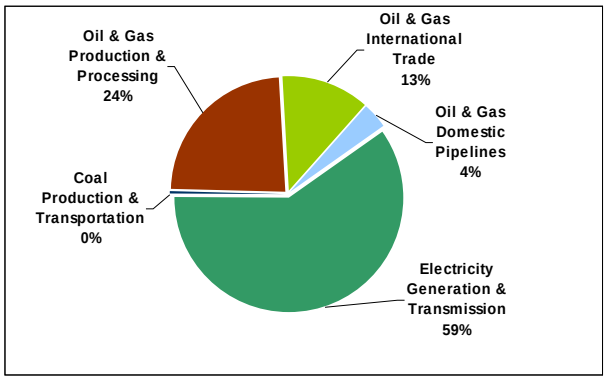
The economy's installed generating capacity is expected to increase from 23 GW in 2002 to 91 GW in 2030. Coal is projected to have an increasing share as more coal-fired electricity generation plants are commissioned after 2015. Subsequently capacity of coal-fired electricity generation is expected to increase from 3 GW in 2002 to 26 GW in 2030. On the other hand, the share of hydro will decline from 13 percent in 2002 to 4 percent in 2030, due largely

to environmental concerns. As part of Thai-Lao cooperation in promoting electricity generation in Lao, Thailand previously concluded an agreement to purchase electricity from various projects, with being expected to reach 42 TWh or 8 percent of the total generation in 2030.

INVESTMENT REQUIREMENTS

The expansion of electricity generation capacity, transmission, including oil and natural gas import infrastructure would require total investment of US$168-211 billion by 2030.

Figure 114 Investment Requirements



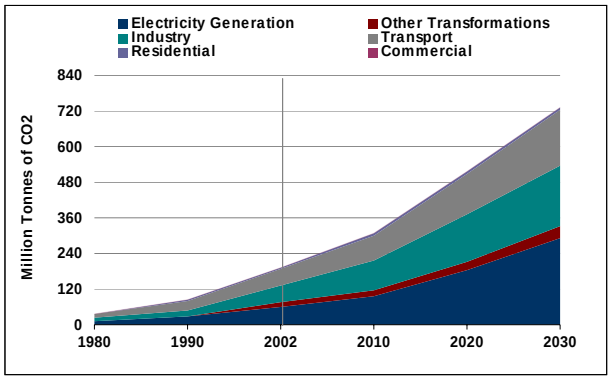
Source: APERC Analysis (2006)

Of this total, government initiatives to extend the economy's indigenous energy reserves will likewise require investment of about US$35-51 billion over the same period.

CO_2 EMISSIONS

Over the outlook period, Thailand's total CO_2 emissions from the energy sector are projected to increase from 193 million tonnes of CO_2 in 2002 to 734 million tonnes of CO_2 in 2030. The electricity sector will be the major contributor accounting for 40 percent of total CO_2 emissions in 2030, or 294 million tonnes CO_2.

Figure 115 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

FUEL DIVERSIFICATION FOR ELECTRICITY GENERATION

Currently all natural gas utilised in the economy is met by domestic production, however, production is projected to decline from a peak of 26.6 Mtoe in 2010 to 16.5 Mtoe in 2030. This expected production decline coupled with the heavy reliance on natural gas for electricity generation, at 74 percent of total electricity generation capacity in 2002, has become a major concern for the government of Thailand and has prompted the desire to diversify fuel sources in order to reduce the economy's vulnerability in the future. Alternative sources such as imported coal and low calorific domestic lignite – with high sulphur content – are seen as a potential supply for the new capacity needed from 2011 onwards.

However, due to opposition on the siting of coal-fired power plants and a deep-sea port to handle coal deliveries/imports by local residents, Thailand is expected to face difficulties promoting coal. One example where local opposition influenced the construction of new coal-fired power plants was an incident in which leakage of heavy sulphur from the Mae Moh power plant in Lampang led to the cancellation of two Independent Power Producers (IPP) coal-fired power plants at Bo Nok and Hin Krut in 2002.

Thailand has tried to promote the utilisation of renewables as another means to diversify energy sources away from natural gas. However, widespread diffusion of renewables has been hampered by the cost competitiveness of renewables with other energy sources, high initial capital costs and the limitation of available renewable resources – especially biomass.

IMPLICATIONS

It is clear that with Thailand's projected high economic growth, supply of the much needed natural gas and oil will be a continuing challenge. Although Thailand has been very active in securing the economy's energy supply through various measures, a very important step is to consider building strong relations with neighbouring economies particularly those of the Greater Mekong Sub Region (GMS) for power interconnection.

Although economies in the GMS possess considerable sources of low-cost electricity generation (from hydro, natural gas and coal), these resources are geographically isolated from load centres and economic borders. Therefore, by interconnecting these areas of supply and demand it

would be possible to provide equitable and cheaper access to electricity, lower costs (through economies of scale), and reduce GHG emissions and other pollutants.

International developers in LaoPDR have started hydro development and have expressed an interest in exporting electricity to Thailand, while there are also plans to build power plants in the Yunan Province of southern China for possible interconnection to Thailand and Viet Nam. Other bilateral arrangements are also being considered and studied including the assessment of barriers to regional electricity trade and cooperation in the region.

Additional energy supply sources such as from overlap areas with Vietnam and Cambodia would have to be sought through joint exploration and drilling in order to secure its supply in the long term.

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UNITED STATES

- *Primary energy demand is expected to grow at an annual rate of 1.2 percent through 2030.*
- *To reduce energy import dependency, the US is expected to increase the utilisation of coal growing at 1.4 percent per year – the fastest rate among the fossil fuels. Likewise, nuclear capacity is expected to expand with the addition of 10 GW sometime after 2010*
- *Voluntary targets to reduce CO_2 intensity by 18 percent in 2012 compared to the 2002 level are unlikely to be met due to the increasing use of coal for electricity generation.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Despite rising crude oil price, the US oil consumption has not shown any sign of slowing-down. Between 2002 and 2004, the US oil consumption continued to grow at an average annual rate of 2.2 percent, despite the NYMEX crude oil price posting the highest in history at US$53 per barrel in October 2004. By product, motor gasoline consumption grew annually at 1.3 percent, at a time when gasoline prices reached US$3 per gallon – the highest nominal level in history. Because of the sustained economic growth, and low interest rates, consumers in the US seem to have been unperturbed by rising high oil prices and have continued to increase their oil consumption.

The rising natural gas prices on the other hand, have had a greater impact on the economy. Faced with high natural gas prices, that have exceeded US$7 per MMBTU, the economy reduced natural gas consumption at an average annual rate of 1.5 percent between 2002 and 2004. The burden of high natural gas prices was severely felt in the electricity generation and industry sectors, which together accounted for about 80 percent of the decline in total natural gas consumption in 2004.

As a result of the steady rise in oil consumption and the decline in oil and gas production, energy import dependency has been rising. In 2004, net energy import dependency reached to 29 percent, ten percent higher than a decade ago. Net oil import dependency increased from 49 percent in 1995 to 63 percent in 2004.

Rising energy import dependency and high energy consumption growth, combined with the surge in oil prices prompted the economy to institute measures to address energy security. To ensure affordable and reliable energy supply, the US Congress passed in July 2005 a comprehensive energy bill allocating a total amount of US$11.5 billion. The bill was signed on 8 August 2005 by President Bush and became effective starting January 2006, termed as the US "Energy Policy Act of 2005".

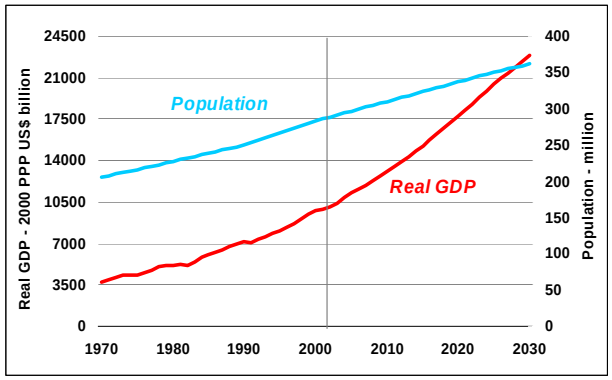
The law includes a number of provisions that are intended to increase domestic energy production, improve energy efficiency, and ultimately reduce energy import dependency over a ten-year time period.

ENERGY DEMAND DRIVERS

The US economy is projected to grow at an annual rate of 3.0 percent through 2030. The projected economic growth is higher in the near-term from 2002 to 2010 at 3.3 percent per year due to productivity improvements associated with ongoing automation of the manufacturing and service sectors. Over the outlook period, the structure of economy is expected to continue shifting towards the service sector from the heavy industry, increasing the share of value added of the service sector from 79 percent in 2002 to 82 percent in 2030.

The US population is expected to continue growing at a moderate pace of 0.8 percent in the next three decades. By 2030, population will reach 361 million from 289 million in 2002. Average fertility rate is near replacement levels of 1.9 children per couple, but immigration will ensure continued population growth for some time. According to the UN projection, immigration will account for about 45 percent of the total population growth over the outlook period. [109]

Figure 116 GDP and Population



Source: Global Insights (2005)

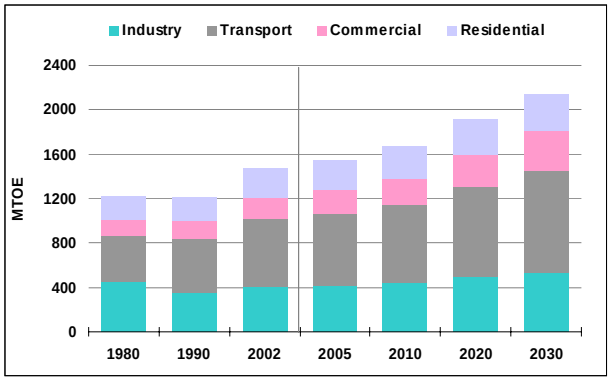
[109] United Nations (2004)

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 1.3 percent per year, a robust growth compared with an annual growth in the previous two decades at 0.9 percent. The transport sector will maintain the largest share at 44 percent, followed by industry sector (25 percent), commercial (16 percent) and residential (15 percent).

Figure 117 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Energy demand in the industrial sector is projected to grow at an average annual rate of 1.0 percent through 2030, slower than that of the past decade at 1.4 percent. Gains in energy efficiency and structural shifts from the energy-intensive to non-energy-intensive industry will lead to the slower projected growth in industrial energy demand growth. Due mainly to the economy's structural shift, energy intensity [110] in the industrial sector is expected to decline at an average annual rate of 1.4 percent from 182 toe per US$ million in 2002 to 123 toe per US$ million in 2030.

Natural gas, which accounted for 35 percent of industrial energy consumption in 2002, is projected to maintain the largest share through 2030. As a feedstock for bulk chemicals and fuel for manufacturing, natural gas is expected to grow at 0.9 percent per year. But natural gas demand is not expected to surpass its 2000 peak until after 2010 because price of natural gas is maintained at high level compared with history. [111] Oil products are projected to take the second largest share at 28 percent in 2030. Demand for LPG as feedstock for petrochemical products is expected to lead the growth in industrial oil demand.[112] Coal demand is projected to rise at 1.0 percent per year as production shifts from integrated steel mills to electric arc furnaces, and reduce demand for coking coal. Demand for steam coal is expected to remain relatively constant. [113] Renewable energy would be the fastest growing energy source, at a rate of 1.2 percent per year, but the share to total industrial energy demand will remain small at 8 percent in 2030.

Transport

With a steady economic growth at 3.0 percent per year through 2030, transport energy demand will continue to grow at an annual rate of 1.5 percent. Between 2002 and 2030, the growth of the US transport sector will account for 37 percent of the total incremental growth of transport energy demand in the APEC region; the largest contribution among the 21 member economies. With steady growth, per capita transport energy demand is expected to reach 2.6 toe per person in 2030, which is the highest among the APEC economies, followed by Canada at 1.9 toe per person and Australia at 1.8 toe per person.

Among the transport sub-sectors, the road sub-sector is projected to maintain the largest share at around 85 percent. By fuel type, gasoline, a major fuel for road transport, is projected to grow at 1.3 percent per year through 2030 - a slightly faster rate than previous three decades at 1.1 percent between 1972 and 2002. The faster trend of future gasoline demand growth is attributed to the consumers' preference for large-sized vehicles (or sport utility vehicles-SUVs). SUVs or light trucks as a share of total vehicle stocks, excluding heavy trucks, will increase from 39 percent in 2002 to 44 percent in 2030.[114] Diesel will maintain the second largest share in the road transport sub-sector, growing at an annual

[110] The amount of energy needed to produce a dollar's worth of industrial sector's value added.

[111] Due to higher natural gas prices, gas-intensive firms, such as fertilizer producers, shutdown factories temporarily or moved production facilities to overseas. According to World Gas Intelligence (2004), about a fifth of fertilizer capacity in the US and Canada has been moved overseas since 2000 due to high prices.

[112] Over the outlook period, LPG demand in the industrial sector is projected to grow at 1.4 percent per year.

[113] Over the outlook period, demand for coking coal in the industrial sector is projected to decline at 2.9 percent per year, whereas demand for steam coal is projected to grow by 0.3 percent.

[114] Light trucks are about thirty percent less efficient than the average passenger vehicles. The US government released a new fuel economy standard for light trucks in March 2006. With new standards, fuel economy of light trucks must average 24.1 miles per gallon (MPG) between 2008 and 2011 - 1.9 MPG higher than the 2007 target. The impact of the tighter standards will be felt in the long-term rather than in the near-term because it takes more than a decade to replace total vehicle stocks. Thus gasoline demand is projected to grow at a faster annual rate of 1.5 percent between 2002 and 2015, compared with that of 1.1 percent between 2015 and 2030.

rate of 2.2 percent. The continued economic growth at 3.0 percent per year will result in the increase for freight transport of goods and supplies, therefore substantially increasing the diesel demand.

Residential and Commercial

Energy demand in the residential sector is projected to grow at an annual rate of 0.9 percent between 2002 and 2030, mainly driven by the projected growth in electricity demand. Electricity is projected to take the largest share in total residential energy demand after 2015 and will grow by 1.5 percent annually throughout the outlook period. Natural gas is projected to grow at 0.6 percent per year while the share in total residential energy demand will decline from 43 percent in 2002 to 39 percent in 2030. The higher equipment efficiency and more stringent building codes will slow down the growth in natural gas demand.

Energy demand in the commercial sector is expected to grow at an annual rate of 2.0 percent – the fastest growth rate in all sectors. The fast growth is driven by the rapid increase in electricity demand. As a result of the increase in demand for cooling and lighting in commercial buildings, electricity is expected to grow at 2.3 percent per year. The share of electricity in total commercial energy demand is expected to reach 58 percent in 2030. Natural gas is projected to grow at 2.0 percent annually while the share in total commercial energy demand will slightly decrease from 37 percent in 2002 to 36 percent in 2030.

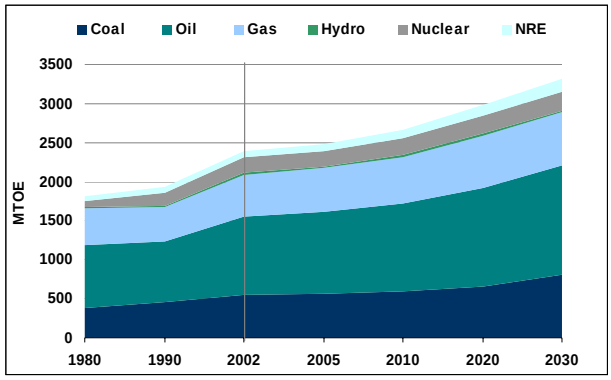
PRIMARY ENERGY DEMAND

Primary energy demand is projected to grow at an annual rate of 1.2 percent through 2030. Among the fossil fuels, coal is projected to grow at the fastest annual growth rate of 1.4 percent per year, followed by oil at 1.2 percent and natural gas at 0.9 percent.

Coal demand is primarily driven by the electricity sector, which will account for 97 percent of projected incremental growth over the outlook period. The growth rate of coal is faster in the long-term at 1.9 percent per year (2015-2030) than in the near-term at 0.9 percent per year (2002-2015) as technological development will make advanced coal-fired generation system more cost competitive than other types.

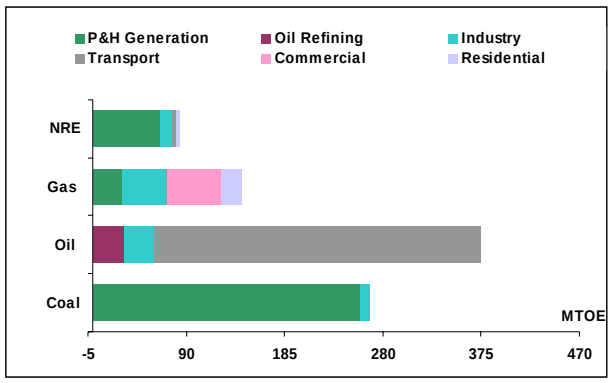
The growth in oil demand will be largely attributed to the transport sector accounting for more than 85 percent of the incremental growth. To meet the expected demand growth, the US government has started to encourage drilling activities at domestic wells with provisions for a number of incentives in offshore Gulf of Mexico. This will result in an increase in crude oil production from 360 Mtoe in 2002 to 451 Mtoe in 2020, however thereafter crude oil production will decline and reach 430 Mtoe in 2030.

Figure 118 Primary Energy Demand



Source: APERC Analysis (2006)

Figure 119 Sectoral Contributions to the Incremental Growth by Source



Source: APERC Analysis (2006)

Natural gas demand will increase faster in the near-term at 1.5 percent per year (2002-2015), while in longer-term, the growth rate of natural gas is projected to be slower at 0.7 percent per year (2015-2030). After 2015 high natural gas prices, relative to coal will limit the use of natural gas for electricity generation. With the decline in domestic production, import dependency of natural gas will increase from 17 percent in 2002 to 23 percent in 2030. By 2030 natural gas imports from Canada are projected to decline to one-third of the 2002 level. To offset the decline in natural gas imports from Canada, more than 80 percent of total imports in 2030 will be supplied by LNG.

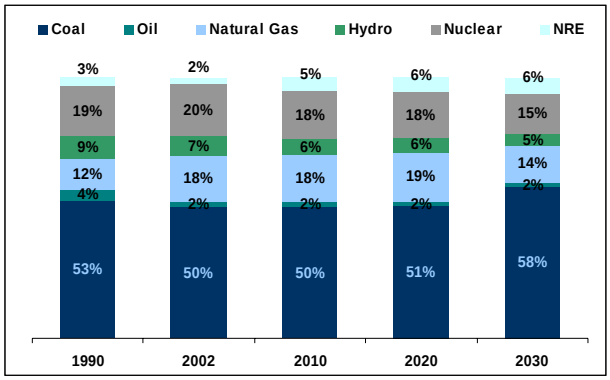
ELECTRICITY

Electricity demand is projected to grow at 1.7 percent per year through 2030. Reflecting the strong economic growth lead by the service sector, electricity demand will grow at a faster rate in the near-term. Between 2002 and 2010, electricity

demand will grow at 2.0 percent per year, but will slow down to 1.4 percent over the rest of the outlook period.

Coal is projected to maintain the dominant share in the economy's total electricity generation mix. The share is expected to increase from 50 percent in 2002 to 58 percent in 2030. The share of natural gas in the electricity generation mix will increase slightly through 2020, but will be replaced by coal thereafter once advanced coal-fired generation, compliant with environmental regulation, becomes cost competitive. The US will increase electricity production from nuclear to ensure security of electricity supply. By 2030, the US is projected to add 10 GW of nuclear generation units in addition to the existing 99 GW. Electricity generation from new and renewable sources is expected to grow fast at an annual growth rate of 5.2 percent, but the share to total electricity generation mix will remain small at around 6 percent.

Figure 120 Electricity Generation Mix

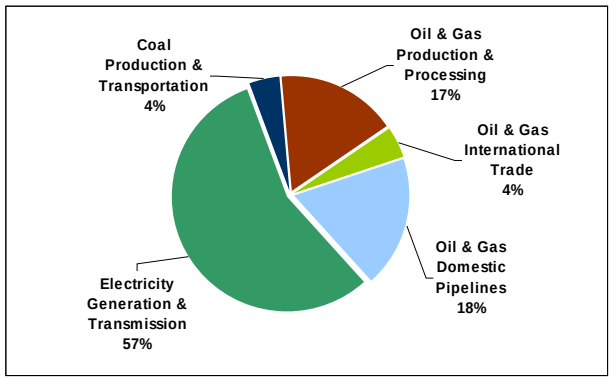


Source: APERC Analysis (2006)

INVESTMENT REQUIREMENTS

The projected energy demand growth will require total investments of between US$1.3-1.8 trillion over the outlook period. Electricity generation and transmission will account for the largest investment requirements, with a total of between US$808-982 billion, followed by oil and gas domestic pipeline at US$224-320 billion and oil and gas production and processing at US$204-297 billion.

Figure 121 Investment Requirements

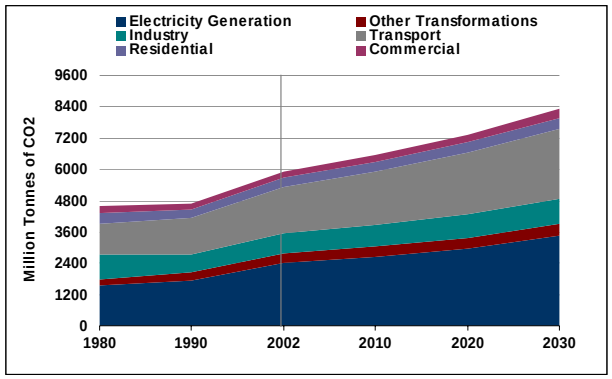


Source: APERC Analysis (2006)

CO_2 EMISSIONS

Despite efforts to limit CO_2 emissions from the energy sector, total emissions will increase from 5,895 million tonnes of CO_2 in 2002 to 8,326 million tonnes of CO_2 in 2030. The electricity sector is expected to account for the largest incremental growth in total CO_2 emissions at 44 percent, followed by the transport sector (39 percent).

Figure 122 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

ENHANCEMENT OF ENERGY SECURITY

The US Energy Policy Act of 2005 has included various provisions that offer, among others, incentives to both energy production and conservation. Some of these provisions are: 1) royalty relief for offshore deep-water oil and gas production, 2) loan guarantee to R&D for "innovative technologies" including advanced nuclear reactor, clean coal and renewable technologies, 3) subsidies for farmers to increase production of ethanol from 4 billion gallons to 7 billion gallons, 4) tax credits for the owners of hybrid vehicles, and 5) tax credits for home owners on their installation of energy efficient appliances.

Absent from these provisions however are measures that could have a greater impact on the future course of energy demand and supply in the US. For example, because of the strong opposition from auto manufacturing industry, the law did not include a provision that will tighten the Corporate Average Fuel Economy (CAFE) standards for passenger vehicles.[115] The tightening of the standards for passenger vehicles will have an impact on the improvement in vehicle fuel economy in the long-term.

CARBON INTENSITY IMPROVEMENT

Although there are no mandatory requirements for the US to curb CO_2 emissions, because of its non-ratification of the Kyoto Protocol, a voluntary target to reduce CO_2 intensity has been set. In February 2002, the Bush administration announced the "Global Climate Change Initiative" to reduce CO_2 intensity by 18 percent in 2012 compared with the 2002 level. A number of measures were undertaken to improve the CO_2 intensity, mostly through technological innovations.

In addition, the US has engaged in extensive international efforts on climate change through its multilateral and bilateral activities. It offered the biggest funding for activities under the UNFCCC and the IPCC. Along with Australia, China, Japan, India and Korea, the US formed the "Asia Pacific Partnership on Clean Development and Climate" to curb the rising trend of CO_2 emissions from energy consumption.

Despite these efforts however, the target in 2012 seems unlikely to be achieved due to the expected growth in coal demand for electricity generation. It is projected that carbon intensity of the energy sector in the US will decline by about 13 percent in 2012, compared with 2002.

IMPLICATIONS

Despite rising energy prices, the US energy demand is expected to increase steadily to fuel its economic growth and to improve quality of life. Declining domestic energy production however along with continued energy demand growth will lead to an increase in energy import dependency.

The US government has implemented a number of measures to improve energy efficiency, and to increase domestic energy production, while the scope of those measures is somewhat constrained by various institutional interests. Exclusion of a provision to tighten the CAFE standards for passenger vehicles from the Energy Policy Act of 2005 suggests that the US policy attempts to harmonise the industrial interest and the national interest, that is, energy security. Thus, policy needs to be well formulated to give appropriate incentives for both consumers and suppliers to improve energy efficiency and enhance energy supply security.

Energy security concerns are likely to outweigh climate change issues, at least in the near-term, as crude oil prices are expected to remain relatively high – above US$50 per barrel. The electricity sector, for example, is expected to increase coal demand because of abundant domestic resources, and cost competitiveness against natural gas. Earlier development of advanced technologies such as coal-fired generation with carbon sequestration technology may be an important option that could resolve the conflicts between enhancement of energy security and mitigation of greenhouse gas emissions.

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[115] Although the law did not include a provision to tighten CAFE standards for passenger vehicles, the law requires that the National Highway Traffic Safety Administration study the options to tighten the CAFE standards for the 2014 model year. In addition, the law requires the Environmental Protection Agency to update and improve fuel economy testing methods.

VIET NAM

- *Viet Nam's primary energy demand is projected to grow annually at 4.4 percent, from 42 Mtoe in 2002 to 142 Mtoe in 2030, as a result of industrialisation of the economy.*
- *Viet Nam is expected to become a net energy importing economy beyond 2020; with the energy import dependency projected to reach 15 percent in 2030.*
- *The total investment requirements are estimated to be between US$136-172 billion; of which four-fifths of the investment will be required for electricity generation and transmission.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Viet Nam's energy consumption has been growing rapidly in parallel with the economy's progress in industrialisation and economic reform to facilitate closer integration into the global economy. Between 2000 and 2005, total primary energy consumption, excluding biomass, grew at an annual rate of 10.6 percent, compared with that of 9.9 percent per year during the previous decade. Despite the fast growth, per capita energy consumption of Viet Nam is one of the lowest in the APEC region at 0.36 toe per person in 2005.

By energy source, natural gas grew at the fastest annual rate of 37 percent between 2000 and 2005, driven largely by the start-up of natural gas supply from Nam Con Son Basin to Phu My electricity complex in 2002.[116] During the same period, coal grew at the second fastest rate of 14.9 percent per year due to the growth in consumption from industry and electricity generation.[117] Oil grew at an annual rate of 8.2 percent driven by the robust growth in transportation sector.

Meeting the economy's growing energy demand, on the back of a surge in the world energy prices has resulted in significant increase in energy production. Oil production increased from 16.9 Mtoe in 2000 to 19.1 Mtoe in 2005[118], and coal production more than doubled from 6.5 Mtoe in 2000 to 17.0 Mtoe in 2005. Natural gas production surged by six-fold from 1.1 Mtoe in 2000 to 6.7 Mtoe in 2005.

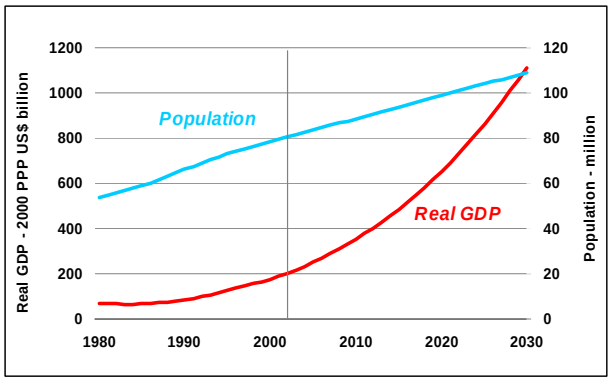
Viet Nam has been a net energy exporter since 1990. With continued expansion of domestic energy production, the net energy export position of the economy has grown considerably from 2 percent in 1990 to 55 percent in 2005. Foreign currency earnings from the export of coal and crude oil are important sources of revenue to the economy, accounting for US$7.4 billion or 25 percent of the total export revenue in 2005.

To supply energy in a manner meeting the rise in consumption, the Ministry of Industry has formulated the National Energy Policy of Viet Nam. Main points of the Policy are: 1) development of energy infrastructure and enhancement of long-term energy supply, 2) development of energy in consideration of environment, 3) improvement of energy efficiency and 4) enhancement of international energy cooperation.

ENERGY DEMAND DRIVERS

Viet Nam's economy is expected to grow rapidly at 7.3 percent annually in the near-term through 2010, but will slowdown thereafter to about 6.0 percent annually until 2030. The industry and service sectors are expected to continue to drive the economic growth.

Figure 123 GDP and Population



Source: Global Insights (2005)

The economy's population is projected to reach 109 million by 2030, growing annually at 1.1 percent from 80.5 million in 2002. The number of people moving from rural areas to cities will moderately urbanise the economy to 43 percent by 2030. The rate of urbanisation growth, at 1.9 percent per year,

[116] Natural gas in the Nam Con Son Basin is supplied through pipeline to six generating plants at Phu My with a combined capacity of 3,870 MW in 2005, which corresponds to one third of Viet Nam's total generation capacity.

[117] To meet the growing electricity demand, installed capacity of coal-fired generation more than doubled from 681 MW in 2000 to 1,631 MW in 2005.

[118] Sourced from the National Statistics of Viet Nam.

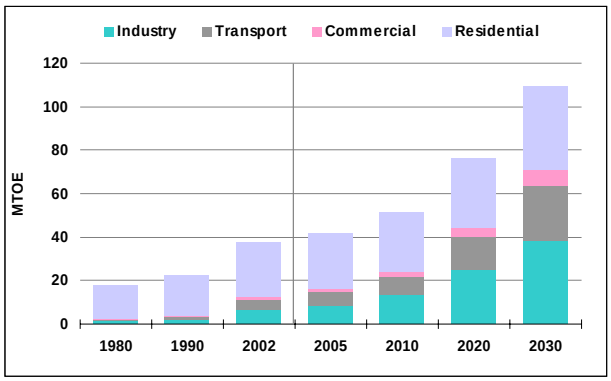
will however be higher than population growth over the outlook period.

OUTLOOK

FINAL ENERGY DEMAND

Viet Nam's final energy demand is projected to grow annually at 3.9 percent over the outlook period, from 38 Mtoe in 2002 to 109 Mtoe in 2030. The projected final energy demand growth is however slower than the past decade of 4.4 percent between 1990 and 2002, but among the fastest growth in the APEC region. The share of the residential sector is projected to remain the largest, but will reduce substantially from 67 percent in 2002 to 35 percent in 2030, as a result of biomass being replaced by commercial energy sources. The industry sector is expected to maintain the second largest share at 35 percent, followed by transport at 24 percent and commercial at 6 percent.

Figure 124 Final Energy Demand



Source: APERC Analysis (2006)

Industry

Over the outlook period, energy demand in the industrial sector is projected to grow at the fastest annual rate of 6.6 percent, slightly faster than the past two decades at 6.4 percent. The rapid growth in industrial value-added of about 7.1 percent per year over the outlook period is as a result of the continued industrialisation of the economy. To achieve Viet Nam's goal of becoming an industrialised economy by 2020, Viet Nam plans to build a number of heavy industries such as cement, iron and steel, fertiliser, chemical, and petrochemical. The government also expects the manufacturing and construction industries to become the driving force for the development of the national economy, with a combined share to total value-added to reach over 42 percent in 2020 from 38 percent in 2002. Energy intensity is expected to continue to increase from 92 toe per US$ million in 2002 to 95 toe per US$ million in 2010, thereafter declining to 81 toe per US$ million in 2030.

Coal has been and will continue to be the major source of energy in Viet Nam's industrial sector but will be replaced by other sources. This trend will continue and is projected to reduce coal's share of total industrial energy demand from 46 percent in 2002 to 35 percent by 2030. The share of oil is also projected to decline from 36 percent in 2002 to 32 percent in 2030 as gas pipelines are developed along the industry routes, marginally displacing oil. By contrast, recent large discoveries of natural gas have fostered the development of the fertiliser and petrochemical industries, and consequently, natural gas demand is projected to lead the growth at 21 percent per year through 2030. Natural gas demand will account for 11 percent of total industrial energy demand in 2030. Electricity is also projected to grow robustly at 7.4 percent per year, with the share increasing from 18 percent in 2002 to 22 percent in 2030, as newly-built industries are expected to introduce more efficient electrical equipment and automated systems.

Transport

Viet Nam's transport sector is characterised by very fast growth in road transport energy consumption of 11.1 percent per year over the last 12 years to 2002. Despite the fast growth, per capita transport energy consumption remained one of the lowest in the APEC region at 0.06 toe per person in 2002, which is about one seventh of the APEC average at 0.42 toe per person in the same year.

During the outlook period, Viet Nam's transport energy demand is projected to continue to grow the fastest in the APEC region at 6.2 percent per year. With accession to the WTO likely from 2006-2007, Viet Nam's economy will be further integrated to the global economy, which will in turn translate into substantial increases in the energy requirements for freight transport. Income growth will spur the shift from motorcycles to passenger vehicles to facilitate the mobility of people. The government has announced plans to upgrade existing road and develop new infrastructure to accommodate the growing volume of freight traffic as well as passenger travel. Viet Nam's transport energy demand is therefore projected to grow by more than five times between 2002 and 2030.

By fuel type, gasoline will grow at the fastest rate of 6.5 percent per year. As of 2006, motorcycles are the largest consumer of gasoline, accounting for about 55 percent of the total gasoline consumption. In major cities such as Hanoi and Hochiminh, motorcycles account for more than 90 percent of total passenger traffic. Dependence on motorcycles is expected to continue, at least in the near-term.

However, in the long-term, passenger vehicles will gradually replace motorcycles, further increasing the gasoline demand growth. By 2030, the number of passenger vehicles is projected to increase by more than seven-fold to reach 870,000 units from 120,000 units in 2002. However, the number of passenger vehicles per 1,000 population will remain small at 10.2 in 2030, the lowest in the APEC region. Diesel for freight trucks and farm vehicles will grow the second fastest annual rate of 6.2 percent through to 2030.

Residential and Commercial

Energy demand in the residential sector is expected to grow at 1.5 percent per year throughout the outlook period, slower in comparison with the 2.2 percent annual growth rate over the past two decades. The residential energy mix is expected to change significantly over the outlook period. Biomass – mostly from fuel wood – which plays an important role in rural areas particularly for cooking, is projected to maintain the largest share to total residential energy demand, although the share is expected to decrease from 90 percent in 2002 to 59 percent in 2030. Substitution of biomass for coal, LPG or gas, and electricity is the main reason for the decline. The share of electricity, on the other hand, will increase from 5 percent in 2002 to 29 percent in 2030, accounting for the second largest share after biomass. Due to strong income growth, moderate growth in urbanisation and the government's policy to promote rural electrification, households are expected to switch to electricity for lighting and electrical appliances. As a result, electricity demand is expected to grow at the fastest rate of 8.1 percent annually. For cooking in the residential sector, LPG is expected to replace coal in urban areas while coal use will be maintained in rural areas as the coal price is lower than that of LPG. Coal and LPG demand is expected to grow annually at 3.7 percent and 7.8 percent respectively, each accounting for 5 percent of total residential energy demand in 2030.

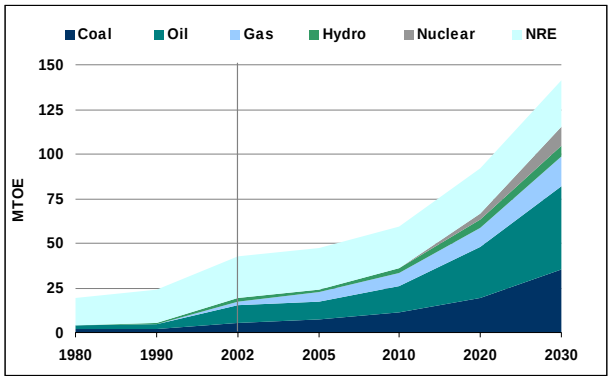
Energy demand in the commercial sector will be mainly driven by the strong growth in GDP, which is projected to grow at 6.1 percent per year. Petroleum products, which will account for 58 percent of total commercial energy demand in 2030, are expected to grow at 5.7 percent per year, supported by the increase in LPG demand for commercial buildings. Electricity is projected to take the second largest share in total commercial energy demand, accounting for 22 percent in 2030. As the demand for cooling and lighting increase, electricity demand will grow at the fastest rate of 8.1 percent annually throughout the outlook period.

With the increasing accessibility to resources, coal demand is expected to grow at 5.3 percent annually, however the share in total commercial energy demand is projected to decline from 22 percent in 2002 to 18 percent in 2030.

PRIMARY ENERGY DEMAND

Viet Nam's primary energy demand is projected to increase more than three-fold from 42 Mtoe in 2002 to about 142 Mtoe in 2030, increasing annually at 4.4 percent over the outlook period. Commercial energy sources will increase rapidly at 6.7 percent per annum and surpass traditional energy sources (mainly biomass) in 2005, and account for more than 50 percent of the primary energy mix. Consequently, the share of biomass will decrease substantially from 55 percent in 2002 to 18 percent in 2030.

Figure 125 Primary Energy Demand



Source: APERC Analysis (2006)

Among the fossil fuels, oil will continue to account for the largest share in total primary energy demand, mainly utilised in the transportation and industrial sectors. In 2002, Viet Nam was an exporter of crude oil, but a net-importer of oil products. From 2009, the first oil refinery to be built in the economy will be commissioned, which will be supplied by domestic and imported crude oil – reducing the import dependence on oil products. However, as oil reserves decline over the outlook period, Viet Nam's oil import dependence is expected to increase to 57 percent in 2030.

Coal and natural gas demand will be mainly driven by rapid development of the electricity sector and industrial sector, accounting for 25 percent and 12 percent respectively in 2030. Over the outlook period both coal and natural gas supply is expected to be met through indigenous supply.

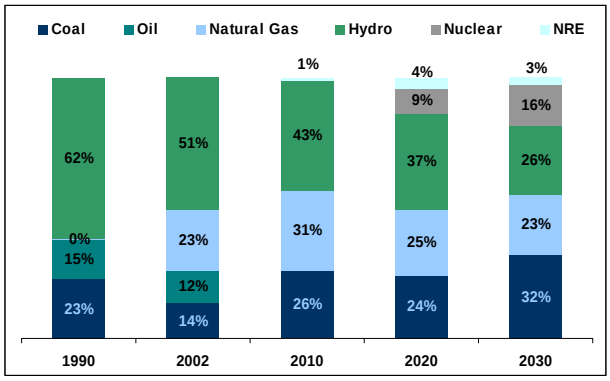
Excluding large-scale hydro, other types of new and renewable energy such as mini-hydro, wind, solar PV, geothermal, and MSW-landfill gas will continue to be promoted, raising the share of renewable energy to 18 percent in 2030. Nuclear power – to be

introduced in 2020 - is expected to account for 8 percent of total primary energy demand in 2030. Electricity import sources will commence from 2010 and account for 0.4 percent of primary energy demand in 2030.

ELECTRICITY

Electricity demand is projected to grow by 7.8 percent per year over the outlook period. The elasticity of GDP to electricity will continue to be above 1.0 although at a downward trend, from 1.4 during the period 2002-2010 to 1.1 during 2010-2030.

Figure 126 Electricity Generation Mix



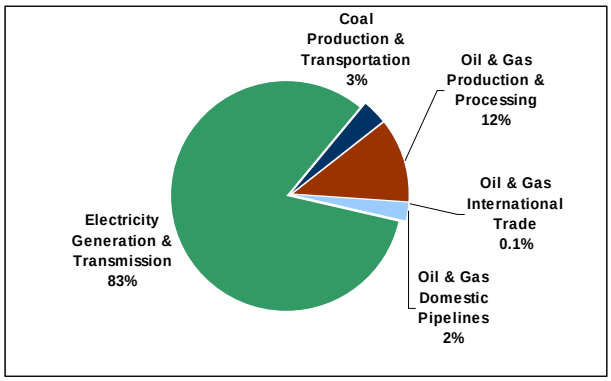
Source: APERC Analysis (2006)

To meet the projected electricity demand, 54 GW of additional generation capacity is expected to be built, which will increase installed capacity to senve-times the 2002 level. Electricity generation will increase at an average growth rate of 7.4 percent per year to reach 266 TWh in 2030. From 2002 to 2030, the share of hydro will decrease considerably from 51 percent to 26 percent, as most possible locations for hydro are fully developed. By contrast, coal-fired electricity generation will gradually increase and take the biggest share at 32 percent in 2030, a two-fold increase over 2002. The share of gas-fired electricity generation is projected to increase in the near-term, however, with the introduction of nuclear power after 2020, the share of natural gas is expected to decrease to 23 percent in 2030. Meanwhile, the share of nuclear will increase from 0 percent in 2002 to 16 percent in 2030. In addition, as the utilisation of domestic resources is pursued, renewables are expected to contribute to electricity generation – especially in remote areas where connection with the national grid is not economically feasible – increasing from 0 percent in 2002 to 3 percent in 2030.

INVESTMENT REQUIREMENTS

The total investment requirements for energy infrastructure development over the outlook period are projected to reach US$136-172 billion. The majority of these investments will be required in the electricity sector. Oil and gas investments will rank the second in terms of importance.

Figure 127 Investment Requirements



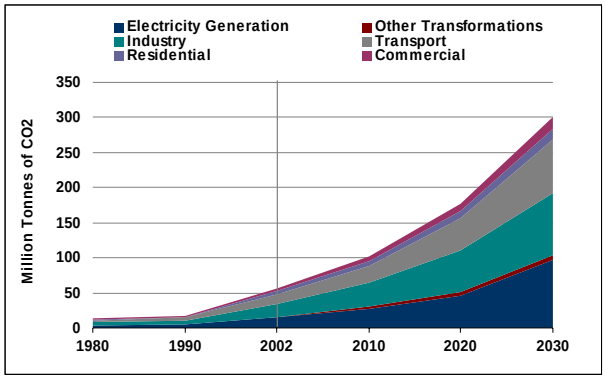
Source: APERC Analysis (2006)

As a percentage of GDP, Viet Nam's cumulative investment requirements for the energy sector will account for between 4.2 and 5.3 percent during the outlook period, the highest percentage level among the APEC economies.

CO_2 EMISSIONS

Viet Nam is currently one of the lowest per capita emitters of CO_2, at 0.7 tonnes of CO_2 in 2002, or about 12.3 percent of APEC average. But the CO_2 emissions per GDP are high, about 2.2 times the APEC average. CO_2 emissions from the energy sector are projected to grow by 6.2 percent per year over the outlook period, reaching about 301 million tonnes of CO_2 in 2030. Emissions are expected to increase rapidly as Viet Nam industrialises and the economy utilises more carbon intensive fuels, moving away from traditional fuels including biomass.

Figure 128 CO_2 Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

IMPORT DEPENDENCE

Despite government efforts to develop a more comprehensive policy to cover all energy sub-sectors from upstream to downstream, and promote the economic and efficient utilisation of energy, Viet Nam is expected to become a net energy importer beyond 2020 with an import dependence ratio of 8 percent in 2025 and 15 percent in 2030. The import dependence of oil is of particular concern and is projected to increase from an initial net oil exporter in 2002 to a net oil importer of 18 percent in 2020 gradually rising to reach 57 percent in 2030.

Since 2001, the state-owned oil and gas corporation PetroVietnam has started their oil and gas exploration and development overseas, such as in Indonesia, Malaysia, Algeria, Iraq and Mongolia.

ENERGY EFFICIENCY IMPROVEMENT

Viet Nam has one of the lowest per capita energy consumption among the APEC economies, and has always been ranked one of the highest economies in terms of energy intensity.[119] During the period 1990-2005, the economy's energy intensity has continually increased at an average annual growth rate of 2.4 percent.[120] This can be attributed in part to the difficulties of a transitional economy developing from a low level, but also the weakness of Viet Nam on energy efficiency management.

Over the outlook period, Viet Nam's energy intensity is expected to have a downward trend, decreasing by 1.8 percent per year. That must be a result of Viet Nam's efforts to accelerate reforming comprehensively energy sector toward higher efficiency, better sustainability, especially from early 2000's.

ENERGY INFRASTRUCTURE DEVELOPMENT

Viet Nam has amended many regulations, laws and codes in recent years to remove impediments to the attraction of domestic and foreign investment and create a fair competitive environment for all business enterprises. However, over the outlook period the investment requirements of the energy sector alone are projected to account for between 4.2 and 5.3 percent of GDP, the highest level in the APEC region. For the other Southeast Asian economies the average investment requirements as a percentage of GDP is between 1.2 and 1.5 percent.[121] Therefore, mobilisation of sufficient investment for development of the energy sector over the outlook period is expected to remain a challenge for the economy.

IMPLICATIONS

Population growth combined with the government's determination to maintain a high rate of economic development over the next two decades will translate into increased energy demand. Given the moderate supply potential of indigenous energy resources, future dependence on import sources is inevitable.

Key principles that Viet Nam needs to consider in building policies to attract investment in energy sector are: minimising financial costs, minimising direct financial responsibility of government, and diversifying financial sources. In addition, Viet Nam's regulations, laws and codes could be further amended to establish a more integrated energy-economic viewpoint that enhances the economy's long-term energy security and facilitates investment.

Among measures to strengthen national energy security, the government of Viet Nam continues to focus attention on diversification of supply sources and enhancement of energy efficiency on the demand side. In terms of diversification of supply side, Viet Nam's greater integration within the Greater Mekong Sub-region (GMS) through power grid interconnection projects and the Trans-ASEAN Gas Pipeline should be pursued. In addition, to secure oil supply, enhancing oil exploration and development, both domestically – especially in deep-water (400-1,000 m) concessions – and overseas is important.

Meanwhile, to increase the efficiency of energy use within the economy, a more rational pricing policy whereby producers and investors are able to recover production costs and the cost of imported energy and make a profit should be pursued, such that they are able to reinvest back into the economy to further facilitate infrastructural development. More rational energy pricing would also reduce the burden on the government to subsidise energy prices.

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[119] Fourth place in 2003 with an energy intensity as high as 590 toe per million 1995 US$ of GDP, APEC-EWG database.

[120] National data, accounting for only commercial energy, excluding biomass

[121] The Southeast Asian economies include Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore and Thailand.

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APPENDIX

COMMONLY USED ABBREVIATIONS AND OUTLOOK RESULTS BY ECONOMY

COMMONLY USED ABBREVIATIONS

ABARE	Australian Bureau of Agriculture and Resource Economics
APEC	Asia Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
ASEAN	Association of Southeast Asian Nations
AUS	Australia
BCM	billion cubic metres
BD	Brunei Darussalam
CCGT	combined cycle gas turbine
CDA	Canada
CAN$	Canadian Dollar
CHL	Chile
CNG	compressed natural gas
CO_2	carbon dioxide
CT	Chinese Taipei
DOE	Department of Energy (USA)
DSM	demand-side management
EDMC	Energy Data and Modelling Center (Japan)
EIA	Energy Information Administration (USA)
EWG	Energy Working Group (APEC)
FEC	final energy consumption
FED	final energy demand
FDI	foreign direct investment
FPI	foreign portfolio investment
FSU	Former Soviet Union
FT	Fischer-Tropsch technology
GDP	gross domestic product
GHG	greenhouse gases
g/kWh	grams per kilowatt-hour (used to measure the emissions caused by the generation of one unit of electricity)
GMS	Greater Mekong Sub Region
GNP	gross national product
GTL	gas to liquids
GW	gigawatt
GWh	gigawatt-hour
GWP	gross world product
HKC	Hong Kong, China
IDR	Indonesian Rupiah
IEA	International Energy Agency
IEEJ	Institute of Energy Economics, Japan
INA	Indonesia
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producers
JPN	Japan
kgoe	kilogram of oil equivalent

ktoe	thousand tonnes of oil equivalent
LEAP	Long-term Energy Analysis Programme
LHV	lower heating value
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MAS	Malaysia
mbd	million barrels per day
MCM	million cubic metres
MEX	Mexico
MMBTU	Million British Thermal Units
MOU	Memorandum of Understanding
MSW	Municipal Solid Waste
Mtoe	million tonnes of oil equivalent
NAFTA	North American Free Trade Agreement
NGV	natural gas vehicle
NRE	new and renewable energy
NYMEX	New York Mercantile Exchange
NZ	New Zealand
PE	Peru
PNG	Papua New Guinea
PPP	purchasing power parity
PRC	People's Republic of China
PV	Photo-voltaic
R&D	research and development
ROK	Republic of Korea
RM	Malaysian Ringgit
RP	the Republic of the Philippines
R/P	reserves-to-production ratio
RUS	the Russian Federation
SIN	Singapore
SUVs	Sports Utility Vehicles
tcf	trillion cubic feet
toe	tonnes of oil equivalent
TPED	total primary energy demand
TPES	total primary energy supply
TWh	terawatt hours
US or USA	United States of America
WTO	World Trade Organisation
VN	Viet Nam

OUTLOOK RESULTS BY ECONOMY

INTRODUCTION

This section provides a compilation of the outlook results by APEC member economy in table formats. A summary of the energy projections for the periods 2002, 2010, 2020 and 2030 is compiled at the beginning of the economy section as the energy balance table (EBT). EBTs are first presented followed by tables on the key macro economic assumptions, total primary energy consumption and transformation, final energy demand, electricity, energy-economy-environment interaction, and investments.

- Figures are rounded off and may not add up to 100 percent.
- Data values that appear negligible or inaccurate are rejected.

ENERGY BALANCE TABLES

The Energy Balance Tables are the final output produced by APERC. Energy Balance Tables included in this section are only for the years 2002, 2010, 2020 and 2030. Discrepancy in the data for the year 2002 is explained by Statistical Differences and Stock Change records in the IEA database.

Primary energy demand, transformations, and final energy demand are presented as:

- "Coal" - all coals, both primary and derived fuels, and peat;
- "Oil" - crude oil, natural gas liquids, refinery feedstocks, and additives as well as other hydrocarbons and petroleum products (excluding biofuels for the US);
- "Gas" - natural gas and town gas;
- "NRE" - biomass, geothermal, wind, solar and other new and renewable energy;
- TFED - Total Final Energy Demand; by fuel (coal, oil, gas, NRE, electricity and heat) and by sector (industry, transportation, residential and commercial).
- TPED - Total Primary Energy Demand; includes indigenous production (coal, oil, gas, hydro, NRE and nuclear) and net imports (coal, oil - both crude and petroleum products-, and natural gas). This equals Total Final Energy demand plus fuel inputs for the transformation sector (electricity and heat generation, petroleum refineries, and others). Net import is import minus export. Regional imports and exports include intraregional trade.
- Transformation sector includes:
  - "Electricity and Heat Generation" includes both public and private utility electricity and heat generation as well as auto-production, and losses in transmission/distribution.
  - "Petroleum refineries" includes biomass (ethanol for blending), heat and electricity for ancillary refining processes.
  - "Others" includes both coal transformation and gas processing, and energy consumption for oil, natural gas and coal extraction industries.
- "(2 %)" - numbers enclosed in parenthesis are the percentage share

KEY MACRO ASSUMPTIONS

Key macro assumptions include GDP, population, income, shares of Services and Industry sectors in GDP, and urbanisation level. Except for the urbanisation level, all macro economic assumptions were obtained from Global Insight Data up to 2025; APERC made the necessary calculations and projected the data between 2025 up to 2030. Urbanisation level was obtained from United Nation Habitat projections.

ENERGY PROJECTIONS

Energy production, primary energy demand, transformation, and final energy demand by sector and energy source, including average annual growth rates and shares are presented. The Energy Balance Tables and Energy Projections Tables are using the aforementioned terminologies, except for the transformation sector. "Input for Electricity and Heat Generation" does not include losses and own use. On the other hand,

"Other Transformation" is a combination of all other transformation processes including petroleum refineries and energy extraction industries (oil and natural gas), coal mining and city gas production. Due to the lack of historical data, energy demand for Russia and biomass demand in the residential sector of China has been included only from 1992 and 1994 respectively. The residential and commercial sector energy demand of Papua New Guinea has been combined in one sector.

Net electricity import is not considered in Primary Energy Demand for the Energy Projections tables, but instead is included in the net imports section.

Historical data prior to 2002 are from the IEA database, and therefore include statistical differences, stock changes, non-energy consumption and others. As a result of the different methodologies in how the data is aggregated some discrepancy in the trend analysis was observed. The energy demand for non-energy use, non-specified transport, pipeline transport, and non-specified other that are included in the IEA database are not included in final energy demand for the APERC energy outlook.

ENERGY SECURITY

"Diversification of Primary Energy Demand" (DoPED) is calculated as the weighted average of the main energy sources consumed by each economy to total primary energy demand (Equation (1)), and are normalised on a 0-100 scale, where a result close to zero implies that the economy is dependent on one energy source and a result close to 100 implies that the economy's energy sources are evenly distributed among the main energy sources

$$\text{DoPED} = \frac{\sqrt{\left(\text{Coal}^2 + \text{Oil}^2 + \text{Gas}^2 + (\text{Hydro} + \text{NRE})^2 + \text{Nuclear}^2\right)}}{\text{TPED}} \quad (1)$$

Net Energy Import Ratio (NEIR) (Equation (2)) represents the economy's dependency on energy imports. For regional balances this parameter is not adjusted to reflect intraregional trade flows.

$$\text{NEIR} = \frac{\text{Net Imports}}{\left(\text{Production} + \text{Net Imports}\right)} \quad (2)$$

Net Oil Import Dependency (NOID) (Equation (3)) represents the economy's dependency on oil imports. For regional balances this parameter is not adjusted to reflect intraregional trade flows.

$$\text{NOID} = \frac{\text{Net Oil Imports}}{\left(\text{Oil Primary Energy Demand}\right)} \quad (3)$$

ELECTRICITY GENERATION

The tables on electricity include total electricity generation and total installed generation capacity by fuel, where installed thermal generation capacity consists of coal, oil and gas.

ENERGY INTENSITY

"Energy intensity" is divided into two sections, the first represents the amount of primary energy consumed per unit volume of GDP, while the second represents the amount of primary energy consumed per capita. In the first section, the "Energy intensity in Industry or Commercial" represents the total amount of final energy consumed in each sector per unit volume of Industrial or Services GDP. In the second section, the "Energy intensity in Industry, Transport, Residential or Commercial" represents the total amount of final energy consumed in Industry, Transport, Residential or Commercial per capita.

CO_2 EMISSIONS

Historical data prior to 2001 are obtained from the IEA CO_2 Emissions from Fuel Combustion database, thus include statistical differences, emissions from non-energy consumption and others. As a result of the different methodologies in how the data is aggregated some discrepancy in the trend analysis was observed. The unit of CO_2 emissions is million tonnes of CO_2.

Projection of CO_2 emissions from fuel combustion is calculated using the "default method" and "IPCC Tier 1 default emissions factors" within LEAP.

TOTAL ENERGY INVESTMENT REQUIREMENTS

The range of values for the energy investment requirements in each time period represents the differences in construction costs among economies, technology costs, facility complexity, land costs difference among economies, differences in construction time.

Energy investment requirements for each type of energy infrastructure from 2003 up to 2030 were calculated. The types of energy infrastructure include:

- Coal production and transportation:

  Coal infrastructure includes major mine installations, equipment and transportation facilities in the form of railways and shipping ports. Other types of transportation infrastructure such as water barges, rail cars or road transport are not considered. The investment requirements for coal production and coal trading were not calculated separately. Investment requirements for coal-import facilities in non-coal producing economies such as Brunei Darussalam, Hong Kong, China, Japan, Papua New Guinea, Singapore, and Chinese Taipei, were not calculated.

- Oil and gas production and processing:

  This category covers simply the necessary investment for increasing domestic oil and gas supply capacity and or imports to meet the projected demand growth. However, this investment excludes investment for exploration activities, which includes all investments needed before a discovery is confirmed, including geophysical and geological analysis, and drilling of exploration wells.

- Oil and gas international trade:

  Necessary investment for LNG-related activities and cross-border pipelines are included. The assumptions about the share between LNG and piped gas for each economy are computed by considering i) the current gas situation of the economy, ii) known government plans, iii) approved LNG projects as at the end of 2005, iv) expert judgement.

- Oil and gas domestic pipeline:

  Mainly to be used for the construction of domestic pipelines and oil-related facilities.

- Electricity generation and transmission:

  Generation includes investments for new generation capacity additions and refurbishment of existing facilities. The transmission investment requirements were calculated by multiplying the current transmission cost for each economy per GWh of electricity demand and the projected growth in electricity demand.

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ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	1 643.9	1 399.2	1 382.5	113.4	382.0	460.1			5 381.2
Net Imports	- 77.6	773.2	- 112.6				- 6.5		576.5
TPED	**1 570.1**	**2 164.6**	**1 254.7**	**113.4**	**382.0**	**460.1**	**- 6.5**		**5 938.6**
Electricity and Heat Generation	-1 167.7	- 143.0	- 506.5	- 113.4	- 382.0	- 78.3	737.4	179.9	-1 473.7
Petroleum Refineries		- 335.6	- 28.7			- 1.3	- 10.7	- 14.0	- 390.2
Others	- 68.6	- 21.7	- 151.6			- 6.7	- 19.5	- 6.8	- 274.9
TFED	**336.7**	**1 680.0**	**565.6**			**373.9**	**693.3**	**169.1**	**3 818.6**
Industry	271.2	418.1	272.0			56.4	306.6	83.0	1 407.1
Transport	5.4	1 076.5	0.7			1.8	7.2		1 091.7
Residential	51.7	99.6	198.1			314.1	200.2	74.7	938.3
Commercial	8.4	85.8	94.9			1.6	179.4	11.4	381.5

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	2 374.0	1 566.5	1 535.1	131.6	442.2	489.7			6 539.0
Net Imports	- 163.5	956.7	- 66.5				- 0.3		726.5
TPED	**2 210.6**	**2 523.2**	**1 468.6**	**131.6**	**442.2**	**489.7**	**- 0.3**		**7 265.5**
Electricity and Heat Generation	-1 687.6	- 110.8	- 587.9	- 131.6	- 442.2	- 118.0	971.9	206.9	-1 899.2
Petroleum Refineries		- 349.4	- 30.3			- 1.3	- 12.0	- 17.4	- 410.4
Others	- 56.1	- 22.9	- 175.9			- 8.9	- 23.6	- 7.2	- 294.6
TFED	**466.8**	**2 040.2**	**674.5**			**361.5**	**935.9**	**182.3**	**4 661.2**
Industry	403.3	511.0	327.7			63.8	438.2	97.8	1 841.8
Transport	3.8	1 323.7	1.7			2.6	9.8		1 341.5
Residential	50.8	117.6	222.0			293.4	249.4	74.3	1 007.6
Commercial	8.9	87.9	123.1			1.7	238.6	10.2	470.4

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	2 812.1	1 667.2	1 709.1	159.0	540.3	526.9			7 414.6
Net Imports	- 96.7	1 314.5	73.8				- 0.5		1 291.2
TPED	**2 715.5**	**2 981.7**	**1 782.9**	**159.0**	**540.3**	**526.9**	**- 0.5**		**8 705.8**
Electricity and Heat Generation	-2 138.1	- 102.6	- 741.3	- 159.0	- 540.3	- 166.5	1 292.6	234.8	-2 320.4
Petroleum Refineries		- 363.7	- 31.0			- 1.3	- 12.6	- 19.6	- 428.2
Others	- 62.3	- 23.2	- 177.9			- 12.7	- 25.3	- 7.3	- 308.6
TFED	**515.1**	**2 491.8**	**832.7**			**346.4**	**1 254.2**	**207.9**	**5 648.1**
Industry	457.4	630.1	408.9			75.8	600.0	116.5	2 288.6
Transport	2.4	1 628.8	2.7			3.9	12.8		1 650.7
Residential	46.6	138.7	253.8			264.9	314.9	81.6	1 100.6
Commercial	8.7	94.1	167.3			1.8	326.4	9.8	608.1

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	3 363.5	1 682.6	1 765.6	196.6	642.8	588.0			8 239.0
Net Imports	2.8	1 804.9	284.3				1.2		2 093.2
TPED	**3 366.3**	**3 487.5**	**2 049.8**	**196.6**	**642.8**	**588.0**	**1.2**		**10 332.2**
Electricity and Heat Generation	-2 738.3	- 101.3	- 837.6	- 196.6	- 642.8	- 228.8	1 678.5	263.3	-2 803.6
Petroleum Refineries		- 390.6	- 32.4			- 1.3	- 13.1	- 21.3	- 458.7
Others	- 67.9	- 22.9	- 169.0			- 17.5	- 26.3	- 7.2	- 310.6
TFED	**560.2**	**2 972.8**	**1 010.8**			**340.4**	**1 640.3**	**234.8**	**6 759.2**
Industry	509.3	738.9	494.9			90.0	796.9	138.6	2 768.6
Transport	0.1	1 973.4	4.1			5.5	16.3		1 999.4
Residential	42.4	161.8	299.7			242.9	389.1	85.3	1 221.2
Commercial	8.4	98.6	212.1			2.0	438.0	10.9	770.1

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MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	10 398	26 682	38 019	56 422	81 654	4.4	4.5	4.0	3.8	4.1
Population (million)	1 842	2 590	2 736	2 894	3 003	1.6	0.7	0.6	0.4	0.5
GDP per capita (2000 PPP US$)	5 646	10 301	13 893	19 498	27 195	2.8	3.8	3.4	3.4	3.5
GDP in Services (2000 PPP US$ billion)	6 946	16 474	22 923	33 505	47 745	4.0	4.2	3.9	3.6	3.9
GDP in Industry (2000 PPP US$ billion)	2 893	7 870	12 065	18 327	26 926	4.7	5.5	4.3	3.9	4.5
Urbanisation level (%)	41	51	56	64	68		1.3	1.3	0.7	1.1

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**2 897.7**	**5 381.2**	**6 539.0**	**7 414.6**	**8 239.0**	**2.9**	**2.5**	**1.3**	**1.1**	**1.5**
Coal	859.8	1 643.9	2 374.0	2 812.1	3 363.5	3.0	4.7	1.7	1.8	2.6
	(30%)	(31%)	(36%)	(38%)	(41%)					
Oil	946.5	1 399.2	1 566.5	1 667.2	1 682.6	1.8	1.4	0.6	0.1	0.7
	(33%)	(26%)	(24%)	(22%)	(20%)					
Gas	590.6	1 382.5	1 535.1	1 709.1	1 765.6	3.9	1.3	1.1	0.3	0.9
	(20%)	(26%)	(23%)	(23%)	(21%)					
Hydro	65.0	113.4	131.6	159.0	196.6	2.6	1.9	1.9	2.1	2.0
	(2%)	(2%)	(2%)	(2%)	(2%)					
NRE	331.6	460.1	489.7	526.9	588.0	1.5	0.8	0.7	1.1	0.9
	(11%)	(9%)	(7%)	(7%)	(7%)					
Nuclear	104.3	382.0	442.2	540.3	642.8	6.1	1.8	2.0	1.8	1.9
	(4%)	(7%)	(7%)	(7%)	(8%)					
Net Imports	**535.9**	**576.5**	**726.5**	**1 291.2**	**2 093.2**	**0.3**	**2.9**	**5.9**	**5.0**	**4.7**
Coal	- 33.0	- 77.6	- 163.5	- 96.7	2.8	4.0	9.8	- 5.1		
Oil	564.9	773.2	956.7	1 314.5	1 804.9	1.4	2.7	3.2	3.2	3.1
Gas	3.9	- 112.6	- 66.5	73.8	284.3		- 6.4		14.4	
Electricity		- 6.5	- 0.3	- 0.5	1.2		-33.3	6.1		
Total Primary Energy Demand	**3 363.2**	**5 938.6**	**7 265.5**	**8 705.8**	**10 332.2**	**2.6**	**2.6**	**1.8**	**1.7**	**2.0**
Coal	822.3	1 570.1	2 210.6	2 715.5	3 366.3	3.0	4.4	2.1	2.2	2.8
	(24%)	(26%)	(30%)	(31%)	(33%)					
Oil	1 444.6	2 164.6	2 523.2	2 981.7	3 487.5	1.9	1.9	1.7	1.6	1.7
	(43%)	(36%)	(35%)	(34%)	(34%)					
Gas	595.3	1 254.7	1 468.6	1 782.9	2 049.8	3.4	2.0	2.0	1.4	1.8
	(18%)	(21%)	(20%)	(20%)	(20%)					
Hydro	65.0	113.7	131.9	159.2	196.9	2.6	1.9	1.9	2.1	2.0
	(2%)	(2%)	(2%)	(2%)	(2%)					
NRE	331.6	460.1	489.7	526.9	588.0	1.5	0.8	0.7	1.1	0.9
	(10%)	(8%)	(7%)	(6%)	(6%)					
Nuclear	104.3	382.0	442.2	540.3	642.8	6.1	1.8	2.0	1.8	1.9
	(3%)	(6%)	(6%)	(6%)	(6%)					
Input for Electricity and Heat Generation	**- 871.0**	**-2 391.0**	**-3 078.0**	**-3 847.8**	**-4 745.4**	**4.7**	**3.2**	**2.3**	**2.1**	**2.5**
Coal	- 399.8	-1 167.7	-1 687.6	-2 138.1	-2 738.3	5.0	4.7	2.4	2.5	3.1
	(46%)	(49%)	(55%)	(56%)	(58%)					
Oil	- 184.3	- 143.0	- 110.8	- 102.6	- 101.3	- 1.1	- 3.1	- 0.8	- 0.1	- 1.2
	(21%)	(6%)	(4%)	(3%)	(2%)					
Gas	- 108.1	- 506.5	- 587.9	- 741.3	- 837.6	7.3	1.9	2.3	1.2	1.8
	(12%)	(21%)	(19%)	(19%)	(18%)					
Hydro	- 65.0	- 113.4	- 131.6	- 159.0	- 196.6	2.6	1.9	1.9	2.1	2.0
	(7%)	(5%)	(4%)	(4%)	(4%)					
NRE	- 9.6	- 78.3	- 118.0	- 166.5	- 228.8	10.0	5.3	3.5	3.2	3.9
	(1%)	(3%)	(4%)	(4%)	(5%)					
Nuclear	- 104.3	- 382.0	- 442.2	- 540.3	- 642.8	6.1	1.8	2.0	1.8	1.9
	(12%)	(16%)	(14%)	(14%)	(14%)					
Other Transformation	**- 176.8**	**- 665.1**	**- 705.0**	**- 736.9**	**- 769.3**	**6.2**	**0.7**	**0.4**	**0.4**	**0.5**
Coal	- 9.7	- 68.6	- 56.1	- 62.3	- 67.9	9.3	- 2.5	1.1	0.9	
	(5%)	(10%)	(8%)	(8%)	(9%)					
Oil	- 100.8	- 357.3	- 372.2	- 386.9	- 413.4	5.9	0.5	0.4	0.7	0.5
	(57%)	(54%)	(53%)	(53%)	(54%)					
Gas	- 57.4	- 180.3	- 206.2	- 208.9	- 201.4	5.3	1.7	0.1	- 0.4	0.4
	(32%)	(27%)	(29%)	(28%)	(26%)					
NRE		- 8.0	- 10.2	- 14.0	- 18.8		3.1	3.2	3.0	3.1
		(1%)	(1%)	(2%)	(2%)					
Electricity	- 8.8	- 30.2	- 35.6	- 37.9	- 39.4	5.8	2.1	0.6	0.4	0.9
	(5%)	(5%)	(5%)	(5%)	(5%)					
Heat	- 0.1	- 20.8	- 24.6	- 26.9	- 28.5		2.1	0.9	0.6	1.1
	(0%)	(3%)	(3%)	(4%)	(4%)					

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	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**2 336.2**	**3 818.6**	**4 661.2**	**5 648.1**	**6 759.2**	**2.3**	**2.5**	**1.9**	**1.8**	**2.1**
Coal	310.5	336.7	466.8	515.1	560.2	0.4	4.2	1.0	0.8	1.8
	(13%)	(9%)	(10%)	(9%)	(8%)					
Oil	1 039.8	1 680.0	2 040.2	2 491.8	2 972.8	2.2	2.5	2.0	1.8	2.1
	(45%)	(44%)	(44%)	(44%)	(44%)					
Gas	396.3	565.6	674.5	832.7	1 010.8	1.6	2.2	2.1	2.0	2.1
	(17%)	(15%)	(14%)	(15%)	(15%)					
NRE	290.8	373.9	361.5	346.4	340.4	1.1	- 0.4	- 0.4	- 0.2	- 0.3
	(12%)	(10%)	(8%)	(6%)	(5%)					
Electricity	290.4	693.3	935.9	1 254.2	1 640.3	4.0	3.8	3.0	2.7	3.1
	(12%)	(18%)	(20%)	(22%)	(24%)					
Heat	8.5	169.1	182.3	207.9	234.8	14.6	0.9	1.3	1.2	1.2
	(0%)	(4%)	(4%)	(4%)	(3%)					
Industry	**932.7**	**1 407.1**	**1 841.8**	**2 288.6**	**2 768.6**	**1.9**	**3.4**	**2.2**	**1.9**	**2.4**
Coal	228.6	271.2	403.3	457.4	509.3	0.8	5.1	1.3	1.1	2.3
	(25%)	(19%)	(22%)	(20%)	(18%)					
Oil	313.0	418.1	511.0	630.1	738.9	1.3	2.5	2.1	1.6	2.1
	(34%)	(30%)	(28%)	(28%)	(27%)					
Gas	199.4	272.0	327.7	408.9	494.9	1.4	2.4	2.2	1.9	2.2
	(21%)	(19%)	(18%)	(18%)	(18%)					
NRE	46.4	56.4	63.8	75.8	90.0	0.9	1.6	1.7	1.7	1.7
	(5%)	(4%)	(3%)	(3%)	(3%)					
Electricity	138.5	306.6	438.2	600.0	796.9	3.7	4.6	3.2	2.9	3.5
	(15%)	(22%)	(24%)	(26%)	(29%)					
Heat	6.8	83.0	97.8	116.5	138.6	12.0	2.1	1.8	1.8	1.9
	(1%)	(6%)	(5%)	(5%)	(5%)					
Transport	**602.8**	**1 091.7**	**1 341.5**	**1 650.7**	**1 999.4**	**2.7**	**2.6**	**2.1**	**1.9**	**2.2**
Coal	9.6	5.4	3.8	2.4	0.1	- 2.6	- 4.3	- 4.4	- 28.5	- 13.8
	(2%)	(0%)	(0%)	(0%)	(0%)					
Oil	591.2	1 076.5	1 323.7	1 628.8	1 973.4	2.8	2.6	2.1	1.9	2.2
	(98%)	(99%)	(99%)	(99%)	(99%)					
Gas		0.7	1.7	2.7	4.1		12.1	5.0	4.2	6.7
		(0%)	(0%)	(0%)	(0%)					
NRE		1.8	2.6	3.9	5.5		4.5	4.0	3.5	4.0
		(0%)	(0%)	(0%)	(0%)					
Electricity	2.0	7.2	9.8	12.8	16.3	6.0	3.9	2.8	2.4	3.0
	(0%)	(1%)	(1%)	(1%)	(1%)					
Residential	**603.0**	**938.3**	**1 007.5**	**1 100.6**	**1 221.2**	**2.0**	**0.9**	**0.9**	**1.0**	**0.9**
Coal	67.8	51.7	50.8	46.6	42.4	- 1.2	- 0.2	- 0.9	- 0.9	- 0.7
	(11%)	(6%)	(5%)	(4%)	(3%)					
Oil	76.2	99.6	117.6	138.7	161.8	1.2	2.1	1.7	1.5	1.7
	(13%)	(11%)	(12%)	(13%)	(13%)					
Gas	127.2	198.1	222.0	253.8	299.7	2.0	1.4	1.3	1.7	1.5
	(21%)	(21%)	(22%)	(23%)	(25%)					
NRE	244.4	314.1	293.4	264.9	242.9	1.1	- 0.8	- 1.0	- 0.9	- 0.9
	(41%)	(33%)	(29%)	(24%)	(20%)					
Electricity	86.4	200.2	249.4	314.9	389.1	3.9	2.8	2.4	2.1	2.4
	(14%)	(21%)	(25%)	(29%)	(32%)					
Heat	1.1	74.7	74.3	81.6	85.3		- 0.1	0.9	0.4	0.5
	(0%)	(8%)	(7%)	(7%)	(7%)					
Commercial	**197.6**	**381.5**	**470.4**	**608.1**	**770.1**	**3.0**	**2.7**	**2.6**	**2.4**	**2.5**
Coal	4.5	8.4	8.9	8.7	8.4	2.9	0.7	- 0.2	- 0.4	
	(2%)	(2%)	(2%)	(1%)	(1%)					
Oil	59.4	85.8	87.9	94.1	98.6	1.7	0.3	0.7	0.5	0.5
	(30%)	(22%)	(19%)	(15%)	(13%)					
Gas	69.8	94.9	123.1	167.3	212.1	1.4	3.3	3.1	2.4	2.9
	(35%)	(25%)	(26%)	(28%)	(28%)					
NRE		1.6	1.7	1.8	2.0	21.4	0.6	0.8	1.0	0.8
		(0%)	(0%)	(0%)	(0%)					
Electricity	63.5	179.4	238.6	326.4	438.0	4.8	3.6	3.2	3.0	3.2
	(32%)	(47%)	(51%)	(54%)	(57%)					
Heat	0.5	11.4	10.2	9.8	10.9	14.9	- 1.4	- 0.4	1.1	- 0.2
	(0%)	(3%)	(2%)	(2%)	(1%)					

Note: Net imports include intraregional trade

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	83	89	88	87	87
Net Energy Import Ratio (%)	16	10	10	15	20
Net Oil Import Dependency (%)	39	36	38	44	52

APEC

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**4 034**	**9 279**	**12 128**	**15 886**	**20 518**	**3.9**	**3.4**	**2.7**	**2.6**	**2.9**
Coal	1 605	4 055	5 919	7 975	10 940	4.3	4.8	3.0	3.2	3.6
	(40%)	(44%)	(49%)	(50%)	(53%)					
Oil	781	506	362	317	299	- 2.0	- 4.1	- 1.3	- 0.6	- 1.9
	(19%)	(5%)	(3%)	(2%)	(1%)					
Gas	481	1 774	2 234	3 087	3 733	6.1	2.9	3.3	1.9	2.7
	(12%)	(19%)	(18%)	(19%)	(18%)					
Hydro	755	1 309	1 530	1 845	2 278	2.5	2.0	1.9	2.1	2.0
	(19%)	(14%)	(13%)	(12%)	(11%)					
NRE	13	147	357	541	741	11.6	11.8	4.3	3.2	6.0
		(2%)	(3%)	(3%)	(4%)					
Nuclear	398	1 488	1 725	2 121	2 526	6.2	1.9	2.1	1.8	1.9
	(10%)	(16%)	(14%)	(13%)	(12%)					
Total Installed Generation Capacity (GW)	**960**	**2 139**	**2 825**	**3 458**	**4 208**	**3.7**	**3.5**	**2.0**	**2.0**	**2.4**
Thermal	677	1 527	2 049	2 499	3 062	3.8	3.7	2.0	2.1	2.5
	(70%)	(71%)	(73%)	(72%)	(73%)					
Coal		752	1 061	1 364	1 711		4.4	2.5	2.3	3.0
		(35%)	(38%)	(39%)	(41%)					
Oil		393	424	380	388		1.0	- 1.1	0.2	- 0.05
		(18%)	(15%)	(11%)	(9%)					
Gas		382	563	755	963		5.0	3.0	2.5	3.4
		(18%)	(20%)	(22%)	(23%)					
Hydro	205	377	466	558	647	2.8	2.7	1.8	1.5	1.9
	(21%)	(18%)	(17%)	(16%)	(15%)					
NRE	3	31	77	124	170	11.7	11.8	4.9	3.2	6.2
		(1%)	(3%)	(4%)	(4%)					
Nuclear	75	204	233	278	329	4.6	1.7	1.8	1.7	1.7
	(8%)	(10%)	(8%)	(8%)	(8%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**323**	**223**	**191**	**155**	**127**	**- 1.7**	**- 1.9**	**- 2.1**	**- 1.9**	**- 2.0**
Industry (toe per US$ million GDP in Industry)	322	179	153	125	103	- 2.6	- 2.0	- 2.0	- 1.9	- 2.0
Commercial (toe per US$ million GDP in Services)	28	23	21	18	16	- 0.9	- 1.5	- 1.2	- 1.2	- 1.3
Energy Intensity (kgoe per capita)	**1 826**	**2 293**	**2 655**	**3 009**	**3 441**	**1.0**	**1.9**	**1.3**	**1.4**	**1.5**
Industry	507	543	673	791	922	0.3	2.7	1.6	1.5	1.9
Transport	327	421	490	570	666	1.2	1.9	1.5	1.6	1.6
Residential	327	362	368	380	407	0.5	0.2	0.3	0.7	0.4
Commercial	107	147	172	210	256	1.4	2.0	2.0	2.0	2.0
CO_2 Emissions (million tonnes)	**7 934**	**14 740**	**18 715**	**22 741**	**27 364**	**1.0**	**1.9**	**1.3**	**1.4**	**1.5**
Electricity Generation	2 305	6 123	8 217	10 287	12 837	4.5	3.7	2.3	2.2	2.7
Transformation other than Electricity Generation	473	1 043	1 106	1 170	1 232	3.7	0.7	0.6	0.5	0.6
Industry	2 239	2 892	3 799	4 541	5 255	1.2	3.5	1.8	1.5	2.2
Transport	1 769	3 199	3 929	4 836	5 856	2.7	2.6	2.1	1.9	2.2
Residential	786	968	1 075	1 197	1 357	1.0	1.3	1.1	1.3	1.2
Commercial	362	514	589	710	827	1.6	1.7	1.9	1.5	1.7
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	822	755	732	651	598	- 0.4	- 0.4	- 1.2	- 0.9	- 0.8
CO_2 emissions per capita (tonnes per capita)	9.2	12.7	14.9	16.7	18.9	1.5	2.0	1.2	1.2	1.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**1 844 - 2 338**	**3 845 - 4 896**	**5 954 - 7 556**
Coal Production & Transportation	112 - 137	209 - 251	326 - 388
Oil & Gas Production & Processing	349 - 512	669 - 984	911 - 1 338
Oil & Gas International Trade	175 - 212	321 - 397	452 - 567
Oil & Gas Domestic Pipeline	142 - 203	333 - 476	488 - 698
Electricity Generation & Transmission	1 066 - 1 273	2 312 - 2 788	3 777 - 4 566

AUSTRALIA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	174.7	33.0	27.0	1.4		5.0			241.2
Net Imports	- 131.6	8.6	- 8.9						- 131.8
TPED	**46.9**	**41.2**	**18.2**	**1.4**		**5.0**			**112.7**
Electricity and Heat Generation	- 44.2	- 1.0	- 7.0	- 1.4		- 0.6	17.1		- 36.9
Petroleum Refineries		- 1.9	- 0.2				- 0.1		- 2.3
Others		- 0.5					- 0.4		- 0.9
TFED	**2.8**	**33.8**	**10.9**			**4.5**	**16.3**		**68.3**
Industry	2.6	5.4	7.1			2.5	7.6		25.2
Transport	0.1	27.7					0.2		27.9
Residential		0.3	2.7			2.0	4.4		9.5
Commercial	0.1	0.3	1.1				4.2		5.7

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	252.2	26.9	51.1	1.4		7.3			338.9
Net Imports	- 202.0	16.2	- 23.6						- 209.4
TPED	**50.2**	**43.1**	**27.5**	**1.4**		**7.3**			**129.5**
Electricity and Heat Generation	- 46.9	- 0.8	- 12.7	- 1.4		- 2.3	20.8		- 43.3
Petroleum Refineries		- 2.1	- 0.2				- 0.1		- 2.5
Others		- 0.8					- 0.6		- 1.4
TFED	**3.4**	**39.3**	**14.6**			**5.0**	**20.1**		**82.3**
Industry	3.3	6.0	9.8			2.9	9.5		31.4
Transport		32.6					0.2		32.9
Residential		0.4	3.3			2.1	5.1		10.7
Commercial		0.4	1.4				5.4		7.2

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	310.9	24.9	90.1	1.5		9.1			436.4
Net Imports	- 253.0	26.0	- 55.8						- 282.9
TPED	**57.9**	**50.9**	**34.2**	**1.5**		**9.1**			**153.5**
Electricity and Heat Generation	- 54.4	- 0.8	- 15.5	- 1.5		- 3.6	26.0		- 49.8
Petroleum Refineries		- 2.4	- 0.3				- 0.2		- 2.8
Others		- 1.0					- 0.7		- 1.7
TFED	**3.5**	**46.6**	**18.5**			**5.5**	**25.2**		**99.2**
Industry	3.4	7.0	12.7			3.4	12.0		38.5
Transport		38.8					0.2		39.1
Residential		0.4	3.9			2.1	5.9		12.3
Commercial		0.5	1.8				7.0		9.3

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	367.6	24.8	115.5	1.5		10.4			519.8
Net Imports	- 301.4	34.6	- 75.5						- 342.2
TPED	**66.2**	**59.4**	**40.1**	**1.5**		**10.4**			**177.6**
Electricity and Heat Generation	- 62.6	- 0.8	- 17.7	- 1.5		- 4.5	31.5		- 55.7
Petroleum Refineries		- 2.7	- 0.3				- 0.2		- 3.1
Others		- 1.1					- 0.8		- 2.0
TFED	**3.6**	**54.8**	**22.1**			**5.9**	**30.5**		**116.8**
Industry	3.5	8.2	15.3			3.8	14.5		45.2
Transport		45.6	0.1				0.2		45.9
Residential		0.4	4.5			2.1	7.0		14.1
Commercial		0.5	2.2				8.7		11.5

AUSTRALIA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	261	536	672	846	1 048	3.3	2.9	2.3	2.2	2.4
Population (million)	14.8	19. 8	21. 3	23. 2	25.0	1.3	1.0	0.8	0.8	0.8
GDP per capita (2000 PPP US$)	17 593	27 112	31 539	36 503	41 864	2.0	1.9	1.5	1.4	1.6
GDP in Services (2000 PPP US$ billion)	157	352	459	605	772	3.7	3.4	2.8	2.5	2.8
GDP in Industry (2000 PPP US$ billion)	73	138	169	220	276	2.9	2.5	2.7	2.3	2.5
Urbanisation level (%)	86	91	94	95	96	0.3	0.3	0.1	0.1	0.2

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**86.1**	**241.2**	**338.9**	**436.4**	**519.8**	**4.8**	**4.3**	**2.6**	**1.8**	**2.8**
Coal	52.6	174.7	252.2	310.9	367.6	5.6	4.7	2.1	1.7	2.7
	(61%)	(72%)	(74%)	(71%)	(71%)					
Oil	21.3	33.0	26.9	24.9	24.8	2.0	- 2.5	- 0.8	- 0.05	- 1.0
	(25%)	(14%)	(8%)	(6%)	(5%)					
Gas	7.5	27.0	51.1	90.1	115.5	6.0	8.3	5.8	2.5	5.3
	(9%)	(11%)	(15%)	(21%)	(22%)					
Hydro	1.1	1.4	1.4	1.5	1.5	1.0	0.4	0.2	0.5	0.4
	(1%)	(1%)	(0%)	(0%)	(0%)					
NRE	3.6	5.0	7.3	9.1	10.4	1.5	4.7	2.3	1.4	2.6
	(4%)	(2%)	(2%)	(2%)	(2%)					
Nuclear										
Net Imports	**- 17.3**	**- 131.8**	**- 209.4**	**- 282.9**	**- 342.2**	**9.7**	**6.0**	**3.1**	**1.9**	**3.5**
Coal	- 28.5	- 131.6	- 202.0	- 253.0	- 301.4	7.2	5.5	2.3	1.8	3.0
Oil	11.2	8.6	16.2	26.0	34.6	- 1.2	8.2	4.9	2.9	5.1
Gas		- 8.9	- 23.6	- 55.8	- 75.5		13.0	9.0	3.1	7.9
Electricity										
Total Primary Energy Demand	**70.4**	**112.7**	**129.5**	**153.5**	**177.6**	**2.2**	**1.8**	**1.7**	**1.5**	**1.6**
Coal	27.3	46.9	50.2	57.9	66.2	2.5	0.9	1.4	1.3	1.2
	(39%)	(42%)	(39%)	(38%)	(37%)					
Oil	30.8	41.2	43.1	50.9	59.4	1.3	0.6	1.7	1.6	1.3
	(44%)	(37%)	(33%)	(33%)	(33%)					
Gas	7.5	18.2	27.5	34.2	40.1	4.1	5.3	2.2	1.6	2.9
	(11%)	(16%)	(21%)	(22%)	(23%)					
Hydro	1.1	1.4	1.4	1.5	1.5	1.0	0.4	0.2	0.5	0.4
	(2%)	(1%)	(1%)	(1%)	(1%)					
NRE	3.6	5.0	7.3	9.1	10.4	1.5	4.7	2.3	1.4	2.6
	(5%)	(4%)	(6%)	(6%)	(6%)					
Nuclear										
Input for Electricity and Heat Generation	**- 24.0**	**- 54.1**	**- 64.1**	**- 75.8**	**- 87.1**	**3.8**	**2.1**	**1.7**	**1.4**	**1.7**
Coal	- 20.2	- 44.2	- 46.9	- 54.4	- 62.6	3.6	0.7	1.5	1.4	1.3
	(84%)	(82%)	(73%)	(72%)	(72%)					
Oil	- 1.1	- 1.0	- 0.8	- 0.8	- 0.8	- 0.7	- 2.1	0.3	- 0.2	- 0.6
	(5%)	(2%)	(1%)	(1%)	(1%)					
Gas	- 1.5	- 7.0	- 12.7	- 15.5	- 17.7	7.2	7.7	2.0	1.3	3.4
	(6%)	(13%)	(20%)	(20%)	(20%)					
Hydro	- 1.1	- 1.4	- 1.4	- 1.5	- 1.5	1.0	0.4	0.2	0.5	0.4
	(5%)	(3%)	(2%)	(2%)	(2%)					
NRE	- 0.1	- 0.6	- 2.3	- 3.6	- 4.5	7.7	19.2	4.7	2.2	7.7
	(0%)	(1%)	(4%)	(5%)	(5%)					
Nuclear										
Other Transformation	**- 4.3**	**- 3.2**	**- 3.9**	**- 4.5**	**- 5.1**	**- 1.3**	**2.4**	**1.5**	**1.3**	**1.7**
Coal	- 0.5									
	(11%)									
Oil	- 2.7	- 2.5	- 2.9	- 3.4	- 3.8	- 0.4	2.1	1.4	1.2	1.6
	(63%)	(77%)	(75%)	(75%)	(74%)					
Gas	- 0.7	- 0.2	- 0.2	- 0.3	- 0.3	- 5.1	1.3	1.2	1.1	1.2
	(16%)	(7%)	(6%)	(6%)	(6%)					
NRE										
Electricity	- 0.3	- 0.5	- 0.7	- 0.9	- 1.0	3.0	3.9	1.9	1.6	2.4
	(7%)	(16%)	(19%)	(19%)	(20%)					
Heat	- 0.1									
	(3%)									

AUSTRALIA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**45.5**	**68.3**	**82.3**	**99.2**	**116.8**	**1.9**	**2.4**	**1.9**	**1.6**	**1.9**
Coal	4.2	2.8	3.4	3.5	3.6	- 1.9	2.4	0.4	0.2	0.9
	(9%)	(4%)	(4%)	(4%)	(3%)					
Oil	25.6	33.8	39.3	46.6	54.8	1.3	1.9	1.7	1.6	1.7
	(56%)	(49%)	(48%)	(47%)	(47%)					
Gas	5.3	10.9	14.6	18.5	22.1	3.3	3.6	2.4	1.8	2.5
	(12%)	(16%)	(18%)	(19%)	(19%)					
NRE	3.5	4.5	5.0	5.5	5.9	1.1	1.3	0.9	0.8	1.0
	(8%)	(7%)	(6%)	(6%)	(5%)					
Electricity	6.8	16.3	20.1	25.2	30.5	4.1	2.6	2.3	1.9	2.2
	(15%)	(24%)	(24%)	(25%)	(26%)					
Heat										
Industry	**19.3**	**25.2**	**31.4**	**38.5**	**45.2**	**1.2**	**2.8**	**2.1**	**1.6**	**2.1**
Coal	4.0	2.6	3.3	3.4	3.5	- 1.8	2.7	0.5	0.2	1.0
	(21%)	(10%)	(10%)	(9%)	(8%)					
Oil	6.7	5.4	6.0	7.0	8.2	- 0.9	1.2	1.6	1.6	1.5
	(35%)	(22%)	(19%)	(18%)	(18%)					
Gas	3.8	7.1	9.8	12.7	15.3	2.8	4.2	2.6	1.9	2.8
	(20%)	(28%)	(31%)	(33%)	(34%)					
NRE	1.9	2.5	2.9	3.4	3.8	1.2	2.2	1.5	1.2	1.6
	(10%)	(10%)	(9%)	(9%)	(8%)					
Electricity	2.9	7.6	9.5	12.0	14.5	4.4	2.8	2.4	1.9	2.3
	(15%)	(30%)	(30%)	(31%)	(32%)					
Heat										
Transport	**17.7**	**27.9**	**32.9**	**39.1**	**45.9**	**2.1**	**2.1**	**1.7**	**1.6**	**1.8**
Coal		0.1	0.1	0.1	0.1		- 1.8			- 0.5
		(0%)	(0%)	(0%)	(0%)					
Oil	17.6	27.7	32.6	38.8	45.6	2.1	2.1	1.7	1.6	1.8
	(100%)	(99%)	(99%)	(99%)	(99%)					
Gas		0.02	0.03	0.1	0.1		5.8	4.2	1.8	3.8
		(0%)	(0%)	(0%)	(0%)					
NRE										
Electricity	0.1	0.2	0.2	0.2	0.2	3.8	2.4	0.5	0.9	1.2
	(0%)	(1%)	(1%)	(1%)	(1%)					
Residential	**6.1**	**9.5**	**10.7**	**12.3**	**14.1**	**2.0**	**1.6**	**1.4**	**1.3**	**1.4**
Coal	0.1					- 11.6				
	(1%)									
Oil	0.8	0.3	0.4	0.4	0.4	- 3.8	0.6	0.7	0.8	0.7
	(13%)	(4%)	(3%)	(3%)	(3%)					
Gas	1.1	2.7	3.3	3.9	4.5	4.2	2.4	1.8	1.5	1.9
	(18%)	(29%)	(30%)	(32%)	(32%)					
NRE	1.6	2.0	2.1	2.1	2.1	1.0	0.3	0.2	0.2	0.2
	(26%)	(21%)	(19%)	(17%)	(15%)					
Electricity	2.5	4.4	5.1	5.9	7.0	2.6	1.7	1.6	1.7	1.7
	(41%)	(47%)	(47%)	(48%)	(50%)					
Heat										
Commercial	**2.4**	**5.7**	**7.2**	**9.3**	**11.5**	**4.0**	**3.0**	**2.5**	**2.2**	**2.5**
Coal	0.2	0.1	0.04	0.03	0.02	- 3.8	- 4.9	- 3.4	- 2.5	- 3.5
	(6%)	(1%)	(0%)	(0%)	(0%)					
Oil	0.5	0.3	0.4	0.5	0.5	- 2.1	2.2	1.8	1.7	1.9
	(21%)	(6%)	(5%)	(5%)	(5%)					
Gas	0.4	1.1	1.4	1.8	2.2	5.0	3.0	2.4	2.0	2.4
	(16%)	(20%)	(20%)	(20%)	(19%)					
NRE										
Electricity	1.3	4.2	5.4	7.0	8.7	5.3	3.2	2.6	2.3	2.7
	(55%)	(73%)	(74%)	(75%)	(76%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	73	76	80	81	81
Net Energy Import Ratio (%)	-25	-121	-162	-184	-193
Net Oil Import Dependency (%)	36	21	38	51	58

AUSTRALIA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**95**	**219**	**267**	**330**	**398**	**3.9**	**2.5**	**2.1**	**1.9**	**2.2**
Coal	70	172	188	226	270	4.2	1.1	1.9	1.8	1.6
	(73%)	(79%)	(70%)	(68%)	(68%)					
Oil	5	4	3	3	3	-1.4	-2.0	0.5	-0.1	-0.4
	(5%)	(2%)	(1%)	(1%)	(1%)					
Gas	7	26	52	73	93	6.1	9.3	3.3	2.5	4.7
	(7%)	(12%)	(20%)	(22%)	(23%)					
Hydro	13	16	17	17	18	1.0	0.4	0.2	0.5	0.4
	(14%)	(7%)	(6%)	(5%)	(4%)					
NRE		1	7	11	14		23.9	5.1	2.5	9.2
		(1%)	(3%)	(3%)	(4%)					
Nuclear										
Total Installed Generation Capacity (GW)	**24**	**49**	**60**	**81**	**94**	**3.2**	**2.8**	**2.9**	**1.6**	**2.4**
Thermal	18	40	48	65	77	3.7	2.2	3.2	1.7	2.4
	(75%)	(82%)	(79%)	(80%)	(81%)					
Coal	14	28	30	40	47	3.2	1.0	2.8	1.6	1.9
	(58%)	(57%)	(50%)	(49%)	(50%)					
Oil	4	2	2	2	2	- 4.2		2.2	0.6	1.0
	(17%)	(3%)	(3%)	(2%)	(2%)					
Gas		11	16	23	28	21.1	4.9	3.8	1.9	3.4
	(1%)	(22%)	(26%)	(29%)	(30%)					
Hydro	6	8	10	10	10	1.0	3.2	0.4	0.2	1.1
	(25%)	(16%)	(16%)	(13%)	(11%)					
NRE		1	3	6	7		15.8	6.1	2.4	7.4
		(2%)	(5%)	(7%)	(8%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**270**	**210**	**193**	**181**	**170**	**- 1.1**	**- 1.1**	**- 0.6**	**- 0.7**	**- 0.8**
Industry (toe per US$ million GDP in Industry)	263	182	186	175	164	-1.7	0.3	- 0.6	- 0.7	- 0.4
Commercial (toe per US$ million GDP in Services)	15	16	16	15	15	0.3	- 0.3	- 0.3	- 0.3	- 0.3
Energy Intensity (kgoe per capita)	**4 752**	**5 703**	**6 077**	**6 623**	**7 097**	**0.8**	**0.8**	**0.9**	**0.7**	**0.8**
Industry	1 306	1 275	1 476	1 662	1 808	- 0.1	1.8	1.2	0.8	1.3
Transport	1 196	1 414	1 544	1 687	1 836	0.8	1.1	0.9	0.8	0.9
Residential	409	479	504	531	562	0.7	0.6	0.5	0.6	0.6
Commercial	162	289	340	401	461	2.7	2.1	1.6	1.4	1.7
CO_2 Emissions (million tonnes)	**203.1**	**340.4**	**396.8**	**472.9**	**549.0**	**2.4**	**1.9**	**1.8**	**1.5**	**1.7**
Electricity Generation	82.6	190.6	214.0	249.8	286.8	3.9	1.5	1.6	1.4	1.5
Transformation other than Electricity Generation	13.1	13.3	19.1	27.8	34.1	0.1	4.6	3.8	2.1	3.4
Industry	47.5	43.3	53.7	64.2	74.2	- 0.4	2.7	1.8	1.5	1.9
Transport	51.7	81.9	96.6	115.0	135.2	2.1	2.1	1.8	1.6	1.8
Residential	5.1	7.4	8.7	10.3	11.8	1.7	2.0	1.7	1.4	1.7
Commercial	3.0	3.9	4.7	5.8	6.9	1.2	2.4	2.1	1.8	2.1
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	779.5	635.5	590.4	558.9	524.1	- 0.9	- 0.9	- 0.5	- 0.6	- 0.7
CO_2 emissions per capita (tonnes per capita)	13.7	17.2	18.6	20.4	21.9	1.0	1.0	0.9	0.7	0.9

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**59.7 - 75.4**	**137.3 - 169.9**	**200.4 - 247.8**
Coal Production & Transportation	12.7 - 15.0	25.9 - 30.0	40.3 - 46.1
Oil & Gas Production & Processing	9.3 - 13.0	17.6 - 24.8	24.7 - 35.1
Oil & Gas International Trade	5.4 - 5.9	17.7 - 19.5	23.1 - 25.6
Oil & Gas Domestic Pipeline	9.4 - 13.4	16.6 - 23.7	22.9 - 32.7
Electricity Generation & Transmission	23.0 - 28.0	59.6 - 71.8	89.3 - 108.3

BRUNEI DARUSSALAM

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		9.7	10.0						19.7
Net Imports		- 9.2	- 8.0						- 17.2
TPED		**0.5**	**2.0**						**2.6**
Electricity and Heat Generation			- 0.7				0.2		- 0.4
Petroleum Refineries		- 0.1							- 0.1
Others			- 1.4						- 1.4
TFED		**0.4**					**0.2**		**0.6**
Industry									0.1
Transport		0.4							0.4
Residential									0.1
Commercial							0.1		0.1

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		10.9	14.9						25.7
Net Imports		- 10.2	- 12.5						- 22.7
TPED		**0.7**	**2.4**						**3.1**
Electricity and Heat Generation			- 0.7				0.2		- 0.4
Petroleum Refineries		- 0.1							- 0.1
Others			- 1.7						- 1.7
TFED		**0.6**					**0.2**		**0.8**
Industry		0.1							0.1
Transport		0.5							0.5
Residential									0.1
Commercial							0.1		0.1

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		11.0	14.8						25.8
Net Imports		- 10.1	- 12.5						- 22.6
TPED		**0.9**	**2.3**						**3.2**
Electricity and Heat Generation			- 0.7				0.3		- 0.4
Petroleum Refineries		- 0.1							- 0.1
Others			- 1.6						- 1.6
TFED		**0.7**					**0.2**		**1.0**
Industry		0.1							0.1
Transport		0.6							0.6
Residential									0.1
Commercial							0.1		0.1

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		11.1	14.7						25.9
Net Imports		- 10.1	- 12.5						- 22.6
TPED		**1.1**	**2.2**						**3.3**
Electricity and Heat Generation			- 0.7				0.3		- 0.4
Petroleum Refineries		- 0.2							- 0.2
Others			- 1.5						- 1.5
TFED		**0.9**					**0.2**		**1.1**
Industry		0.1							0.1
Transport		0.8							0.8
Residential									0.1
Commercial							0.1		0.1

BRUNEI DARUSSALAM

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	5.7	5.8	6.6	7.9	9.3	0.1	1.6	1.7	1.7	1.7
Population (million)	0.19	0.35	0.40	0.43	0.46	2.8	1.5	0.9	0.6	1.0
GDP per capita (2000 PPP US$)	29 407	16 683	16 807	18 210	20 308	-2.5	0.1	0.8	1.1	0.7
GDP in Services (2000 PPP US$ billion)	1.4	3.0	3.4	4.0	4.8	3.4	1.7	1.8	1.7	1.7
GDP in Industry (2000 PPP US$ billion)	3.9	2.7	3.0	3.6	4.2	-1.6	1.5	1.6	1.5	1.5
Urbanisation level (%)	60	75	81	85	87	1.0	0.8	0.5	0.3	0.5

ENERGY PROJECTIONS

Mtoe

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**21.1**	**19.7**	**25.7**	**25.8**	**25.9**	**- 0.3**	**3.4**			**1.0**
Coal										
Oil	12.2	9.7	10.9	11.0	11.1	- 1.0	1.4	0.1	0.2	0.5
	(58%)	(49%)	(42%)	(43%)	(43%)					
Gas	8.9	10.0	14.9	14.8	14.7	0.5	5.1	- 0.04	- 0.04	1.4
	(42%)	(51%)	(58%)	(57%)	(57%)					
Hydro										
NRE										
Nuclear										
Net Imports	**- 18.2**	**- 17.2**	**- 22.7**	**- 22.6**	**- 22.6**	**- 0.3**	**3.5**			**1.0**
Coal										
Oil	- 11.8	- 9.2	- 10.2	- 10.1	- 10.1	- 1.1	1.3	- 0.1		0.3
Gas	- 6.5	- 8.0	- 12.5	- 12.5	- 12.5	1.0	5.8			1.6
Electricity										
Total Primary Energy Demand	**2.68**	**2.57**	**3.07**	**3.18**	**3.28**	**- 0.2**	**2.3**	**0.3**	**0.3**	**0.9**
Coal										
Oil	0.20	0.55	0.72	0.88	1.05	4.6	3.4	2.1	1.8	2.3
	(8%)	(21%)	(23%)	(28%)	(32%)					
Gas	2.46	2.02	2.35	2.29	2.23	- 0.9	1.9	- 0.3	- 0.3	0.3
	(92%)	(79%)	(77%)	(72%)	(68%)					
Hydro										
NRE										
Nuclear										
Input for Electricity and Heat Generation	**- 0.14**	**- 0.66**	**- 0.67**	**- 0.69**	**- 0.69**	**7.5**	**0.2**	**0.2**	**0.1**	**0.2**
Coal										
Oil	-0.001									
	(1%)									
Gas	-0.13	-0.66	-0.67	-0.68	-0.69	7.5	0.2	0.2	0.1	0.2
	(99%)	(99%)	(99%)	(99%)	(99%)					
Hydro										
NRE										
Nuclear										
Other Transformation	**- 0.78**	**- 1.46**	**- 1.81**	**- 1.74**	**- 1.69**	**2.9**	**2.7**	**- 0.4**	**- 0.3**	**0.5**
Coal										
Oil		-0.10	-0.12	-0.13	-0.15		2.5	1.3	1.3	1.6
		(7%)	(7%)	(8%)	(9%)					
Gas	-0.78	-1.36	-1.69	-1.61	-1.54	2.6	2.7	- 0.5	- 0.4	0.4
	(100%)	(93%)	(93%)	(92%)	(91%)					
NRE										
Electricity										
Heat										

BRUNEI DARUSSALAM

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**0.22**	**0.64**	**0.81**	**0.97**	**1.13**	**5.0**	**2.9**	**1.8**	**1.5**	**2.0**
Coal										
Oil	0.19	0.45	0.60	0.74	0 .89	3.9	3.7	2.2	1.8	2.5
	(88%)	(69%)	(74%)	(77%)	(79%)					
Gas										
NRE										
Electricity	0.03	0.20	0.21	0.22	0.24	9.7	0.7	0.7	0.5	0.6
	(12%)	(31%)	(26%)	(23%)	(21%)					
Heat										
Industry	**0.06**	**0.07**	**0.09**	**0.10**	**0.12**	**1.3**	**2.5**	**1.5**	**1.1**	**1.6**
Coal										
Oil	0.05	0.05	0.06	0.06	0.07	- 0.2	2.2	1.3	1.0	1.5
	(89%)	(64%)	(63%)	(62%)	(62%)					
Gas										
NRE										
Electricity	0.01	0.03	0.03	0.04	0.04	6.9	2.2	1.8	1.5	1.8
	(11%)	(36%)	(35%)	(36%)	(37%)					
Heat										
Transport	**0.14**	**0.38**	**0.51**	**0.65**	**0.79**	**4.8**	**4.0**	**2.4**	**2.0**	**2.7**
Coal										
Oil	0.14	0.38	0.51	0.65	0.79	4.8	4.0	2.4	2.0	2.7
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity										
Residential	**0.02**	**0.06**	**0.06**	**0.07**	**0.08**	**5.2**	**1.7**	**1.6**	**0.8**	**1.3**
Coal										
Oil	0.01	0.02	0.03	0.03	0.03	3.6	2.1	1.8	0.9	1.6
	(56%)	(40%)	(41%)	(42%)	(43%)					
Gas										
NRE										
Electricity	0.01	0.03	0.04	0.04	0.05	6.7	1.4	1.5	0.7	1.2
	(44%)	(60%)	(59%)	(58%)	(58%)					
Heat										
Commercial	**0.01**	**0.14**	**0.14**	**0.14**	**0.15**	**12.2**	**0.2**	**0.1**	**0.2**	**0.2**
Coal										
Oil										
Gas										
NRE										
Electricity	0.01	0.14	0.14	0.14	0.15	12.2	0.2	0.1	0.2	0.2
	(100%)	(100%)	(100%)	(100%)	(100%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	14	33	36	41	45
Net Energy Import Ratio (%)	-630	-668	-737	-711	-688
Net Oil Import Dependency (%)	-5 835	-1 669	-1 410	-1 142	-959

BRUNEI DARUSSALAM

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**0.34**	**2.70**	**2.83**	**3.01**	**3.14**	**9.8**	**0.6**	**0.6**	**0.4**	**0.5**
Coal										
Oil	0.004	0.025	0.026	0.026	0.026	8.7	0.3			0.1
	(1%)	(1%)	(1%)	(1%)	(1%)					
Gas	0.3	2.68	2.80	2.98	3.12	9.8	0.6	0.6	0.4	0.5
	(99%)	(99%)	(99%)	(99%)	(99%)					
Hydro										
NRE										
Nuclear										
Total Installed Generation Capacity (GW)	**0.08**	**0.64**	**0.86**	**1.04**	**1.04**	**10.2**	**3.7**	**1.9**		**1.8**
Thermal	0.08	0.64	0.86	1.04	1.04	10.2	3.7	1.9		1.8
	(100%)	(100%)	(100%)	(100%)	(100%)					
Coal										
Oil		0.004								
		(1%)								
Gas	0.08	0.63	0.85	1.03	1.03	10.2	3.8	1.9		1.8
	(100%)	(99%)	(100%)	(100%)	(100%)					
Hydro										
NRE										
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**473**	**439**	**463**	**403**	**353**	**- 0.3**	**0.7**	**- 1.4**	**- 1.3**	**- 0.8**
Industry (toe per US$ million GDP in Industry)	14	27	29	29	28	3.0	1.0	- 0.1	- 0.4	0.1
Commercial (toe per US$ million GDP in Services)	8	47	42	35	30	8.6	- 1.5	- 1.6	- 1.5	- 1.5
Energy Intensity (kgoe per capita)	**13 907**	**7 330**	**7 781**	**7 347**	**7 178**	**- 2.9**	**0.7**	**- 0.6**	**- 0.2**	**- 0.1**
Industry	285	208	225	238	252	- 1.4	1.0	0.6	0.5	0.7
Transport	699	1 075	1 301	1 501	1 724	2.0	2.4	1.4	1.4	1.7
Residential	93	157	159	171	175	2.4	0.2	0.7	0.2	0.4
Commercial	57	396	357	331	319	9.2	- 1.3	- 0.8	- 0.3	- 0.8
CO_2 Emissions (million tonnes)	**2.7**	**7.5**	**9.1**	**9.7**	**10.1**	**4.7**	**2.5**	**0.6**	**0.5**	**1.1**
Electricity Generation	0.3	1.6	1.6	1.6	1.6	7.4	0.2	0.2	0.1	0.2
Transformation other than Electricity Generation	1.8	4.6	5.8	5.8	5.9	4.3	2.8	0.1	0.04	0.8
Industry	0.1	0.1	0.2	0.2	0.2	0.4	2.2	1.3	1.1	1.5
Transport	0.4	1.1	1.5	1.9	2.3	4.8	4.0	2.4	2.0	2.7
Residential		0.1	0.1	0.1	0.1	3.7	1.9	2.0	0.9	1.6
Commercial										
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	477.5	1 284.7	1 375.1	1 226.6	1 092.8	4.6	0.9	- 1.1	- 1.1	- 0.6
CO_2 emissions per capita (tonnes per capita)	14.0	21.4	23.1	22.3	22.2	1.9	0.9	- 0.3	- 0.1	0.1

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**2.86 - 3.73**	**3.14 - 4.09**	**3.35 - 4.41**
Coal Production & Transportation			
Oil & Gas Production & Processing	1.30 - 1.96	1.36 - 2.06	1.46 - 2.22
Oil & Gas International Trade	1.25 - 1.38	1.25 - 1.38	1.25 - 1.38
Oil & Gas Domestic Pipeline	0.15 - 0.21	0.24 - 0.35	0.34 - 0.49
Electricity Generation & Transmission	0.16 - 0.18	0.28 - 0.31	0.29 - 0.32

CANADA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	32.7	133.3	150.3	30.2	22.6	11.6			380.5
Net Imports	1.2	- 45.1	- 72.6				- 6.1		- 122.7
TPED	**33.8**	**88.2**	**77.7**	**30.2**	**22.6**	**11.6**	**- 6.1**		**257.9**
Electricity and Heat Generation	- 30.9	- 3.6	- 11.3	- 30.2	- 22.6	- 2.1	50.3	0.8	- 49.5
Petroleum Refineries		- 6.5	- 1.0				- 0.5		- 8.0
Others	- 0.1	- 1.5	- 17.4				- 1.8		- 20.9
TFED	**2.9**	**76.5**	**48.0**			**9.4**	**41.8**	**0.8**	**179.5**
Industry	2.8	18.0	22.8			7.6	18.4	0.8	70.4
Transport		48.5					0.1		48.6
Residential		3.0	13.9			1.8	12.3		31.1
Commercial		6.9	11.3				11.2		29.4

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	40.2	205.7	139.8	32.6	20.8	14.9			454.0
Net Imports	- 16.8	- 105.1	- 45.6				- 1.5		- 169.0
TPED	**23.5**	**100.6**	**94.2**	**32.6**	**20.8**	**14.9**	**- 1.5**		**285.0**
Electricity and Heat Generation	- 20.6	- 3.4	- 16.1	- 32.6	- 20.8	- 3.8	52.4	1.0	- 43.9
Petroleum Refineries		- 7.4	- 1.1				- 0.6		- 9.1
Others	- 0.1	- 2.2	- 22.8				- 2.4		- 27.6
TFED	**2.7**	**87.6**	**54.1**			**11.1**	**47.9**	**1.0**	**204.4**
Industry	2.7	21.4	25.5			9.2	21.8	1.0	81.6
Transport		56.0	0.1				0.1		56.2
Residential		2.8	15.7			1.9	13.9		34.3
Commercial		7.4	12.8				12.2		32.4

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	40.6	230.7	125.2	33.8	19.3	19.4			469.0
Net Imports	- 17.1	- 116.2	- 13.9				- 1.3		- 148.6
TPED	**23.5**	**114.5**	**111.3**	**33.8**	**19.3**	**19.4**	**- 1.3**		**320.4**
Electricity and Heat Generation	- 20.6	- 3.5	- 24.9	- 33.8	- 19.3	- 6.2	59.6	1.1	- 47.6
Petroleum Refineries		- 7.6	- 1.2				- 0.6		- 9.3
Others	- 0.1	- 2.4	- 23.4				- 2.5		- 28.5
TFED	**2.8**	**100.6**	**61.8**			**13.2**	**55.2**	**1.1**	**234.7**
Industry	2.8	23.6	28.6			11.2	26.0	1.1	93.3
Transport		66.5	0.1				0.1		66.7
Residential		2.5	18.3			2.0	15.7		38.5
Commercial		8.0	14.8				13.4		36.1

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	42.2	235.7	109.3	33.5	17.2	24.3			462.1
Net Imports	- 17.9	- 111.2	15.5				- 1.5		- 115.1
TPED	**24.3**	**124.6**	**124.8**	**33.5**	**17.2**	**24.3**	**- 1.5**		**347.0**
Electricity and Heat Generation	- 21.4	- 3.3	- 32.8	- 33.5	- 17.2	- 9.2	65.8	1.3	- 50.4
Petroleum Refineries		- 7.7	- 1.2				- 0.6		- 9.4
Others	- 0.1	- 2.3	- 22.3				- 2.4		- 27.2
TFED	**2.7**	**111.2**	**68.4**			**15.1**	**61.2**	**1.3**	**260.0**
Industry	2.7	25.1	31.0			13.0	29.9	1.2	103.0
Transport		75.4	0.1				0.1		75.6
Residential		2.3	21.1			2.1	16.9		42.4
Commercial		8.5	16.3				14.3		39.1

CANADA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	518	961	1 194	1 517	1 792	2.8	2.8	2.4	1.7	2.3
Population (million)	24.5	31.3	33.3	35.4	37.0	1.1	0.8	0.6	0.4	0.6
GDP per capita (2000 PPP US$)	21 185	30 672	35 815	42 821	48 386	1.7	2.0	1.8	1.2	1.6
GDP in Services (2000 PPP US$ billion)	297	585	742	973	1 209	3.1	3.0	2.7	2.2	2.6
GDP in Industry (2000 PPP US$ billion)	185	282	351	443	525	1.9	2.8	2.4	1.7	2.2
Urbanisation level (%)	76	80	83	85	87	0.3	0.4	0.3	0.2	0.3

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**207.4**	**380.5**	**454.0**	**469.0**	**462.1**	**2.8**	**2.2**	**0.3**	**- 0.1**	**0.7**
Coal	20.5	32.7	40.2	40.6	42.2	2.1	2.6	0.1	0.4	0.9
	(10%)	(9%)	(9%)	(9%)	(9%)					
Oil	83.6	133.3	205.7	230.7	235.7	2.1	5.6	1.2	0.2	2.1
	(40%)	(35%)	(45%)	(49%)	(51%)					
Gas	63.6	150.3	139.8	125.2	109.3	4.0	- 0.9	- 1.1	- 1.3	- 1.1
	(31%)	(39%)	(31%)	(27%)	(24%)					
Hydro	21.6	30.2	32.6	33.8	33.5	1.5	1.0	0.4	- 0.1	0.4
	(10%)	(8%)	(7%)	(7%)	(7%)					
NRE	7.6	11.6	14.9	19.4	24.3	1.9	3.2	2.7	2.3	2.7
	(4%)	(3%)	(3%)	(4%)	(5%)					
Nuclear	10.4	22.6	20.8	19.3	17.2	3.6	- 1.0	- 0.7	- 1.2	- 1.0
	(5%)	(6%)	(5%)	(4%)	(4%)					
Net Imports	**- 12.0**	**- 122.7**	**- 169.0**	**- 148.6**	**- 115.1**	**11.2**	**4.1**	**- 1.3**	**- 2.5**	**- 0.2**
Coal	0.3	1.2	- 16.8	- 17.1	- 17.9	5.7		0.2	0.4	
Oil	8.4	- 45.1	- 105.1	- 116.2	- 111.2		11.1	1.0	- 0.4	3.3
Gas	- 18.4	- 72.6	- 45.6	- 13.9	15.5	6.4	- 5.6	- 11.2		
Electricity	- 2.3	- 6.1	- 1.5	- 1.3	- 1.5	4.5	- 16.3	- 1.2	1.5	- 4.8
Total Primary Energy Demand	**193.0**	**257.9**	**285.0**	**320.4**	**347.0**	**1.3**	**1.3**	**1.2**	**0.8**	**1.1**
Coal	21.2	33.8	23.5	23.5	24.3	2.1	- 4.5		0.3	- 1.2
	(11%)	(13%)	(8%)	(7%)	(7%)					
Oil	88.9	88.2	100.6	114.5	124.6		1.7	1.3	0.8	1.2
	(46%)	(34%)	(35%)	(36%)	(36%)					
Gas	45.6	77.7	94.2	111.3	124.8	2.5	2.4	1.7	1.1	1.7
	(24%)	(30%)	(33%)	(35%)	(36%)					
Hydro	21.6	30.2	32.6	33.8	33.5	1.5	1.0	0.4	- 0.1	0.4
	(11%)	(12%)	(11%)	(11%)	(10%)					
NRE	7.6	11.6	14.9	19.4	24.3	1.9	3.2	2.7	2.3	2.7
	(4%)	(4%)	(5%)	(6%)	(7%)					
Nuclear	10.4	22.6	20.8	19.3	17.2	3.6	- 1.0	- 0.7	- 1.2	- 1.0
	(5%)	(9%)	(7%)	(6%)	(5%)					
Input for Electricity and Heat Generation	**- 52.2**	**- 100.6**	**- 97.3**	**- 108.3**	**- 117.4**	**3.0**	**- 0.4**	**1.1**	**0.8**	**0.6**
Coal	- 15.0	- 30.9	- 20.6	- 20.6	- 21.4	3.3	- 4.9		0.4	- 1.3
	(29%)	(31%)	(21%)	(19%)	(18%)					
Oil	- 3.2	- 3.6	- 3.4	- 3.5	- 3.3	0.6	- 0.9	0.6	- 0.6	- 0.3
	(6%)	(4%)	(3%)	(3%)	(3%)					
Gas	- 1.8	- 11.3	- 16.1	- 24.9	- 32.8	8.8	4.6	4.5	2.8	3.9
	(3%)	(11%)	(17%)	(23%)	(28%)					
Hydro	- 21.6	- 30.2	- 32.6	- 33.8	- 33.5	1.5	1.0	0.4	- 0.1	0.4
	(41%)	(30%)	(33%)	(31%)	(29%)					
NRE	- 0.2	- 2.1	- 3.8	- 6.2	- 9.2	10.7	7.6	4.9	4.0	5.3
	(0%)	(2%)	(4%)	(6%)	(8%)					
Nuclear	- 10.4	- 22.6	- 20.8	- 19.3	- 17.2	3.6	- 1.0	- 0.7	- 1.2	- 1.0
	(20%)	(22%)	(21%)	(18%)	(15%)					
Other Transformation	**- 12.1**	**- 28.9**	**- 36.7**	**- 37.8**	**- 36.6**	**4.0**	**3.0**	**0.3**	**- 0.3**	**0.9**
Coal	- 0.004	- 0.1	- 0.1	- 0.1	- 0.1	15.7	2.1	- 0.3	- 0.2	0.4
	(0%)	(0%)	(0%)	(0%)	(0%)					
Oil	- 6.3	- 8.0	- 9.6	- 9.9	- 10.0	1.1	2.3	0.3	0.05	0.8
	(52%)	(28%)	(26%)	(26%)	(27%)					
Gas	- 5.4	- 18.4	- 23.9	- 24.6	- 23.5	5.7	3.3	0.3	- 0.5	0.9
	(45%)	(64%)	(65%)	(65%)	(64%)					
NRE										
Electricity	- 0.4	- 2.3	- 3.0	- 3.1	- 3.0	8.5	3.3	0.3	- 0.3	0.9
	(3%)	(8%)	(8%)	(8%)	(8%)					
Heat										

CANADA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**148.5**	**179.5**	**204.4**	**234.7**	**260.0**	**0.9**	**1.6**	**1.4**	**1.0**	**1.3**
Coal	4.2	2.9	2.7	2.8	2.7	- 1.7	- 0.5	0.2	- 0.2	- 0.2
	(3%)	(2%)	(1%)	(1%)	(1%)					
Oil	75.4	76.5	87.6	100.6	111.2	0.1	1.7	1.4	1.0	1.3
	(51%)	(43%)	(43%)	(43%)	(43%)					
Gas	34.6	48.0	54.1	61.8	68.4	1.5	1.5	1.3	1.0	1.3
	(23%)	(27%)	(26%)	(26%)	(26%)					
NRE	7.4	9.4	11.1	13.2	15.1	1.1	2.0	1.8	1.4	1.7
	(5%)	(5%)	(5%)	(6%)	(6%)					
Electricity	25.9	41.8	47.9	55.2	61.2	2.2	1.7	1.4	1.0	1.4
	(17%)	(23%)	(23%)	(24%)	(24%)					
Heat	1.0	0.8	1.0	1.1	1.3	- 0.9	1.8	1.5	1.0	1.4
	(1%)	(0%)	(0%)	(0%)	(0%)					
Industry	**58.7**	**70.4**	**81.6**	**93.3**	**103.0**	**0.8**	**1.8**	**1.4**	**1.0**	**1.4**
Coal	4.1	2.8	2.7	2.8	2.7	- 1.7	- 0.5	0.2	- 0.2	- 0.1
	(7%)	(4%)	(3%)	(3%)	(3%)					
Oil	17.0	18.0	21.4	23.6	25.1	0.3	2.2	1.0	0.6	1.2
	(29%)	(26%)	(26%)	(25%)	(24%)					
Gas	18.8	22.8	25.5	28.6	31.0	0.9	1.4	1.2	0.8	1.1
	(32%)	(32%)	(31%)	(31%)	(30%)					
NRE	5.5	7.6	9.2	11.2	13.0	1.5	2.3	2.0	1.6	1.9
	(9%)	(11%)	(11%)	(12%)	(13%)					
Electricity	12.3	18.4	21.8	26.0	29.9	1.8	2.2	1.8	1.4	1.8
	(21%)	(26%)	(27%)	(28%)	(29%)					
Heat	1.0	0.8	1.0	1.1	1.2	- 0.8	1.8	1.5	1.0	1.4
	(2%)	(1%)	(1%)	(1%)	(1%)					
Transport	**43.1**	**48.6**	**56.2**	**66.7**	**75.6**	**0.6**	**1.8**	**1.7**	**1.3**	**1.6**
Coal										
Oil	43.1	48.5	56.0	66.5	75.4	0.5	1.8	1.7	1.3	1.6
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas			0.1	0.1	0.1		5.1	2.9	2.1	3.2
			(0%)	(0%)	(0%)					
NRE										
Electricity		0.1	0.1	0.1	0.1		0.3			0.1
		(0%)	(0%)	(0%)	(0%)					
Residential	**28.4**	**31.1**	**34.3**	**38.5**	**42.4**	**0.4**	**1.2**	**1.2**	**1.0**	**1.1**
Coal	0.08	0.03	0.02	0.01	0.01	- 4.5	- 4.7	- 4.5	- 5.2	- 4.8
	(0%)	(0%)	(0%)	(0%)	(0%)					
Oil	10.4	3.0	2.8	2.5	2.3	- 5.5	- 1.2	- 1.2	- 0.8	- 1.0
	(37%)	(10%)	(8%)	(6%)	(5%)					
Gas	8.7	13.9	15.7	18.3	21.1	2.1	1.5	1.5	1.5	1.5
	(31%)	(45%)	(46%)	(47%)	(50%)					
NRE	1.9	1.8	1.9	2.0	2.1	- 0.2	0.6	0.5	0.4	0.5
	(7%)	(6%)	(6%)	(5%)	(5%)					
Electricity	7.3	12.3	13.9	15.7	16.9	2.4	1.6	1.3	0.7	1.2
	(26%)	(39%)	(40%)	(41%)	(40%)					
Heat										
Commercial	**18.3**	**29.4**	**32.4**	**36.1**	**39.1**	**2.2**	**1.2**	**1.1**	**0.8**	**1.0**
Coal										
Oil	5.0	6.9	7.4	8.0	8.5	1.5	0.8	0.8	0.6	0.7
	(27%)	(24%)	(23%)	(22%)	(22%)					
Gas	7.0	11.3	12.8	14.8	16.3	2.2	1.6	1.4	1.0	1.3
	(38%)	(38%)	(40%)	(41%)	(42%)					
NRE										
Electricity	6.2	11.2	12.2	13.4	14.3	2.7	1.1	0.9	0.7	0.9
	(34%)	(38%)	(38%)	(37%)	(37%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	81	89	86	84	83
Net Energy Import Ratio (%)	-6	-48	-59	-46	-33
Net Oil Import Dependency (%)	9	-51	-105	-102	-89

CANADA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**373**	**601**	**628**	**712**	**782**	**2.2**	**0.5**	**1.3**	**1.0**	**0.9**
Coal	60	117	83	88	97	3.1	- 4.3	0.6	1.0	- 0.7
	(16%)	(20%)	(13%)	(12%)	(12%)					
Oil	14	14	13	14	13	0.2	- 1.0	0.6	-0.6	- 0.3
	(4%)	(2%)	(2%)	(2%)	(2%)					
Gas	9	34	57	103	153	6.1	6.6	6.2	4.0	5.5
	(2%)	(6%)	(9%)	(14%)	(19%)					
Hydro	251	351	379	393	389	1.5	1.0	0.4	- 0.1	0.4
	(67%)	(58%)	(60%)	(55%)	(50%)					
NRE	1	9	24	43	64	9.4	12.4	6.0	4.2	7.1
		(2%)	(4%)	(6%)	(8%)					
Nuclear	38	76	72	71	66	3.2	- 0.5	- 0.2	- 0.7	- 0.5
	(10%)	(13%)	(12%)	(10%)	(8%)					
Total Installed Generation Capacity (GW)	**83**	**122**	**131**	**147**	**162**	**1.8**	**0.9**	**1.2**	**1.0**	**1.0**
Thermal	28	40	42	53	62	1.5	0.8	2.3	1.7	1.6
	(34%)	(32%)	(32%)	(36%)	(38%)					
Coal	13	17	18	19	19	1.3	0.3	0.5	0.3	0.4
	(16%)	(14%)	(13%)	(13%)	(12%)					
Oil	8	7	7	8	8	- 0.5	- 0.3	1.0	0.3	0.4
	(10%)	(6%)	(6%)	(5%)	(5%)					
Gas	4	15	17	26	35	6.8	1.8	4.2	3.0	3.1
	(4%)	(12%)	(13%)	(18%)	(22%)					
Hydro	48	69	71	73	75	1.7	0.3	0.3	0.3	0.3
	(58%)	(57%)	(54%)	(50%)	(46%)					
NRE	0.4	2	4	8	12	7.4	11.1	5.7	4.1	6.6
	(0%)	(2%)	(3%)	(5%)	(7%)					
Nuclear	6	11	14	14	14	2.9	2.7			0.8
	(7%)	(9%)	(10%)	(9%)	(8%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**372**	**268**	**239**	**211**	**194**	**- 1.5**	**- 1.5**	**- 1.2**	**- 0.9**	**- 1.2**
Industry (toe per US$ million GDP in Industry)	318	250	233	211	196	- 1.1	- 0.9	- 1.0	- 0.7	- 0.9
Commercial (toe per US$ million GDP in Services)	62	50	44	37	32	- 0.9	- 1.7	- 1.6	- 1.4	- 1.6
Energy Intensity (kgoe per capita)	**7 887**	**8 233**	**8 547**	**9 047**	**9 368**	**0.2**	**0.5**	**0.6**	**0.3**	**0.5**
Industry	2 400	2 249	2 446	2 636	2 780	- 0.3	1.1	0.8	0.5	0.8
Transport	1 759	1 552	1 684	1 882	2 040	- 0.6	1.0	1.1	0.8	1.0
Residential	1 162	992	1 029	1 088	1 146	- 0.7	0.5	0.6	0.5	0.5
Commercial	749	939	972	1 020	1 055	1.0	0.4	0.5	0.3	0.4
CO_2 Emissions (million tonnes)	**421**	**574**	**608**	**687**	**751**	**1.4**	**0.7**	**1.2**	**0.9**	**1.0**
Electricity Generation	71	157	128	149	170	3.7	- 2.5	1.5	1.3	0.3
Transformation other than Electricity Generation	34	70	88	90	87	3.3	2.9	0.3	- 0.3	0.8
Industry	106	115	130	143	152	0.4	1.6	1.0	0.6	1.0
Transport	126	142	165	196	222	0.6	1.8	1.7	1.3	1.6
Residential	52	42	45	50	56	- 1.0	1.0	1.1	1.1	1.1
Commercial	32	48	53	59	64	1.8	1.3	1.1	0.8	1.1
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	812	597	509	453	419	- 1.4	- 2.0	- 1.2	- 0.8	- 1.3
CO_2 emissions per capita (tonnes per capita)	17.2	18.3	18.2	19.4	20.3	0.3	- 0.1	0.6	0.5	0.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**148 - 213**	**255 - 361**	**335 - 464**
Coal Production & Transportation	1.9 - 2.2	2.9 - 3.2	4.1 - 4.5
Oil & Gas Production & Processing	89.5 - 133.5	143.9 - 212.3	175.4 - 256.5
Oil & Gas International Trade	22.1 - 32.7	34.7 - 50.0	47.0 - 64.2
Oil & Gas Domestic Pipeline	8.1 - 11.6	16.7 - 23.8	23.3 - 33.3
Electricity Generation & Transmission	26.3 - 33.0	57.2 - 71.3	85.1 - 105.4

CHILE

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.3	0.4	1.8	2.0		4.4			8.9
Net Imports	2.7	10.4	2.0						15.1
TPED	**2.8**	**11.1**	**3.8**	**2.0**		**4.4**			**24.1**
Electricity and Heat Generation	- 2.1	- 0.1	- 2.4	- 2.0		- 0.6	3.6		- 3.5
Petroleum Refineries		- 1.8	- 0.1						- 2.0
Others									
TFED	**0.7**	**9.2**	**1.3**			**3.9**	**3.5**		**18.6**
Industry	0.7	2.1	0.8			1.0	2.4		7.1
Transport		5.9							6.0
Residential		1.0	0.3			2.9	0.6		4.8
Commercial		0.2	0.1				0.5		0.7

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.3	0.3	1.4	2.3		5.2			9.5
Net Imports	4.2	15.3	5.2				0.2		25.0
TPED	**4.5**	**15.6**	**6.6**	**2.3**		**5.2**	**0.2**		**34.5**
Electricity and Heat Generation	- 3.6	- 0.1	- 4.7	- 2.3		- 0.9	5.4		- 6.2
Petroleum Refineries		- 1.8	- 0.2						- 2.0
Others									
TFED	**0.9**	**13.7**	**1.8**			**4.2**	**5.6**		**26.3**
Industry	0.9	3.1	1.2			1.3	3.9		10.4
Transport		9.0							9.1
Residential		1.4	0.4			3.0	1.0		5.8
Commercial		0.2	0.1				0.7		1.0

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.4	0.2	1.0	3.1		5.8			10.6
Net Imports	7.8	22.3	10.1				0.2		40.4
TPED	**8.2**	**22.4**	**11.2**	**3.1**		**5.8**	**0.2**		**51.0**
Electricity and Heat Generation	- 6.9	- 0.1	- 8.4	- 3.1		- 1.3	9.0		- 10.9
Petroleum Refineries		- 1.4	- 0.2						- 1.6
Others									
TFED	**1.3**	**20.9**	**2.6**			**4.5**	**9.2**		**38.5**
Industry	1.3	4.5	1.7			1.7	6.4		15.7
Transport		14.3	0.1						14.4
Residential		1.9	0.5			2.8	1.8		7.1
Commercial		0.2	0.2				1.0		1.4

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.5	0.1	0.8	3.8		6.7			11.9
Net Imports	11.4	33.1	18.0				0.2		62.8
TPED	**11.9**	**33.2**	**18.8**	**3.8**		**6.7**	**0.2**		**74.7**
Electricity and Heat Generation	- 10.1	- 0.1	- 14.8	- 3.8		- 1.7	13.6		- 16.9
Petroleum Refineries		- 1.4	- 0.2						- 1.5
Others									
TFED	**1.8**	**31.8**	**3.9**			**5.0**	**13.8**		**56.2**
Industry	1.8	6.5	2.7			2.3	9.5		22.7
Transport		22.4	0.1						22.5
Residential		2.7	0.6			2.7	3.1		9.1
Commercial		0.3	0.4				1.2		1.9

CHILE

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	67	179	266	432	689	4.6	5.0	5.0	4.8	4.9
Population (million)	11.1	15.6	17.2	19.0	20.4	1.5	1.2	1.0	0.7	1.0
GDP per capita (2000 PPP US$)	6 040	11 500	15 494	22 763	33 849	3.0	3.8	3.9	4.0	3.9
GDP in Services (2000 PPP US$ billion)	47	95	146	256	436	3.2	5.6	5.8	5.5	5.6
GDP in Industry (2000 PPP US$ billion)	30	65	95	156	257	3.6	4.8	5.1	5.1	5.0
Urbanisation level (%)	81	87	89	91	92	0.3	0.4	0.2	0.1	0.2

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**5.8**	**8.9**	**9.5**	**10.6**	**11.9**	**2.0**	**0.8**	**1.1**	**1.2**	**1.0**
Coal	0.8	0.3	0.3	0.4	0.5	- 4.3	2.0	2.0	2.0	2.0
	(13%)	(3%)	(3%)	(4%)	(4%)					
Oil	1.8	0.4	0.3	0.2	0.1	- 6.6	- 4.7	- 5.0	- 5.0	- 4.9
	(32%)	(4%)	(3%)	(2%)	(1%)					
Gas	0.7	1.8	1.4	1.0	0.8	4.3	- 3.0	- 3.0	- 3.0	- 3.0
	(12%)	(20%)	(15%)	(10%)	(6%)					
Hydro	0.7	2.0	2.3	3.1	3.8	5.0	1.7	3.2	2.1	2.4
	(12%)	(22%)	(24%)	(30%)	(32%)					
NRE	1.8	4.4	5.2	5.8	6.7	4.2	1.9	1.2	1.3	1.4
	(31%)	(50%)	(55%)	(55%)	(56%)					
Nuclear										
Net Imports	**4.0**	**15.1**	**25.0**	**40.4**	**62.8**	**6.2**	**6.5**	**4.9**	**4.5**	**5.2**
Coal	0.6	2.7	4.2	7.8	11.4	6.9	5.6	6.4	3.9	5.2
Oil	3.4	10.4	15.3	22.3	33.1	5.2	5.0	3.8	4.1	4.2
Gas		2.0	5.2	10.1	18.0		13.0	6.8	5.9	8.2
Electricity			0.2	0.2	0.2					
Total Primary Energy Demand	**9.7**	**24.1**	**34.5**	**51.0**	**74.7**	**4.3**	**4.5**	**4.0**	**3.9**	**4.1**
Coal	1.2	2.8	4.5	8.2	11.9	3.9	6.1	6.1	3.8	5.3
	(13%)	(12%)	(13%)	(16%)	(16%)					
Oil	5.3	11.1	15.6	22.4	33.2	3.5	4.3	3.7	4.0	4.0
	(54%)	(46%)	(45%)	(44%)	(44%)					
Gas	0.7	3.8	6.6	11.2	18.8	7.8	7.3	5.3	5.3	5.9
	(7%)	(16%)	(19%)	(22%)	(25%)					
Hydro	0.7	2.0	2.3	3.1	3.8	5.0	1.7	3.2	2.1	2.4
	(7%)	(8%)	(7%)	(6%)	(5%)					
NRE	1.8	4.4	5.2	5.8	6.7	4.2	1.9	1.2	1.3	1.4
	(19%)	(18%)	(15%)	(11%)	(9%)					
Nuclear										
Input for Electricity and Heat Generation	**- 1.8**	**- 7.2**	**- 11.6**	**- 19.8**	**- 30.5**	**6.4**	**6.2**	**5.5**	**4.4**	**5.3**
Coal	- 0.5	- 2.1	- 3.6	- 6.9	- 10.1	7.1	7.0	6.7	3.9	5.8
	(26%)	(29%)	(31%)	(35%)	(33%)					
Oil	- 0.6	- 0.1	- 0.1	- 0.1	- 0.1	- 6.9	- 0.1	- 2.0	- 2.8	- 1.7
	(33%)	(2%)	(1%)	(1%)	(0%)					
Gas	- 0.04	- 2.4	- 4.7	- 8.4	- 14.8	20.4	8.8	6.1	5.8	6.8
	(2%)	(33%)	(40%)	(42%)	(48%)					
Hydro	- 0.7	- 2.0	- 2.3	- 3.1	- 3.8	5.0	1.7	3.2	2.1	2.4
	(37%)	(28%)	(20%)	(16%)	(13%)					
NRE	-0.04	- 0.6	- 0.9	- 1.3	- 1.7	13.4	6.4	3.3	2.5	3.9
	(2%)	(8%)	(8%)	(7%)	(5%)					
Nuclear										
Other Transformation	**- 0.9**	**- 2.0**	**- 2.0**	**- 1.6**	**- 1.5**	**3.5**	**0.1**	**- 2.2**	**- 0.3**	**- 0.9**
Coal										
Oil	- 0.4	- 1.8	- 1.8	- 1.4	- 1.4	7.0	- 0.1	- 2.4	- 0.3	- 1.0
	(44%)	(91%)	(90%)	(88%)	(88%)					
Gas	- 0.5	- 0.1	- 0.2	- 0.2	- 0.2	- 5.1	2.2	- 0.8	- 0.5	0.2
	(50%)	(7%)	(9%)	(10%)	(10%)					
NRE										
Electricity	- 0.02	- 0.02	- 0.03	- 0.03	- 0.03	0.2	2.4	- 0.4	- 0.7	0.3
	(2%)	(1%)	(1%)	(2%)	(2%)					
Heat										

CHILE

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**7.4**	**18.6**	**26.3**	**38.5**	**56.2**	**4.3**	**4.4**	**3.9**	**3.9**	**4.0**
Coal	0.5	0.7	0.9	1.3	1.8	1.8	3.2	3.4	3.1	3.2
	(7%)	(4%)	(4%)	(3%)	(3%)					
Oil	4.1	9.2	13.7	20.9	31.8	3.7	5.1	4.3	4.3	4.5
	(56%)	(50%)	(52%)	(54%)	(56%)					
Gas	0.2	1.3	1.8	2.6	3.9	9.9	4.7	3.7	4.0	4.1
	(2%)	(7%)	(7%)	(7%)	(7%)					
NRE	1.8	3.9	4.2	4.5	5.0	3.7	1.1	0.7	1.0	0.9
	(24%)	(21%)	(16%)	(12%)	(9%)					
Electricity	0.8	3.5	5.6	9.2	13.8	6.7	6.0	5.1	4.2	5.0
	(11%)	(19%)	(21%)	(24%)	(25%)					
Heat										
Industry	**2.8**	**7.1**	**10.4**	**15.7**	**22.7**	**4.4**	**4.8**	**4.2**	**3.8**	**4.2**
Coal	0.4	0.7	0.9	1.3	1.8	2.3	3.2	3.4	3.1	3.2
	(16%)	(10%)	(9%)	(8%)	(8%)					
Oil	1.2	2.1	3.1	4.5	6.5	2.4	4.8	3.9	3.6	4.1
	(45%)	(30%)	(30%)	(29%)	(29%)					
Gas		0.8	1.2	1.7	2.7	23.5	4.9	3.6	4.3	4.2
		(12%)	(12%)	(11%)	(12%)					
NRE	0.5	1.0	1.3	1.7	2.3	3.0	2.8	3.0	3.1	3.0
	(19%)	(14%)	(12%)	(11%)	(10%)					
Electricity	0.6	2.4	3.9	6.4	9.5	6.9	6.1	5.1	4.1	5.0
	(20%)	(34%)	(37%)	(41%)	(42%)					
Heat										
Transport	**2.3**	**6.0**	**9.1**	**14.4**	**22.5**	**4.5**	**5.4**	**4.7**	**4.6**	**4.9**
Coal	0.1									
	(2%)									
Oil	2.2	5.9	9.0	14.3	22.4	4.6	5.4	4.7	4.6	4.9
	(97%)	(99%)	(99%)	(99%)	(99%)					
Gas		0.02	0.05	0.1	0.1		8.8	6.4	4.5	6.4
		(0%)	(0%)	(1%)	(1%)					
NRE										
Electricity	0.02	0.02	0.02	0.02	0.02	0.3	1.3			0.4
	(1%)	(0%)	(0%)	(0%)	(0%)					
Residential	**2.2**	**4.8**	**5.8**	**7.1**	**9.1**	**3.6**	**2.3**	**2.0**	**2.6**	**2.3**
Coal										
Oil	0.7	1.0	1.4	1.9	2.7	1.7	4.0	3.3	3.6	3.6
	(31%)	(21%)	(24%)	(27%)	(29%)					
Gas	0.1	0.3	0.4	0.5	0.6	4.7	3.1	2.6	2.0	2.5
	(5%)	(7%)	(7%)	(8%)	(7%)					
NRE	1.2	2.9	3.0	2.8	2.7	3.9	0.5	- 0.5	- 0.5	- 0.2
	(56%)	(60%)	(52%)	(40%)	(30%)					
Electricity	0.2	0.6	1.0	1.8	3.1	6.5	6.5	5.9	5.5	5.9
	(7%)	(13%)	(18%)	(26%)	(34%)					
Heat										
Commercial	**0.1**	**0.7**	**1.0**	**1.5**	**1.9**	**7.2**	**4.9**	**3.7**	**3.0**	**3.8**
Coal										
Oil		0.2	0.2	0.2	0.3		2.2	1.8	1.7	1.9
		(22%)	(18%)	(15%)	(13%)					
Gas	0.03	0.1	0.1	0.2	0.4	4.0	7.3	6.0	5.7	6.3
	(20%)	(11%)	(14%)	(17%)	(22%)					
NRE										
Electricity	0.1	0.5	0.7	1.0	1.2	6.4	5.2	3.7	2.4	3.7
	(78%)	(66%)	(68%)	(68%)	(64%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	69	78	81	82	81
Net Energy Import Ratio (%)	41	63	72	79	84
Net Oil Import Dependency (%)	65	93	98	99	100

CHILE

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**12**	**46**	**68**	**113**	**172**	**6.4**	**5.1**	**5.2**	**4.3**	**4.8**
Coal	2	9	15	30	45	7.2	7.3	7.0	4.2	6.1
	(16%)	(19%)	(22%)	(26%)	(26%)					
Oil	2	0.5	0.5	0.4	0.3	-5.6	0.2	-1.6	-2.4	-1.4
	(15%)	(1%)	(1%)	(1%)	(0%)					
Gas		12	24	44	79	21.9	9.1	6.3	6.1	7.0
	(1%)	(26%)	(35%)	(39%)	(46%)					
Hydro	8	23	27	36	45	5.0	1.7	3.2	2.1	2.4
	(67%)	(51%)	(39%)	(32%)	(26%)					
NRE		2	2	3	3	13.4	3.1	1.9	1.6	2.1
	(1%)	(4%)	(3%)	(2%)	(2%)					
Nuclear										
Total Installed Generation Capacity (GW)	**3**	**11**	**13**	**21**	**31**	**6.2**	**1.8**	**5.3**	**3.9**	**3.8**
Thermal	1	7	8	15	23	7.1	2.2	6.2	4.6	4.5
	(50%)	(61%)	(62%)	(68%)	(73%)					
Coal		2	3	5	8		2.1	7.2	3.8	4.5
		(20%)	(21%)	(25%)	(25%)					
Oil		1	1	1	1		-7.2	0.9		-1.8
		(9%)	(4%)	(3%)	(2%)					
Gas		3	5	9	14		4.1	6.1	5.4	5.3
		(31%)	(37%)	(40%)	(46%)					
Hydro	1	4	5	7	8	4.8	1.1	3.7	2.1	2.4
	(50%)	(38%)	(35%)	(30%)	(26%)					
NRE		0.21	0.31	0.41	0.51		4.9	2.8	2.2	3.2
		(2%)	(2%)	(2%)	(2%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**144**	**135**	**129**	**118**	**108**	**- 0.3**	**- 0.5**	**- 0.9**	**- 0.9**	**- 0.8**
Industry (toe per US$ million GDP in Industry)	93	109	109	100	88	0.7	0.1	- 0.9	- 1.3	- 0.7
Commercial (toe per US$ million GDP in Services)	3	7	7	6	4	3.9	- 0.7	- 2.0	- 2.4	- 1.8
Energy Intensity (kgoe per capita)	**867**	**1 547**	**2 006**	**2 685**	**3 665**	**2.7**	**3.3**	**3.0**	**3.2**	**3.1**
Industry	250	456	604	824	1 113	2.8	3.6	3.1	3.1	3.2
Transport	204	381	530	757	1 106	2.9	4.2	3.6	3.9	3.9
Residential	196	307	336	371	447	2.1	1.1	1.0	1.9	1.3
Commercial	13	44	59	76	95	5.6	3.6	2.7	2.2	2.8
CO_2 Emissions (million tonnes)	**19.8**	**48.1**	**75.0**	**121.5**	**186.3**	**4.1**	**5.7**	**4.9**	**4.4**	**5.0**
Electricity Generation	2.1	14.0	25.2	46.7	74.0	9.1	7.6	6.4	4.7	6.1
Transformation other than Electricity Generation	2.6	0.7	0.8	0.7	0.7	- 5.8	1.7	- 1.3		
Industry	6.2	11.2	15.9	23.0	32.8	2.8	4.5	3.8	3.6	3.9
Transport	6.7	17.7	27.1	42.9	67.3	4.5	5.5	4.7	4.6	4.9
Residential	2.1	3.8	5.1	7.0	9.7	2.6	3.7	3.2	3.3	3.4
Commercial	0.1	0.7	0.9	1.2	1.8	10.4	3.2	2.9	4.1	3.4
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	293.7	268.0	281.8	281.0	270.2	- 0.4	0.6		- 0.4	
CO_2 emissions per capita (tonnes per capita)	1.8	3.1	4.4	6.4	9.1	2.5	4.5	3.9	3.6	4.0

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**11.4 - 14.8**	**34.2 - 44.0**	**64.0 - 83.2**
Coal Production & Transportation	0.01 - 0.01	0.02 - 0.03	0.03 - 0.04
Oil & Gas Production & Processing	2.59 - 3.27	4.98 - 6.73	8.91 - 12.40
Oil & Gas International Trade	2.12 - 2.74	4.29 - 5.80	7.39 - 10.30
Oil & Gas Domestic Pipeline	0.87 - 1.24	3.44 - 4.91	8.39 - 11.99
Electricity Generation & Transmission	5.84 - 7.53	21.47 - 26.49	39.29 - 48.46

CHINA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	664.4	170.8	35.0	23.6	7.0	218.1			1 118.9
Net Imports	- 45.7	48.6	- 1.9				- 0.1		0.9
TPED	**618.7**	**218.1**	**33.0**	**23.6**	**7.0**	**218.1**	**- 0.1**		**1 118.6**
Electricity and Heat Generation	- 363.5	- 20.8	- 2.5	- 23.6	- 7.0	- 2.0	110.5	27.0	- 282.1
Petroleum Refineries		- 13.7	- 1.1				- 1.9	- 6.3	- 23.0
Others	- 28.1	- 7.5	- 6.3				- 6.3	- 1.4	- 49.6
TFED	**227.1**	**180.2**	**20.5**			**216.1**	**102.2**	**29.2**	**775.3**
Industry	173.7	74.7	13.4				76.5	22.3	360.8
Transport	5.4	73.2	0.1				1.4		80.0
Residential	42.7	15.5	6.4			216.1	17.2	6.4	304.3
Commercial	5.3	16.8	0.6				7.0	0.6	30.2

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	1 167.2	188.9	57.6	32.5	23.9	194.5			1 664.7
Net Imports	- 39.4	145.8	5.7				- 0.1		112.0
TPED	**1 127.8**	**334.7**	**63.3**	**32.5**	**23.9**	**194.5**	**- 0.1**		**1 776.7**
Electricity and Heat Generation	- 773.7	- 18.9	- 10.5	- 32.5	- 23.9	- 4.0	227.3	57.4	- 578.8
Petroleum Refineries		- 20.5	- 1.6				- 2.9	- 9.3	- 34.3
Others	- 17.3	- 8.4	- 7.4				- 9.1	- 1.7	- 43.7
TFED	**336.9**	**286.9**	**43.9**			**190.5**	**215.2**	**46.4**	**1 119.8**
Industry	285.1	111.1	22.4				160.0	34.0	612.7
Transport	3.8	131.1	0.3				2.5		137.6
Residential	42.3	31.2	13.2			190.5	35.8	11.1	324.1
Commercial	5.7	13.5	7.9				17.0	1.2	45.4

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	1 507.5	204.1	99.4	52.9	60.0	165.5			2 089.3
Net Imports	- 49.6	275.4	30.0				- 0.1		255.8
TPED	**1 457.9**	**479.5**	**129.4**	**52.9**	**60.0**	**165.5**	**- 0.1**		**2 345.1**
Electricity and Heat Generation	-1 074.7	- 20.0	- 26.0	- 52.9	- 60.0	- 9.8	368.6	86.5	- 788.3
Petroleum Refineries		- 24.8	- 1.9				- 3.5	- 11.2	- 41.4
Others	- 22.3	- 8.8	- 8.7				- 10.6	- 1.8	- 52.2
TFED	**360.9**	**425.9**	**92.8**			**155.7**	**354.5**	**73.6**	**1 463.3**
Industry	314.3	166.0	36.6				249.5	49.8	816.1
Transport	2.4	197.4	0.6				4.4		204.7
Residential	38.9	49.7	27.1			155.7	58.1	21.1	350.5
Commercial	5.3	12.8	28.5				42.6	2.7	91.9

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	1 862.2	198.8	114.8	88.3	116.5	148.0			2 528.5
Net Imports	- 28.2	470.1	126.0				- 0.1		567.8
TPED	**1 833.9**	**668.9**	**240.8**	**88.3**	**116.5**	**148.0**	**- 0.1**		**3 096.4**
Electricity and Heat Generation	-1 423.1	- 25.0	- 72.1	- 88.3	- 116.5	- 20.8	581.7	115.3	-1 048.8
Petroleum Refineries		- 28.6	- 2.1				- 3.9	- 12.8	- 47.4
Others	- 27.5	- 8.5	- 8.6				- 11.7	- 1.8	- 58.1
TFED	**383.3**	**606.9**	**158.0**			**127.2**	**566.0**	**100.8**	**1 942.1**
Industry	343.4	222.7	54.2				373.7	69.3	1 063.3
Transport		298.0	1.0				6.9		306.0
Residential	35.1	70.1	52.8			127.2	87.8	26.4	399.5
Commercial	4.7	16.1	49.9				97.5	5.2	173.4

CHINA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	744	5 494	9 940	17 935	31 108	9.5	7.7	6.1	5.7	6.4
Population (million)	981	1 285	1 343	1 404	1 436	1.2	0.6	0.4	0.2	0.4
GDP per capita (2000 PPP US$)	758	4 277	7 399	12 773	21 664	8.2	7.1	5.6	5.4	6.0
GDP in Services (2000 PPP US$ billion)	249	1 751	3 342	6 494	12 074	9.3	8.4	6.9	6.4	7.1
GDP in Industry (2000 PPP US$ billion)	332	2 288	4 724	8 272	13 751	9.2	9.5	5.8	5.2	6.6
Urbanisation level (%)	20	38	45	56	60	3.0	2.3	2.2	0.7	1.7

ENERGY PROJECTIONS

Mtoe	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**615.5**	**1 118.9**	**1 664.7**	**2 089.3**	**2 528.5**	**2.8**	**5.1**	**2.3**	**1.9**	**3.0**
Coal	310.7	664.4	1 167.2	1 507.5	1 862.2	3.5	7.3	2.6	2.1	3.7
	(50%)	(59%)	(70%)	(72%)	(74%)					
Oil	107.9	170.8	188.9	204.1	198.8	2.1	1.3	0.8	- 0.3	0.5
	(18%)	(15%)	(11%)	(10%)	(8%)					
Gas	12.0	35.0	57.6	99.4	114.8	5.0	6.4	5.6	1.5	4.3
	(2%)	(3%)	(3%)	(5%)	(5%)					
Hydro	5.0	23.6	32.5	52.9	88.3	7.3	4.1	5.0	5.3	4.8
	(1%)	(2%)	(2%)	(3%)	(3%)					
NRE	179.9	218.1	194.5	165.5	148.0	0.9	- 1.4	- 1.6	- 1.1	- 1.4
	(29%)	(19%)	(12%)	(8%)	(6%)					
Nuclear		7.0	23.9	60.0	116.5		16.5	9.6	6.9	10.5
		(1%)	(1%)	(3%)	(5%)					
Net Imports	**- 20.6**	**0.9**	**112.0**	**255.8**	**567.8**			**8.6**	**8.3**	
Coal	- 3.2	- 45.7	- 39.4	- 49.6	- 28.2	12.9	- 1.8	2.3	- 5.5	- 1.7
Oil	- 17.4	48.6	145.8	275.4	470.1		14.7	6.6	5.5	8.4
Gas		- 1.9	5.7	30.0	126.0			18.1	15.4	
Electricity		- 0.1	- 0.1	- 0.1	- 0.1		0.2	1.7	2.2	1.4
Total Primary Energy Demand	**598.5**	**1 118.6**	**1 776.7**	**2 345.1**	**3 096.4**	**2.9**	**6.0**	**2.8**	**2.8**	**3.7**
Coal	312.6	618.7	1 127.8	1 457.9	1 833.9	3.2	7.8	2.6	2.3	4.0
	(52%)	(55%)	(63%)	(62%)	(59%)					
Oil	89.1	218.1	334.7	479.5	668.9	4.2	5.5	3.7	3.4	4.1
	(15%)	(19%)	(19%)	(20%)	(22%)					
Gas	12.0	33.0	63.3	129.4	240.8	4.7	8.5	7.4	6.4	7.4
	(2%)	(3%)	(4%)	(6%)	(8%)					
Hydro	5.0	23.6	32.5	52.9	88.3	7.3	4.1	5.0	5.3	4.8
	(1%)	(2%)	(2%)	(2%)	(3%)					
NRE	179.9	218.1	194.5	165.5	148.0	0.9	- 1.4	- 1.6	- 1.1	- 1.4
	(30%)	(19%)	(11%)	(7%)	(5%)					
Nuclear		7.0	23.9	60.0	116.5		16.5	9.6	6.9	10.5
		(1%)	(1%)	(3%)	(4%)					
Input for Electricity and Heat Generation	**- 83.3**	**- 419.5**	**- 863.5**	**-1 243.5**	**-1 745.8**	**7.6**	**9.4**	**3.7**	**3.5**	**5.2**
Coal	- 57.9	- 363.5	- 773.7	-1 074.7	-1 423.1	8.7	9.9	3.3	2.8	5.0
	(70%)	(87%)	(90%)	(86%)	(82%)					
Oil	- 20.2	- 20.8	- 18.9	- 20.0	- 25.0	0.1	- 1.2	0.6	2.3	0.7
	(24%)	(5%)	(2%)	(2%)	(1%)					
Gas	- 0.2	- 2.5	- 10.5	- 26.0	- 72.1	12.8	19.8	9.5	10.7	12.8
	(0%)	(1%)	(1%)	(2%)	(4%)					
Hydro	- 5.0	- 23.6	- 32.5	- 52.9	- 88.3	7.3	4.1	5.0	5.3	4.8
	(6%)	(6%)	(4%)	(4%)	(5%)					
NRE		- 2.0	- 4.0	- 9.8	- 20.8		9.2	9.4	7.8	8.8
		(0%)	(0%)	(1%)	(1%)					
Nuclear		- 7.0	- 23.9	- 60.0	- 116.5		16.5	9.6	6.9	10.5
		(2%)	(3%)	(5%)	(7%)					
Other Transformation	**- 18.0**	**- 72.6**	**- 78.0**	**- 93.5**	**- 105.5**	**6.6**	**0.9**	**1.8**	**1.2**	**1.3**
Coal	- 3.2	- 28.1	- 17.3	- 22.3	- 27.5	10.4	- 5.9	2.6	2.1	- 0.1
	(18%)	(39%)	(22%)	(24%)	(26%)					
Oil	- 8.7	- 21.2	- 28.9	- 33.6	- 37.0	4.1	3.9	1.5	1.0	2.0
	(48%)	(29%)	(37%)	(36%)	(35%)					
Gas	- 5.4	- 7.4	- 8.9	- 10.6	- 10.8	1.5	2.4	1.7	0.2	1.4
	(30%)	(10%)	(11%)	(11%)	(10%)					
NRE										
Electricity	- 0.7	- 8.2	- 12.0	- 14.0	- 15.6	11.6	4.8	1.6	1.1	2.3
	(4%)	(11%)	(15%)	(15%)	(15%)					
Heat		- 7.7	- 11.0	- 13.0	- 14.5		4.5	1.7	1.1	2.3
		(11%)	(14%)	(14%)	(14%)					

CHINA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**474.0**	**775.3**	**1 119.8**	**1 463.3**	**1 942.1**	**2.3**	**4.7**	**2.7**	**2.9**	**3.3**
Coal	212.4	227.1	336.9	360.9	383.3	0.3	5.1	0.7	0.6	1.9
	(45%)	(29%)	(30%)	(25%)	(20%)					
Oil	47.0	180.2	286.9	425.9	606.9	6.3	6.0	4.0	3.6	4.4
	(10%)	(23%)	(26%)	(29%)	(31%)					
Gas	6.7	20.5	43.9	92.8	158.0	5.2	10.0	7.8	5.5	7.6
	(1%)	(3%)	(4%)	(6%)	(8%)					
NRE	179.9	216.1	190.5	155.7	127.2	0.8	- 1.6	- 2.0	- 2.0	- 1.9
	(38%)	(28%)	(17%)	(11%)	(7%)					
Electricity	20.6	102.2	215.2	354.5	566.0	7.6	9.8	5.1	4.8	6.3
	(4%)	(13%)	(19%)	(24%)	(29%)					
Heat	7.3	29.2	46.4	73.6	100.8	6.5	5.9	4.7	3.2	4.5
	(2%)	(4%)	(4%)	(5%)	(5%)					
Industry	**206.9**	**360.8**	**612.7**	**816.1**	**1 063.3**	**2.6**	**6.8**	**2.9**	**2.7**	**3.9**
Coal	144.0	173.7	285.1	314.3	343.4	0.9	6.4	1.0	0.9	2.5
	(70%)	(48%)	(47%)	(39%)	(32%)					
Oil	31.4	74.7	111.1	166.0	222.7	4.0	5.1	4.1	3.0	4.0
	(15%)	(21%)	(18%)	(20%)	(21%)					
Gas	6.3	13.4	22.4	36.6	54.2	3.5	6.6	5.0	4.0	5.1
	(3%)	(4%)	(4%)	(4%)	(5%)					
NRE										
Electricity	19.4	76.5	160.0	249.5	373.7	6.4	9.7	4.5	4.1	5.8
	(9%)	(21%)	(26%)	(31%)	(35%)					
Heat	5.8	22.3	34.0	49.8	69.3	6.3	5.4	3.9	3.4	4.1
	(3%)	(6%)	(6%)	(6%)	(7%)					
Transport	**20.7**	**80.0**	**137.6**	**204.7**	**306.0**	**6.3**	**7.0**	**4.1**	**4.1**	**4.9**
Coal	9.5	5.4	3.8	2.4	0.03	- 2.6	- 4.3	- 4.5	- 35.4	- 16.9
	(46%)	(7%)	(3%)	(1%)						
Oil	11.0	73.2	131.1	197.4	298.0	9.0	7.6	4.2	4.2	5.1
	(53%)	(91%)	(95%)	(96%)	(97%)					
Gas		0.1	0.3	0.6	1.0		21.8	6.7	5.1	10.2
		(0%)	(0%)	(0%)	(0%)					
NRE										
Electricity	0.2	1.4	2.5	4.4	6.9	8.7	7.0	5.9	4.7	5.8
	(1%)	(2%)	(2%)	(2%)	(2%)					
Residential	**240.6**	**304.3**	**324.1**	**350.5**	**399.5**	**1.1**	**0.8**	**0.8**	**1.3**	**1.0**
Coal	56.7	42.7	42.3	38.9	35.1	- 1.3	- 0.1	- 0.8	- 1.0	- 0.7
	(24%)	(14%)	(13%)	(11%)	(9%)					
Oil	1.5	15.5	31.2	49.7	70.1	11.1	9.1	4.8	3.5	5.5
	(1%)	(5%)	(10%)	(14%)	(18%)					
Gas[1]	0.4	6.4	13.2	27.1	52.8	14.0	9.5	7.4	6.9	7.8
	(0%)	(2%)	(4%)	(8%)	(13%)					
NRE	179.9	216.1	190.5	155.7	127.2	0.8	- 1.6	- 2.0	- 2.0	- 1.9
	(75%)	(71%)	(59%)	(44%)	(32%)					
Electricity[1]	0.9	17.2	35.8	58.1	87.8	14.1	9.6	5.0	4.2	6.0
	(0%)	(6%)	(11%)	(17%)	(22%)					
Heat	1.1	6.4	11.1	21.1	26.4	8.3	7.3	6.6	2.3	5.2
	(0%)	(2%)	(3%)	(6%)	(7%)					
Commercial	**5.8**	**30.2**	**45.4**	**91.9**	**173.4**	**7.8**	**5.2**	**7.3**	**6.5**	**6.4**
Coal	2.3	5.3	5.7	5.3	4.7	3.9	1.0	- 0.7	- 1.3	- 0.4
	(39%)	(18%)	(13%)	(6%)	(3%)					
Oil	3.0	16.8	13.5	12.8	16.1	8.1	- 2.6	- 0.5	2.3	- 0.2
	(53%)	(55%)	(30%)	(14%)	(9%)					
Gas	0.1	0.6	7.9	28.5	49.9	11.7	37.3	13.7	5.8	16.9
	(1%)	(2%)	(17%)	(31%)	(29%)					
NRE										
Electricity		7.0	17.0	42.6	97.5		11.8	9.6	8.6	9.9
		(23%)	(37%)	(46%)	(56%)					
Heat	0.4	0.6	1.2	2.7	5.2	1.4	10.5	8.0	6.9	8.3
	(7%)	(2%)	(3%)	(3%)	(3%)					

Note: 1 Historical data prior to 2002 are from national sources.

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	68	68	59	61	65
Net Energy Import Ratio (%)	-3	0	6	11	18
Net Oil Import Dependency (%)	-20	22	44	57	70

CHINA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**301**	**1 416**	**2 869**	**4 585**	**7 162**	**7.3**	**9.2**	**4.8**	**4.6**	**6.0**
Coal	164	1 056	2 324	3 567	5 202	8.8	10.4	4.4	3.8	5.9
	(55%)	(75%)	(81%)	(78%)	(73%)					
Oil	78	49	32	24	28	-2.0	-5.2	-2.8	1.4	-2.0
	(26%)	(3%)	(1%)	(1%)						
Gas	1	5	33	106	360	9.1	27.9	12.3	13.0	16.8
			(1%)	(2%)	(5%)					
Hydro	58	275	378	616	1 027	7.3	4.1	5.0	5.3	4.8
	(19%)	(19%)	(13%)	(13%)	(14%)					
NRE		4	10	42	98		14.1	15.1	8.9	12.6
				(1%)	(1%)					
Nuclear		27	92	230	447		16.5	9.6	6.9	10.5
		(2%)	(3%)	(5%)	(6%)					
Total Installed Generation Capacity (GW)	**66**	**355**	**670**	**973**	**1 278**	**8.0**	**8.3**	**3.8**	**2.8**	**4.7**
Thermal	46	262	503	707	888	8.3	8.5	3.5	2.3	4.5
	(69%)	(74%)	(75%)	(73%)	(69%)					
Coal	40	244	462	643	769	8.6	8.3	3.4	1.8	4.2
	(61%)	(69%)	(69%)	(66%)	(60%)					
Oil	6	11	15	15	15	3.2	3.7			1.0
	(8%)	(3%)	(2%)	(2%)	(1%)					
Gas		6	26	49	104	20.9	18.9	6.5	7.8	10.4
		(2%)	(4%)	(5%)	(8%)					
Hydro	20	86	150	219	297	6.8	7.2	3.9	3.1	4.5
	(31%)	(24%)	(22%)	(23%)	(23%)					
NRE		2	5	17	35		9.7	13.1	7.5	10.1
		(1%)	(1%)	(2%)	(3%)					
Nuclear		4	12	30	58		13.1	9.6	6.8	9.6
		(1%)	(2%)	(3%)	(5%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**805**	**204**	**179**	**131**	**100**	**- 6.1**	**- 1.6**	**- 3.1**	**- 2.7**	**- 2.5**
Industry (toe per US$ million GDP in Industry)	622	158	130	99	77	- 6.1	- 2.4	- 2.7	- 2.4	- 2.5
Commercial (toe per US$ million GDP in Services)	23	17	14	14	14	- 1.3	- 3.0	0.4	0.1	- 0.7
Energy Intensity (kgoe per capita)	**610**	**871**	**1 322**	**1 670**	**2 156**	**1.6**	**5.4**	**2.4**	**2.6**	**3.3**
Industry	211	281	456	581	741	1.3	6.2	2.5	2.5	3.5
Transport	21	62	102	146	213	5.0	6.4	3.6	3.9	4.5
Residential	245	237	241	250	278	- 0.2	0.2	0.3	1.1	0.6
Commercial	6	24	34	65	121	6.5	4.6	6.8	6.3	6.0
CO_2 Emissions (million tonnes)	**1 324**	**3 128**	**5 508**	**7 370**	**9 648**	**4.0**	**7.3**	**3.0**	**2.7**	**4.1**
Electricity Generation	238	1 479	3 083	4 290	5 764	8.7	9.6	3.4	3.0	5.0
Transformation other than Electricity Generation	76	183	164	199	227	4.0	- 1.4	2.0	1.3	0.8
Industry	698	928	1 487	1 795	2 115	1.3	6.1	1.9	1.7	3.0
Transport	69	237	402	595	886	5.8	6.8	4.0	4.1	4.8
Residential	225	228	290	365	473		3.1	2.3	2.6	2.6
Commercial	18	73	82	126	184	6.5	1.4	4.4	3.8	3.4
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	1 781	569	554	411	310	- 5.1	- 0.3	- 2.9	- 2.8	- 2.1
CO_2 emissions per capita (tonnes per capita)	1.3	2.4	4.1	5.2	6.7	2.7	6.7	2.5	2.5	3.7

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**522 - 630**	**1 136 - 1 382**	**1 876 - 2 307**
Coal Production & Transportation	67 - 84	124 - 154	188 - 232
Oil & Gas Production & Processing	47 - 67	98 - 145	146 - 216
Oil & Gas International Trade	12 - 18	40 - 55	66 - 92
Oil & Gas Domestic Pipeline	20 - 28	56 - 79	113 - 161
Electricity Generation & Transmission	377 - 434	818 - 948	1 362 - 1 606

HONG KONG, CHINA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production									
Net Imports	4.8	8.1	2.5				0.5		15.9
TPED	**4.8**	**8.1**	**2.5**				**0.5**		**15.9**
Electricity and Heat Generation	- 5.2		- 2.3				2.8		- 4.8
Petroleum Refineries									
Others		- 0.5	0.5						- 0.1
TFED		**7.5**	**0.6**				**3.3**		**11.4**
Industry		0.9					0.4		1.3
Transport		6.2							6.2
Residential			0.3				0.8		1.2
Commercial		0.4	0.2				2.1		2.7

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production									
Net Imports	5.4	11.9	4.7				0.5		22.5
TPED	**5.4**	**11.9**	**4.7**				**0.5**		**22.5**
Electricity and Heat Generation	- 5.4		- 4.2				3.8		- 5.8
Petroleum Refineries									
Others		- 0.3	0.2						- 0.1
TFED		**11.6**	**0.7**				**4.3**		**16.6**
Industry		1.1					0.4		1.5
Transport		10.1							10.1
Residential			0.4				1.1		1.5
Commercial		0.4	0.2				2.8		3.5

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production									
Net Imports	6.4	16.0	6.6				0.5		29.6
TPED	**6.4**	**16.0**	**6.6**				**0.5**		**29.6**
Electricity and Heat Generation	- 6.4		- 5.9				5.2		- 7.1
Petroleum Refineries									
Others		- 0.3	0.2						- 0.1
TFED		**15.7**	**0.9**				**5.7**		**22.4**
Industry		1.5					0.5		2.0
Transport		13.7							13.7
Residential			0.6				1.3		2.0
Commercial		0.5	0.3				3.9		4.7

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production									
Net Imports	7.7	19.7	8.0				0.6		35.9
TPED	**7.7**	**19.7**	**8.0**				**0.6**		**35.9**
Electricity and Heat Generation	- 7.7		- 7.2				6.6		- 8.3
Petroleum Refineries									
Others		- 0.4	0.3						- 0.1
TFED		**19.2**	**1.1**				**7.2**		**27.5**
Industry		1.8					0.5		2.4
Transport		16.8							16.8
Residential			0.8				1.6		2.4
Commercial		0.6	0.3				5.0		5.9

HONG KONG, CHINA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	66	197	291	421	554	5.1	5.0	3.8	2.8	3.8
Population (million)	5.06	6.79	7.03	7.42	7.81	1.3	0.4	0.5	0.5	0.5
GDP per capita (2000 PPP US$)	12 957	29 074	41 386	56 737	70 912	3.7	4.5	3.2	2.3	3.2
GDP in Services (2000 PPP US$ billion)	49	179	271	400	529	6.0	5.4	4.0	2.8	4.0
GDP in Industry (2000 PPP US$ billion)	16	25	27	36	45	2.0	1.0	3.1	2.2	2.2
Urbanisation level (%)	91	100	100	100	100	0.4				

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production									0.6	
Coal										
Oil										
Gas										
Hydro										
NRE										
Nuclear										
Net Imports	6.4	15.9	22.5	29.6	35.9	4.2	4.4	2.8	2.0	3.0
Coal		4.8	5.4	6.4	7.7		1.4	1.7	1.9	1.7
Oil	6.4	8.1	11.9	16.0	19.7	1.0	5.0	3.0	2.0	3.2
Gas		2.5	4.7	6.6	8.0		8.5	3.4	1.9	4.3
Electricity		0.5	0.5	0.5	0.6		- 0.9	1.0	1.0	0.5
Total Primary Energy Demand	5.4	15.9	22.5	29.6	35.9	5.0	4.5	2.8	2.0	3.0
Coal		4.8	5.4	6.4	7.7		1.4	1.7	1.9	1.7
		(30%)	(24%)	(21%)	(21%)					
Oil	5.4	8.1	11.9	16.0	19.7	1.8	5.0	3.0	2.0	3.2
	(99%)	(51%)	(53%)	(54%)	(55%)					
Gas		2.5	4.7	6.6	8.0		8.5	3.4	1.9	4.3
		(16%)	(21%)	(22%)	(22%)					
Hydro										
NRE	0.05			0.016	0.017				0.6	
	(1%)			(0%)	(0%)					
Nuclear										
Input for Electricity and Heat Generation	- 2.8	- 7.6	- 9.6	- 12.3	- 14.9	4.7	2.9	2.6	1.9	2.4
Coal		- 5.2	- 5.4	- 6.4	- 7.7		0.3	1.7	1.9	1.4
		(69%)	(56%)	(52%)	(52%)					
Oil	- 2.8	- 0.04	- 0.02	- 0.01	- 0.01	-18.0	- 7.4	- 7.2	1.1	- 4.4
	(100%)	(0%)	(0%)	(0%)	(0%)					
Gas		- 2.3	- 4.2	- 5.9	- 7.2		7.5	3.5	1.9	4.1
		(31%)	(44%)	(48%)	(48%)					
Hydro										
NRE				-0.016	-0.017				0.6	
				(0%)	(0%)					
Nuclear										
Other Transformation		- 0.1	- 0.1	- 0.1	- 0.1		2.9	2.4	1.9	2.4
Coal										
Oil		- 0.5	- 0.3	- 0.3	- 0.4		- 8.2	2.5	1.9	- 0.9
		(100%)	(100%)	(100%)	(100%)					
Gas		0.5	0.2	0.2	0.3		- 11.1	2.5	1.9	- 1.8
		(100%)	(100%)	(100%)	(100%)					
NRE										
Electricity										
Heat										

HONG KONG, CHINA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**3.6**	**11.4**	**16.6**	**22.4**	**27.5**	**5.3**	**4.8**	**3.0**	**2.1**	**3.2**
Coal										
Oil	2.6	7.5	11.6	15.7	19.2	5.0	5.7	3.0	2.0	3.4
	(71%)	(66%)	(70%)	(70%)	(70%)					
Gas	0.1	0.6	0.7	0.9	1.1	9.6	2.9	2.5	1.9	2.4
	(2%)	(5%)	(4%)	(4%)	(4%)					
NRE										
Electricity	0.9	3.3	4.3	5.7	7.2	5.9	3.2	3.0	2.3	2.8
	(26%)	(29%)	(26%)	(26%)	(26%)					
Heat										
Industry	**1.1**	**1.3**	**1.5**	**2.0**	**2.4**	**1.0**	**2.0**	**2.7**	**1.6**	**2.1**
Coal										
Oil	0.7	0.9	1.1	1.5	1.8	1.3	2.5	3.1	1.8	2.4
	(65%)	(69%)	(72%)	(75%)	(76%)					
Gas	0.01	0.02	0.03	0.04	0.05	6.7	2.7	3.3	2.3	2.8
	(0%)	(2%)	(2%)	(2%)	(2%)					
NRE										
Electricity	0.4	0.4	0.4	0.5	0.5	0.3	0.5	1.7	1.1	1.2
	(34%)	(29%)	(26%)	(23%)	(22%)					
Heat										
Transport	**1.6**	**6.2**	**10.1**	**13.7**	**16.8**	**6.3**	**6.3**	**3.1**	**2.1**	**3.6**
Coal										
Oil	1.6	6.2	10.1	13.7	16.8	6.3	6.3	3.1	2.1	3.6
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity										
Residential	**0.4**	**1.2**	**1.5**	**2.0**	**2.4**	**4.7**	**3.3**	**2.7**	**2.1**	**2.6**
Coal										
Oil	0.2									
	(35%)									
Gas		0.3	0.4	0.6	0.8	10.1	4.4	3.3	2.3	3.3
		(27%)	(30%)	(32%)	(32%)					
NRE										
Electricity	0.2	0.8	1.1	1.3	1.6	6.8	2.9	2.4	2.0	2.4
	(47%)	(73%)	(70%)	(68%)	(68%)					
Heat										
Commercial	**0.5**	**2.7**	**3.5**	**4.7**	**5.9**	**7.6**	**3.3**	**3.0**	**2.3**	**2.9**
Coal										
Oil	0.1	0.4	0.4	0.5	0.6	5.0	2.4	2.0	1.6	2.0
	(23%)	(13%)	(12%)	(11%)	(10%)					
Gas	0.03	0.2	0.2	0.3	0.3	9.3	0.6	0.6	0.7	0.6
	(6%)	(9%)	(7%)	(6%)	(5%)					
NRE										
Electricity	0.4	2.1	2.8	3.9	5.0	8.1	3.7	3.4	2.5	3.2
	(71%)	(78%)	(81%)	(83%)	(85%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	1	70	69	68	67
Net Energy Import Ratio (%)	99	100	100	100	100
Net Oil Import Dependency (%)	100	100	100	100	100

HONG KONG, CHINA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**13**	**34**	**46**	**63**	**80**	**4.6**	**3.8**	**3.2**	**2.4**	**3.1**
Coal		22	24	30	38		1.0	2.3	2.4	2.0
		(64%)	(51%)	(47%)	(47%)					
Oil	13	0.1	0.1	0.04	0.04	-18.3	-7.0	-6.9	0.8	-4.3
	(100%)	(0%)	(0%)	(0%)	(0%)					
Gas		12	23	33	42		7.9	3.9	2.3	4.5
		(36%)	(49%)	(53%)	(52%)					
Hydro										
NRE				0.18	0.20			50.5	0.8	
				(0%)	(1%)					
Nuclear										
Total Installed Generation Capacity (GW)	**3**	**10**	**12**	**13**	**14**	**5.0**	**2.5**	**1.3**	**0.7**	**1.4**
Thermal	3	10	12	13	14	5.0	2.5	1.2	0.7	1.4
	(100%)	(100%)	(100%)	(99%)	(99%)					
Coal		7	7	7	7					
		(69%)	(57%)	(50%)	(47%)					
Oil		1	1	0.3	0.3		-7.3	-7.2		-4.7
		(12%)	(5%)	(2%)	(2%)					
Gas		2	4	6	7		11.6	3.5	1.4	5.0
		(19%)	(38%)	(47%)	(51%)					
Hydro										
NRE				0.09	0.09			49.9		
				(1%)	(1%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**83**	**80**	**77**	**70**	**65**	**- 0.1**	**- 0.5**	**- 1.0**	**- 0.8**	**- 0.8**
Industry (toe per US$ million GDP in Industry)	67	54	58	56	53	- 1.0	0.9	- 0.4	- 0.6	- 0.1
Commercial (toe per US$ million GDP in Services)	11	15	13	12	11	1.5	- 1.9	- 0.9	- 0.5	- 1.1
Energy Intensity (kgoe per capita)	**1 075**	**2 336**	**3 203**	**3 989**	**4 602**	**3.6**	**4.0**	**2.2**	**1.4**	**2.5**
Industry	208	195	220	273	305	- 0.3	1.5	2.2	1.1	1.6
Transport	319	914	1 434	1 841	2 154	4.9	5.8	2.5	1.6	3.1
Residential	85	172	215	265	310	3.3	2.9	2.1	1.6	2.1
Commercial	105	394	495	632	755	6.2	2.9	2.5	1.8	2.3
CO_2 Emissions (million tonnes)	**16.9**	**49.9**	**67.4**	**88.1**	**107.0**	**5.1**	**3.8**	**2.7**	**2.0**	**2.8**
Electricity Generation	8.9	25.9	30.3	38.2	46.1	5.0	2.0	2.3	1.9	2.1
Transformation other than Electricity Generation										
Industry	2.2	2.8	3.5	4.7	5.6	1.1	2.8	3.0	1.8	2.5
Transport	4.8	18.8	30.6	41.5	51.0	6.4	6.3	3.1	2.1	3.6
Residential	0.5	0.8	1.1	1.5	1.8	1.8	4.1	3.2	1.8	2.9
Commercial	0.4	1.6	1.9	2.2	2.5	6.6	2.2	1.5	1.3	1.6
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	257.5	252.9	231.7	209.3	193.2	- 0.1	- 1.1	- 1.0	- 0.8	- 1.0
CO_2 emissions per capita (tonnes per capita)	3.3	7.4	9.6	11.9	13.7	3.7	3.4	2.2	1.4	2.2

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**4.3 - 5.9**	**8.7 - 12.0**	**11.8 - 16.5**
Coal Production & Transportation			
Oil & Gas Production & Processing			
Oil & Gas International Trade	1.83 - 2.77	3.71 - 5.69	5.00 - 7.82
Oil & Gas Domestic Pipeline	0.76 - 1.09	1.40 - 1.99	1.86 - 2.65
Electricity Generation & Transmission	1.72 - 2.03	3.59 - 4.32	4.95 - 6.04

INDONESIA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	75.4	63.5	73.4	0.9		45.7			258.9
Net Imports	- 56.1	- 1.5	- 33.8						- 91.4
TPED	**18.7**	**63.0**	**39.7**	**0.9**		**45.7**			**168.0**
Electricity and Heat Generation	- 9.4	- 3.3	- 6.7	- 0.9		- 4.5	7.6		- 17.2
Petroleum Refineries		- 12.1	- 1.1						- 13.1
Others	- 3.7		- 21.2						- 24.8
TFED	**5.7**	**46.9**	**10.7**			**41.2**	**7.5**		**112.0**
Industry	5.7	11.6	10.6			2.0	3.2		33.1
Transport		23.7							23.7
Residential		10.5				39.0	2.9		52.5
Commercial		1.2				0.2	1.4		2.8

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	126.4	65.0	112.5	0.9		52.9			357.7
Net Imports	- 87.0	14.5	- 54.5				0.2		- 126.8
TPED	**39.4**	**79.5**	**58.1**	**0.9**		**52.9**	**0.2**		**231.0**
Electricity and Heat Generation	- 20.0	- 3.3	- 8.8	- 0.9		- 7.6	11.9		- 28.7
Petroleum Refineries		- 15.3	- 1.3						- 16.6
Others	- 9.8		- 33.7						- 43.5
TFED	**9.5**	**60.9**	**14.2**			**45.3**	**12.2**		**142.2**
Industry	9.5	16.2	14.1			2.6	5.0		47.4
Transport		32.8							32.9
Residential		10.5				42.5	4.8		57.9
Commercial		1.4				0.2	2.3		4.0

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	138.2	55.6	111.5	1.3		57.1			363.7
Net Imports	- 82.6	47.7	- 39.8				0.5		- 74.2
TPED	**55.6**	**103.2**	**71.7**	**1.3**		**57.1**	**0.5**		**289.5**
Electricity and Heat Generation	- 30.3	- 1.5	- 16.0	- 1.3		- 6.0	18.4		- 36.7
Petroleum Refineries		- 19.4	- 1.6						- 21.0
Others	- 10.7		- 31.4						- 42.1
TFED	**14.5**	**82.4**	**22.7**			**51.2**	**18.9**		**189.7**
Industry	14.5	22.6	22.5			3.5	7.7		70.8
Transport		47.8							47.8
Residential		10.4				47.4	7.3		65.1
Commercial		1.6	0.1			0.3	3.9		5.9

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	145.3	54.9	90.6	1.8		65.2			357.8
Net Imports	- 77.0	81.3	- 4.0				0.5		0.8
TPED	**68.3**	**136.2**	**86.7**	**1.8**		**65.2**	**0.5**		**358.6**
Electricity and Heat Generation	- 36.7	- 1.4	- 24.3	- 1.8		- 8.9	25.9		- 47.1
Petroleum Refineries		- 24.9	- 2.0						- 26.9
Others	- 11.3		- 26.7						- 38.0
TFED	**20.3**	**109.9**	**33.7**			**56.3**	**26.4**		**246.7**
Industry	20.3	29.5	33.5			4.7	10.7		98.6
Transport		68.6	0.1						68.7
Residential		9.9	0.1			51.3	9.5		70.9
Commercial		1.9	0.1			0.3	6.2		8.5

INDONESIA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	273	790	1 152	1 809	2 795	5.0	4.8	4.6	4.4	4.6
Population (million)	148	212	233	258	276	1.6	1.2	1.0	0.7	1.0
GDP per capita (2000 PPP US$)	1 838	3 729	4 944	7 021	10 116	3.3	3.6	3.6	3.7	3.6
GDP in Services (2000 PPP US$ billion)	107	283	467	782	1 276	4.5	6.5	5.3	5.0	5.5
GDP in Industry (2000 PPP US$ billion)	86	246	332	519	788	4.9	3.8	4.6	4.3	4.3
Urbanisation level (%)	22	44	53	62	68	3.2	2.3	1.5	0.9	1.5

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**125.0**	**258.9**	**357.7**	**363.7**	**357.8**	**3.4**	**4.1**	**0.2**	**- 0.2**	**1.2**
Coal		75.4	126.4	138.2	145.3		6.7	0.9	0.5	2.4
		(29%)	(35%)	(38%)	(41%)					
Oil	80.0	63.5	65.0	55.6	54.9	- 1.0	0.3	- 1.6	- 0.1	- 0.5
	(64%)	(25%)	(18%)	(15%)	(15%)					
Gas	15.0	73.4	112.5	111.5	90.6	7.5	5.5	- 0.1	- 2.0	0.8
	(12%)	(28%)	(31%)	(31%)	(25%)					
Hydro	0.2	0.9	0.9	1.3	1.8	7.0	1.2	3.6	2.8	2.6
	(0%)	(0%)	(0%)	(0%)	(0%)					
NRE	29.7	45.7	52.9	57.1	65.2	2.0	1.8	0.8	1.3	1.3
	(24%)	(18%)	(15%)	(16%)	(18%)					
Nuclear										
Net Imports	**- 68.1**	**- 91.4**	**- 126.8**	**- 74.2**	**0.8**	**1.3**	**4.2**	**- 5.2**		
Coal		- 56.1	- 87.0	- 82.6	- 77.0		5.6	- 0.5	- 0.7	1.1
Oil	- 58.1	- 1.5	14.5	47.7	81.3	-15.3		12.6	5.5	
Gas	- 10.0	- 33.8	- 54.5	- 39.8	- 4.0	5.7	6.2	- 3.1	-20.6	- 7.3
Electricity			0.2	0.5	0.5			9.1		
Total Primary Energy Demand	**56.0**	**168.0**	**231.0**	**289.5**	**358.6**	**5.1**	**4.1**	**2.3**	**2.2**	**2.7**
Coal	0.2	18.7	39.4	55.6	68.3	23.9	9.7	3.5	2.1	4.7
	(0%)	(11%)	(17%)	(19%)	(19%)					
Oil	21.0	63.0	79.5	103.2	136.2	5.1	2.9	2.6	2.8	2.8
	(38%)	(38%)	(34%)	(36%)	(38%)					
Gas	4.9	39.7	58.1	71.7	86.7	9.9	4.9	2.1	1.9	2.8
	(9%)	(24%)	(25%)	(25%)	(24%)					
Hydro	0.2	0.9	0.9	1.3	1.8	7.0	1.2	3.6	2.8	2.6
	(0%)	(1%)	(0%)	(0%)	(0%)					
NRE	29.6	45.7	52.9	57.1	65.2	2.0	1.8	0.8	1.3	1.3
	(53%)	(27%)	(23%)	(20%)	(18%)					
Nuclear										
Input for Electricity and Heat Generation	**- 2.3**	**- 24.8**	**- 40.7**	**- 55.1**	**- 73.0**	**11.3**	**6.4**	**3.1**	**2.9**	**3.9**
Coal		- 9.4	- 20.0	- 30.3	- 36.7		9.9	4.2	1.9	5.0
		(38%)	(49%)	(55%)	(50%)					
Oil	- 2.1	- 3.3	- 3.3	- 1.5	- 1.4	2.0	0.1	- 7.6	- 0.9	- 3.1
	(92%)	(13%)	(8%)	(3%)	(2%)					
Gas		- 6.7	- 8.8	- 16.0	- 24.3		3.5	6.1	4.3	4.7
		(27%)	(22%)	(29%)	(33%)					
Hydro	- 0.2	- 0.9	- 0.9	- 1.3	- 1.8	7.0	1.2	3.6	2.8	2.6
	(8%)	(3%)	(2%)	(2%)	(2%)					
NRE		- 4.5	- 7.6	- 6.0	- 8.9		6.7	- 2.3	4.1	2.5
		(18%)	(19%)	(11%)	(12%)					
Nuclear										
Other Transformation	**- 2.3**	**- 38.0**	**- 60.1**	**- 63.1**	**- 64.8**	**13.7**	**5.9**	**0.5**	**0.3**	**1.9**
Coal	- 0.04	- 3.7	- 9.8	- 10.7	- 11.3	23.1	13.1	0.9	0.5	4.1
	(2%)	(10%)	(16%)	(17%)	(17%)					
Oil	- 1.1	- 12.1	- 15.3	- 19.4	- 24.9	11.7	3.0	2.4	2.5	2.6
	(47%)	(32%)	(25%)	(31%)	(38%)					
Gas	- 1.2	- 22.2	- 35.0	- 33.0	- 28.6	14.4	5.8	- 0.6	- 1.4	0.9
	(51%)	(59%)	(58%)	(52%)	(44%)					
NRE										
Electricity										
Heat										

INDONESIA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**47.8**	**112.0**	**142.2**	**189.7**	**246.7**	**3.9**	**3.0**	**2.9**	**2.7**	**2.9**
Coal	0.1	5.7	9.5	14.5	20.3	18.0	6.7	4.3	3.4	4.7
	(0%)	(5%)	(7%)	(8%)	(8%)					
Oil	17.2	46.9	60.9	82.4	109.9	4.7	3.3	3.1	2.9	3.1
	(36%)	(42%)	(43%)	(43%)	(45%)					
Gas	2.4	10.7	14.2	22.7	33.7	7.1	3.6	4.8	4.0	4.2
	(5%)	(10%)	(10%)	(12%)	(14%)					
NRE	27.8	41.2	45.3	51.2	56.3	1.8	1.2	1.2	1.0	1.1
	(58%)	(37%)	(32%)	(27%)	(23%)					
Electricity	0.4	7.5	12.2	18.9	26.4	14.9	6.3	4.5	3.4	4.6
	(1%)	(7%)	(9%)	(10%)	(11%)					
Heat										
Industry	**8.3**	**33.1**	**47.4**	**70.8**	**98.6**	**6.5**	**4.6**	**4.1**	**3.4**	**4.0**
Coal	0.1	5.7	9.5	14.5	20.3	18.6	6.7	4.3	3.4	4.7
	(2%)	(17%)	(20%)	(21%)	(21%)					
Oil	5.7	11.6	16.2	22.6	29.5	3.3	4.3	3.4	2.7	3.4
	(68%)	(35%)	(34%)	(32%)	(30%)					
Gas	2.4	10.6	14.1	22.5	33.5	7.1	3.6	4.8	4.0	4.2
	(28%)	(32%)	(30%)	(32%)	(34%)					
NRE		2.0	2.6	3.5	4.7		3.2	3.1	2.8	3.0
		(6%)	(5%)	(5%)	(5%)					
Electricity	0.2	3.2	5.0	7.7	10.7	14.8	5.9	4.3	3.4	4.4
	(2%)	(10%)	(11%)	(11%)	(11%)					
Heat										
Transport	**6.2**	**23.7**	**32.9**	**47.8**	**68.7**	**6.3**	**4.2**	**3.8**	**3.7**	**3.9**
Coal										
Oil	6.2	23.7	32.8	47.8	68.6	6.3	4.2	3.8	3.7	3.9
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas		0.03	0.04	0.1	0.1		1.5	3.6	4.1	3.2
		(0%)	(0%)	(0%)	(0%)					
NRE										
Electricity										
Residential	**33.3**	**52.5**	**57.9**	**65.1**	**70.9**	**2.1**	**1.2**	**1.2**	**0.9**	**1.1**
Coal										
Oil	5.3	10.5	10.5	10.4	9.9	3.2		- 0.2	- 0.4	- 0.2
	(16%)	(20%)	(18%)	(16%)	(14%)					
Gas		0.02	0.02	0.03	0.1		4.9	4.1	4.7	4.5
		(0%)	(0%)	(0%)	(0%)					
NRE	27.8	39.0	42.5	47.4	51.3	1.6	1.1	1.1	0.8	1.0
	(83%)	(74%)	(73%)	(73%)	(72%)					
Electricity	0.2	2.9	4.8	7.3	9.5	13.0	6.4	4.3	2.7	4.3
	(1%)	(6%)	(8%)	(11%)	(13%)					
Heat										
Commercial		**2.8**	**4.0**	**5.9**	**8.5**		**4.6**	**4.0**	**3.6**	**4.0**
Coal										
Oil[1]		1.2	1.4	1.6	1.9		2.2	1.8	1.2	1.7
		(41%)	(34%)	(28%)	(22%)					
Gas[1]		0.03	0.1	0.1	0.1		7.0	5.6	5.1	5.8
		(1%)	(1%)	(1%)	(2%)					
NRE[1]		0.2	0.2	0.3	0.3		1.3	1.0	1.0	1.1
		(8%)	(6%)	(5%)	(4%)					
Electricity[1]		1.4	2.3	3.9	6.2		6.7	5.3	4.6	5.5
		(50%)	(58%)	(66%)	(73%)					
Heat										

Note: 1 Historical data prior to 2002 are from national sources.

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	62	84	88	88	86
Net Energy Import Ratio (%)	-120	-55	-55	-26	0
Net Oil Import Dependency (%)	-276	-2	18	46	60

INDONESIA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**8**	**95**	**151**	**231**	**324**	**11.9**	**5.9**	**4.4**	**3.5**	**4.5**
Coal		30	69	118	159		10.8	5.5	3.0	6.1
		(32%)	(46%)	(51%)	(49%)					
Oil	6	16	16	7	7	4.7	0.2	-7.5	-0.8	-3.0
	(72%)	(17%)	(11%)	(3%)	(2%)					
Gas		34	45	83	127		3.6	6.3	4.4	4.8
		(35%)	(30%)	(36%)	(39%)					
Hydro	2	10	11	16	20	7.0	1.2	3.6	2.8	2.6
	(28%)	(10%)	(7%)	(7%)	(6%)					
NRE		5	9	8	11		7.6	-2.1	3.8	2.7
		(5%)	(6%)	(3%)	(3%)					
Nuclear										
Total Installed Generation Capacity (GW)	**3**	**28**	**41**	**81**	**108**	**11.5**	**4.8**	**7.0**	**2.9**	**4.9**
Thermal	2	24	35	71	95	11.4	5.0	7.3	3.0	5.1
	(85%)	(83%)	(85%)	(87%)	(88%)					
Coal		7	14	36	50		8.9	9.7	3.4	7.1
		(26%)	(35%)	(44%)	(46%)					
Oil	2	8	7	5	5	6.1	-0.8	-3.4		-1.5
	(84%)	(28%)	(18%)	(6%)	(5%)					
Gas		8	13	30	40		5.8	8.4	3.1	5.7
		(30%)	(32%)	(36%)	(37%)					
Hydro	0.4	4	4	7	9	10.5	0.9	6.6	2.1	3.3
	(15%)	(13%)	(9%)	(9%)	(8%)					
NRE		1	2	3	4		10.3	1.9	3.3	4.8
		(4%)	(6%)	(4%)	(4%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**205**	**213**	**201**	**160**	**128**	**0.2**	**- 0.7**	**- 2.2**	**- 2.2**	**- 1.8**
Industry (toe per US$ million GDP in Industry)	97	135	143	137	125	1.5	0.7	- 0.4	- 0.9	- 0.3
Commercial (toe per US$ million GDP in Services)		10	9	8	7		- 1.7	- 1.2	- 1.3	- 1.4
Energy Intensity (kgoe per capita)	**377**	**794**	**992**	**1 124**	**1 298**	**3.4**	**2.8**	**1.3**	**1.5**	**1.8**
Industry	56	156	204	275	357	4.8	3.4	3.0	2.6	3.0
Transport	42	112	141	186	249	4.6	2.9	2.8	3.0	2.9
Residential	224	248	248	253	256	0.5	0.0	0.2	0.2	0.1
Commercial		13	17	23	31		3.4	2.9	2.9	3.1
CO_2 Emissions (million tonnes)	**70.0**	**291.8**	**415.5**	**571.2**	**745.9**	**6.7**	**4.5**	**3.2**	**2.7**	**3.4**
Electricity Generation	6.8	62.2	108.3	159.4	203.4	10.6	7.2	3.9	2.5	4.3
Transformation other than Electricity Generation	5.1	41.6	54.0	55.4	56.0	10.0	3.3	0.3	0.1	1.1
Industry	23.5	82.0	119.1	177.7	246.5	5.8	4.8	4.1	3.3	4.0
Transport	18.4	70.4	97.7	141.9	203.7	6.3	4.2	3.8	3.7	3.9
Residential	15.8	32.0	32.1	31.6	30.3	3.3		- 0.2	- 0.4	- 0.2
Commercial	0.3	3.6	4.3	5.2	6.0	11.8	2.2	1.9	1.4	1.8
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	256.6	369.6	360.8	315.8	266.9	1.7	- 0.3	- 1.3	- 1.7	- 1.2
CO_2 emissions per capita (tonnes per capita)	0.5	1.4	1.8	2.2	2.7	5.0	3.3	2.2	2.0	2.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**65.0 - 83.6**	**147.6 - 184.4**	**218.8 - 274.4**
Coal Production & Transportation	6.2 - 8.1	8.7 - 11.4	10.5 - 14.0
Oil & Gas Production & Processing	17.3 - 25.6	26.8 - 39.2	38.2 - 55.7
Oil & Gas International Trade	11.9 - 12.8	15.5 - 16.9	17.6 - 19.3
Oil & Gas Domestic Pipeline	0.8 - 1.1	1.5 - 2.1	2.4 - 3.5
Electricity Generation & Transmission	28.8 - 36.0	95.1 - 114.8	150.0 - 182.1

JAPAN

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			2.4	7.9	72.6	7.4			90.3
Net Imports	95.4	254.4	66.6						416.4
TPED	**95.4**	**251.6**	**69.5**	**7.9**	**72.6**	**7.4**			**504.4**
Electricity and Heat Generation	- 48.8	- 25.2	- 48.8	- 7.9	- 72.6	- 4.2	86.1	0.5	- 120.9
Petroleum Refineries		- 12.2	- 0.1				- 0.7		- 13.0
Others	- 26.9	- 3.9	2.8				- 0.1		- 28.1
TFED	**21.4**	**210.8**	**24.1**			**3.2**	**84.7**	**0.5**	**344.8**
Industry	21.4	70.7	10.4			2.4	36.7		141.6
Transport		92.9					1.6		94.4
Residential		16.8	8.7			0.8	22.9		49.2
Commercial		30.5	5.0				23.5	0.5	59.6

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			1.5	8.2	85.0	10.2			104.9
Net Imports	105.2	253.0	75.4						433.5
TPED	**105.2**	**253.0**	**76.9**	**8.2**	**85.0**	**10.2**			**538.4**
Electricity and Heat Generation	- 59.8	- 12.5	- 49.1	- 8.2	- 85.0	- 6.9	91.9	0.6	- 129.1
Petroleum Refineries		- 11.7	- 0.1				- 0.7		- 12.5
Others	- 24.3	- 3.5	2.8				- 0.1		- 25.1
TFED	**21.1**	**225.2**	**30.5**			**3.2**	**91.1**	**0.6**	**371.7**
Industry	21.1	73.1	14.3			2.4	36.5		147.4
Transport		101.2					1.6		102.8
Residential		17.4	9.7			0.8	25.5		53.5
Commercial		33.5	6.5				27.5	0.6	68.1

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production				8.0	94.5	11.9			114.5
Net Imports	107.4	255.2	92.1						454.6
TPED	**107.4**	**255.2**	**92.1**	**8.0**	**94.5**	**11.9**			**569.1**
Electricity and Heat Generation	- 62.4	- 11.4	- 59.2	- 8.0	- 94.5	- 8.6	102.2	0.6	- 141.3
Petroleum Refineries		- 11.3	- 0.1				- 0.7		- 12.1
Others	- 24.2	- 3.5	2.9				- 0.1		- 24.9
TFED	**20.8**	**229.0**	**35.6**			**3.3**	**101.4**	**0.6**	**390.7**
Industry	20.8	70.9	16.6			2.5	41.7		152.4
Transport		103.5					1.5		104.9
Residential		17.4	11.1			0.8	26.9		56.2
Commercial		37.2	8.0				31.3	0.6	77.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production				8.2	108.1	13.3			129.5
Net Imports	107.6	247.7	100.9						456.2
TPED	**107.6**	**247.7**	**100.9**	**8.2**	**108.1**	**13.3**			**585.8**
Electricity and Heat Generation	- 63.2	- 10.6	- 64.2	- 8.2	- 108.1	- 9.9	110.9	0.7	- 152.6
Petroleum Refineries		- 10.4	- 0.1				- 0.6		- 11.1
Others	- 23.9	- 3.5	2.9				- 0.1		- 24.6
TFED	**20.5**	**223.2**	**39.5**			**3.3**	**110.2**	**0.7**	**397.5**
Industry	20.5	68.2	18.7			2.6	46.5		156.6
Transport		102.9					1.5		104.4
Residential		17.0	12.3			0.8	26.8		56.9
Commercial		35.2	8.4				35.4	0.7	79.6

JAPAN

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	1 912	3 275	3 806	4 424	4 975	2.5	1.9	1.5	1.2	1.5
Population (million)	117	127	128	125	120	0.4	0.1	-0.3	-0.4	-0.2
GDP per capita (2000 PPP US$)	16 377	25 717	29 736	35 457	41 487	2.1	1.8	1.8	1.6	1.7
GDP in Services (2000 PPP US$ billion)	1 231	2 428	2 840	3 340	3 892	3.1	2.0	1.6	1.5	1.7
GDP in Industry (2000 PPP US$ billion)	620	1 010	1 131	1 317	1 538	2.2	1.4	1.5	1.6	1.5
Urbanisation level (%)	60	65	67	69	73	0.4	0.2	0.4	0.5	0.4

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**43.2**	**90.3**	**104.9**	**114.5**	**129.5**	**3.4**	**1.9**	**0.9**	**1.2**	**1.3**
Coal	10.9									
	(25%)									
Oil										
Gas	1.9	2.4	1.5			1.0	- 5.8			
	(4%)	(3%)	(1%)							
Hydro	7.6	7.9	8.2	8.0	8.2	0.2	0.4	- 0.2	0.1	0.1
	(18%)	(9%)	(8%)	(7%)	(6%)					
NRE	0.8	7.4	10.2	11.9	13.3	10.7	4.0	1.6	1.1	2.1
	(2%)	(8%)	(10%)	(10%)	(10%)					
Nuclear	21.5	72.6	85.0	94.5	108.1	5.7	2.0	1.1	1.4	1.4
	(50%)	(80%)	(81%)	(83%)	(83%)					
Net Imports	**318.8**	**416.4**	**433.5**	**454.6**	**456.2**	**1.2**	**0.5**	**0.5**	**0.04**	**0.3**
Coal	47.5	95.4	105.2	107.4	107.6	3.2	1.2	0.2	0.02	0.4
Oil	251.7	254.4	253.0	255.2	247.7		- 0.1	0.1	- 0.3	- 0.1
Gas	19.5	66.6	75.4	92.1	100.9	5.7	1.6	2.0	0.9	1.5
Electricity										
Total Primary Energy Demand	**346.5**	**504.4**	**538.4**	**569.1**	**585.8**	**1.7**	**0.8**	**0.6**	**0.3**	**0.5**
Coal	59.6	95.4	105.2	107.4	107.6	2.2	1.2	0.2	0.02	0.4
	(17%)	(19%)	(20%)	(19%)	(18%)					
Oil	235.6	251.6	253.0	255.2	247.7	0.3	0.1	0.1	- 0.3	- 0.1
	(68%)	(50%)	(47%)	(45%)	(42%)					
Gas	21.4	69.5	76.9	92.1	100.9	5.5	1.3	1.8	0.9	1.3
	(6%)	(14%)	(14%)	(16%)	(17%)					
Hydro	7.6	7.9	8.2	8.0	8.2	0.2	0.4	- 0.2	0.1	0.1
	(2%)	(2%)	(2%)	(1%)	(1%)					
NRE	0.8	7.4	10.2	11.9	13.3	10.7	4.0	1.6	1.1	2.1
	(0%)	(1%)	(2%)	(2%)	(2%)					
Nuclear	21.5	72.6	85.0	94.5	108.1	5.7	2.0	1.1	1.4	1.4
	(6%)	(14%)	(16%)	(17%)	(18%)					
Input for Electricity and Heat Generation	**- 116.3**	**- 207.6**	**- 221.5**	**- 244.1**	**- 264.2**	**2.7**	**0.8**	**1.0**	**0.8**	**0.9**
Coal	- 10.5	- 48.8	- 59.8	- 62.4	- 63.2	7.2	2.6	0.4	0.1	0.9
	(9%)	(23%)	(27%)	(26%)	(24%)					
Oil	- 60.3	- 25.2	- 12.5	- 11.4	- 10.6	- 3.9	- 8.4	- 1.0	- 0.7	- 3.1
	(52%)	(12%)	(6%)	(5%)	(4%)					
Gas	- 15.6	- 48.8	- 49.1	- 59.2	- 64.2	5.3	0.1	1.9	0.8	1.0
	(13%)	(24%)	(22%)	(24%)	(24%)					
Hydro	- 7.6	- 7.9	- 8.2	- 8.0	- 8.2	0.2	0.4	- 0.2	0.1	0.1
	(7%)	(4%)	(4%)	(3%)	(3%)					
NRE	- 0.8	- 4.2	- 6.9	- 8.6	- 9.9	8.0	6.4	2.2	1.4	3.1
	(1%)	(2%)	(3%)	(4%)	(4%)					
Nuclear	- 21.5	- 72.6	- 85.0	- 94.5	- 108.1	5.7	2.0	1.1	1.4	1.4
	(19%)	(35%)	(38%)	(39%)	(41%)					
Other Transformation	**- 17.8**	**- 41.1**	**- 37.6**	**- 37.0**	**- 35.7**	**3.9**	**- 1.1**	**- 0.2**	**- 0.4**	**- 0.5**
Coal	- 2.4	- 26.9	- 24.3	- 24.2	- 23.9	11.6	- 1.3	- 0.04	- 0.1	- 0.4
	(14%)	(65%)	(65%)	(65%)	(67%)					
Oil	- 14.1	- 16.1	- 15.2	- 14.8	- 13.9	0.6	- 0.7	- 0.3	- 0.6	- 0.5
	(79%)	(39%)	(41%)	(40%)	(39%)					
Gas	- 0.5	2.7	2.7	2.8	2.8		0.1	0.1	0.1	0.1
	(3%)	-(7%)	-(7%)	-(7%)	-(8%)					
NRE										
Electricity	- 0.8	- 0.8	- 0.8	- 0.7	- 0.7	0.04	- 0.5	- 0.4	- 0.9	- 0.6
	(5%)	(2%)	(2%)	(2%)	(2%)					
Heat										

JAPAN

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**215.8**	**344.8**	**371.7**	**390.7**	**397.5**	**2.2**	**0.9**	**0.5**	**0.2**	**0.5**
Coal	21.4	21.4	21.1	20.8	20.5		- 0.2	- 0.2	- 0.1	- 0.1
	(10%)	(6%)	(6%)	(5%)	(5%)					
Oil	140.5	210.8	225.2	229.0	223.2	1.9	0.8	0.2	- 0.3	0.2
	(65%)	(61%)	(61%)	(59%)	(56%)					
Gas	9.7	24.1	30.5	35.6	39.5	4.2	3.0	1.6	1.0	1.8
	(4%)	(7%)	(8%)	(9%)	(10%)					
NRE		3.2	3.2	3.3	3.3		- 0.1	0.2	0.2	0.1
		(1%)	(1%)	(1%)	(1%)					
Electricity	44.1	84.7	91.1	101.4	110.2	3.0	0.9	1.1	0.8	0.9
	(20%)	(25%)	(25%)	(26%)	(28%)					
Heat	0.1	0.5	0.6	0.6	0.7	7.9	1.1	0.9	0.9	1.0
	(0%)	(0%)	(0%)	(0%)	(0%)					
Industry	**114.2**	**141.6**	**147.4**	**152.4**	**156.6**	**1.0**	**0.5**	**0.3**	**0.3**	**0.4**
Coal	20.8	21.4	21.1	20.8	20.5	0.1	- 0.2	- 0.2	- 0.1	- 0.1
	(18%)	(15%)	(14%)	(14%)	(13%)					
Oil	62.3	70.7	73.1	70.9	68.2	0.6	0.4	- 0.3	- 0.4	- 0.1
	(55%)	(50%)	(50%)	(46%)	(44%)					
Gas	2.7	10.4	14.3	16.6	18.7	6.3	4.1	1.5	1.2	2.1
	(2%)	(7%)	(10%)	(11%)	(12%)					
NRE		2.4	2.4	2.5	2.6		- 0.1	0.3	0.3	0.2
		(2%)	(2%)	(2%)	(2%)					
Electricity	28.3	36.7	36.5	41.7	46.5	1.2	- 0.1	1.4	1.1	0.9
	(25%)	(26%)	(25%)	(27%)	(30%)					
Heat										
Transport	**55.4**	**94.4**	**102.8**	**104.9**	**104.4**	**2.5**	**1.1**	**0.2**	**- 0.1**	**0.4**
Coal										
Oil	54.1	92.9	101.2	103.5	102.9	2.5	1.1	0.2	- 0.1	0.4
	(98%)	(98%)	(98%)	(99%)	(99%)					
Gas										
NRE										
Electricity	1.3	1.6	1.6	1.5	1.5	0.9	- 0.3	- 0.5	- 0.02	- 0.3
	(2%)	(2%)	(2%)	(1%)	(1%)					
Residential	**25.9**	**49.2**	**53.5**	**56.2**	**56.9**	**3.0**	**1.0**	**0.5**	**0.1**	**0.5**
Coal	0.6									
	(2%)									
Oil	9.8	16.8	17.4	17.4	17.0	2.5	0.4	0.02	- 0.3	0.03
	(38%)	(34%)	(33%)	(31%)	(30%)					
Gas	5.5	8.7	9.7	11.1	12.3	2.1	1.4	1.3	1.1	1.3
	(21%)	(18%)	(18%)	(20%)	(22%)					
NRE		0.8	0.8	0.8	0.8					
		(2%)	(1%)	(1%)	(1%)					
Electricity	10.0	22.9	25.5	26.9	26.8	3.8	1.4	0.5	- 0.02	0.6
	(39%)	(46%)	(48%)	(48%)	(47%)					
Heat										
Commercial	**20.4**	**59.6**	**68.1**	**77.2**	**79.6**	**5.0**	**1.7**	**1.3**	**0.3**	**1.0**
Coal										
Oil	14.3	30.5	33.5	37.2	35.2	3.5	1.2	1.1	- 0.6	0.5
	(70%)	(51%)	(49%)	(48%)	(44%)					
Gas	1.4	5.0	6.5	8.0	8.4	5.9	3.3	2.1	0.5	1.8
	(7%)	(8%)	(10%)	(10%)	(11%)					
NRE										
Electricity	4.6	23.5	27.5	31.3	35.4	7.8	2.0	1.3	1.2	1.5
	(22%)	(39%)	(40%)	(41%)	(44%)					
Heat	0.1	0.5	0.6	0.6	0.7	7.6	1.2	1.0	0.9	1.0
	(1%)	(1%)	(1%)	(1%)	(1%)					

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	53	78	81	83	86
Net Energy Import Ratio (%)	88	82	81	80	78
Net Oil Import Dependency (%)	100	100	100	100	100

JAPAN

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**573**	**1 024**	**1 090**	**1 210**	**1 312**	**2.7**	**0.8**	**1.0**	**0.8**	**0.9**
Coal	55	233	289	306	314	6.8	2.7	0.6	0.3	1.1
	(10%)	(23%)	(26%)	(25%)	(24%)					
Oil	265	132	66	61	58	-3.1	-8.2	-0.8	-0.5	-2.9
	(46%)	(13%)	(6%)	(5%)	(4%)					
Gas	81	262	267	329	363	5.5	0.3	2.1	1.0	1.2
	(14%)	(26%)	(25%)	(27%)	(28%)					
Hydro	88	92	95	94	95	0.2	0.4	-0.2	0.1	0.1
	(15%)	(9%)	(9%)	(8%)	(7%)					
NRE	1	10	27	36	41	11.5	13.2	3.0	1.3	5.2
		(1%)	(2%)	(3%)	(3%)					
Nuclear	83	296	346	385	440	6.0	2.0	1.1	1.4	1.4
	(14%)	(29%)	(32%)	(32%)	(34%)					
Total Installed Generation Capacity (GW)	**144**	**243**	**259**	**283**	**297**	**2.4**	**0.8**	**0.9**	**0.5**	**0.7**
Thermal	98	147	153	171	179	1.9	0.4	1.1	0.5	0.7
	(68%)	(61%)	(59%)	(60%)	(60%)					
Coal	5	36	39	44	48	9.1	1.2	1.2	0.8	1.1
	(4%)	(15%)	(15%)	(16%)	(16%)					
Oil	60	54	51	48	45	-0.5	-0.6	-0.6	-0.7	-0.6
	(42%)	(22%)	(20%)	(17%)	(15%)					
Gas	20	58	62	78	86	5.0	0.8	2.4	1.0	1.4
	(14%)	(24%)	(24%)	(28%)	(29%)					
Hydro	30	47	48	48	48	2.0	0.4			0.1
	(21%)	(19%)	(19%)	(17%)	(16%)					
NRE		3	8	11	12	16.5	13.7	3.0	1.0	5.2
		(1%)	(3%)	(4%)	(4%)					
Nuclear	16	46	50	54	58	5.0	1.1	0.7	0.7	0.8
	(11%)	(19%)	(19%)	(19%)	(20%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**181**	**154**	**141**	**129**	**118**	**- 0.7**	**- 1.1**	**- 0.9**	**- 0.9**	**- 1.0**
Industry (toe per US$ million GDP in Industry)	184	140	130	116	102	- 1.2	- 0.9	- 1.2	- 1.3	- 1.1
Commercial (toe per US$ million GDP in Services)	17	25	24	23	20	1.8	- 0.3	- 0.4	- 1.2	- 0.6
Energy Intensity (kgoe per capita)	**2 967**	**3 961**	**4 206**	**4 561**	**4 885**	**1.3**	**0.8**	**0.8**	**0.7**	**0.8**
Industry	978	1 112	1 151	1 222	1 306	0.6	0.4	0.6	0.7	0.6
Transport	475	742	803	841	870	2.0	1.0	0.5	0.3	0.6
Residential	221	386	418	450	475	2.6	1.0	0.8	0.5	0.7
Commercial	174	468	532	619	664	4.6	1.6	1.5	0.7	1.3
CO_2 Emissions (million tonnes)	**786**	**1 186**	**1 245**	**1 296**	**1 294**	**1.9**	**0.6**	**0.4**	**- 0.02**	**0.3**
Electricity Generation	237	380	385	415	427	2.2	0.2	0.8	0.3	0.4
Transformation other than Electricity Generation	44	33	31	30	27	- 1.4	- 0.6	- 0.5	- 1.0	- 0.7
Industry	255	322	337	335	331	1.1	0.6	- 0.1	- 0.1	0.1
Transport	160	275	299	306	302	2.5	1.1	0.2	- 0.1	0.3
Residential	43	72	76	79	80	2.3	0.7	0.4	0.2	0.4
Commercial	45	104	117	132	127	3.9	1.4	1.2	- 0.4	0.7
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	411	362	327	293	260	- 0.6	- 1.3	- 1.1	- 1.2	- 1.2
CO_2 emissions per capita (tonnes per capita)	6.7	9.3	9.7	10.4	10.8	1.5	0.6	0.7	0.4	0.5

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**38.6 - 45.9**	**82.5 - 100.0**	**116.5 - 141.8**
Coal Production & Transportation			
Oil & Gas Production & Processing	0.67 - 0.96	1.29 - 1.85	1.29 - 1.85
Oil & Gas International Trade	4.00 - 4.28	6.04 - 7.04	7.02 - 8.26
Oil & Gas Domestic Pipeline	0.20 - 0.28	0.60 - 0.85	0.83 - 1.18
Electricity Generation & Transmission	33.7 - 40.4	74.6 - 90.3	107.3 - 130.5

KOREA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production				1.2	25.7	5.1			31.9
Net Imports	35.1	106.4	27.8						169.3
TPED	**34.5**	**105.8**	**27.4**	**1.2**	**25.7**	**5.1**			**199.7**
Electricity and Heat Generation	- 20.1	- 5.9	- 14.6	- 1.2	- 25.7	- 4.8	25.3	3.2	- 43.7
Petroleum Refineries		- 16.5	- 0.3						- 16.7
Others	- 5.9	- 0.6				- 0.1			- 6.6
TFED	**8.6**	**83.7**	**13.1**			**0.1**	**25.3**	**3.2**	**134.1**
Industry	8.1	39.2	3.4				13.5	2.0	66.2
Transport		32.8	0.1				0.2		33.1
Residential	0.6	4.4	7.9			0.1	3.6	1.1	17.6
Commercial		7.3	1.7			0.1	7.9	0.1	17.2

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			0.4	1.7	31.7	9.4			43.1
Net Imports	44.4	110.3	43.5						198.2
TPED	**44.4**	**110.3**	**43.9**	**1.7**	**31.7**	**9.4**			**241.3**
Electricity and Heat Generation	- 32.9	- 5.3	- 22.4	- 1.7	- 31.7	- 9.2	37.2	5.6	- 60.4
Petroleum Refineries		- 5.0	- 0.3						- 5.3
Others		- 0.6							- 0.6
TFED	**11.5**	**99.4**	**21.1**			**0.2**	**37.2**	**5.6**	**175.1**
Industry	11.4	43.2	6.6				19.2	3.5	83.9
Transport		45.8	0.1				0.3		46.3
Residential	0.1	3.4	11.4			0.1	5.2	1.9	22.2
Commercial		6.9	3.0			0.1	12.5	0.2	22.7

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production				1.6	49.6	13.3			64.6
Net Imports	53.8	125.0	60.2						238.9
TPED	**53.8**	**125.0**	**60.2**	**1.6**	**49.6**	**13.3**			**303.5**
Electricity and Heat Generation	- 39.2	- 4.3	- 30.2	- 1.6	- 49.6	- 13.0	50.3	7.4	- 80.4
Petroleum Refineries		- 4.7	- 0.3						- 5.1
Others		- 0.1							- 0.1
TFED	**14.5**	**115.8**	**29.6**			**0.3**	**50.3**	**7.4**	**218.0**
Industry	14.5	50.5	10.8				26.3	4.8	106.9
Transport		55.5	0.3				0.5		56.2
Residential		3.2	14.1			0.2	5.9	2.3	25.8
Commercial		6.7	4.5			0.1	17.6	0.3	29.1

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production				1.9	62.4	16.1			80.3
Net Imports	62.8	135.6	72.9						271.3
TPED	**62.8**	**135.6**	**72.9**	**1.9**	**62.4**	**16.1**			**351.7**
Electricity and Heat Generation	- 45.8	- 4.7	- 35.7	- 1.9	- 62.4	- 15.7	61.1	8.9	- 96.1
Petroleum Refineries		- 4.9	- 0.3						- 5.2
Others		- 0.1							- 0.1
TFED	**16.9**	**125.9**	**36.9**			**0.4**	**61.1**	**8.9**	**250.2**
Industry	16.9	54.7	14.2				32.6	5.9	124.3
Transport		61.8	0.4				0.6		62.7
Residential		3.0	16.4			0.3	6.3	2.7	28.7
Commercial		6.5	5.9			0.1	21.6	0.4	34.4

KOREA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	149	662	982	1 393	1 786	7.0	5.0	3.6	2.5	3.6
Population (million)	38.5	47.8	49.7	50.7	50.3	1.0	0.5	0.2	- 0.1	0.2
GDP per capita (2000 PPP US$)	3 856	13 862	19 781	27 489	35 463	6.0	4.5	3.3	2.6	3.4
GDP in Services (2000 PPP US$ billion)	70	329	447	630	813	7.3	3.9	3.5	2.6	3.3
GDP in Industry (2000 PPP US$ billion)	39	242	389	575	760	8.6	6.1	4.0	2.8	4.2
Urbanisation level (%)	57	80	82	84	86	1.6	0.3	0.3	0.2	0.3

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**9.3**	**31.9**	**43.1**	**64.6**	**80.3**	**5.8**	**3.8**	**4.1**	**2.2**	**3.3**
Coal	8.2									
	(88%)									
Oil										
Gas										
Hydro	0.2	1.2	1.7	1.6	1.9	9.1	4.7	- 0.4	1.4	1.7
	(0%)	(4%)	(4%)	(3%)	(2%)					
NRE		5.1	9.4	13.3	16.1		8.0	3.6	1.9	4.2
		(16%)	(22%)	(21%)	(20%)					
Nuclear	0.9	25.7	31.7	49.6	62.4	16.4	2.6	4.6	2.3	3.2
	(10%)	(81%)	(73%)	(77%)	(78%)					
Net Imports	**30.7**	**169.3**	**198.2**	**238.9**	**271.3**	**8.1**	**2.0**	**1.9**	**1.3**	**1.7**
Coal	3.5	35.1	44.4	53.8	62.8	11.1	3.0	1.9	1.6	2.1
Oil	27.2	106.4	110.3	125.0	135.6	6.4	0.4	1.3	0.8	0.9
Gas		27.8	43.5	60.2	72.9		5.8	3.3	1.9	3.5
Electricity										
Total Primary Energy Demand	**41.4**	**199.7**	**241.3**	**303.5**	**351.7**	**7.4**	**2.4**	**2.3**	**1.5**	**2.0**
Coal	13.5	34.5	44.4	53.8	62.8	4.4	3.2	1.9	1.6	2.2
	(33%)	(17%)	(18%)	(18%)	(18%)					
Oil	26.8	105.8	110.3	125.0	135.6	6.4	0.5	1.3	0.8	0.9
	(65%)	(53%)	(46%)	(41%)	(39%)					
Gas		27.4	43.9	60.2	72.9		6.1	3.2	1.9	3.6
		(14%)	(18%)	(20%)	(21%)					
Hydro	0.2	1.2	1.7	1.6	1.9	9.1	4.7	- 0.4	1.4	1.7
	(0%)	(1%)	(1%)	(1%)	(1%)					
NRE		5.1	9.4	13.3	16.1		8.0	3.6	1.9	4.2
		(3%)	(4%)	(4%)	(5%)					
Nuclear	0.9	25.7	31.7	49.6	62.4	16.4	2.6	4.6	2.3	3.2
	(2%)	(13%)	(13%)	(16%)	(18%)					
Input for Electricity and Heat Generation	**- 8.4**	**- 72.2**	**- 103.2**	**- 138.1**	**- 166.1**	**10.3**	**4.6**	**3.0**	**1.9**	**3.0**
Coal	- 0.8	- 20.1	- 32.9	- 39.2	- 45.8	15.5	6.4	1.8	1.6	3.0
	(10%)	(28%)	(32%)	(28%)	(28%)					
Oil	- 6.4	- 5.9	- 5.3	- 4.3	- 4.7	- 0.4	- 1.3	- 2.0	0.8	- 0.8
	(77%)	(8%)	(5%)	(3%)	(3%)					
Gas		- 14.6	- 22.4	- 30.2	- 35.7		5.5	3.0	1.7	3.2
		(20%)	(22%)	(22%)	(21%)					
Hydro	- 0.2	- 1.2	- 1.7	- 1.6	- 1.9	9.1	4.7	- 0.4	1.4	1.7
	(2%)	(2%)	(2%)	(1%)	(1%)					
NRE		- 4.8	- 9.2	- 13.0	- 15.7		8.4	3.6	1.9	4.3
		(7%)	(9%)	(9%)	(9%)					
Nuclear	- 0.9	- 25.7	- 31.7	- 49.6	- 62.4	16.4	2.6	4.6	2.3	3.2
	(11%)	(36%)	(31%)	(36%)	(38%)					
Other Transformation	**- 1.4**	**- 23.3**	**- 5.9**	**- 5.2**	**- 5.4**	**13.7**	**- 15.8**	**- 1.3**	**0.4**	**- 5.1**
Coal	- 1.0	- 5.9				8.5				
	(70%)	(25%)								
Oil	- 0.4	- 17.0	- 5.6	- 4.8	- 5.0	18.4	- 13.0	- 1.4	0.4	- 4.3
	(30%)	(73%)	(95%)	(94%)	(94%)					
Gas		- 0.3	- 0.3	- 0.3	- 0.3		1.4	0.8	0.3	0.8
		(1%)	(5%)	(6%)	(6%)					
NRE		- 0.1								
		(1%)								
Electricity										
Heat										

KOREA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**27.2**	**134.1**	**175.1**	**218.0**	**250.2**	**7.5**	**3.4**	**2.2**	**1.4**	**2.3**
Coal	9.7	8.6	11.5	14.5	16.9	- 0.6	3.7	2.4	1.6	2.4
	(36%)	(6%)	(7%)	(7%)	(7%)					
Oil	14.6	83.7	99.4	115.8	125.9	8.3	2.2	1.5	0.8	1.5
	(54%)	(62%)	(57%)	(53%)	(50%)					
Gas	13.1	21.1	29.6	36.9		6.2	3.4	2.2	3.8	
	(10%)	(12%)	(14%)	(15%)						
NRE	0.1	0.2	0.3	0.4		6.0	3.5	2.6	3.9	
	(0%)	(0%)	(0%)	(0%)						
Electricity	2.8	25.3	37.2	50.3	61.1	10.5	4.9	3.1	2.0	3.2
	(10%)	(19%)	(21%)	(23%)	(24%)					
Heat	3.2	5.6	7.4	8.9		7.0	2.9	1.8	3.7	
	(2%)	(3%)	(3%)	(4%)						
Industry	**13.3**	**66.2**	**83.9**	**106.9**	**124.3**	**7.6**	**3.0**	**2.5**	**1.5**	**2.3**
Coal	1.3	8.1	11.4	14.5	16.9	8.5	4.4	2.5	1.6	2.7
	(10%)	(12%)	(14%)	(14%)	(14%)					
Oil	9.9	39.2	43.2	50.5	54.7	6.4	1.2	1.6	0.8	1.2
	(75%)	(59%)	(52%)	(47%)	(44%)					
Gas	3.4	6.6	10.8	14.2		8.6	5.0	2.8	5.2	
	(5%)	(8%)	(10%)	(11%)						
NRE						14.7	5.2	7.2	8.6	
Electricity	2.0	13.5	19.2	26.3	32.6	9.1	4.5	3.2	2.2	3.2
	(15%)	(20%)	(23%)	(25%)	(26%)					
Heat	2.0	3.5	4.8	5.9		7.5	3.2	2.0	4.0	
	(3%)	(4%)	(5%)	(5%)						
Transport	**2.1**	**33.1**	**46.3**	**56.2**	**62.7**	**13.3**	**4.3**	**2.0**	**1.1**	**2.3**
Coal										
Oil	2.1	32.8	45.8	55.5	61.8	13.3	4.3	1.9	1.1	2.3
	(98%)	(99%)	(99%)	(99%)	(98%)					
Gas	0.1	0.1	0.3	0.4		9.1	5.7	5.0	6.4	
	(0%)	(0%)	(0%)	(1%)						
NRE										
Electricity	0.2	0.3	0.5	0.6	8.7	5.5	3.7	2.2	3.7	
	(1%)	(1%)	(1%)	(1%)						
Residential	**9.2**	**17.6**	**22.2**	**25.8**	**28.7**	**3.0**	**2.9**	**1.5**	**1.1**	**1.8**
Coal	8.3	0.6	0.1	0.02	0.002	-11.6	- 17.0	- 18.1	-19.3	- 18.2
	(90%)	(3%)	(1%)							
Oil	0.5	4.4	3.4	3.2	3.0	10.6	- 3.0	- 0.7	- 0.5	- 1.3
	(5%)	(25%)	(15%)	(12%)	(11%)					
Gas	7.9	11.4	14.1	16.4		4.7	2.2	1.5	2.7	
	(45%)	(51%)	(55%)	(57%)						
NRE	0.1	0.1	0.2	0.3		8.0	3.8	2.7	4.6	
	(0%)	(1%)	(1%)	(1%)						
Electricity	0.5	3.6	5.2	5.9	6.3	9.9	4.7	1.3	0.6	2.0
	(5%)	(21%)	(24%)	(23%)	(22%)					
Heat	1.1	1.9	2.3	2.7		6.5	2.2	1.5	3.1	
	(6%)	(8%)	(9%)	(9%)						
Commercial	**2.6**	**17.2**	**22.7**	**29.1**	**34.4**	**9.0**	**3.6**	**2.5**	**1.7**	**2.5**
Coal	0.1									
	(4%)									
Oil	2.1	7.3	6.9	6.7	6.5	5.8	- 0.7	- 0.4	- 0.4	- 0.5
	(82%)	(43%)	(31%)	(23%)	(19%)					
Gas	1.7	3.0	4.5	5.9		7.6	4.0	2.8	4.6	
	(10%)	(13%)	(15%)	(17%)						
NRE	0.1	0.1	0.1	0.1		3.0	2.9	2.3	2.7	
	(0%)	(0%)	(0%)	(0%)						
Electricity	0.4	7.9	12.5	17.6	21.6	15.2	5.8	3.5	2.1	3.6
	(14%)	(46%)	(55%)	(60%)	(63%)					
Heat	0.1	0.2	0.3	0.4		3.9	3.5	2.6	3.3	
	(1%)	(1%)	(1%)	(1%)						

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	50	74	83	87	89
Net Energy Import Ratio (%)	77	84	82	79	77
Net Oil Import Dependency (%)	100	100	100	100	100

KOREA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**37**	**330**	**456**	**612**	**733**	**10.4**	**4.1**	**3.0**	**1.8**	**2.9**
Coal	2	134	201	243	284	19.9	5.2	1.9	1.6	2.7
	(7%)	(41%)	(44%)	(40%)	(39%)					
Oil	29	32	20	10	10	0.3	-5.8	-6.2	-0.3	-4.0
	(79%)	(10%)	(4%)	(2%)	(1%)					
Gas		42	63	91	114		5.3	3.8	2.2	3.6
		(13%)	(14%)	(15%)	(16%)					
Hydro	2	3	18	15	13	2.2	24.0	-1.9	-1.4	5.1
	(5%)	(1%)	(4%)	(2%)	(2%)					
NRE			11	25	30			8.1	1.7	
			(3%)	(4%)	(4%)					
Nuclear	3	119	144	227	283	17.4	2.4	4.7	2.2	3.1
	(9%)	(36%)	(31%)	(37%)	(39%)					
Total Installed Generation Capacity (GW)	**9**	**55**	**92**	**118**	**153**	**8.3**	**6.6**	**2.5**	**2.6**	**3.7**
Thermal	8	35	60	71	92	7.2	6.9	1.7	2.6	3.5
	(81%)	(64%)	(65%)	(61%)	(60%)					
Coal	2	17	32	39	49	10.2	8.3	1.9	2.4	3.9
	(21%)	(31%)	(35%)	(33%)	(32%)					
Oil	6	5	5	4	5	-0.8	0.7	-3.1	3.0	0.1
	(59%)	(8%)	(5%)	(3%)	(3%)					
Gas		14	23	29	38		6.8	2.3	2.7	3.7
		(25%)	(25%)	(25%)	(25%)					
Hydro	1	4	6	7	10	5.5	6.2	1.3	3.4	3.4
	(13%)	(7%)	(7%)	(6%)	(7%)					
NRE			5	10	11			7.8	1.3	
			(5%)	(8%)	(7%)					
Nuclear	1	16	21	29	40	16.0	3.5	3.6	3.0	3.4
	(6%)	(29%)	(23%)	(25%)	(26%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**279**	**301**	**246**	**218**	**197**	**0.4**	**- 2.5**	**- 1.2**	**- 1.0**	**- 1.5**
Industry (toe per US$ million GDP in Industry)	336	273	215	186	164	- 0.9	- 2.9	- 1.5	- 1.3	- 1.8
Commercial (toe per US$ million GDP in Services)	36	52	51	46	42	1.6	- 0.3	- 0.9	- 0.9	- 0.7
Energy Intensity (kgoe per capita)	**1 074**	**4 179**	**4 861**	**5 990**	**6 985**	**6.4**	**1.9**	**2.1**	**1.5**	**1.9**
Industry	344	1 385	1 690	2 109	2 469	6.5	2.5	2.2	1.6	2.1
Transport	55	692	932	1 109	1 246	12.2	3.8	1.8	1.2	2.1
Residential	240	369	446	510	570	2.0	2.4	1.3	1.1	1.6
Commercial	66	359	457	575	684	8.0	3.1	2.3	1.8	2.3
CO_2 Emissions (million tonnes)	**111**	**480**	**608**	**715**	**811**	**6.9**	**3.0**	**1.6**	**1.3**	**1.9**
Electricity Generation	24	152	202	228	268	8.8	3.6	1.2	1.6	2.1
Transformation other than Electricity Generation	9	12	12	12	11	1.0	- 0.1	- 0.2	- 0.2	- 0.2
Industry	31	158	191	235	265	7.7	2.4	2.1	1.2	1.9
Transport	6	98	138	167	186	13.4	4.3	1.9	1.1	2.3
Residential	34	34	37	43	48		1.3	1.4	1.1	1.2
Commercial	7	26	28	31	34	6.4	0.9	0.9	0.8	0.9
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	746	725	619	513	454	- 0.1	- 2.0	- 1.9	- 1.2	- 1.7
CO_2 emissions per capita (tonnes per capita)	2.9	10.1	12.2	14.1	16.1	5.9	2.5	1.4	1.3	1.7

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**76.2 - 91.2**	**152.8 - 185.6**	**227.3 - 276.2**
Coal Production & Transportation			
Oil & Gas Production & Processing	4.76 - 6.81	10.68 - 15.35	14.97 - 21.54
Oil & Gas International Trade	9.80 - 10.31	20.35 - 21.93	26.69 - 29.26
Oil & Gas Domestic Pipeline	1.44 - 2.06	2.90 - 4.14	4.03 - 5.76
Electricity Generation & Transmission	60.24 - 72.05	118.85 - 144.15	181.63 - 219.68

MALAYSIA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.2	39.5	44.2	0.7		1.5			86.1
Net Imports	2.4	- 14.1	- 19.5						- 31.2
TPED	**2.5**	**26.3**	**24.7**	**0.7**		**1.5**			**55.8**
Electricity and Heat Generation	- 1.3	- 1.6	- 12.5	- 0.7			5.9		- 10.2
Petroleum Refineries		- 3.7							- 3.7
Others	- 0.2	- 0.7	- 6.9						- 7.8
TFED	**1.1**	**20.0**	**5.1**			**1.5**	**5.9**		**33.6**
Industry	1.1	5.1	5.0			0.1	3.1		14.3
Transport		13.4							13.4
Residential		0.7				1.4	1.2		3.3
Commercial		0.8					1.7		2.5

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.3	41.3	58.3	0.7		1.9			102.5
Net Imports	12.3	- 9.5	- 26.6						- 23.8
TPED	**12.6**	**31.8**	**31.7**	**0.7**		**1.9**			**78.7**
Electricity and Heat Generation	- 11.1	- 0.3	- 13.8	- 0.7		- 0.2	9.0		- 17.1
Petroleum Refineries		- 3.7							- 3.7
Others		- 0.7	- 9.1						- 9.8
TFED	**1.6**	**27.1**	**8.8**			**1.6**	**9.0**		**48.1**
Industry	1.6	6.3	8.7			0.1	4.9		21.5
Transport		18.9	0.1						19.0
Residential		0.8				1.6	1.9		4.3
Commercial		1.1					2.1		3.2

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.3	41.1	58.3	0.9		2.2			102.9
Net Imports	22.1	1.0	- 16.5						6.6
TPED	**22.4**	**42.1**	**41.9**	**0.9**		**2.2**			**109.5**
Electricity and Heat Generation	- 20.0	- 0.3	- 18.5	- 0.9		- 0.4	14.3		- 25.9
Petroleum Refineries		- 3.3							- 3.3
Others		- 0.7	- 9.1						- 9.8
TFED	**2.4**	**37.9**	**14.2**			**1.8**	**14.3**		**70.6**
Industry	2.4	7.8	13.9			0.1	8.4		32.6
Transport		27.6	0.2						27.8
Residential		1.1				1.7	3.1		5.9
Commercial		1.3	0.1				2.8		4.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	0.4	37.4	58.3	1.0		2.5			99.6
Net Imports	33.4	17.6	- 3.9						47.0
TPED	**33.7**	**55.0**	**54.4**	**1.0**		**2.5**			**146.7**
Electricity and Heat Generation	- 30.4	- 0.2	- 25.0	- 1.0		- 0.5	21.4		- 35.6
Petroleum Refineries		- 2.6							- 2.6
Others		- 0.6	- 9.1						- 9.7
TFED	**3.4**	**51.6**	**20.4**			**2.0**	**21.4**		**98.7**
Industry	3.4	9.6	19.9			0.1	13.4		46.4
Transport		39.0	0.3						39.3
Residential		1.4	0.1			1.9	4.4		7.7
Commercial		1.6	0.1				3.6		5.3

MALAYSIA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	63	231	347	550	860	6.1	5.2	4.7	4.6	4.8
Population (million)	13.9	24.5	28.5	32.8	36.1	2.6	1.9	1.4	1.0	1.4
GDP per capita (2000 PPP US$)	4 527	9 417	12 170	16 780	23 780	3.4	3.3	3.3	3.5	3.4
GDP in Services (2000 PPP US$ billion)	24	114	168	270	417	7.3	5.0	4.8	4.5	4.7
GDP in Industry (2000 PPP US$ billion)	25	108	175	286	442	6.8	6.2	5.0	4.5	5.2
Urbanisation level (%)	42	63	68	74	78	1.9	1.0	0.8	0.5	0.7

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**18.2**	**86.1**	**102.5**	**102.9**	**99.6**	**7.3**	**2.2**	**0.05**	**- 0.3**	**0.5**
Coal		0.2	0.3	0.3	0.4		7.4	1.0	1.0	2.8
Oil	14.5	39.5	41.3	41.1	37.4	4.7	0.6	- 0.04	- 0.9	- 0.2
	(79%)	(46%)	(40%)	(40%)	(38%)					
Gas	2.0	44.2	58.3	58.3	58.3	15.1	3.5			1.0
	(11%)	(51%)	(57%)	(57%)	(59%)					
Hydro		0.7	0.7	0.9	1.0	8.6	- 1.3	3.7	0.7	1.2
		(1%)	(1%)	(1%)	(1%)					
NRE	1.6	1.5	1.9	2.2	2.5	- 0.3	2.9	1.6	1.2	1.8
	(9%)	(2%)	(2%)	(2%)	(3%)					
Nuclear										
Net Imports	**- 5.5**	**- 31.2**	**- 23.8**	**6.6**	**47.0**	**8.2**	**- 3.3**		**21.8**	
Coal		2.4	12.3	22.1	33.4	20.3	22.7	6.0	4.2	9.9
Oil	- 5.6	- 14.1	- 9.5	1.0	17.6	4.3	- 4.8		33.6	
Gas		- 19.5	- 26.6	- 16.5	- 3.9		4.0	- 4.7	-13.4	- 5.6
Electricity										
Total Primary Energy Demand	**12.2**	**55.8**	**78.7**	**109.5**	**146.7**	**7.2**	**4.4**	**3.4**	**3.0**	**3.5**
Coal	0.04	2.5	12.6	22.4	33.7	20.6	22.3	5.9	4.2	9.7
		(5%)	(16%)	(20%)	(23%)					
Oil	8.4	26.3	31.8	42.1	55.0	5.3	2.4	2.8	2.7	2.7
	(69%)	(47%)	(40%)	(38%)	(38%)					
Gas	2.0	24.7	31.7	41.9	54.4	12.1	3.1	2.8	2.7	2.9
	(17%)	(44%)	(40%)	(38%)	(37%)					
Hydro	0.1	0.7	0.7	0.9	1.0	8.6	- 1.3	3.7	0.7	1.2
	(1%)	(1%)	(1%)	(1%)	(1%)					
NRE	1.6	1.5	1.9	2.2	2.5	- 0.3	2.9	1.6	1.2	1.8
	(13%)	(3%)	(2%)	(2%)	(2%)					
Nuclear										
Input for Electricity and Heat Generation	**- 2.5**	**- 16.2**	**- 26.1**	**- 40.2**	**- 57.1**	**8.9**	**6.1**	**4.4**	**3.6**	**4.6**
Coal		- 1.3	- 11.1	- 20.0	- 30.4		31.0	6.1	4.2	12.0
		(8%)	(43%)	(50%)	(53%)					
Oil	- 2.4	- 1.6	- 0.3	- 0.3	- 0.2	- 1.6	- 20.4	0.9	- 1.8	- 6.6
	(94%)	(10%)	(1%)	(1%)	(0%)					
Gas		- 12.5	- 13.8	- 18.5	- 25.0		1.2	3.0	3.0	2.5
		(77%)	(53%)	(46%)	(44%)					
Hydro	- 0.1	- 0.7	- 0.7	- 0.9	- 1.0	8.6	- 1.3	3.7	0.7	1.2
	(5%)	(5%)	(3%)	(2%)	(2%)					
NRE			- 0.2	- 0.4	- 0.5			4.8	2.1	
			(1%)	(1%)	(1%)					
Nuclear										
Other Transformation	**- 0.5**	**- 11.5**	**- 13.5**	**- 13.0**	**- 12.3**	**14.9**	**2.0**	**- 0.4**	**- 0.6**	**0.2**
Coal		- 0.2								
		(1%)								
Oil	- 0.5	- 4.5	- 4.5	- 4.0	- 3.2	10.1		- 1.2	- 2.1	- 1.2
	(100%)	(39%)	(33%)	(30%)	(26%)					
Gas		- 6.9	- 9.1	- 9.1	- 9.1		3.5			1.0
		(60%)	(67%)	(70%)	(74%)					
NRE										
Electricity										
Heat										

MALAYSIA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**7.1**	**33.6**	**48.1**	**70.6**	**98.7**	**7.3**	**4.6**	**3.9**	**3.4**	**3.9**
Coal	0.04	1.1	1.6	2.4	3.4	16.1	4.7	4.3	3.7	4.2
		(3%)	(3%)	(3%)	(3%)					
Oil	5.4	20.0	27.1	37.9	51.6	6.2	3.9	3.4	3.1	3.4
	(75%)	(60%)	(56%)	(54%)	(52%)					
Gas		5.1	8.8	14.2	20.4		7.1	4.9	3.6	5.1
		(15%)	(18%)	(20%)	(21%)					
NRE	1.0	1.5	1.6	1.8	2.0	2.0	1.1	1.0	1.0	1.0
	(14%)	(4%)	(3%)	(3%)	(2%)					
Electricity	0.7	5.9	9.0	14.3	21.4	9.9	5.3	4.8	4.1	4.7
	(10%)	(18%)	(19%)	(20%)	(22%)					
Heat										
Industry	**2.9**	**14.3**	**21.5**	**32.6**	**46.4**	**7.5**	**5.2**	**4.2**	**3.6**	**4.3**
Coal	0.04	1.1	1.6	2.4	3.4	16.1	4.7	4.3	3.7	4.2
		(8%)	(7%)	(7%)	(7%)					
Oil	2.5	5.1	6.3	7.8	9.6	3.3	2.7	2.2	2.1	2.3
	(84%)	(35%)	(29%)	(24%)	(21%)					
Gas		5.0	8.7	13.9	19.9		7.0	4.9	3.6	5.0
		(35%)	(40%)	(43%)	(43%)					
NRE		0.1	0.1	0.1	0.1	3.9	3.2	2.6	2.4	2.7
		(0%)	(0%)	(0%)	(0%)					
Electricity	0.4	3.1	4.9	8.4	13.4	9.9	6.2	5.5	4.7	5.4
	(13%)	(21%)	(23%)	(26%)	(29%)					
Heat										
Transport	**2.5**	**13.4**	**19.0**	**27.8**	**39.3**	**8.0**	**4.4**	**3.9**	**3.5**	**3.9**
Coal										
Oil	2.5	13.4	18.9	27.6	39.0	8.0	4.4	3.9	3.5	3.9
	(100%)	(100%)	(99%)	(99%)	(99%)					
Gas		0.03	0.10	0.20	0.30		18.2	7.5	4.2	9.2
		(0%)	(1%)	(1%)	(1%)					
NRE										
Electricity										
Residential	**1.4**	**3.3**	**4.3**	**5.9**	**7.7**	**4.0**	**3.5**	**3.1**	**2.7**	**3.1**
Coal										
Oil	0.4	0.7	0.8	1.1	1.4	2.2	2.4	2.4	2.7	2.5
	(31%)	(21%)	(20%)	(18%)	(18%)					
Gas	0.03		0.01	0.03	0.05	- 8.9	13.5	9.4	7.2	9.7
	(2%)		(0%)	(0%)	(1%)					
NRE	0.9	1.4	1.6	1.7	1.9	1.9	1.0	0.9	0.9	0.9
	(67%)	(43%)	(36%)	(29%)	(24%)					
Electricity		1.2	1.9	3.1	4.4		6.5	4.9	3.5	4.9
		(35%)	(44%)	(52%)	(57%)					
Heat										
Commercial	**0.4**	**2.5**	**3.2**	**4.2**	**5.3**	**9.2**	**3.0**	**2.8**	**2.4**	**2.7**
Coal										
Oil		0.8	1.1	1.3	1.6		3.3	2.5	1.6	2.4
		(32%)	(33%)	(32%)	(29%)					
Gas		0.01	0.03	0.08	0.15		14.7	9.9	6.7	10.1
		(0%)	(1%)	(2%)	(3%)					
NRE										
Electricity	0.4	1.7	2.1	2.8	3.6	7.3	2.8	2.8	2.6	2.7
	(100%)	(67%)	(66%)	(66%)	(68%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	50	63	74	76	77
Net Energy Import Ratio (%)	-44	-57	-30	6	32
Net Oil Import Dependency (%)	-67	-54	-30	2	32

MALAYSIA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**10**	**77**	**116**	**185**	**274**	**9.7**	**5.2**	**4.8**	**4.0**	**4.6**
Coal		4	42	83	136		32.3	7.0	5.1	13.0
		(6%)	(36%)	(45%)	(50%)					
Oil	9	7	1	1	1	-1.0	-19.8	1.5	-1.2	-6.0
	(85%)	(9%)	(1%)	(1%)						
Gas	0.1	58	65	89	123		1.5	3.3	3.3	2.8
	(1%)	(74%)	(56%)	(48%)	(45%)					
Hydro	1	8	8	11	12	8.6	-1.3	3.7	0.7	1.2
	(14%)	(11%)	(7%)	(6%)	(4%)					
NRE			0.76	1.29	1.69			5.5	2.7	
			(1%)	(1%)	(1%)					
Nuclear										
Total Installed Generation Capacity (GW)	**2**	**16**	**28**	**34**	**50**	**9.1**	**7.3**	**2.0**	**4.0**	**4.2**
Thermal	2	14	25	31	47	9.9	8.1	2.1	4.2	4.5
	(74%)	(86%)	(92%)	(92%)	(94%)					
Coal		2	11	15	23		26.3	2.9	4.3	9.7
		(11%)	(40%)	(44%)	(45%)					
Oil		1.1	0.5	0.5	0.5		-9.2			-2.7
		(7%)	(2%)	(1%)	(1%)					
Gas		11	14	16	24		3.1	1.4	4.2	2.9
		(69%)	(50%)	(47%)	(48%)					
Hydro	1	2	2	2	2	5.9	0.1	0.7	0.6	0.5
	(26%)	(13%)	(8%)	(7%)	(5%)					
NRE		0.01	0.2	0.3	0.4		42.2	4.1	1.5	12.8
			(1%)	(1%)	(1%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**193**	**242**	**227**	**199**	**171**	**1.0**	**- 0.8**	**- 1.3**	**- 1.5**	**- 1.2**
Industry (toe per US$ million GDP in Industry)	115	132	123	114	105	0.6	- 0.9	- 0.7	- 0.8	- 0.8
Commercial (toe per US$ million GDP in Services)	15	22	19	16	13	1.8	- 1.9	- 1.9	- 2.0	- 1.9
Energy Intensity (kgoe per capita)	**875**	**2 275**	**2 760**	**3 341**	**4 057**	**4.4**	**2.4**	**1.9**	**2.0**	**2.1**
Industry	210	584	755	996	1 283	4.8	3.3	2.8	2.6	2.9
Transport	177	548	666	849	1 087	5.3	2.5	2.5	2.5	2.5
Residential	101	135	152	180	213	1.3	1.5	1.7	1.7	1.7
Commercial	26	103	112	128	148	6.4	1.1	1.4	1.4	1.3
CO_2 Emissions (million tonnes)	**24.1**	**132.3**	**205.9**	**299.9**	**414.0**	**8.0**	**5.7**	**3.8**	**3.3**	**4.2**
Electricity Generation	7.6	39.2	76.0	121.9	176.8	7.8	8.6	4.8	3.8	5.5
Transformation other than Electricity Generation	0.2	17.5	22.7	22.7	22.6	23.1	3.3			0.9
Industry	7.8	31.1	45.0	65.0	88.1	6.5	4.7	3.7	3.1	3.8
Transport	7.2	39.8	56.3	82.7	117.0	8.1	4.4	3.9	3.5	3.9
Residential	1.3	2.2	2.6	3.3	4.4	2.3	2.1	2.4	2.9	2.5
Commercial		2.5	3.3	4.3	5.1		3.5	2.7	1.7	2.6
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	384.2	572.8	593.5	545.3	481.6	1.8	0.4	- 0.8	- 1.2	- 0.6
CO_2 emissions per capita (tonnes per capita)	1.7	5.4	7.2	9.2	11.5	5.3	3.7	2.4	2.3	2.7

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**37.0 - 44.4**	**66.0 - 82.2**	**107.4 - 135.1**
Coal Production & Transportation	0.02 - 0.02	0.02 - 0.03	0.03 - 0.04
Oil & Gas Production & Processing	8.1 - 11.9	17.3 - 25.1	28.4 - 40.8
Oil & Gas International Trade	11.5 - 12.0	15.4 - 16.3	17.5 - 19.0
Oil & Gas Domestic Pipeline	0.54 - 0.77	1.33 - 1.91	2.32 - 3.31
Electricity Generation & Transmission	16.82 - 19.71	31.93 - 38.87	59.15 - 71.96

MEXICO

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.3	174.9	32.4	2.1	2.5	12.0			229.2
Net Imports	3.5	- 92.0	3.3						- 85.2
TPED	**7.9**	**82.9**	**35.7**	**2.1**	**2.5**	**12.0**			**143.1**
Electricity and Heat Generation	- 6.9	- 18.8	- 16.5	- 2.1	- 2.5	- 4.7	16.1		- 35.5
Petroleum Refineries		- 10.4					- 0.3		- 10.7
Others			- 9.5						- 9.5
TFED	**1.0**	**59.6**	**9.4**			**7.3**	**14.4**		**91.6**
Industry	1.0	11.9	8.5			1.2	9.4		32.0
Transport		38.5					0.1		38.6
Residential		7.4	0.6			6.1	3.3		17.4
Commercial		1.8	0.2			0.1	1.6		3.7

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.9	163.3	32.8	2.6	2.6	12.9			220.0
Net Imports	3.2	- 65.0	18.0				0.4		- 43.3
TPED	**9.2**	**98.3**	**50.8**	**2.6**	**2.6**	**12.9**	**0.4**		**176.7**
Electricity and Heat Generation	- 8.4	- 15.2	- 28.7	- 2.6	- 2.6	- 5.6	20.5		- 42.6
Petroleum Refineries		- 11.7					- 0.4		- 12.0
Others			- 8.5						- 8.5
TFED	**0.8**	**71.4**	**13.6**			**7.2**	**20.5**		**113.6**
Industry	0.8	13.8	11.8			0.9	13.9		41.2
Transport		47.4	0.1				0.1		47.6
Residential		7.9	1.3			6.2	4.5		19.9
Commercial		2.2	0.5			0.1	2.1		4.9

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	6.9	184.4	37.7	2.9	2.7	13.1			247.7
Net Imports	9.0	- 68.7	33.2						- 26.5
TPED	**15.9**	**115.7**	**70.9**	**2.9**	**2.7**	**13.1**			**221.2**
Electricity and Heat Generation	- 15.3	- 13.0	- 43.0	- 2.9	- 2.7	- 6.0	28.7		- 54.1
Petroleum Refineries		- 10.3					- 0.4		- 10.6
Others			- 9.1						- 9.1
TFED	**0.6**	**92.5**	**18.7**			**7.1**	**28.4**		**147.3**
Industry	0.6	17.4	15.2			0.9	19.4		53.6
Transport		63.8	0.1				0.1		64.1
Residential		8.7	2.4			6.0	6.0		23.1
Commercial		2.6	0.9			0.1	2.9		6.6

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	8.0	208.4	59.5	2.9	2.7	12.9			294.4
Net Imports	17.0	- 70.9	30.0				0.6		- 23.3
TPED	**25.0**	**137.4**	**89.5**	**2.9**	**2.7**	**12.9**	**0.6**		**271.1**
Electricity and Heat Generation	- 24.4	- 10.7	- 56.9	- 2.9	- 2.7	- 6.2	38.0		- 65.9
Petroleum Refineries		- 9.8					- 0.3		- 10.2
Others			- 9.8						- 9.8
TFED	**0.6**	**116.9**	**22.8**			**6.7**	**38.3**		**185.2**
Industry	0.6	20.4	18.3			0.9	26.7		66.9
Transport		84.0	0.2				0.1		84.4
Residential		9.5	3.1			5.5	7.6		25.7
Commercial		3.0	1.2			0.2	3.9		8.3

MEXICO

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	566	962	1 289	1 952	2 868	2.4	3.7	4.2	3.9	4.0
Population (million)	67	101	112	122	131	1.9	1.3	0.9	0.7	0.9
GDP per capita (2000 PPP US$)	8 466	9 519	11 517	15 975	21 850	0.5	2.4	3.3	3.2	3.0
GDP in Services (2000 PPP US$ billion)	393	622	843	1 252	1 811	2.1	3.9	4.0	3.8	3.9
GDP in Industry (2000 PPP US$ billion)	155	242	316	465	666	2.1	3.4	4.0	3.7	3.7
Urbanisation level (%)	67	75	77	81	83	0.5	0.4	0.5	0.3	0.4

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**147.6**	**229.2**	**220.0**	**247.7**	**294.4**	**2.0**	**- 0.5**	**1.2**	**1.7**	**0.9**
Coal	1.7	5.3	5.9	6.9	8.0	5.2	1.5	1.5	1.5	1.5
	(1%)	(2%)	(3%)	(3%)	(3%)					
Oil	115.2	174.9	163.3	184.4	208.4	1.9	- 0.9	1.2	1.2	0.6
	(78%)	(76%)	(74%)	(74%)	(71%)					
Gas	21.5	32.4	32.8	37.7	59.5	1.9	0.1	1.4	4.7	2.2
	(15%)	(14%)	(15%)	(15%)	(20%)					
Hydro	1.5	2.1	2.6	2.9	2.9	1.8	2.2	1.3		1.1
	(1%)	(1%)	(1%)	(1%)	(1%)					
NRE	7.7	12.0	12.9	13.1	12.9	2.1	0.9	0.2	- 0.2	0.3
	(5%)	(5%)	(6%)	(5%)	(4%)					
Nuclear		2.5	2.6	2.7	2.7		0.3	0.3	0.2	0.2
		(1%)	(1%)	(1%)	(1%)					
Net Imports	**- 49.3**	**- 85.2**	**- 43.3**	**- 26.5**	**- 23.3**	**2.5**	**- 8.1**	**- 4.8**	**- 1.3**	**- 4.5**
Coal	0.6	3.5	3.2	9.0	17.0	8.4	- 1.0	10.8	6.5	5.8
Oil	- 47.6	- 92.0	- 65.0	- 68.7	- 70.9	3.0	- 4.3	0.6	0.3	- 0.9
Gas	- 2.4	3.3	18.0	33.2	30.0		23.4	6.3	- 1.0	8.1
Electricity	0.1		0.4		0.6					
Total Primary Energy Demand	**97.1**	**143.1**	**176.7**	**221.2**	**271.1**	**1.8**	**2.7**	**2.3**	**2.1**	**2.3**
Coal	2.4	7.9	9.2	15.9	25.0	5.6	2.0	5.7	4.6	4.2
	(2%)	(5%)	(5%)	(7%)	(9%)					
Oil	66.5	82.9	98.3	115.7	137.4	1.0	2.2	1.6	1.7	1.8
	(68%)	(58%)	(56%)	(52%)	(51%)					
Gas	19.1	35.7	50.8	70.9	89.5	2.9	4.5	3.4	2.4	3.3
	(20%)	(25%)	(29%)	(32%)	(33%)					
Hydro	1.5	2.1	2.6	2.9	2.9	1.8	2.2	1.3		1.1
	(1%)	(1%)	(1%)	(1%)	(1%)					
NRE	7.7	12.0	12.9	13.1	12.9	2.1	0.9	0.2	- 0.2	0.3
	(8%)	(8%)	(7%)	(6%)	(5%)					
Nuclear		2.5	2.6	2.7	2.7		0.3	0.3	0.2	0.2
		(2%)	(1%)	(1%)	(1%)					
Input for Electricity and Heat Generation	**- 14.9**	**- 51.5**	**- 63.1**	**- 82.8**	**- 103.9**	**5.8**	**2.6**	**2.8**	**2.3**	**2.5**
Coal		- 6.9	- 8.4	- 15.3	- 24.4		2.6	6.1	4.8	4.6
		(13%)	(13%)	(18%)	(24%)					
Oil	- 9.8	- 18.8	- 15.2	- 13.0	- 10.7	3.0	- 2.6	- 1.6	- 1.9	- 2.0
	(66%)	(36%)	(24%)	(16%)	(10%)					
Gas	- 2.8	- 16.5	- 28.7	- 43.0	- 56.9	8.3	7.2	4.1	2.8	4.5
	(19%)	(32%)	(45%)	(52%)	(55%)					
Hydro	- 1.5	- 2.1	- 2.6	- 2.9	- 2.9	1.8	2.2	1.3		1.1
	(10%)	(4%)	(4%)	(3%)	(3%)					
NRE	- 0.8	- 4.7	- 5.6	- 6.0	- 6.2	8.4	2.4	0.7	0.3	1.0
	(5%)	(9%)	(9%)	(7%)	(6%)					
Nuclear		- 2.5	- 2.6	- 2.7	- 2.7		0.3	0.3	0.2	0.2
		(5%)	(4%)	(3%)	(3%)					
Other Transformation	**- 13.3**	**- 20.2**	**- 20.5**	**- 19.7**	**- 20.0**	**1.9**	**0.2**	**- 0.4**	**0.1**	
Coal										
Oil	- 9.9	- 10.4	- 11.7	- 10.3	- 9.8	0.3	1.4	- 1.3	- 0.4	- 0.2
	(74%)	(52%)	(57%)	(52%)	(49%)					
Gas	- 3.5	- 9.5	- 8.5	- 9.1	- 9.8	4.7	- 1.3	0.7	0.7	0.1
	(26%)	(47%)	(41%)	(46%)	(49%)					
NRE										
Electricity		- 0.3	- 0.4	- 0.4	- 0.3		2.4	- 0.1	- 0.5	0.5
		(1%)	(2%)	(2%)	(2%)					
Heat										

MEXICO

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**53.5**	**91.6**	**113.6**	**147.3**	**185.2**	**2.5**	**2.7**	**2.6**	**2.3**	**2.5**
Coal	1.6	1.0	0.8	0.6	0.6	- 2.2	- 3.2	- 1.6	- 1.2	- 1.9
	(3%)	(1%)	(1%)	(0%)	(0%)					
Oil	27.7	59.6	71.4	92.5	116.9	3.5	2.3	2.6	2.4	2.4
	(52%)	(65%)	(63%)	(63%)	(63%)					
Gas	12.8	9.4	13.6	18.7	22.8	- 1.4	4.8	3.2	2.0	3.2
	(24%)	(10%)	(12%)	(13%)	(12%)					
NRE	6.9	7.3	7.2	7.1	6.7	0.3	- 0.2	- 0.2	- 0.6	- 0.3
	(13%)	(8%)	(6%)	(5%)	(4%)					
Electricity	4.5	14.4	20.5	28.4	38.3	5.4	4.5	3.3	3.0	3.6
	(8%)	(16%)	(18%)	(19%)	(21%)					
Heat										
Industry	**27.9**	**32.0**	**41.2**	**53.6**	**66.9**	**0.6**	**3.2**	**2.7**	**2.2**	**2.7**
Coal	1.6	1.0	0.8	0.6	0.6	- 2.2	- 3.2	- 1.6	- 1.2	- 1.9
	(6%)	(3%)	(2%)	(1%)	(1%)					
Oil	9.4	11.9	13.8	17.4	20.4	1.1	1.9	2.3	1.6	2.0
	(34%)	(37%)	(34%)	(32%)	(31%)					
Gas	12.4	8.5	11.8	15.2	18.3	- 1.7	4.1	2.6	1.8	2.8
	(44%)	(27%)	(29%)	(28%)	(27%)					
NRE	1.5	1.2	0.9	0.9	0.9	- 1.2	- 2.8			- 0.8
	(6%)	(4%)	(2%)	(2%)	(1%)					
Electricity	2.9	9.4	13.9	19.4	26.7	5.5	5.0	3.4	3.3	3.8
	(10%)	(29%)	(34%)	(36%)	(40%)					
Heat										
Transport	**16.4**	**38.6**	**47.6**	**64.1**	**84.4**	**4.0**	**2.6**	**3.0**	**2.8**	**2.8**
Coal										
Oil	16.4	38.5	47.4	63.8	84.0	4.0	2.6	3.0	2.8	2.8
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas		0.02	0.1	0.1	0.2		15.0	10.0	5.0	9.6
			(0%)	(0%)	(0%)					
NRE										
Electricity		0.1	0.1	0.1	0.1	4.5	1.4	0.8	0.5	0.9
		(0%)	(0%)	(0%)	(0%)					
Residential	**7.7**	**17.4**	**19.9**	**23.1**	**25.7**	**3.8**	**1.7**	**1.5**	**1.0**	**1.4**
Coal										
Oil	1.0	7.4	7.9	8.7	9.5	9.3	0.9	0.9	0.9	0.9
	(13%)	(42%)	(40%)	(38%)	(37%)					
Gas	0.5	0.6	1.3	2.4	3.1	1.2	10.0	6.5	2.5	6.0
	(6%)	(3%)	(7%)	(11%)	(12%)					
NRE	5.3	6.1	6.2	6.0	5.5	0.6	0.2	- 0.3	- 0.9	- 0.4
	(69%)	(35%)	(31%)	(26%)	(21%)					
Electricity	0.9	3.3	4.5	6.0	7.6	6.3	3.8	3.0	2.3	3.0
	(11%)	(19%)	(22%)	(26%)	(29%)					
Heat										
Commercial	**1.5**	**3.7**	**4.9**	**6.6**	**8.3**	**4.0**	**3.7**	**3.0**	**2.4**	**3.0**
Coal										
Oil	0.9	1.8	2.2	2.6	3.0	3.4	2.6	1.7	1.3	1.8
	(56%)	(49%)	(45%)	(40%)	(36%)					
Gas		0.2	0.5	0.9	1.2		10.0	6.5	2.5	6.0
		(6%)	(10%)	(14%)	(14%)					
NRE		0.1	0.1	0.1	0.2		5.0	5.0	5.0	5.0
		(2%)	(2%)	(2%)	(3%)					
Electricity	0.7	1.6	2.1	2.9	3.9	3.9	3.6	3.3	3.1	3.3
	(44%)	(43%)	(43%)	(44%)	(48%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	51	65	66	68	70
Net Energy Import Ratio (%)	-50	-59	-24	-12	-9
Net Oil Import Dependency (%)	-72	-111	-66	-59	-52

MEXICO

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**67**	**215**	**277**	**384**	**505**	**5.4**	**3.2**	**3.3**	**2.8**	**3.1**
Coal		26	33	60	98		2.8	6.3	5.0	4.8
		(12%)	(12%)	(16%)	(19%)					
Oil	39	79	66	58	49	3.3	-2.3	-1.3	-1.6	-1.7
	(58%)	(37%)	(24%)	(15%)	(10%)					
Gas	10	69	129	209	299	9.0	8.1	5.0	3.6	5.4
	(15%)	(32%)	(47%)	(54%)	(59%)					
Hydro	17	25	30	34	34	1.8	2.2	1.3		1.1
	(25%)	(12%)	(11%)	(9%)	(7%)					
NRE	1	6	10	14	16	8.8	7.0	3.0	1.7	3.7
	(1%)	(3%)	(4%)	(4%)	(3%)					
Nuclear		10	10	10	10		0.3	0.2	0.2	0.2
		(5%)	(4%)	(3%)	(2%)					
Total Installed Generation Capacity (GW)	**15**	**41**	**57**	**80**	**94**	**4.8**	**4.1**	**3.4**	**1.6**	**3.0**
Thermal	9	29	43	62	76	5.8	4.8	3.9	2.0	3.5
	(58%)	(71%)	(74%)	(78%)	(81%)					
Coal		4	5	10	16		4.9	6.9	4.0	5.3
		(9%)	(9%)	(13%)	(17%)					
Oil	8	15	16	15	12	3.1	0.1	-0.6	-2.4	-1.1
	(54%)	(37%)	(27%)	(18%)	(12%)					
Gas	1	10	22	37	49	14.3	9.8	5.6	2.7	5.7
	(4%)	(25%)	(38%)	(47%)	(52%)					
Hydro	6	10	11	13	13	2.2	2.0	1.3		1.0
	(41%)	(23%)	(20%)	(16%)	(14%)					
NRE		1	2	3	4	7.8	8.2	4.9	1.7	4.6
	(1%)	(3%)	(3%)	(4%)	(4%)					
Nuclear		1	1	1	1					
		(3%)	(2%)	(2%)	(1%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**172**	**149**	**137**	**113**	**95**	**- 0.6**	**- 1.0**	**- 1.9**	**- 1.8**	**- 1.6**
Industry (toe per US$ million GDP in Industry)	180	132	130	115	100	- 1.4	- 0.2	- 1.2	- 1.4	- 1.0
Commercial (toe per US$ million GDP in Services)	4	6	6	5	5	1.9	- 0.2	- 1.0	- 1.3	- 0.9
Energy Intensity (kgoe per capita)	**1 453**	**1 417**	**1 579**	**1 810**	**2 065**	**- 0.1**	**1.4**	**1.4**	**1.3**	**1.4**
Industry	417	316	368	439	509	- 1.2	1.9	1.8	1.5	1.7
Transport	246	382	425	524	643	2.0	1.3	2.1	2.1	1.9
Residential	115	172	178	189	195	1.8	0.4	0.6	0.3	0.5
Commercial	23	36	44	54	63	2.1	2.4	2.1	1.6	2.0
CO_2 Emissions (million tonnes)	**177.3**	**377.6**	**448.1**	**577.7**	**724.1**	**3.5**	**2.2**	**2.6**	**2.3**	**2.4**
Electricity Generation	37.9	122.6	146.3	199.6	260.8	5.5	2.2	3.2	2.7	2.7
Transformation other than Electricity Generation	24.5	48.9	51.3	53.4	56.9	3.2	0.6	0.4	0.6	0.5
Industry	60.8	60.1	72.8	91.5	107.5	- 0.1	2.4	2.3	1.6	2.1
Transport	47.2	113.9	140.3	188.8	248.8	4.1	2.6	3.0	2.8	2.8
Residential	4.2	26.1	29.5	34.3	38.3	8.7	1.5	1.5	1.1	1.4
Commercial	2.7	6.0	7.9	10.1	11.8	3.6	3.5	2.5	1.6	2.4
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	313.2	392.6	347.6	296.0	252.5	1.0	- 1.5	- 1.6	- 1.6	- 1.6
CO_2 emissions per capita (tonnes per capita)	2.7	3.7	4.0	4.7	5.5	1.6	0.9	1.7	1.6	1.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**46.3 - 59.7**	**112.6 - 146.7**	**172.1 - 228.3**
Coal Production & Transportation	0.31 - 0.41	0.49 - 0.65	0.69 - 0.93
Oil & Gas Production & Processing	8.82 - 12.47	25.99 - 37.85	44.84 - 65.82
Oil & Gas International Trade	4.66 - 5.41	9.42 - 11.03	9.47 - 11.15
Oil & Gas Domestic Pipeline	6.93 - 9.90	15.56 - 22.23	24.63 - 35.19
Electricity Generation & Transmission	25.55 - 31.49	61.15 - 74.92	92.48 - 115.2

NEW ZEALAND

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	2.7	1.4	5.4	1.9		3.7			15.1
Net Imports	- 1.7	5.3							3.6
TPED	**1.2**	**6.6**	**5.4**	**1.9**		**3.7**			**18.8**
Electricity and Heat Generation	- 0.3		- 2.0	- 1.9		- 2.6	3.0		- 3.7
Petroleum Refineries		- 0.6							- 0.6
Others			- 0.1						- 0.1
TFED	**0.9**	**6.1**	**3.0**			**1.0**	**3.0**		**14.0**
Industry	0.8	0.5	2.5			0.8	1.3		6.0
Transport		5.4							5.4
Residential			0.2			0.2	1.0		1.5
Commercial	0.1	0.1	0.3				0.6		1.1

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	3.0	1.3	2.0	2.3		5.0			13.5
Net Imports	- 0.6	6.4							5.8
TPED	**2.4**	**7.7**	**2.0**	**2.3**		**5.0**			**19.3**
Electricity and Heat Generation	- 1.4		- 0.6	- 2.3		- 3.6	3.6		- 4.3
Petroleum Refineries		- 0.6							- 0.7
Others			- 0.1			- 0.1			- 0.1
TFED	**0.9**	**7.1**	**1.3**			**1.3**	**3.6**		**14.2**
Industry	0.8	0.6	0.7			1.1	1.7		5.0
Transport		6.3							6.3
Residential		0.1	0.2			0.2	1.2		1.7
Commercial	0.1	0.1	0.3				0.7		1.2

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	3.3	1.1	2.4	2.5		8.0			17.4
Net Imports	- 0.9	7.9							7.0
TPED	**2.4**	**9.0**	**2.4**	**2.5**		**8.0**			**24.4**
Electricity and Heat Generation	- 1.4		- 0.9	- 2.5		- 6.5	4.5		- 6.8
Petroleum Refineries		- 0.6							- 0.6
Others			- 0.1			- 0.1			- 0.1
TFED	**1.0**	**8.4**	**1.5**			**1.5**	**4.4**		**16.8**
Industry	0.9	0.7	0.8			1.2	2.2		5.9
Transport		7.5							7.6
Residential		0.1	0.3			0.2	1.4		2.0
Commercial	0.1	0.1	0.4				0.8		1.4

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	3.6	1.0	3.3	2.4		11.8			22.2
Net Imports	- 0.9	9.3							8.4
TPED	**2.7**	**10.3**	**3.3**	**2.4**		**11.8**			**30.6**
Electricity and Heat Generation	- 1.6		- 1.5	- 2.4		- 10.2	5.3		- 10.5
Petroleum Refineries		- 0.6							- 0.6
Others						- 0.1			- 0.1
TFED	**1.0**	**9.7**	**1.7**			**1.6**	**5.3**		**19.3**
Industry	1.0	0.8	1.0			1.3	2.6		6.6
Transport		8.8							8.8
Residential		0.1	0.3			0.3	1.8		2.4
Commercial	0.1	0.1	0.5				0.9		1.5

NEW ZEALAND

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	47	83	105	134	166	2.6	2.9	2.4	2.2	2.5
Population (million)	3.15	3.95	4.43	5.03	5.44	1.0	1.4	1.3	0.8	1.2
GDP per capita (2000 PPP US$)	15 045	21 133	23 721	26 606	30 465	1.6	1.5	1.2	1.4	1.3
GDP in Services (2000 PPP US$ billion)	31	59	75	102	133	3.0	3.1	3.1	2.6	2.9
GDP in Industry (2000 PPP US$ billion)	13	19	25	33	41	1.9	3.4	2.7	2.3	2.7
Urbanisation level (%)	83	86	86	88	89	0.1	0.1	0.1	0.2	0.1

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	5.5	15.1	13.5	17.4	22.2	4.7	- 1.4	2.6	2.5	1.4
Coal	1.1	2.7	3.0	3.3	3.6	4.0	1.1	1.0	0.9	1.0
	(21%)	(18%)	(22%)	(19%)	(16%)					
Oil	0.4	1.4	1.3	1.1	1.0	6.1	- 1.0	- 1.0	- 1.0	- 1.0
		(9%)	(9%)	(7%)	(5%)					
Gas	0.8	5.4	2.0	2.4	3.3	9.1	- 11.9	2.0	3.2	- 1.8
	(14%)	(36%)	(15%)	(14%)	(15%)					
Hydro	1.6	1.9	2.3	2.5	2.4	0.6	2.6	0.8	- 0.2	1.0
	(30%)	(12%)	(17%)	(14%)	(11%)					
NRE	1.6	3.7	5.0	8.0	11.8	4.0	3.8	4.9	3.9	4.3
	(28%)	(24%)	(37%)	(46%)	(53%)					
Nuclear										
Net Imports	4.2	3.6	5.8	7.0	8.4	- 0.7	6.2	1.9	1.8	3.0
Coal	- 0.1	- 1.7	- 0.6	- 0.9	- 0.9	17.4	- 12.1	3.5	0.9	- 2.1
Oil	4.3	5.3	6.4	7.9	9.3	1.0	2.5	2.0	1.7	2.0
Gas										
Electricity										
Total Primary Energy Demand	9.2	18.8	19.3	24.4	30.6	3.3	0.4	2.4	2.3	1.8
Coal	1.0	1.2	2.4	2.4	2.7	0.7	8.9	0.3	0.9	2.9
	(11%)	(6%)	(12%)	(10%)	(9%)					
Oil	4.2	6.6	7.7	9.0	10.3	2.0	2.0	1.6	1.4	1.6
	(46%)	(35%)	(40%)	(37%)	(34%)					
Gas	0.8	5.4	2.0	2.4	3.3	9.2	- 11.9	2.0	3.2	- 1.8
	(9%)	(29%)	(10%)	(10%)	(11%)					
Hydro	1.6	1.9	2.3	2.5	2.4	0.6	2.6	0.8	- 0.2	1.0
	(18%)	(10%)	(12%)	(10%)	(8%)					
NRE	1.6	3.7	5.0	8.0	11.8	4.0	3.8	4.9	3.9	4.3
	(17%)	(20%)	(26%)	(33%)	(39%)					
Nuclear										
Input for Electricity and Heat Generation	- 3.2	- 6.7	- 8.0	- 11.3	- 15.8	3.4	2.1	3.6	3.4	3.1
Coal	- 0.2	- 0.3	- 1.4	- 1.4	- 1.6	3.4	20.5	0.1	1.1	5.9
	(5%)	(5%)	(18%)	(13%)	(10%)					
Oil										
Gas	- 0.3	- 2.0	- 0.6	- 0.9	- 1.5	8.4	- 13.3	3.1	6.2	- 0.9
	(10%)	(29%)	(8%)	(8%)	(10%)					
Hydro	- 1.6	- 1.9	- 2.3	- 2.5	- 2.4	0.6	2.6	0.8	- 0.2	1.0
	(50%)	(28%)	(29%)	(22%)	(15%)					
NRE	- 1.1	- 2.6	- 3.6	- 6.5	- 10.2	4.0	4.3	6.1	4.6	5.0
	(34%)	(38%)	(45%)	(58%)	(65%)					
Nuclear										
Other Transformation	- 0.5	- 0.8	- 0.8	- 0.8	- 0.7	2.3	0.3	- 0.3	- 0.3	- 0.1
Coal										
Oil	- 0.4	- 0.6	- 0.6	- 0.6	- 0.6	2.5	0.5	- 0.2	- 0.2	
	(76%)	(79%)	(81%)	(81%)	(82%)					
Gas	- 0.1	- 0.1	- 0.1	- 0.1	- 0.1	- 1.5	- 1.3	- 1.5	- 1.3	- 1.4
	(25%)	(11%)	(9%)	(8%)	(8%)					
NRE		- 0.1	- 0.1	- 0.1	- 0.1		0.2	0.2		0.1
		(7%)	(7%)	(7%)	(7%)					
Electricity		-0.02	-0.02	-0.02	-0.02	10.8	0.6	- 0.5	- 0.5	- 0.2
		(3%)	(3%)	(3%)	(2%)					
Heat										

NEW ZEALAND

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**6.5**	**14.0**	**14.2**	**16.8**	**19.3**	**3.6**	**0.2**	**1.7**	**1.4**	**1.2**
Coal	0.8	0.9	0.9	1.0	1.0	0.5	0.7	0.5	0.5	0.6
	(12%)	(6%)	(7%)	(6%)	(5%)					
Oil	3.2	6.1	7.1	8.4	9.7	3.0	1.9	1.7	1.5	1.7
	(49%)	(44%)	(50%)	(50%)	(50%)					
Gas	0.4	3.0	1.3	1.5	1.7	10.0	- 10.1	1.6	1.3	- 2.0
	(6%)	(21%)	(9%)	(9%)	(9%)					
NRE	0.5	1.0	1.3	1.5	1.6	3.8	2.8	1.1	0.6	1.4
	(7%)	(7%)	(9%)	(9%)	(8%)					
Electricity	1.7	3.0	3.6	4.4	5.3	2.6	2.5	2.1	1.7	2.1
	(26%)	(21%)	(25%)	(26%)	(27%)					
Heat										
Industry	**2.7**	**6.0**	**5.0**	**5.9**	**6.6**	**3.7**	**- 2.3**	**1.7**	**1.2**	**0.4**
Coal	0.5	0.8	0.8	0.9	1.0	1.6	1.1	0.8	0.6	0.8
	(20%)	(13%)	(17%)	(15%)	(15%)					
Oil	0.8	0.5	0.6	0.7	0.8	- 2.0	1.7	1.5	1.1	1.5
	(31%)	(9%)	(12%)	(12%)	(12%)					
Gas	0.3	2.5	0.7	0.8	1.0	10.8	- 14.4	1.4	1.2	- 3.5
	(10%)	(42%)	(15%)	(14%)	(14%)					
NRE	0.3	0.8	1.1	1.2	1.3	4.2	3.3	1.2	0.6	1.6
	(13%)	(14%)	(22%)	(21%)	(20%)					
Electricity	0.7	1.3	1.7	2.2	2.6	2.9	3.5	2.5	1.7	2.5
	(26%)	(22%)	(35%)	(38%)	(39%)					
Heat										
Transport	**2.1**	**5.4**	**6.3**	**7.6**	**8.8**	**4.5**	**1.9**	**1.8**	**1.5**	**1.7**
Coal										
Oil	2.1	5.4	6.3	7.5	8.8	4.5	1.9	1.8	1.5	1.7
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas			0.01	0.01	0.01		2.8			0.8
			(0%)	(0%)	(0%)					
NRE										
Electricity		0.01	0.01	0.01	0.01	2.3				
		(0%)	(0%)	(0%)	(0%)					
Residential	**1.0**	**1.5**	**1.7**	**2.0**	**2.4**	**1.7**	**1.8**	**1.7**	**1.8**	**1.8**
Coal	0.1	0.01				- 10.1	- 11.3			
	(13%)									
Oil	0.03	0.05	0.1	0.1	0.1	3.1	3.0	1.6	1.4	1.9
			(4%)	(4%)	(4%)					
Gas		0.2	0.2	0.3	0.3	6.4	2.9	1.7	1.4	1.9
		(12%)	(13%)	(13%)	(12%)					
NRE	0.1	0.2	0.2	0.2	0.3	2.8	0.9	0.5	0.5	0.6
	(12%)	(15%)	(14%)	(12%)	(11%)					
Electricity	0.7	1.0	1.2	1.4	1.8	1.8	1.8	1.9	2.1	2.0
	(68%)	(69%)	(70%)	(71%)	(74%)					
Heat										
Commercial	**0.7**	**1.1**	**1.2**	**1.4**	**1.5**	**2.0**	**1.2**	**1.2**	**1.1**	**1.2**
Coal	0.1	0.1	0.1	0.1	0.1	- 0.2	- 1.3	- 1.3	- 1.1	- 1.2
	(16%)	(10%)	(8%)	(7%)	(5%)					
Oil	0.3	0.1	0.1	0.1	0.1	- 5.5	0.2	0.3	0.5	0.3
	(36%)	(7%)	(6%)	(6%)	(5%)					
Gas	0.1	0.3	0.3	0.4	0.5	7.9	1.9	1.9	1.6	1.8
	(7%)	(26%)	(27%)	(29%)	(30%)					
NRE										
Electricity	0.3	0.6	0.7	0.8	0.9	3.6	1.4	1.4	1.2	1.3
	(40%)	(57%)	(58%)	(59%)	(59%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	74	82	78	75	74
Net Energy Import Ratio (%)	43	19	30	29	27
Net Oil Import Dependency (%)	100	80	84	87	90

NEW ZEALAND

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**23**	**36**	**43**	**53**	**63**	**2.2**	**2.3**	**2.1**	**1.7**	**2.0**
Coal	0.4	1	6	7	7	5.6	20.8	0.3	1.1	6.1
	(2%)	(4%)	(15%)	(12%)	(12%)					
Oil										
Gas	2	10	3	5	9	8.1	-12.7	3.7	6.8	-0.2
	(8%)	(26%)	(7%)	(9%)	(14%)					
Hydro	19	22	26	29	28	0.6	2.6	0.8	-0.2	1.0
	(84%)	(59%)	(61%)	(54%)	(45%)					
NRE	2	4	7	13	19	4.2	8.6	6.1	3.5	5.9
	(7%)	(11%)	(17%)	(25%)	(30%)					
Nuclear										
Total Installed Generation Capacity (GW)	**6**	**8**	**11**	**15**	**16**	**1.5**	**3.4**	**2.9**	**0.7**	**2.2**
Thermal	2	3	4	5	5	1.4	4.5	3.2	0.3	2.5
	(30%)	(30%)	(32%)	(34%)	(32%)					
Coal		0.3	1.1	1.1	1.1		16.0			4.3
		(4%)	(10%)	(7%)	(7%)					
Oil										
Gas		2	2	4	4		1.6	4.4	0.3	2.1
		(26%)	(22%)	(26%)	(25%)					
Hydro	4	5	6	7	7	1.2	0.9	1.9	0.2	1.0
	(66%)	(62%)	(51%)	(46%)	(44%)					
NRE	0.2	1	2	3	4	4.6	12.4	6.1	2.2	6.4
	(4%)	(8%)	(15%)	(20%)	(24%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**195**	**225**	**184**	**182**	**184**	**0.7**	**- 2.5**	**- 0.1**	**0.1**	**- 0.7**
Industry (toe per US$ million GDP in Industry)	211	310	198	180	161	1.8	- 5.5	- 1.0	- 1.1	- 2.3
Commercial (toe per US$ million GDP in Services)	23	18	16	13	11	- 1.0	- 1.9	- 1.8	- 1.5	- 1.7
Energy Intensity (kgoe per capita)	**2 929**	**4 751**	**4 358**	**4 848**	**5 616**	**2.2**	**- 1.1**	**1.1**	**1.5**	**0.6**
Industry	851	1 516	1 125	1 169	1 215	2.7	- 3.7	0.4	0.4	- 0.8
Transport	662	1 378	1 430	1 502	1 616	3.4	0.5	0.5	0.7	0.6
Residential	322	372	382	397	440	0.7	0.3	0.4	1.0	0.6
Commercial	226	275	270	269	279	0.9	- 0.2	- 0.0	0.3	0.0
CO_2 Emissions (million tonnes)	**15.7**	**36.6**	**36.9**	**42.1**	**49.2**	**3.9**	**0.1**	**1.3**	**1.6**	**1.1**
Electricity Generation	1.4	5.9	7.1	7.6	10.0	6.6	2.4	0.8	2.7	1.9
Transformation other than Electricity Generation	0.8	2.2	2.1	2.1	2.1	5.0	- 0.4			- 0.1
Industry	5.4	10.6	6.8	7.7	8.4	3.1	- 5.3	1.1	0.9	- 0.8
Transport	6.0	16.1	18.8	22.4	26.1	4.6	1.9	1.8	1.5	1.7
Residential	0.7	0.6	0.7	0.8	0.9	- 0.9	2.1	1.5	1.4	1.6
Commercial	1.4	1.3	1.4	1.5	1.6	- 0.2	0.6	0.8	0.8	0.8
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	331.6	438.9	351.0	314.9	296.6	1.3	- 2.8	- 1.1	- 0.6	- 1.4
CO_2 emissions per capita (tonnes per capita)	5.0	9.3	8.3	8.4	9.0	2.9	- 1.3	0.1	0.8	- 0.1

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**4.55 - 5.35**	**11.02 - 12.99**	**14.87 - 17.88**
Coal Production & Transportation	0.08 - 0.08	0.18 - 0.19	0.28 - 0.31
Oil & Gas Production & Processing	0.22 - 0.28	0.58 - 0.79	1.16 - 1.62
Oil & Gas International Trade			
Oil & Gas Domestic Pipeline	0.03 - 0.04	0.08 - 0.11	0.16 - 0.22
Electricity Generation & Transmission	4.23 - 4.95	10.19 - 11.88	13.27 - 15.71

PAPUA NEW GUINEA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		2.6	0.1	0.1					2.8
Net Imports		- 1.4							- 1.4
TPED		**1.2**	**0.1**	**0.1**					**1.4**
Electricity and Heat Generation		- 0.4	- 0.1	- 0.1			0.2		- 0.4
Petroleum Refineries									
Others									
TFED		**0.8**					**0.2**		**1.0**
Industry		0.5					0.2		0.7
Transport		0.3							0.3
Residential							0.1		0.1
Commercial									

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		2.3	1.6	0.2		0.3			4.4
Net Imports		- 0.8	- 1.6						- 2.3
TPED		**1.5**	**0.1**	**0.2**		**0.3**			**2.1**
Electricity and Heat Generation		- 0.3	- 0.1	- 0.2		- 0.3	0.3		- 0.6
Petroleum Refineries		- 0.1							- 0.1
Others									
TFED		**1.1**					**0.3**		**1.4**
Industry		0.8					0.2		1.0
Transport		0.3							0.3
Residential							0.1		0.1
Commercial									

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		2.0	5.8	0.2		0.4			8.4
Net Imports		0.1	- 5.5						- 5.4
TPED		**2.2**	**0.2**	**0.2**		**0.4**			**3.0**
Electricity and Heat Generation		- 0.5	- 0.2	- 0.2		- 0.4	0.5		- 0.8
Petroleum Refineries		- 0.1							- 0.1
Others									
TFED		**1.6**					**0.5**		**2.1**
Industry		1.2					0.3		1.5
Transport		0.4							0.4
Residential							0.1		0.2
Commercial									

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		1.9	5.9	0.2		0.4			8.4
Net Imports		0.9	- 5.5						- 4.5
TPED		**2.8**	**0.4**	**0.2**		**0.4**			**3.8**
Electricity and Heat Generation		- 0.6	- 0.4	- 0.2		- 0.4	0.6		- 1.0
Petroleum Refineries		- 0.1							- 0.1
Others									
TFED		**2.1**					**0.6**		**2.7**
Industry		1.6					0.4		2.0
Transport		0.4							0.4
Residential		0.1					0.2		0.3
Commercial									

PAPUA NEW GUINEA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	7	12	16	23	30	2.6	3.9	3.6	2.8	3.4
Population (million)	3.09	5.38	6.37	7.59	8.76	2.6	2.1	1.8	1.4	1.8
GDP per capita (2000 PPP US$)	2 166	2 207	2 531	3 034	3 482	0.1	1.7	1.8	1.4	1.6
GDP in Services (2000 PPP US$ billion)	3	4	5	6	9	1.4	2.8	3.3	3.3	3.2
GDP in Industry (2000 PPP US$ billion)	2	5	7	11	15	4.6	5.0	4.3	2.8	4.0
Urbanisation level (%)	13	13	14	16	20	0.1	0.4	1.5	2.6	1.6

ENERGY PROJECTIONS

Mtoe	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production		2.8	4.4	8.4	8.4	23.5	5.9	6.6	-0.04	4.0
Coal										
Oil		2.6	2.3	2.0	1.9		- 1.5	- 1.0	- 1.0	- 1.1
		(91%)	(51%)	(24%)	(22%)					
Gas		0.1	1.6	5.8	5.9		39.5	13.4	0.3	15.1
		(4%)	(37%)	(69%)	(71%)					
Hydro	0.03	0.09	0.18	0.18	0.17	5.7	8.7	0.2	- 0.9	2.2
		(3%)	(4%)	(2%)	(2%)					
NRE		0.04	0.34	0.39	0.41		29.7	1.5	0.6	8.5
		(1%)	(8%)	(5%)	(5%)					
Nuclear										
Net Imports	0.6	- 1.4	- 2.3	- 5.4	- 4.5		6.6	8.7	- 1.7	4.3
Coal										
Oil	0.6	- 1.4	- 0.8	0.1	0.9		- 7.4		21.6	
Gas			- 1.6	- 5.5	- 5.5			13.4	- 0.1	
Electricity										
Total Primary Energy Demand	0.7	1.4	2.1	3.0	3.8	3.5	5.1	3.7	2.5	3.6
Coal										
Oil	0.6	1.2	1.5	2.2	2.8	2.8	3.4	3.8	2.5	3.2
	(96%)	(82%)	(72%)	(73%)	(73%)					
Gas		0.1	0.1	0.2	0.4		- 7.1	13.8	6.8	5.0
		(8%)	(3%)	(8%)	(12%)					
Hydro	0.03	0.1	0.2	0.2	0.2	5.7	8.7	0.2	- 0.9	2.2
	(5%)	(7%)	(9%)	(6%)	(4%)					
NRE			0.3	0.4	0.4		29.7	1.5	0.6	8.5
			(16%)	(13%)	(11%)					
Nuclear										
Input for Electricity and Heat Generation	- 0.3	- 0.6	- 0.9	- 1.3	- 1.6	3.4	4.9	3.7	2.5	3.6
Coal										
Oil	- 0.3	- 0.4	- 0.3	- 0.5	- 0.6	1.4	- 1.6	4.3	2.9	2.1
	(91%)	(59%)	(35%)	(38%)	(39%)					
Gas		- 0.1	- 0.1	- 0.2	- 0.4		- 7.1	13.8	6.5	4.8
		(19%)	(7%)	(18%)	(26%)					
Hydro		- 0.1	- 0.2	- 0.2	- 0.2	5.7	8.7	0.2	- 0.9	2.2
		(15%)	(20%)	(14%)	(10%)					
NRE			- 0.3	- 0.4	- 0.4		29.7	1.5	0.6	8.5
			(38%)	(30%)	(25%)					
Nuclear										
Other Transformation			- 0.1	- 0.1	- 0.1					
Coal										
Oil			- 0.1	- 0.1	- 0.1					
			(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity										
Heat										

PAPUA NEW GUINEA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**0.43**	**1.02**	**1.42**	**2.07**	**2.67**	**4.0**	**4.2**	**3.9**	**2.6**	**3.5**
Coal										
Oil	0.34	0.79	1.10	1.61	2.05	3.9	4.2	3.9	2.5	3.5
	(78%)	(77%)	(77%)	(78%)	(77%)					
Gas										
NRE										
Electricity	0.09	0.23	0.32	0.46	0.61	4.3	3.9	3.7	2.9	3.5
	(22%)	(23%)	(23%)	(22%)	(23%)					
Heat										
Industry	**0.19**	**0.65**	**0.99**	**1.51**	**1.95**	**5.7**	**5.4**	**4.3**	**2.6**	**4.0**
Coal										
Oil	0.11	0.48	0.76	1.19	1.56	7.0	5.9	4.7	2.7	4.3
	(56%)	(74%)	(77%)	(79%)	(80%)					
Gas										
NRE										
Electricity	0.08	0.17	0.23	0.32	0.40	3.4	3.8	3.2	2.2	3.0
	(44%)	(26%)	(23%)	(21%)	(20%)					
Heat										
Transport	**0.21**	**0.27**	**0.30**	**0.37**	**0.44**	**1.2**	**1.1**	**2.1**	**1.9**	**1.7**
Coal										
Oil	0.21	0.27	0.30	0.37	0.44	1.2	1.1	2.1	1.9	1.7
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity										
Residential	**0.03**	**0.10**	**0.13**	**0.19**	**0.27**	**5.8**	**3.4**	**3.7**	**3.7**	**3.6**
Coal										
Oil	0.02	0.04	0.04	0.05	0.06	3.2	1.8	1.3	1.0	1.3
	(66%)	(38%)	(34%)	(26%)	(20%)					
Gas										
NRE										
Electricity	0.01	0.06	0.09	0.14	0.22	8.6	4.3	4.8	4.5	4.6
	(34%)	(62%)	(66%)	(74%)	(80%)					
Heat										
Commercial										
Coal										
Oil										
Gas										
NRE										
Electricity										
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	7	30	43	43	44
Net Energy Import Ratio (%)	96	-100	-112	-182	-120
Net Oil Import Dependency (%)	100	-122	-51	6	33

PAPUA NEW GUINEA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)		**3.0**	**4.1**	**5.9**	**7.8**		**3.8**	**3.7**	**2.9**	**3.5**
Coal										
Oil		1.5	1.3	2.2	3.1		-1.1	4.9	3.5	2.7
		(48%)	(33%)	(37%)	(39%)					
Gas		0.5	0.3	1.1	2.3		-6.0	15.0	7.5	6.0
		(15%)	(7%)	(19%)	(30%)					
Hydro		1.1	2.1	2.1	1.9		8.8	0.2	-0.9	2.2
		(35%)	(51%)	(36%)	(25%)					
NRE		0.05	0.4	0.5	0.5		29.7	1.5	0.6	8.5
		(2%)	(10%)	(8%)	(6%)					
Nuclear										
Total Installed Generation Capacity (GW)	**0.3**	**0.6**	**1.2**	**1.6**	**2.1**	**2.4**	**10.6**	**2.5**	**2.7**	**4.8**
Thermal	0.2	0.4	0.7	1.0	1.5	3.1	8.8	4.1	3.9	5.3
	(55%)	(63%)	(55%)	(65%)	(73%)					
Coal										
Oil	0.2	0.2	0.4	0.5	0.7	1.3	6.1	3.3	3.1	4.0
	(52%)	(41%)	(30%)	(32%)	(34%)					
Gas		0.1	0.3	0.5	0.8		12.9	4.9	4.6	7.0
		(22%)	(26%)	(33%)	(39%)					
Hydro	0.2	0.2	0.5	0.5	0.5	1.3	12.2			3.3
	(45%)	(36%)	(40%)	(31%)	(24%)					
NRE		0.01	0.1	0.1	0.1		32.2			8.3
		(1%)	(5%)	(4%)	(3%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**98**	**118**	**129**	**129**	**125**	**0.9**	**1.2**	**0.0**	**- 0.4**	**0.2**
Industry (toe per US$ million GDP in Industry)	104	133	136	137	134	1.1	0.4	0.1	- 0.3	0.0
Commercial (toe per US$ million GDP in Services)										
Energy Intensity (kgoe per capita)	**211**	**260**	**327**	**392**	**434**	**0.9**	**2.9**	**1.8**	**1.0**	**1.9**
Industry	62	121	155	199	223	3.1	3.2	2.5	1.1	2.2
Transport	68	51	47	48	50	- 1.4	- 1.0	0.3	0.4	- 0.0
Residential	9	19	21	25	31	3.2	1.3	1.9	2.2	1.8
Commercial										
CO_2 Emissions (million tonnes)	**1.9**	**3.7**	**4.5**	**6.9**	**9.1**	**3.1**	**2.2**	**4.5**	**2.9**	**3.2**
Electricity Generation	0.4	1.4	1.1	2.0	2.9	6.0	- 2.5	6.0	3.9	2.8
Transformation other than Electricity Generation		0.02	0.05	0.1	0.1		10.0	3.3	- 0.2	3.9
Industry	0.8	1.4	2.3	3.6	4.6	2.9	6.0	4.6	2.7	4.3
Transport	0.8	0.8	0.9	1.1	1.3	0.3	1.1	2.1	1.9	1.8
Residential		0.1	0.1	0.2	0.2		1.7	1.5	0.8	1.3
Commercial										
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	285.8	315.5	276.2	298.9	299.2	0.5	- 1.6	0.8		- 0.2
CO_2 emissions per capita (tonnes per capita)	0.6	0.7	0.7	0.9	1.0	0.5		2.6	1.4	1.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**4.50 - 4.88**	**7.42 - 8.32**	**7.98 - 9.06**
Coal Production & Transportation			
Oil & Gas Production & Processing	0.53 - 0.70	0.81 - 1.11	0.91 - 1.28
Oil & Gas International Trade	3.09 - 3.19	5.34 - 5.71	5.36 - 5.74
Oil & Gas Domestic Pipeline			
Electricity Generation & Transmission	0.88 - 1.00	1.28 - 1.49	1.71 - 2.04

PERU

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		4.8	0.5	1.6		2.4			9.3
Net Imports	0.7	2.8							3.4
TPED	**0.6**	**7.6**	**0.5**	**1.6**		**2.4**			**12.7**
Electricity and Heat Generation	- 0.1	- 0.6	- 0.2	- 1.6		- 0.1	1.7		- 0.8
Petroleum Refineries		- 0.3	- 0.3						- 0.6
Others						- 0.2			- 0.2
TFED	**0.5**	**6.1**				**2.1**	**1.7**		**10.5**
Industry	0.5	1.9				0.2	1.0		3.6
Transport		3.0							3.0
Residential		1.0				1.9	0.4		3.3
Commercial		0.2					0.3		0.5

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		3.6	6.6	1.7		2.3			14.3
Net Imports	0.8	5.2	- 4.5				- 0.1		1.5
TPED	**0.8**	**8.7**	**2.2**	**1.7**		**2.3**	**- 0.1**		**15.7**
Electricity and Heat Generation	- 0.1	- 0.7	- 1.7	- 1.7		- 0.1	2.5		- 1.8
Petroleum Refineries		- 0.4	- 0.3						- 0.7
Others						- 0.2			- 0.2
TFED	**0.7**	**7.7**	**0.2**			**2.0**	**2.5**		**13.0**
Industry	0.7	2.2	0.1			0.2	1.3		4.4
Transport		4.0							4.0
Residential		1.3	0.1			1.8	0.7		3.9
Commercial		0.2					0.5		0.7

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		5.2	9.0	2.1		2.3			18.6
Net Imports	1.4	5.5	- 4.6				- 0.1		2.2
TPED	**1.4**	**10.7**	**4.4**	**2.1**		**2.3**	**- 0.1**		**20.7**
Electricity and Heat Generation	- 0.3	- 0.5	- 3.8	- 2.1		- 0.1	3.8		- 3.0
Petroleum Refineries		- 0.4	- 0.3						- 0.8
Others						- 0.2			- 0.2
TFED	**1.1**	**9.7**	**0.3**			**2.0**	**3.7**		**16.8**
Industry	1.1	2.6	0.1			0.2	1.8		5.8
Transport		5.3							5.3
Residential		1.5	0.2			1.8	0.9		4.5
Commercial		0.3					0.9		1.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production		5.4	11.7	2.5		2.3			21.9
Net Imports	2.1	7.6	- 4.8				- 0.1		4.8
TPED	**2.1**	**13.0**	**6.8**	**2.5**		**2.3**	**- 0.1**		**26.7**
Electricity and Heat Generation	- 0.5	- 0.4	- 6.1	- 2.5		- 0.1	5.3		- 4.2
Petroleum Refineries		- 0.4	- 0.3						- 0.8
Others						- 0.2			- 0.2
TFED	**1.6**	**12.2**	**0.4**			**2.0**	**5.2**		**21.5**
Industry	1.6	3.1	0.1			0.3	2.5		7.5
Transport		7.1							7.1
Residential		1.7	0.4			1.8	1.2		5.1
Commercial		0.3					1.5		1.8

PERU

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	91	128	180	269	396	1.5	4.4	4.1	3.9	4.1
Population (million)	17.3	26.7	30.0	33.9	37.4	2.0	1.4	1.3	1.0	1.2
GDP per capita (2000 PPP US$)	5 274	4 789	6 021	7 940	10 580	- 0.4	2.9	2.8	2.9	2.9
GDP in Services (2000 PPP US$ billion)	56	72	107	173	273	1.2	5.1	4.9	4.7	4.9
GDP in Industry (2000 PPP US$ billion)	25	35	49	72	104	1.5	4.3	4.0	3.8	4.0
Urbanisation level (%)	65	74	76	80	83	0.6	0.5	0.4	0.4	0.4

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**14.5**	**9.3**	**14.3**	**18.6**	**21.9**	**- 2.0**	**5.5**	**2.7**	**1.7**	**3.1**
Coal										
Oil	10.0	4.8	3.6	5.2	5.4	- 3.2	- 3.8	3.8	0.5	0.4
	(69%)	(52%)	(25%)	(28%)	(25%)					
Gas		0.5	6.6	9.0	11.7	0.5	38.0	3.1	2.6	11.9
		(5%)	(47%)	(48%)	(53%)					
Hydro	0.6	1.6	1.7	2.1	2.5	4.4	1.5	1.9	1.6	1.7
	(4%)	(17%)	(12%)	(11%)	(11%)					
NRE	3.4	2.4	2.3	2.3	2.3	- 1.7	- 0.4		0.1	- 0.1
	(24%)	(26%)	(16%)	(12%)	(11%)					
Nuclear										
Net Imports	**- 2.9**	**3.4**	**1.5**	**2.2**	**4.8**		**- 10.1**	**4.0**	**8.2**	**1.2**
Coal	0.1	0.7	0.8	1.4	2.1	7.9	2.8	5.3	4.3	4.2
Oil	- 3.0	2.8	5.2	5.5	7.6		8.1	0.6	3.3	3.7
Gas			- 4.5	- 4.6	- 4.8			0.3	0.5	
Electricity			- 0.1	- 0.1	- 0.1			3.1	- 1.7	
Total Primary Energy Demand	**11.6**	**12.7**	**15.7**	**20.7**	**26.7**	**0.4**	**2.7**	**2.8**	**2.5**	**2.7**
Coal	0.1	0.6	0.8	1.4	2.1	7.1	3.4	5.3	4.3	4.4
	(1%)	(5%)	(5%)	(7%)	(8%)					
Oil	6.9	7.6	8.7	10.7	13.0	0.4	1.7	2.0	2.0	1.9
	(60%)	(60%)	(56%)	(51%)	(49%)					
Gas	0.4	0.5	2.2	4.4	6.8	0.5	20.0	7.3	4.5	9.8
	(4%)	(4%)	(14%)	(21%)	(26%)					
Hydro	0.6	1.6	1.7	2.1	2.5	4.4	1.5	1.9	1.6	1.7
	(5%)	(12%)	(11%)	(10%)	(9%)					
NRE	3.4	2.4	2.3	2.3	2.3	- 1.7	- 0.4		0.1	- 0.1
	(30%)	(19%)	(15%)	(11%)	(9%)					
Nuclear										
Input for Electricity and Heat Generation	**- 1.5**	**- 2.5**	**- 4.3**	**- 6.8**	**- 9.5**	**2.3**	**6.8**	**4.6**	**3.5**	**4.8**
Coal		- 0.1	- 0.1	- 0.3	- 0.5		0.7	9.3	5.2	5.3
		(5%)	(3%)	(5%)	(5%)					
Oil	- 0.9	- 0.6	- 0.7	- 0.5	- 0.4	- 1.8	1.9	- 2.5	- 3.0	- 1.4
	(56%)	(23%)	(16%)	(8%)	(4%)					
Gas	- 0.05	- 0.2	- 1.7	- 3.8	- 6.1	7.2	28.8	8.2	4.9	12.5
		(9%)	(40%)	(56%)	(64%)					
Hydro	- 0.6	- 1.6	- 1.7	- 2.1	- 2.5	4.4	1.5	1.9	1.6	1.7
	(39%)	(61%)	(40%)	(31%)	(26%)					
NRE	- 0.03	- 0.1	- 0.1	- 0.1	- 0.1	4.0	- 1.4	1.1	1.1	0.4
		(3%)	(1%)	(1%)	(1%)					
Nuclear										
Other Transformation	**- 0.7**	**- 0.8**	**- 0.9**	**- 1.0**	**- 1.0**	**0.5**	**0.9**	**1.1**	**- 0.2**	**0.6**
Coal										
Oil	- 0.4	- 0.3	- 0.4	- 0.4	- 0.4	- 0.8	1.5	1.5	- 0.2	0.9
	(55%)	(41%)	(43%)	(45%)	(45%)					
Gas	- 0.3	- 0.3	- 0.3	- 0.3	- 0.3	- 1.0	1.5	1.4	- 0.2	0.9
	(45%)	(32%)	(33%)	(34%)	(34%)					
NRE		- 0.2	- 0.2	- 0.2	- 0.2					
		(25%)	(23%)	(21%)	(21%)					
Electricity										
Heat										

PERU

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**9.2**	**10.5**	**13.0**	**16.8**	**21.5**	**0.6**	**2.8**	**2.5**	**2.5**	**2.6**
Coal	0.1	0.5	0.7	1.1	1.6	8.3	4.8	4.4	4.0	4.4
	(1%)	(5%)	(5%)	(6%)	(7%)					
Oil	5.0	6.1	7.7	9.7	12.2	0.9	2.8	2.3	2.3	2.5
	(55%)	(59%)	(59%)	(58%)	(57%)					
Gas	0.1	0.01	0.2	0.3	0.4	- 11.4	54.2	5.8	4.2	17.2
	(1%)	(0%)	(1%)	(2%)	(2%)					
NRE	3.2	2.1	2.0	2.0	2.0	- 1.9	- 0.4		0.1	- 0.1
	(35%)	(20%)	(16%)	(12%)	(10%)					
Electricity	0.8	1.7	2.5	3.7	5.2	3.8	4.6	4.1	3.5	4.0
	(8%)	(16%)	(19%)	(22%)	(24%)					
Heat										
Industry	**2.9**	**3.6**	**4.4**	**5.8**	**7.5**	**1.0**	**2.6**	**2.8**	**2.6**	**2.7**
Coal	0.1	0.5	0.7	1.1	1.6	8.3	4.8	4.4	4.0	4.4
	(3%)	(14%)	(16%)	(19%)	(21%)					
Oil	1.8	1.9	2.2	2.6	3.1	0.2	1.6	1.7	1.8	1.7
	(63%)	(53%)	(49%)	(44%)	(41%)					
Gas	0.04	0.005	0.1	0.1	0.1	- 8.7	34.6	1.6	0.8	9.8
			(1%)	(1%)	(1%)					
NRE	0.5	0.2	0.2	0.2	0.3	- 4.2	1.1	1.6	1.5	1.4
	(16%)	(5%)	(4%)	(4%)	(4%)					
Electricity	0.5	1.0	1.3	1.8	2.5	3.5	2.8	3.6	3.1	3.2
	(17%)	(29%)	(29%)	(32%)	(33%)					
Heat										
Transport	**2.3**	**3.0**	**4.0**	**5.3**	**7.1**	**1.3**	**3.8**	**2.8**	**2.8**	**3.1**
Coal										
Oil	2.3	3.0	4.0	5.3	7.1	1.3	3.8	2.8	2.8	3.1
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity										
Residential	**3.9**	**3.3**	**3.9**	**4.5**	**5.1**	**- 0.7**	**1.8**	**1.5**	**1.4**	**1.5**
Coal										
Oil	0.9	1.0	1.3	1.5	1.7	0.5	2.5	1.8	1.5	1.9
	(24%)	(31%)	(33%)	(34%)	(34%)					
Gas			0.1	0.2	0.4			7.5	5.0	
			(3%)	(5%)	(7%)					
NRE	2.8	1.9	1.8	1.8	1.8	- 1.6	- 0.6	- 0.2	- 0.1	- 0.3
	(72%)	(58%)	(48%)	(40%)	(35%)					
Electricity[1]	0.2	0.4	0.7	0.9	1.2	4.3	7.0	3.6	2.7	4.2
	(4%)	(11%)	(17%)	(21%)	(24%)					
Heat										
Commercial	**0.2**	**0.5**	**0.7**	**1.2**	**1.8**	**5.7**	**4.7**	**4.6**	**4.4**	**4.5**
Coal										
Oil[1]	0.04	0.2	0.2	0.3	0.3	7.9	1.3	1.5	1.2	1.3
	(26%)	(42%)	(32%)	(24%)	(18%)					
Gas										
NRE										
Electricity[1]	0.1	0.3	0.5	0.9	1.5	4.6	6.8	5.8	5.2	5.9
	(73%)	(58%)	(68%)	(76%)	(82%)					
Heat										

Note: 1 Historical data prior to 2002 are from national sources.

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	55	58	67	73	75
Net Energy Import Ratio (%)	-25	27	9	10	18
Net Oil Import Dependency (%)	-43	36	59	52	58

PERU

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**10**	**22**	**32**	**47**	**66**	**3.6**	**4.7**	**4.1**	**3.4**	**4.0**
Coal		0.5	1	1	2		1.1	9.7	5.5	5.7
		(2%)	(2%)	(3%)	(4%)					
Oil	3	2	3	2	2	-0.9	2.2	-2.2	-2.7	-1.2
	(27%)	(10%)	(9%)	(5%)	(2%)					
Gas		1	8	19	33	7.8	29.9	9.0	5.6	13.3
	(2%)	(4%)	(25%)	(40%)	(50%)					
Hydro	7	18	20	24	29	4.4	1.5	1.9	1.6	1.7
	(70%)	(82%)	(64%)	(52%)	(43%)					
NRE	0.1	0.2	0.2	0.3	0.4	3.8	-0.1	3.9	2.9	2.4
	(1%)	(1%)	(1%)	(1%)	(1%)					
Nuclear										
Total Installed Generation Capacity (GW)	**3**	**6**	**8**	**11**	**13**	**3.0**	**3.8**	**2.8**	**2.2**	**2.9**
Thermal	1	3	4	6	8	3.9	5.4	3.6	2.6	3.8
	(40%)	(49%)	(55%)	(60%)	(62%)					
Coal		0.15	0.15	0.30	0.43			7.2	3.5	3.8
		(3%)	(2%)	(3%)	(3%)					
Oil		2	2	2	2			-0.8	-1.0	-0.6
		(41%)	(30%)	(21%)	(15%)					
Gas		0.3	2	4	6		23.7	7.3	4.2	10.6
		(6%)	(23%)	(36%)	(44%)					
Hydro	2	3	4	4	5	2.2	2.1	1.8	1.5	1.8
	(60%)	(50%)	(44%)	(39%)	(37%)					
NRE		0.05	0.06	0.11	0.14		2.9	5.1	2.7	3.6
		(1%)	(1%)	(1%)	(1%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**127**	**99**	**87**	**77**	**67**	**- 1.1**	**- 1.6**	**- 1.2**	**- 1.3**	**- 1.4**
Industry (toe per US$ million GDP in Industry)	115	103	91	81	72	- 0.5	- 1.6	- 1.2	- 1.1	- 1.3
Commercial (toe per US$ million GDP in Services)	3	7	7	7	7	4.5	- 0.4	- 0.3	- 0.3	- 0.3
Energy Intensity (kgoe per capita)	**668**	**475**	**525**	**611**	**712**	**- 1.5**	**1.3**	**1.5**	**1.5**	**1.5**
Industry	167	135	147	171	201	- 1.0	1.1	1.5	1.6	1.4
Transport	131	112	134	157	188	- 0.7	2.3	1.6	1.8	1.9
Residential	224	125	129	131	136	- 2.6	0.4	0.2	0.4	0.3
Commercial	9	19	25	34	48	3.6	3.3	3.3	3.3	3.3
CO_2 Emissions (million tonnes)	**19.0**	**24.3**	**34.5**	**47.4**	**62.9**	**1.1**	**4.5**	**3.2**	**2.9**	**3.5**
Electricity Generation	0.7	2.7	6.5	11.6	17.4	6.1	11.6	6.0	4.1	6.9
Transformation other than Electricity Generation	1.7	1.7	2.6	2.8	2.8		5.5	0.7		1.8
Industry	6.5	7.7	9.3	12.0	15.6	0.8	2.4	2.6	2.7	2.6
Transport	6.8	9.0	12.1	16.1	21.3	1.3	3.8	2.9	2.8	3.1
Residential	2.8	3.1	3.8	4.6	5.3	0.5	2.6	1.9	1.4	1.9
Commercial	0.6	0.1	0.2	0.3	0.5	- 8.0	9.1	4.1	5.2	5.9
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	208.4	189.7	191.3	176.0	158.8	- 0.4	0.1	- 0.8	- 1.0	- 0.6
CO_2 emissions per capita (tonnes per capita)	1.1	0.9	1.2	1.4	1.7	- 0.9	3.0	2.0	1.9	2.2

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**10.4 - 12.6**	**19.2 - 24.4**	**28.9 - 37.5**
Coal Production & Transportation			
Oil & Gas Production & Processing	2.65 - 3.18	4.90 - 6.54	6.68 - 9.12
Oil & Gas International Trade	2.54 - 2.67	2.58 - 2.71	2.65 - 2.79
Oil & Gas Domestic Pipeline	1.29 - 1.84	2.03 - 2.89	3.39 - 4.84
Electricity Generation & Transmission	3.90 - 4.90	9.66 - 12.25	16.20 - 20.73

PHILIPPINES

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	1.0	0.3	1.4	0.5		18.2			21.5
Net Imports	6.0	16.2	0.4						22.5
TPED	**7.1**	**16.3**	**1.8**	**0.5**		**18.2**			**43.9**
Electricity and Heat Generation	- 6.0	- 0.6	- 1.8	- 0.5		- 11.0	3.5		- 16.4
Petroleum Refineries		- 2.1							- 2.1
Others	- 0.2								- 0.2
TFED	**0.8**	**13.8**				**7.2**	**3.4**		**25.2**
Industry	0.8	2.1				3.9	1.3		8.2
Transport		9.0							9.0
Residential		1.2				3.2	1.2		5.6
Commercial		1.6					0.8		2.4

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	3.3	1.0	2.7	0.7		19.4			27.0
Net Imports	8.1	22.7	3.0						33.8
TPED	**11.4**	**23.7**	**5.7**	**0.7**		**19.4**			**60.8**
Electricity and Heat Generation	- 9.6	- 1.0	- 5.0	- 0.7		- 11.8	5.9		- 22.2
Petroleum Refineries		- 2.8							- 2.8
Others	- 0.7								- 0.7
TFED	**1.1**	**19.9**	**0.6**			**7.6**	**5.9**		**35.2**
Industry	1.1	2.5	0.6			4.3	2.0		10.5
Transport		14.0							14.0
Residential		1.4				3.3	2.4		7.2
Commercial		2.0					1.5		3.5

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.1	1.1	4.7	0.9		20.4			32.2
Net Imports	14.8	32.6	3.2						50.6
TPED	**19.9**	**33.7**	**7.9**	**0.9**		**20.4**			**82.8**
Electricity and Heat Generation	- 17.5	- 1.2	- 6.9	- 0.9		- 12.0	10.1		- 28.3
Petroleum Refineries		- 4.1							- 4.1
Others	- 1.0								- 1.0
TFED	**1.5**	**28.3**	**1.0**			**8.4**	**10.1**		**49.4**
Industry	1.5	3.1	1.0			5.0	3.2		13.8
Transport		21.2							21.2
Residential		1.7				3.4	4.4		9.5
Commercial		2.3					2.6		4.9

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.9	1.2	4.7	1.3		22.1			35.3
Net Imports	24.1	44.5	7.1						75.6
TPED	**30.0**	**45.7**	**11.8**	**1.3**		**22.1**			**110.9**
Electricity and Heat Generation	- 27.0	- 1.4	- 10.4	- 1.3		- 12.6	15.9		- 36.8
Petroleum Refineries		- 5.9							- 5.9
Others	- 1.1								- 1.1
TFED	**1.9**	**38.4**	**1.4**			**9.5**	**15.9**		**67.1**
Industry	1.9	3.9	1.4			6.0	4.9		18.1
Transport		29.8							29.8
Residential		2.1				3.5	7.0		12.5
Commercial		2.6					4.0		6.7

PHILIPPINES

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	139	235	338	506	732	2.4	4.7	4.1	3.8	4.1
Population (million)	48.0	79.9	92.3	105.6	116.5	2.3	1.8	1.4	1.0	1.4
GDP per capita (2000 PPP US$)	2 884	2 935	3 660	4 792	6 282	0.1	2.8	2.7	2.7	2.8
GDP in Services (2000 PPP US$ billion)	53	130	199	318	481	4.2	5.5	4.8	4.2	4.8
GDP in Industry (2000 PPP US$ billion)	32	80	115	177	266	4.3	4.6	4.4	4.2	4.4
Urbanisation level (%)	38	60	66	72	76	2.2	1.2	0.8	0.6	0.8

ENERGY PROJECTIONS

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
	Mtoe									
Production	**9.8**	**21.5**	**27.0**	**32.2**	**35.3**	**3.7**	**2.9**	**1.8**	**0.9**	**1.8**
Coal		1.0	3.3	5.1	5.9	8.9	15.8	4.6	1.4	6.5
		(5%)	(12%)	(16%)	(17%)					
Oil	0.5	0.3	1.0	1.1	1.2	- 2.1	15.3	0.7	1.5	5.0
	(5%)	(1%)	(4%)	(3%)	(4%)					
Gas		1.4	2.7	4.7	4.7		8.2	5.9		4.4
		(7%)	(10%)	(15%)	(13%)					
Hydro		0.5	0.7	0.9	1.3	2.6	3.9	2.2	3.9	3.3
		(2%)	(3%)	(3%)	(4%)					
NRE	8.8	18.2	19.4	20.4	22.1	3.4	0.8	0.5	0.8	0.7
	(90%)	(85%)	(72%)	(63%)	(63%)					
Nuclear										
Net Imports	**11.6**	**22.5**	**33.8**	**50.6**	**75.6**	**3.1**	**5.2**	**4.1**	**4.1**	**4.4**
Coal	0.2	6.0	8.1	14.8	24.1	16.3	3.8	6.2	5.0	5.1
Oil	11.4	16.2	22.7	32.6	44.5	1.6	4.3	3.7	3.2	3.7
Gas		0.4	3.0	3.2	7.1		30.8	0.6	8.3	11.3
Electricity										
Total Primary Energy Demand	**20.4**	**43.9**	**60.8**	**82.8**	**110.9**	**3.5**	**4.2**	**3.1**	**3.0**	**3.4**
Coal	0.4	7.1	11.4	19.9	30.0	14.5	6.1	5.8	4.2	5.3
	(2%)	(16%)	(19%)	(24%)	(27%)					
Oil	10.9	16.3	23.7	33.7	45.7	1.8	4.8	3.6	3.1	3.8
	(54%)	(37%)	(39%)	(41%)	(41%)					
Gas		1.8	5.7	7.9	11.8		15.6	3.4	4.1	7.0
		(4%)	(9%)	(10%)	(11%)					
Hydro	0.3	0.5	0.7	0.9	1.3	2.6	3.9	2.2	3.9	3.3
	(1%)	(1%)	(1%)	(1%)	(1%)					
NRE	8.8	18.2	19.4	20.4	22.1	3.4	0.8	0.5	0.8	0.7
	(43%)	(42%)	(32%)	(25%)	(20%)					
Nuclear										
Input for Electricity and Heat Generation	**- 5.5**	**- 19.9**	**- 28.1**	**- 38.4**	**- 52.7**	**6.0**	**4.4**	**3.2**	**3.2**	**3.5**
Coal	- 0.1	- 6.0	- 9.6	- 17.5	- 27.0	24.3	6.1	6.2	4.4	5.5
	(1%)	(30%)	(34%)	(45%)	(51%)					
Oil	- 3.4	- 0.6	- 1.0	- 1.2	- 1.4	- 7.9	7.8	1.6	1.5	3.3
	(61%)	(3%)	(4%)	(3%)	(3%)					
Gas		- 1.8	- 5.0	- 6.9	- 10.4		13.9	3.2	4.2	6.5
		(9%)	(18%)	(18%)	(20%)					
Hydro	- 0.3	- 0.5	- 0.7	- 0.9	- 1.3	2.6	3.9	2.2	3.9	3.3
	(5%)	(3%)	(3%)	(2%)	(3%)					
NRE	- 1.8	- 11.0	- 11.8	- 12.0	- 12.6	8.6	0.8	0.2	0.5	0.5
	(32%)	(56%)	(42%)	(31%)	(24%)					
Nuclear										
Other Transformation	**- 1.3**	**- 2.3**	**- 3.5**	**- 5.1**	**- 7.0**	**2.8**	**5.1**	**4.0**	**3.2**	**4.0**
Coal		- 0.2	- 0.7	- 1.0	- 1.1		15.4	4.2	1.0	6.1
		(9%)	(19%)	(19%)	(16%)					
Oil	- 1.3	- 2.1	- 2.8	- 4.1	- 5.9	2.4	3.5	4.0	3.6	3.7
	(100%)	(91%)	(81%)	(81%)	(84%)					
Gas										
NRE										
Electricity										
Heat										

PHILIPPINES

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**10.8**	**25.2**	**35.2**	**49.4**	**67.1**	**3.9**	**4.3**	**3.5**	**3.1**	**3.6**
Coal	0.2	0.8	1.1	1.5	1.9	6.5	4.0	2.9	2.6	3.1
	(2%)	(3%)	(3%)	(3%)	(3%)					
Oil	6.0	13.8	19.9	28.3	38.4	3.9	4.6	3.6	3.1	3.7
	(55%)	(55%)	(56%)	(57%)	(57%)					
Gas			0.6	1.0	1.4			4.6	3.3	
			(2%)	(2%)	(2%)					
NRE	3.5	7.2	7.6	8.4	9.5	3.4	0.7	1.0	1.2	1.0
	(32%)	(29%)	(22%)	(17%)	(14%)					
Electricity	1.2	3.4	5.9	10.1	15.9	4.8	7.3	5.5	4.6	5.7
	(11%)	(13%)	(17%)	(21%)	(24%)					
Heat										
Industry	**4.8**	**8.2**	**10.5**	**13.8**	**18.1**	**2.5**	**3.2**	**2.7**	**2.8**	**2.9**
Coal	0.2	0.8	1.1	1.5	1.9	6.5	4.0	2.9	2.6	3.1
	(4%)	(10%)	(11%)	(11%)	(11%)					
Oil	3.0	2.1	2.5	3.1	3.9	- 1.7	2.5	2.1	2.4	2.3
	(63%)	(25%)	(24%)	(22%)	(22%)					
Gas			0.6	1.0	1.4			4.6	3.3	
			(6%)	(7%)	(8%)					
NRE	0.9	3.9	4.3	5.0	6.0	7.2	1.0	1.5	1.9	1.5
	(18%)	(48%)	(41%)	(36%)	(33%)					
Electricity	0.7	1.3	2.0	3.2	4.9	3.0	4.9	4.9	4.4	4.7
	(15%)	(16%)	(19%)	(23%)	(27%)					
Heat										
Transport	**1.9**	**9.0**	**14.0**	**21.2**	**29.8**	**7.2**	**5.7**	**4.2**	**3.5**	**4.4**
Coal										
Oil	1.9	9.0	14.0	21.2	29.8	7.2	5.7	4.2	3.5	4.4
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity		0.007	0.010	0.010	0.010		4.6			1.3
		(0%)	(0%)	(0%)	(0%)					
Residential	**3.7**	**5.6**	**7.2**	**9.5**	**12.5**	**1.9**	**3.1**	**2.9**	**2.8**	**2.9**
Coal										
Oil	0.8	1.2	1.4	1.7	2.1	1.6	2.2	2.1	2.1	2.1
	(22%)	(21%)	(19%)	(18%)	(17%)					
Gas										
NRE	2.6	3.2	3.3	3.4	3.5	1.0	0.3	0.2	0.2	0.2
	(71%)	(58%)	(46%)	(36%)	(28%)					
Electricity	0.3	1.2	2.4	4.4	7.0	7.2	9.5	6.0	4.7	6.5
	(7%)	(21%)	(34%)	(46%)	(56%)					
Heat										
Commercial	**0.4**	**2.4**	**3.5**	**4.9**	**6.7**	**8.4**	**4.6**	**3.5**	**3.1**	**3.7**
Coal										
Oil	0.2	1.6	2.0	2.3	2.6	11.0	2.8	1.8	1.3	1.9
	(39%)	(65%)	(56%)	(48%)	(40%)					
Gas										
NRE										
Electricity[1]	0.3	0.8	1.5	2.6	4.0	5.6	7.5	5.5	4.6	5.7
	(61%)	(35%)	(44%)	(52%)	(60%)					
Heat										

Note: 1 Historical data prior to 2002 are from national sources.

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	55	74	81	82	82
Net Energy Import Ratio (%)	54	51	56	61	68
Net Oil Import Dependency (%)	100	100	96	97	97

PHILIPPINES

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**18**	**51**	**89**	**136**	**208**	**4.9**	**7.0**	**4.4**	**4.3**	**5.1**
Coal		21	35	69	113	24.1	6.8	6.9	5.1	6.2
	(1%)	(41%)	(40%)	(51%)	(54%)					
Oil	12	2	4	5	6	-7.4	8.1	1.8	1.8	3.6
	(68%)	(4%)	(5%)	(4%)	(3%)					
Gas		9	27	37	57		14.1	3.4	4.4	6.7
		(18%)	(30%)	(27%)	(28%)					
Hydro	4	6	8	10	15	2.6	3.9	2.2	3.9	3.3
	(20%)	(12%)	(9%)	(8%)	(7%)					
NRE	2	13	14	15	16	8.6	1.1	0.4	1.0	0.8
	(12%)	(25%)	(16%)	(11%)	(8%)					
Nuclear										
Total Installed Generation Capacity (GW)	**4**	**15**	**18**	**26**	**36**	**5.6**	**2.8**	**3.4**	**3.5**	**3.3**
Thermal	3	10	13	20	29	5.6	2.9	4.4	3.9	3.8
	(70%)	(70%)	(70%)	(77%)	(80%)					
Coal		4	6	11	17		4.5	6.6	4.8	5.3
		(27%)	(31%)	(41%)	(47%)					
Oil		4	3	3	3		-2.6	0.8		-0.5
		(24%)	(15%)	(12%)	(9%)					
Gas		3	4	6	9		5.9	3.3	4.0	4.3
		(19%)	(24%)	(23%)	(25%)					
Hydro	1	3	3	4	5	4.8	3.1	0.9	2.5	2.1
	(20%)	(17%)	(17%)	(14%)	(12%)					
NRE		2	2	2	3	7.4	2.4	0.6	1.1	1.3
	(9%)	(13%)	(13%)	(10%)	(8%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**147**	**187**	**180**	**164**	**152**	**1.1**	**- 0.5**	**- 1.0**	**- 0.8**	**- 0.7**
Industry (toe per US$ million GDP in Industry)	149	102	91	78	68	- 1.7	- 1.3	- 1.6	- 1.3	- 1.4
Commercial (toe per US$ million GDP in Services)	8	18	17	15	14	4.1	- 0.8	- 1.2	- 1.1	- 1.0
Energy Intensity (kgoe per capita)	**425**	**549**	**659**	**784**	**952**	**1.2**	**2.3**	**1.7**	**2.0**	**2.0**
Industry	100	102	114	130	156	0.1	1.4	1.3	1.8	1.5
Transport	40	113	152	201	256	4.8	3.8	2.8	2.4	3.0
Residential	77	70	78	90	107	- 0.4	1.3	1.5	1.8	1.5
Commercial	9	30	37	46	57	5.9	2.8	2.1	2.1	2.3
CO_2 Emissions (million tonnes)	**30.6**	**75.1**	**119.4**	**183.6**	**262.0**	**4.2**	**6.0**	**4.4**	**3.6**	**4.6**
Electricity Generation	8.8	29.1	52.0	87.4	133.0	5.6	7.5	5.3	4.3	5.6
Transformation other than Electricity Generation	2.4	1.4	3.4	5.1	5.7	- 2.6	12.1	4.3	1.2	5.3
Industry	10.8	9.4	11.9	15.1	19.3	- 0.6	3.0	2.4	2.5	2.6
Transport	5.7	27.0	42.0	63.7	89.5	7.4	5.7	4.3	3.5	4.4
Residential	2.4	3.6	4.2	5.2	6.4	1.8	2.2	2.1	2.1	2.1
Commercial	0.5	4.8	5.9	7.1	8.0	10.7	2.8	1.8	1.3	1.9
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	220.8	320.3	353.7	362.8	357.9	1.7	1.2	0.3	- 0.1	0.4
CO_2 emissions per capita (tonnes per capita)	0.6	0.9	1.3	1.7	2.2	1.8	4.1	3.0	2.6	3.2

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**15.6 - 21.0**	**37.5 - 48.9**	**67.5 - 87.4**
Coal Production & Transportation	0.27 - 0.34	0.52 - 0.68	0.66 - 0.88
Oil & Gas Production & Processing	5.14 - 7.54	8.57 - 12.57	13.48 - 19.71
Oil & Gas International Trade	0.02 - 0.04	0.56 - 0.76	1.10 - 1.47
Oil & Gas Domestic Pipeline	1.13 - 1.62	1.86 - 2.65	3.04 - 4.34
Electricity Generation & Transmission	9.05 - 11.41	25.94 - 32.25	49.26 - 60.98

RUSSIA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	121.4	383.5	518.9	13.9	38.1	11.7			1 087.5
Net Imports	- 15.2	- 263.7	- 172.7				- 1.1		- 452.7
TPED	**106.1**	**120.0**	**346.3**	**13.9**	**38.1**	**11.7**	**- 1.1**		**635.0**
Electricity and Heat Generation	- 84.8	- 25.7	- 207.3	- 13.9	- 38.1	- 9.3	63.5	142.9	- 172.7
Petroleum Refineries		- 12.1	- 3.4				- 2.3	- 6.8	- 24.7
Others	- 3.5	- 6.5	- 49.4				- 7.2	- 5.4	- 72.1
TFED	**17.8**	**75.7**	**86.2**			**2.3**	**50.4**	**130.7**	**363.1**
Industry	11.1	20.9	41.7			0.6	29.4	53.3	156.9
Transport		50.0					3.1		53.1
Residential	6.4	3.9	42.2			1.7	12.3	67.2	133.6
Commercial	0.4	0.9	2.3				5.6	10.2	19.4

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	136.8	401.3	522.7	15.9	53.9	14.1			1 144.6
Net Imports	- 18.8	- 269.6	- 182.8				- 2.3		- 473.6
TPED	**118.0**	132	**339.9**	**15.9**	**53.9**	**14.1**	**- 2.3**		**671.1**
Electricity and Heat Generation	- 96.5	- 18.8	- 190.9	- 15.9	- 53.9	- 11.2	73.2	136.7	- 177.3
Petroleum Refineries		- 13.0	- 3.6				- 2.4	- 7.2	- 26.3
Others	- 4.0	- 6.6	- 48.3				- 7.3	- 5.5	- 71.6
TFED	**17.4**	**93.3**	**97.1**			**2.9**	**61.1**	**124.0**	**395.8**
Industry	11.1	27.0	53.8			0.7	36.3	54.5	183.3
Transport		60.6					4.5		65.1
Residential	6.1	4.7	41.4			2.2	13.4	61.3	129.1
Commercial	0.3	0.9	1.9				6.9	8.2	18.2

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	137.1	425.6	552.7	16.6	65.5	16.4			1 213.9
Net Imports	- 18.8	- 280.4	- 188.1				- 3.6		- 490.9
TPED	**118.3**	**145.2**	**364.6**	**16.6**	**65.5**	**16.4**	**- 3.6**		**723.0**
Electricity and Heat Generation	- 97.9	- 17.3	- 198.2	- 16.6	- 65.5	- 12.6	87.0	133.4	- 187.7
Petroleum Refineries		- 14.0	- 3.8			- 0.1	- 2.5	- 7.6	- 28.0
Others	- 4.0	- 6.6	- 48.7				- 7.3	- 5.5	- 72.1
TFED	**16.5**	**107.2**	**113.8**			**3.7**	**73.5**	**120.3**	**435.1**
Industry	11.2	34.1	68.4			0.8	44.7	55.9	215.1
Transport		67.2					5.5		72.8
Residential	5.1	5.0	43.5			2.8	14.8	58.2	129.5
Commercial	0.2	0.9	1.9			0.1	8.5	6.2	17.8

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	136.2	445.2	582.7	17.0	82.9	19.1			1 283.1
Net Imports	- 18.8	- 294.0	- 196.7				- 4.5		- 514.0
TPED	**117.4**	**151.2**	**385.9**	**17.0**	**82.9**	**19.1**	**- 4.5**		**769.1**
Electricity and Heat Generation	- 97.8	- 14.8	- 197.1	- 17.0	- 82.9	- 13.7	99.0	131.4	- 192.7
Petroleum Refineries		- 14.6	- 3.9			- 0.1	- 2.6	- 7.7	- 28.8
Others	- 4.0	- 6.6	- 48.9				- 7.3	- 5.4	- 72.1
TFED	**15.7**	**115.3**	**136.1**			**5.4**	**84.8**	**118.3**	**475.4**
Industry	11.3	38.8	82.1			0.9	52.1	57.4	242.5
Transport		70.2					6.3		76.5
Residential	4.2	5.4	52.2			4.4	16.1	56.2	138.4
Commercial	0.2	0.9	1.9			0.1	10.3	4.7	18.1

RUSSIA

MACRO ASSUMPTIONS

	1992	2002	2010	2020	2030	Growth Rate (% per annum) 92-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	1 820	1 658	2 514	3 574	4 752	- 0.9	5.3	3.6	2.9	3.8
Population (million)	148	145	138	129	121	- 0.2	- 0.7	- 0.6	- 0.7	- 0.7
GDP per capita (2000 PPP US$)	12 275	11 441	18 285	27 688	39 376	- 0.7	6.0	4.2	3.6	4.5
GDP in Services (2000 PPP US$ billion)	894	862	1 310	1 926	2 651	- 0.4	5.4	3.9	3.2	4.1
GDP in Industry (2000 PPP US$ billion)	708	412	629	941	1 273	- 5.3	5.4	4.1	3.1	4.1
Urbanisation level (%)	73	73	74	75	78	0.0	0.1	0.2	0.4	0.2

ENERGY PROJECTIONS

Mtoe

	1992	2002	2010	2020	2030	Growth rate (% per annum) 92-02	02-10	10-20	20-30	02-30
Production	**1 118.7**	**1 087.5**	**1 144.6**	**1 213.9**	**1 283.1**	**- 0.3**	**0.6**	**0.6**	**0.6**	**0.6**
Coal	143.9	121.4	136.8	137.1	136.2	-1.7	1.5	0.03	- 0.1	0.4
	(13%)	(11%)	(12%)	(11%)	(11%)					
Oil	398.8	383.5	401.3	425.6	445.2	-0.4	0.6	0.6	0.5	0.5
	(36%)	(35%)	(35%)	(35%)	(35%)					
Gas	517.2	518.9	522.7	552.7	582.7	0.0	0.1	0.6	0.5	0.4
	(46%)	(48%)	(46%)	(46%)	(45%)					
Hydro	14.8	13.9	15.9	16.6	17.0		1.6	0.4	0.2	0.7
	(1%)	(1%)	(1%)	(1%)	(1%)					
NRE	12.5	11.7	14.1	16.4	19.1	-0.6	2.3	1.5	1.6	1.8
	(1%)	(1%)	(1%)	(1%)	(1%)					
Nuclear	31.5	38.1	53.9	65.5	82.9	1.9	4.4	2.0	2.4	2.8
	(3%)	(3%)	(5%)	(5%)	(6%)					
Net Imports	**- 328.7**	**- 452.7**	**- 473.6**	**- 490.9**	**- 514.0**	**3.3**	**0.6**	**0.4**	**0.5**	**0.5**
Coal	- 1.4	- 15.2	- 18.8	- 18.8	- 18.8	27.0	2.7			0.8
Oil	- 173.8	- 263.7	- 269.6	- 280.4	- 294.0	4.3	0.3	0.4	0.5	0.4
Gas	- 152.1	- 172.7	- 182.8	- 188.1	- 196.7	1.3	0.7	0.3	0.5	0.5
Electricity	- 1.4	- 1.1	- 2.3	- 3.6	- 4.5	-2.2	9.6	4.5	2.2	5.1
Total Primary Energy Demand	**776.2**	**635.0**	**671.1**	**723.0**	**769.1**	**- 2.0**	**0.7**	**0.7**	**0.6**	**0.7**
Coal	132.2	106.1	118.0	118.3	117.4	-2.2	1.3	0.03	- 0.1	0.4
	(17%)	(17%)	(18%)	(16%)	(15%)					
Oil	221.0	120.0	131.7	145.2	151.2	-5.9	1.2	1.0	0.4	0.8
	(28%)	(19%)	(20%)	(20%)	(20%)					
Gas	364.2	346.3	339.9	364.6	385.9	-0.5	- 0.2	0.7	0.6	0.4
	(47%)	(55%)	(51%)	(50%)	(50%)					
Hydro	14.8	14.2	16.2	16.8	17.2	-0.2	1.6	0.4	0.2	0.7
	(2%)	(2%)	(2%)	(2%)	(2%)					
NRE	12.5	11.7	14.1	16.4	19.1	-0.6	2.3	1.5	1.6	1.8
	(2%)	(2%)	(2%)	(2%)	(2%)					
Nuclear	31.5	38.1	53.9	65.5	82.9		4.4	2.0	2.4	2.8
	(4%)	(6%)	(8%)	(9%)	(11%)					
Input for Electricity and Heat Generation	**- 413.6**	**- 379.1**	**- 387.2**	**- 408.1**	**- 423.1**	**- 0.9**	**0.3**	**0.5**	**0.4**	**0.4**
Coal	- 86.2	- 84.8	- 96.5	- 97.9	- 97.8	-0.2	1.6	0.1		0.5
	(21%)	(22%)	(25%)	(24%)	(23%)					
Oil	- 59.2	- 25.7	- 18.8	- 17.3	- 14.8	-8.0	- 3.8	- 0.8	- 1.5	- 2.0
	(14%)	(7%)	(5%)	(4%)	(3%)					
Gas	- 217.5	- 207.3	- 190.9	- 198.2	- 197.1	-0.5	- 1.0	0.4	- 0.1	- 0.2
	(53%)	(55%)	(49%)	(49%)	(47%)					
Hydro	- 14.8	- 13.9	- 15.9	- 16.6	- 17.0	-0.6	1.6	0.4	0.2	0.7
	(4%)	(4%)	(4%)	(4%)	(4%)					
NRE	- 4.4	- 9.3	- 11.2	- 12.6	- 13.7	7.9	2.3	1.3	0.8	1.4
	(1%)	(2%)	(3%)	(3%)	(3%)					
Nuclear	- 31.5	- 38.1	- 53.9	- 65.5	- 82.9	1.9	4.4	2.0	2.4	2.8
	(8%)	(10%)	(14%)	(16%)	(20%)					
Other Transformation	**- 85.0**	**- 96.8**	**- 97.9**	**- 100.1**	**- 100.9**	**1.3**	**0.1**	**0.2**	**0.1**	**0.1**
Coal	- 0.4	- 3.5	- 4.0	- 4.0	- 4.0	23.4	1.5		- 0.1	0.4
	(1%)	(4%)	(4%)	(4%)	(4%)					
Oil	- 19.8	- 18.6	- 19.5	- 20.6	- 21.2	-0.6	0.6	0.5	0.3	0.5
	(23%)	(19%)	(20%)	(21%)	(21%)					
Gas	- 40.0	- 52.8	- 51.9	- 52.5	- 52.8	2.8	- 0.2	0.1		
	(47%)	(55%)	(53%)	(52%)	(52%)					
NRE	- 0.1			- 0.1	- 0.1				0.2	
	(0%)			(0%)	(0%)					
Electricity	- 9.4	- 9.5	- 9.7	- 9.9	- 9.8	0.1	0.2	0.2		0.1
	(11%)	(10%)	(10%)	(10%)	(10%)					
Heat	- 15.2	- 12.2	- 12.7	- 13.1	- 13.1	-2.2	0.5	0.3		0.2
	(18%)	(13%)	(13%)	(13%)	(13%)					

RUSSIA

	Mtoe					Growth rate (% per annum)				
	1992	2002	2010	2020	2030	92-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**517.2**	**363.1**	**395.8**	**435.1**	**475.4**	**- 3.5**	**1.1**	**1.0**	**0.9**	**1.0**
Coal	28.6	17.8	17.4	16.5	15.7	-4.6	- 0.2	- 0.6	- 0.5	- 0.5
	(6%)	(5%)	(4%)	(4%)	(3%)					
Oil	116.6	75.7	93.3	107.2	115.3	-4.2	2.7	1.4	0.7	1.5
	(23%)	(21%)	(24%)	(25%)	(24%)					
Gas	102.1	86.2	97.1	113.8	136.1	-1.7	1.5	1.6	1.8	1.6
	(20%)	(24%)	(25%)	(26%)	(29%)					
NRE	7.9	2.3	2.9	3.7	5.4	-11.5	2.7	2.5	3.9	3.0
	(2%)	(1%)	(1%)	(1%)	(1%)					
Electricity	57.6	50.4	61.1	73.5	84.8	-1.3	2.4	1.9	1.4	1.9
	(11%)	(14%)	(15%)	(17%)	(18%)					
Heat	204.4	130.7	124.0	120.3	118.3	-4.4	- 0.7	- 0.3	- 0.2	- 0.4
	(40%)	(36%)	(31%)	(28%)	(25%)					
Industry	**249.3**	**156.9**	**183.3**	**215.1**	**242.5**	**- 4.5**	**2.0**	**1.6**	**1.2**	**1.6**
Coal	13.8	11.1	11.1	11.2	11.3	-2.2		0.1	0.1	0.1
	(6%)	(7%)	(6%)	(5%)	(5%)					
Oil	36.3	20.9	27.0	34.1	38.8	-5.4	3.3	2.3	1.3	2.2
	(15%)	(13%)	(15%)	(16%)	(16%)					
Gas	52.7	41.7	53.8	68.4	82.1	-2.3	3.2	2.4	1.8	2.4
	(21%)	(27%)	(29%)	(32%)	(34%)					
NRE	1.6	0.6	0.7	0.8	0.9	-10.2	2.3	1.9	1.5	1.9
	(1%)	(0%)	(0%)	(0%)	(0%)					
Electricity	42.1	29.4	36.3	44.7	52.1	-3.5	2.6	2.1	1.5	2.1
	(17%)	(19%)	(20%)	(21%)	(21%)					
Heat	102.9	53.3	54.5	55.9	57.4	-6.4	0.3	0.3	0.3	0.3
	(41%)	(34%)	(30%)	(26%)	(24%)					
Transport	**77.4**	**53.1**	**65.1**	**72.8**	**76.5**	**- 3.7**	**2.6**	**1.1**	**0.5**	**1.3**
Coal										
Oil	71.4	50.0	60.6	67.2	70.2	-3.5	2.4	1.0	0.4	1.2
	(92%)	(94%)	(93%)	(92%)	(92%)					
Gas	1.1									
	(1%)									
NRE										
Electricity	5.0	3.1	4.5	5.5	6.3	-4.6	4.7	2.1	1.2	2.5
	(6%)	(6%)	(7%)	(8%)	(8%)					
Residential	**163.4**	**133.6**	**129.1**	**129.5**	**138.4**	**- 2.0**	**- 0.4**		**0.7**	**0.1**
Coal	9.5	6.4	6.1	5.1	4.2	-3.9	- 0.5	- 1.8	- 1.8	- 1.5
	(6%)	(5%)	(5%)	(4%)	(3%)					
Oil	8.6	3.9	4.7	5.0	5.4	-7.7	2.5	0.6	0.7	1.2
	(5%)	(3%)	(4%)	(4%)	(4%)					
Gas	40.6	42.2	41.4	43.5	52.2	0.4	- 0.2	0.5	1.8	0.8
	(25%)	(32%)	(32%)	(34%)	(38%)					
NRE	5.7	1.7	2.2	2.8	4.4	-11.1	2.8	2.6	4.5	3.3
	(3%)	(1%)	(2%)	(2%)	(3%)					
Electricity	10.0	12.3	13.4	14.8	16.1	2.1	1.1	1.0	0.9	1.0
	(6%)	(9%)	(10%)	(11%)	(12%)					
Heat	89.0	67.2	61.3	58.2	56.2	-2.8	- 1.1	- 0.5	- 0.4	- 0.6
	(54%)	(50%)	(47%)	(45%)	(41%)					
Commercial	**32.1**	**19.4**	**18.2**	**17.8**	**18.1**	**- 4.9**	**- 0.8**	**- 0.2**	**0.2**	**- 0.3**
Coal	5.3	0.4	0.3	0.2	0.2	-23.7	- 2.6	- 2.6	- 2.6	- 2.6
	(16%)	(2%)	(2%)	(1%)	(1%)					
Oil	0.3	0.9	0.9	0.9	0.9	10.4	0.4			0.1
	(1%)	(5%)	(5%)	(5%)	(5%)					
Gas	7.8	2.3	1.9	1.9	1.9	-11.4	- 2.6	- 0.2		- 0.8
	(24%)	(12%)	(10%)	(10%)	(10%)					
NRE	0.7			0.1	0.1				4.9	
	(2%)			(0%)	(1%)					
Electricity	5.6	5.6	6.9	8.5	10.3	0.1	2.6	2.1	1.9	2.2
	(17%)	(29%)	(38%)	(48%)	(57%)					
Heat	12.5	10.2	8.2	6.2	4.7	-2.0	- 2.7	- 2.7	- 2.7	- 2.7
	(39%)	(52%)	(45%)	(35%)	(26%)					

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	76	71	76	76	77
Net Energy Import Ratio (%)	-42	-71	-71	-68	-67
Net Oil Import Dependency (%)	-79	-220	-205	-193	-194

RUSSIA

ELECTRICITY GENERATION

	1992	2002	2010	2020	2030	Growth rate (% per annum) 92-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**1 008**	**889**	**1 009**	**1 160**	**1 280**	**- 1.2**	**1.6**	**1.4**	**1.0**	**1.3**
Coal	154	170	231	246	253	1.0	3.9	0.6	0.3	1.4
	(15%)	(19%)	(23%)	(21%)	(20%)					
Oil	100	27	12	10	2	- 12.2	- 9.4	- 2.1	- 13.7	- 8.5
	(10%)	(3%)	(1%)	(1%)						
Gas	461	385	371	453	496	- 1.8	- 0.4	2.0	0.9	0.9
	(46%)	(43%)	(37%)	(39%)	(39%)					
Hydro	172	162	185	193	197	- 0.6	1.6	0.4	0.2	0.7
	(17%)	(18%)	(18%)	(17%)	(15%)					
NRE	2	3	9	15	22	4.6	14.3	5.6	3.8	7.4
			(1%)	(1%)	(2%)					
Nuclear	120	142	201	244	308	1.7	4.4	2.0	2.4	2.8
	(12%)	(16%)	(20%)	(21%)	(24%)					
Total Installed Generation Capacity (GW)	**213**	**223**	**270**	**309**	**352**	**0.4**	**2.4**	**1.4**	**1.3**	**1.6**
Thermal	150	156	191	222	256	0.4	2.6	1.5	1.4	1.8
	(70%)	(70%)	(71%)	(72%)	(73%)					
Coal		89	97	130	86		5.9	0.1	0.3	1.8
		(23%)	(30%)	(27%)	(24%)					
Oil		15	12	9	3		- 2.8	- 2.8	- 10.4	- 5.6
		(7%)	(4%)	(3%)	(1%)					
Gas		89	97	130	167		1.1	2.9	2.5	2.3
		(40%)	(36%)	(42%)	(47%)					
Hydro	43	45	50	52	53	0.4	1.3	0.4	0.2	0.6
	(20%)	(20%)	(19%)	(17%)	(15%)					
NRE	0.01	1	2	3	4	49.1	16.3	5.0	1.8	6.9
			(1%)	(1%)	(1%)					
Nuclear	20	21	27	32	40	0.5	2.8	1.9	2.3	2.3
	(9%)	(10%)	(10%)	(10%)	(11%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1992	2002	2010	2020	2030	Growth Rates (% per annum) 92-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**426**	**383**	**267**	**202**	**162**	**- 1.1**	**- 4.4**	**- 2.7**	**- 2.2**	**- 3.0**
Industry (toe per US$ million GDP in Industry)	352	381	292	228	191	0.8	- 3.3	- 2.4	- 1.8	- 2.4
Commercial (toe per US$ million GDP in Services)	36	23	14	9	7	- 4.6	- 5.8	- 4.0	- 3.0	- 4.2
Energy Intensity (kgoe per capita)	**5 234**	**4 381**	**4 880**	**5 601**	**6 373**	**- 1.8**	**1.4**	**1.4**	**1.3**	**1.3**
Industry	1 681	1 083	1 333	1 666	2 010	- 4.3	2.6	2.3	1.9	2.2
Transport	522	367	474	564	634	- 3.5	3.3	1.8	1.2	2.0
Residential	1 102	922	939	1 003	1 147	- 1.8	0.2	0.7	1.3	0.8
Commercial	217	134	133	138	150	- 4.7	- 0.1	0.4	0.8	0.4
CO_2 Emissions (million tonnes)	**1 497**	**1 521**	**1 587**	**1 685**	**1 749**	**0.2**	**0.5**	**0.6**	**0.4**	**0.5**
Electricity Generation	756	846	834	853	843	1.1	- 0.2	0.2	- 0.1	
Transformation other than Electricity Generation	49	179	180	183	183	13.9	0.1	0.1		0.1
Industry	282	204	251	307	354	- 3.2	2.6	2.0	1.4	2.0
Transport	214	148	179	198	207	- 3.6	2.4	1.0	0.4	1.2
Residential	158	135	135	137	155	- 1.6		0.1	1.2	0.5
Commercial	40	10	8	8	8	-13.3	- 1.7	- 0.4	- 0.3	- 0.7
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	823	917	631	472	368	1.1	- 4.6	- 2.9	- 2.4	- 3.2
CO_2 emissions per capita (tonnes per capita)	10.1	10.5	11.5	13.1	14.5	0.4	1.2	1.2	1.0	1.2

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**261 - 327**	**492 - 637**	**709 - 923**
Coal Production & Transportation	3.7 - 4.2	6.5 - 6.9	9.1 - 9.6
Oil & Gas Production & Processing	36 - 55	85 - 132	120 - 186
Oil & Gas International Trade	63 - 72	94 - 108	131 - 152
Oil & Gas Domestic Pipeline	6 - 9	28 - 40	44 - 63
Electricity Generation & Transmission	152 - 187	279 - 351	405 - 513

SINGAPORE

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production						0.6			0.6
Net Imports		17.7	3.1						20.7
TPED		**17.7**	**3.1**			**0.6**			**21.3**
Electricity and Heat Generation		- 4.2	- 2.9			- 0.6	2.8		- 4.9
Petroleum Refineries		- 4.2					- 0.2		- 4.5
Others									
TFED		**9.3**	**0.1**				**2.5**		**11.9**
Industry		4.3					1.0		5.3
Transport		4.9							5.0
Residential			0.1				0.5		0.6
Commercial							1.0		1.0

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production						0.6			0.6
Net Imports		20.1	7.4						27.5
TPED		**20.1**	**7.4**			**0.6**			**28.1**
Electricity and Heat Generation		- 1.6	- 7.3			- 0.6	3.8		- 5.6
Petroleum Refineries		- 4.6					- 0.2		- 4.8
Others									
TFED		**14.0**	**0.1**				**3.6**		**17.7**
Industry		7.6	0.1				1.3		9.0
Transport		6.3							6.4
Residential			0.1				0.8		0.9
Commercial							1.4		1.4

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production						0.6			0.6
Net Imports		25.4	11.1						36.5
TPED		**25.4**	**11.1**			**0.6**			**37.1**
Electricity and Heat Generation		- 1.2	- 10.9			- 0.6	5.4		- 7.3
Petroleum Refineries		- 4.5					- 0.2		- 4.8
Others									
TFED		**19.7**	**0.2**				**5.2**		**25.1**
Industry		11.6	0.1				1.8		13.5
Transport		8.0							8.1
Residential			0.1				1.1		1.3
Commercial							2.2		2.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production						0.7			0.7
Net Imports		31.3	14.7						46.0
TPED		**31.3**	**14.7**			**0.7**			**46.7**
Electricity and Heat Generation		- 1.3	- 14.5			- 0.7	7.3		- 9.1
Petroleum Refineries		- 4.5					- 0.3		- 4.7
Others									
TFED		**25.5**	**0.2**				**7.1**		**32.8**
Industry		15.6	0.1				2.2		18.0
Transport		9.9							9.9
Residential			0.1				1.5		1.7
Commercial							3.3		3.3

SINGAPORE

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	26	110	154	224	313	6.8	4.4	3.8	3.4	3.8
Population (million)	2.41	4.17	4.59	5.28	6.10	2.5	1.2	1.4	1.5	1.4
GDP per capita (2000 PPP US$)	10 605	26 273	33 619	42 437	51 365	4.2	3.1	2.4	1.9	2.4
GDP in Services (2000 PPP US$ billion)	15	72	102	154	221	7.4	4.4	4.3	3.6	4.1
GDP in Industry (2000 PPP US$ billion)	13	39	58	87	120	5.3	5.1	4.1	3.3	4.1
Urbanisation level (%)	100	100	100	100	100	0.0	0.0	0.0	0.0	0.0

ENERGY PROJECTIONS

Mtoe

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production		0.6	0.6	0.6	0.7		0.3	0.6	0.9	0.6
Coal										
Oil										
Gas										
Hydro										
NRE		0.6	0.6	0.6	0.7		0.3	0.6	0.9	0.6
		(100%)	(100%)	(100%)	(100%)					
Nuclear										
Net Imports	8.0	20.7	27.5	36.5	46.0	4.4	3.6	2.9	2.3	2.9
Coal										
Oil	8.0	17.7	20.1	25.4	31.3	3.7	1.7	2.4	2.1	2.1
Gas		3.1	7.4	11.1	14.7		11.7	4.1	2.9	5.8
Electricity										
Total Primary Energy Demand	6.1	21.3	28.1	37.1	46.7	5.9	3.5	2.8	2.3	2.8
Coal										
Oil	6.1	17.7	20.1	25.4	31.3	5.0	1.7	2.4	2.1	2.1
	(100%)	(83%)	(72%)	(68%)	(67%)					
Gas		3.1	7.4	11.1	14.7		11.7	4.1	2.9	5.8
		(14%)	(26%)	(30%)	(32%)					
Hydro										
NRE		0.6	0.6	0.6	0.7	23.9	0.3	0.6	0.9	0.6
		(3%)	(2%)	(2%)	(1%)					
Nuclear										
Input for Electricity and Heat Generation	- 1.6	- 7.7	- 9.4	- 12.7	- 16.5	7.5	2.6	3.1	2.6	2.8
Coal										
Oil	- 1.6	- 4.2	- 1.6	- 1.2	- 1.3	4.5	- 11.6	- 2.7	0.9	- 4.1
	(100%)	(54%)	(17%)	(9%)	(8%)					
Gas		- 2.9	- 7.3	- 10.9	- 14.5		11.9	4.2	2.9	5.9
		(38%)	(77%)	(86%)	(88%)					
Hydro										
NRE		- 0.6	- 0.6	- 0.6	- 0.7		0.3	0.6	0.9	0.6
		(7%)	(6%)	(5%)	(4%)					
Nuclear										
Other Transformation	- 1.9	- 4.5	- 4.8	- 4.8	- 4.7	3.9	1.0	- 0.1	- 0.1	0.2
Coal										
Oil	- 1.9	- 4.2	- 4.6	- 4.5	- 4.5	3.8	1.0	- 0.2	- 0.1	0.2
	(97%)	(95%)	(95%)	(95%)	(95%)					
Gas										
NRE										
Electricity	- 0.1	- 0.2	- 0.2	- 0.2	- 0.3	6.5	1.3	0.2	0.2	0.5
	(3%)	(5%)	(5%)	(5%)	(5%)					
Heat										

SINGAPORE

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**2.7**	**11.9**	**17.7**	**25.1**	**32.8**	**6.9**	**5.1**	**3.6**	**2.7**	**3.7**
Coal										
Oil	2.2	9.3	14.0	19.7	25.5	6.8	5.3	3.5	2.6	3.7
	(81%)	(78%)	(79%)	(79%)	(78%)					
Gas		0.1	0.1	0.2	0.2	4.0	3.3	3.0	2.4	2.9
		(1%)	(1%)	(1%)	(1%)					
NRE										
Electricity	0.5	2.5	3.6	5.2	7.1	7.9	4.4	3.8	3.2	3.8
	(17%)	(21%)	(20%)	(21%)	(22%)					
Heat										
Industry	**0.5**	**5.3**	**9.0**	**13.5**	**18.0**	**11.5**	**6.8**	**4.1**	**2.9**	**4.4**
Coal										
Oil	0.3	4.3	7.6	11.6	15.6	13.7	7.4	4.3	3.0	4.7
	(52%)	(81%)	(85%)	(86%)	(87%)					
Gas	0.02	0.05	0.1	0.1	0.1	4.2	2.8	2.7	2.3	2.6
	(4%)	(1%)	(1%)	(1%)	(1%)					
NRE										
Electricity	0.2	1.0	1.3	1.8	2.2	7.2	3.9	3.0	2.4	3.0
	(43%)	(18%)	(15%)	(13%)	(12%)					
Heat										
Transport	**1.9**	**5.0**	**6.4**	**8.1**	**9.9**	**4.6**	**3.1**	**2.4**	**2.1**	**2.5**
Coal										
Oil	1.9	4.9	6.3	8.0	9.9	4.5	3.1	2.4	2.1	2.5
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity										
Residential	**0.2**	**0.6**	**0.9**	**1.3**	**1.7**	**5.4**	**4.6**	**3.8**	**2.9**	**3.7**
Coal										
Oil	0.1									
	(38%)									
Gas		0.1	0.1	0.1	0.1	3.6	3.6	3.3	2.5	3.1
		(10%)	(9%)	(9%)	(8%)					
NRE										
Electricity	0.1	0.5	0.8	1.1	1.5	8.7	4.7	3.8	2.9	3.7
	(45%)	(90%)	(91%)	(91%)	(92%)					
Heat										
Commercial	**0.2**	**1.0**	**1.4**	**2.2**	**3.3**	**8.1**	**4.9**	**4.7**	**3.9**	**4.4**
Coal										
Oil										
Gas										
NRE										
Electricity	0.2	1.0	1.4	2.2	3.3	8.1	4.9	4.7	3.9	4.4
	(100%)	(100%)	(100%)	(100%)	(100%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	0	28	43	46	47
Net Energy Import Ratio (%)	100	97	98	98	99
Net Oil Import Dependency (%)	100	100	100	100	100

SINGAPORE

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**7**	**35**	**47**	**66**	**89**	**7.5**	**3.8**	**3.6**	**3.0**	**3.4**
Coal										
Oil	7	18	7	5	6	4.3	- 11.5	- 2.6	1.0	- 4.0
	(100%)	(51%)	(14%)	(8%)	(6%)					
Gas		15	38	59	81		12.3	4.5	3.2	6.2
		(44%)	(82%)	(89%)	(91%)					
Hydro										
NRE		2	2	2	2		0.3	0.6	0.9	0.6
		(6%)	(4%)	(3%)	(3%)					
Nuclear										
Total Installed Generation Capacity (GW)	**2**	**8**	**11**	**15**	**18**	**6.7**	**3.3**	**3.1**	**2.4**	**2.9**
Thermal	2	8	10	14	18	6.5	3.4	3.1	2.5	3.0
	(100%)	(97%)	(98%)	(98%)	(98%)					
Coal										
Oil		4	4	3	3		- 1.1	- 1.3	- 1.4	- 1.3
		(52%)	(37%)	(24%)	(16%)					
Gas		4	7	11	15		7.3	5.1	3.5	5.2
		(45%)	(61%)	(74%)	(82%)					
Hydro										
NRE		0.3	0.3	0.3	0.3		0.7	1.1	1.0	0.9
		(3%)	(2%)	(2%)	(2%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**237**	**194**	**182**	**166**	**149**	**- 0.9**	**- 0.8**	**- 0.9**	**- 1.1**	**- 0.9**
Industry (toe per US$ million GDP in Industry)	39	137	156	155	150	5.9	1.6	0.0	- 0.4	0.3
Commercial (toe per US$ million GDP in Services)	12	13	14	15	15	0.7	0.5	0.4	0.2	0.4
Energy Intensity (kgoe per capita)	**2 511**	**5 097**	**6 121**	**7 028**	**7 649**	**3.3**	**2.3**	**1.4**	**0.9**	**1.5**
Industry	202	1 277	1 965	2 554	2 943	8.7	5.5	2.7	1.4	3.0
Transport	770	1 193	1 384	1 528	1 624	2.0	1.9	1.0	0.6	1.1
Residential	80	145	189	237	273	2.8	3.4	2.3	1.4	2.3
Commercial	72	234	310	426	540	5.5	3.6	3.2	2.4	3.0
CO_2 Emissions (million tonnes)	**15.2**	**54.0**	**69.2**	**91.2**	**115.0**	**5.9**	**3.1**	**2.8**	**2.3**	**2.7**
Electricity Generation	5.0	19.5	21.7	29.1	37.8	6.4	1.3	3.0	2.7	2.4
Transformation other than Electricity Generation	3.6	9.6	10.6	10.7	11.0	4.6	1.2	0.1	0.3	0.5
Industry	0.8	10.3	18.2	27.6	37.0	12.1	7.4	4.3	3.0	4.7
Transport	5.5	14.5	18.5	23.5	28.9	4.5	3.1	2.4	2.1	2.5
Residential	0.3	0.1	0.2	0.3	0.3	- 4.3	9.1	4.1		4.0
Commercial										
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	592.9	492.7	448.4	406.9	366.9	- 0.8	- 1.2	- 1.0	- 1.0	- 1.0
CO_2 emissions per capita (tonnes per capita)	6.3	12.9	15.1	17.3	18.8	3.3	1.9	1.4	0.9	1.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**9.2 - 12.7**	**19.8 - 27.2**	**30.5 - 42.2**
Coal Production & Transportation			
Oil & Gas Production & Processing	2.83 - 4.09	8.43 - 12.22	14.66 - 21.23
Oil & Gas International Trade	3.11 - 4.37	4.68 - 6.60	5.47 - 8.05
Oil & Gas Domestic Pipeline	1.11 - 1.59	1.11 - 1.59	1.12 - 1.60
Electricity Generation & Transmission	2.14 - 2.62	5.55 - 6.77	9.28 - 11.34

CHINESE TAIPEI

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			0.7	0.5	10.3	0.2			11.8
Net Imports	31.5	42.4	6.7						80.6
TPED	**32.4**	**41.6**	**7.4**	**0.5**	**10.3**	**0.2**			**92.4**
Electricity and Heat Generation	- 26.3	- 4.7	- 5.1	- 0.5	- 10.3	- 0.2	16.0		- 31.2
Petroleum Refineries		- 3.5	- 0.6				- 0.3		- 4.3
Others									
TFED	**6.7**	**33.4**	**1.7**				**13.6**		**55.5**
Industry	6.7	17.6	0.9				8.2		33.4
Transport		13.9					0.1		13.9
Residential		1.3	0.6				3.2		5.1
Commercial		0.6	0.2				2.2		3.0

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			0.7	0.6	13.6	2.0			16.8
Net Imports	35.8	52.1	13.6						101.5
TPED	**35.8**	**52.1**	**14.3**	**0.6**	**13.6**	**2.0**			**118.3**
Electricity and Heat Generation	- 27.5	- 3.6	- 11.3	- 0.6	- 13.6	- 2.0	20.9		- 37.6
Petroleum Refineries		- 4.4	- 0.7				- 0.4		- 5.5
Others									
TFED	**8.3**	**44.1**	**2.2**				**20.6**		**75.2**
Industry	8.3	25.1	1.2				13.3		47.8
Transport		16.9					0.1		17.0
Residential		1.5	0.8				4.3		6.6
Commercial		0.7	0.2				2.9		3.8

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			0.7	0.5	11.2	6.4			18.9
Net Imports	55.5	61.6	18.4						135.5
TPED	**55.5**	**61.7**	**19.1**	**0.5**	**11.2**	**6.4**			**154.4**
Electricity and Heat Generation	- 45.0	- 2.1	- 15.5	- 0.5	- 11.2	- 6.4	29.6		- 51.2
Petroleum Refineries		- 4.4	- 0.7				- 0.3		- 5.4
Others									
TFED	**10.5**	**55.2**	**2.8**				**29.3**		**97.7**
Industry	10.5	31.7	1.5				18.8		62.5
Transport		21.3					0.1		21.4
Residential		1.6	1.0				6.1		8.6
Commercial		0.7	0.3				4.2		5.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			0.7	0.6	6.4	11.8			19.6
Net Imports	65.0	69.5	24.5						159.0
TPED	**65.0**	**69.6**	**25.2**	**0.6**	**6.4**	**11.8**			**178.6**
Electricity and Heat Generation	- 53.6	- 1.5	- 21.2	- 0.6	- 6.4	- 11.8	36.1		- 59.0
Petroleum Refineries		- 4.2	- 0.7				- 0.3		- 5.2
Others									
TFED	**11.4**	**63.9**	**3.3**				**35.8**		**114.4**
Industry	11.4	36.2	1.8				22.3		71.7
Transport		25.3					0.2		25.4
Residential		1.6	1.2				7.8		10.5
Commercial		0.7	0.4				5.6		6.7

CHINESE TAIPEI

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	109	441	621	903	1 184	6.5	4.4	3.8	2.7	3.6
Population (million)	17.6	22.4	23.2	24.3	24.6	1.1	0.4	0.4	0.1	0.3
GDP per capita (2000 PPP US$)	6 206	19 693	26 745	37 215	48 077	5.4	3.9	3.4	2.6	3.2
GDP in Services (2000 PPP US$ billion)	53	321	416	593	770	8.5	3.3	3.6	2.6	3.2
GDP in Industry (2000 PPP US$ billion)	51	139	212	306	382	4.6	5.4	3.7	2.2	3.7
Urbanisation level (%)		79	78	77	76		- 0.1	- 0.2	- 0.1	- 0.1

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**5.8**	**11.8**	**16.8**	**18.9**	**19.6**	**3.3**	**4.5**	**1.2**	**0.3**	**1.8**
Coal	1.6									
	(27%)									
Oil	0.25	0.05	0.04	0.05	0.05	- 7.2	- 1.4	0.7	0.4	
	(4%)	(0%)	(0%)	(0%)	(0%)					
Gas	1.6	0.7	0.7	0.7	0.7	- 3.6	- 0.6	0.2	0.3	
	(27%)	(6%)	(4%)	(4%)	(4%)					
Hydro	0.3	0.5	0.6	0.5	0.6	3.6	0.2	- 0.4	0.3	
	(5%)	(5%)	(3%)	(3%)	(3%)					
NRE	0.02	0.2	2.0	6.4	11.8	11.7	30.9	12.5	6.3	15.1
	(0%)	(2%)	(12%)	(34%)	(60%)					
Nuclear	2.1	10.3	13.6	11.2	6.4	7.4	3.5	- 1.9	- 5.4	- 1.7
	(37%)	(87%)	(81%)	(59%)	(33%)					
Net Imports	**24.5**	**80.6**	**101.5**	**135.5**	**159.0**	**5.6**	**2.9**	**2.9**	**1.6**	**2.5**
Coal	3.1	31.5	35.8	55.5	65.0	11.1	1.6	4.5	1.6	2.6
Oil	21.4	42.4	52.1	61.6	69.5	3.2	2.6	1.7	1.2	1.8
Gas		6.7	13.6	18.4	24.5		9.3	3.0	2.9	4.7
Electricity										
Total Primary Energy Demand	**28.5**	**92.4**	**118.3**	**154.4**	**178.6**	**5.5**	**3.1**	**2.7**	**1.5**	**2.4**
Coal	3.9	32.4	35.8	55.5	65.0	10.1	1.3	4.5	1.6	2.5
	(14%)	(35%)	(30%)	(36%)	(36%)					
Oil	20.6	41.6	52.1	61.7	69.6	3.2	2.9	1.7	1.2	1.9
	(72%)	(45%)	(44%)	(40%)	(39%)					
Gas	1.6	7.4	14.3	19.1	25.2	7.2	8.6	2.9	2.8	4.5
	(6%)	(8%)	(12%)	(12%)	(14%)					
Hydro	0.3	0.5	0.6	0.5	0.6	3.6	0.2	- 0.4	0.3	0.03
	(1%)	(1%)	(0%)	(0%)	(0%)					
NRE	0.02	0.2	2.0	6.4	11.8	11.7	30.9	12.5	6.3	15.1
	(0%)	(0%)	(2%)	(4%)	(7%)					
Nuclear	2.1	10.3	13.6	11.2	6.4	7.4	3.5	- 1.9	- 5.4	- 1.7
	(7%)	(11%)	(11%)	(7%)	(4%)					
Input for Electricity and Heat Generation	**- 9.4**	**- 47.2**	**- 58.6**	**- 80.9**	**- 95.1**	**7.6**	**2.7**	**3.3**	**1.6**	**2.5**
Coal	- 1.6	- 26.3	- 27.5	- 45.0	- 53.6	13.7	0.6	5.0	1.8	2.6
	(17%)	(56%)	(47%)	(56%)	(56%)					
Oil	- 5.4	- 4.7	- 3.6	- 2.1	- 1.5	- 0.6	- 3.5	- 5.1	- 3.5	- 4.0
	(58%)	(10%)	(6%)	(3%)	(2%)					
Gas		- 5.1	- 11.3	- 15.5	- 21.2		10.5	3.2	3.2	5.2
		(11%)	(19%)	(19%)	(22%)					
Hydro	- 0.3	- 0.5	- 0.6	- 0.5	- 0.6	3.6	0.2	- 0.4	0.3	0.03
	(3%)	(1%)	(1%)	(1%)	(1%)					
NRE		- 0.2	- 2.0	- 6.4	- 11.8		30.9	12.5	6.3	15.1
		(0%)	(3%)	(8%)	(12%)					
Nuclear	- 2.1	- 10.3	- 13.6	- 11.2	- 6.4	7.4	3.5	- 1.9	- 5.4	- 1.7
	(23%)	(22%)	(23%)	(14%)	(7%)					
Other Transformation	**- 3.0**	**- 4.4**	**- 5.5**	**- 5.4**	**- 5.2**	**1.7**	**3.1**	**- 0.2**	**- 0.4**	**0.7**
Coal										
Oil	- 2.8	- 3.5	- 4.4	- 4.4	- 4.2	1.0	3.1	- 0.2	- 0.3	0.7
	(94%)	(80%)	(80%)	(81%)	(81%)					
Gas	- 0.1	- 0.6	- 0.7	- 0.7	- 0.7	10.8	2.9	- 0.4	- 0.5	0.5
	(2%)	(13%)	(13%)	(13%)	(13%)					
NRE										
Electricity	- 0.1	- 0.3	- 0.4	- 0.4	- 0.3	5.4	2.8	- 0.4	- 0.5	0.5
	(3%)	(7%)	(7%)	(7%)	(6%)					
Heat										

CHINESE TAIPEI

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**18.3**	**55.5**	**75.2**	**97.7**	**114.4**	**5.2**	**3.9**	**2.7**	**1.6**	**2.6**
Coal	2.1	6.7	8.3	10.5	11.4	5.5	2.6	2.4	0.9	1.9
	(11%)	(12%)	(11%)	(11%)	(10%)					
Oil	11.9	33.4	44.1	55.2	63.9	4.8	3.5	2.3	1.5	2.3
	(65%)	(60%)	(59%)	(56%)	(56%)					
Gas	1.4	1.7	2.2	2.8	3.3	1.1	3.3	2.5	1.7	2.4
	(7%)	(3%)	(3%)	(3%)	(3%)					
NRE										
Electricity	3.0	13.6	20.6	29.3	35.8	7.1	5.3	3.6	2.0	3.5
	(16%)	(25%)	(27%)	(30%)	(31%)					
Heat										
Industry	**12.5**	**33.4**	**47.8**	**62.5**	**71.7**	**4.6**	**4.6**	**2.7**	**1.4**	**2.8**
Coal	2.1	6.7	8.3	10.5	11.4	5.5	2.6	2.4	0.9	1.9
	(17%)	(20%)	(17%)	(17%)	(16%)					
Oil	7.2	17.6	25.1	31.7	36.2	4.1	4.5	2.4	1.4	2.6
	(58%)	(53%)	(53%)	(51%)	(51%)					
Gas	1.1	0.9	1.2	1.5	1.8	- 0.9	3.8	2.6	1.5	2.5
	(9%)	(3%)	(2%)	(2%)	(2%)					
NRE										
Electricity	2.1	8.2	13.3	18.8	22.3	6.3	6.2	3.6	1.7	3.6
	(17%)	(24%)	(28%)	(30%)	(31%)					
Heat										
Transport	**3.4**	**13.9**	**17.0**	**21.4**	**25.4**	**6.6**	**2.5**	**2.3**	**1.7**	**2.2**
Coal										
Oil	3.4	13.9	16.9	21.3	25.3	6.6	2.5	2.3	1.7	2.2
	(99%)	(99%)	(99%)	(99%)	(99%)					
Gas										
NRE										
Electricity		0.1	0.1	0.1	0.2	6.4	3.7	2.7	2.3	2.8
		(1%)	(1%)	(1%)	(1%)					
Residential	**1.6**	**5.1**	**6.6**	**8.6**	**10.5**	**5.4**	**3.2**	**2.7**	**2.1**	**2.6**
Coal										
Oil	0.8	1.3	1.5	1.6	1.6	2.5	1.6	0.6	0.3	0.8
	(47%)	(25%)	(22%)	(18%)	(15%)					
Gas	0.2	0.6	0.8	1.0	1.2	4.9	2.6	2.2	1.7	2.2
	(14%)	(12%)	(12%)	(11%)	(11%)					
NRE										
Electricity	0.6	3.2	4.3	6.1	7.8	7.8	3.9	3.4	2.5	3.2
	(38%)	(62%)	(66%)	(71%)	(74%)					
Heat										
Commercial	**0.8**	**3.0**	**3.8**	**5.2**	**6.7**	**6.2**	**2.9**	**3.3**	**2.5**	**2.9**
Coal										
Oil	0.5	0.6	0.7	0.7	0.7	0.9	0.6	0.6	0.6	0.6
	(64%)	(21%)	(17%)	(13%)	(11%)					
Gas		0.2	0.2	0.3	0.4	7.2	3.3	2.8	2.3	2.7
		(6%)	(6%)	(6%)	(6%)					
NRE										
Electricity	0.2	2.2	2.9	4.2	5.6	10.5	3.5	3.9	2.8	3.4
	(31%)	(73%)	(76%)	(81%)	(83%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	47	75	80	80	80
Net Energy Import Ratio (%)	81	87	86	88	89
Net Oil Import Dependency (%)	100	100	100	100	100

CHINESE TAIPEI

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**43**	**199**	**261**	**364**	**438**	**7.3**	**3.4**	**3.4**	**1.9**	**2.8**
Coal	6	107	118	204	257	14.0	1.2	5.7	2.3	3.2
	(14%)	(54%)	(45%)	(56%)	(59%)					
Oil	26	20	15	9	7	- 1.1	- 3.2	- 4.8	- 3.2	- 3.8
	(60%)	(10%)	(6%)	(3%)	(2%)					
Gas		26	59	84	119		10.9	3.6	3.5	5.6
		(13%)	(23%)	(23%)	(27%)					
Hydro	3	6	6	6	6	3.6	0.2	- 0.4	0.3	0.03
	(7%)	(3%)	(2%)	(2%)	(1%)					
NRE		1	10	17	24		39.2	5.7	3.9	13.6
		(0%)	(4%)	(5%)	(6%)					
Nuclear	8	40	52	43	25	7.4	3.5	- 1.9	- 5.4	- 1.7
	(19%)	(20%)	(20%)	(12%)	(6%)					
Total Installed Generation Capacity (GW)	**9**	**37**	**54**	**73**	**86**	**6.6**	**4.8**	**3.1**	**1.6**	**3.0**
Thermal	6	29	37	56	70	7.1	3.3	4.2	2.2	3.2
	(70%)	(78%)	(69%)	(77%)	(81%)					
Coal	1	13	19	34	44	12.5	4.8	6.2	2.4	4.4
	(11%)	(35%)	(35%)	(47%)	(51%)					
Oil	5	4	4	2	2	- 1.9	- 0.03	- 4.5	- 3.3	- 2.8
	(59%)	(10%)	(7%)	(3%)	(2%)					
Gas		12	15	19	24		2.4	2.7	2.3	2.5
		(33%)	(27%)	(26%)	(28%)					
Hydro	1	3	6	6	6	2.9	10.5	0.6		3.1
	(15%)	(7%)	(11%)	(8%)	(7%)					
NRE		0.5	3	5	6		25.4	4.2	3.1	9.5
		(1%)	(6%)	(6%)	(7%)					
Nuclear	1	5	8	7	4	6.5	5.4	- 1.8	- 5.7	- 1.2
	(14%)	(14%)	(15%)	(9%)	(4%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**260**	**210**	**191**	**171**	**151**	**- 1.0**	**- 1.2**	**- 1.1**	**- 1.2**	**- 1.2**
Industry (toe per US$ million GDP in Industry)	242	240	225	204	188	- 0.04	- 0.8	- 1.0	- 0.8	- 0.9
Commercial (toe per US$ million GDP in Services)	15	9	9	9	9	- 2.1	- 0.4	- 0.3	- 0.1	- 0.2
Energy Intensity (kgoe per capita)	**1 617**	**4 128**	**5 097**	**6 364**	**7 254**	**4.4**	**2.7**	**2.2**	**1.3**	**2.0**
Industry	707	1 491	2 059	2 578	2 914	3.4	4.1	2.3	1.2	2.4
Transport	194	623	732	881	1 033	5.5	2.0	1.9	1.6	1.8
Residential	91	229	284	354	428	4.3	2.7	2.2	1.9	2.3
Commercial	45	134	162	215	272	5.1	2.5	2.9	2.3	2.6
CO_2 Emissions (million tonnes)	**72.9**	**265.9**	**323.6**	**439.8**	**515.2**	**6.1**	**2.5**	**3.1**	**1.6**	**2.4**
Electricity Generation	23.4	128.3	144.2	217.4	262.0	8.0	1.5	4.2	1.9	2.6
Transformation other than Electricity Generation	5.6	8.3	10.5	10.1	9.6	1.8	3.0	- 0.4	- 0.5	0.5
Industry	29.6	81.6	111.1	140.4	158.5	4.7	3.9	2.4	1.2	2.4
Transport	10.1	40.0	49.0	62.1	74.3	6.5	2.6	2.4	1.8	2.2
Residential	2.5	5.4	6.3	7.0	7.6	3.5	1.9	1.1	0.8	1.2
Commercial	1.7	2.3	2.5	2.8	3.2	1.5	1.0	1.1	1.3	1.2
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	665.9	602.9	521.2	487.2	435.3	- 0.5	- 1.8	- 0.7	- 1.1	- 1.2
CO_2 emissions per capita (tonnes per capita)	4.1	11.9	13.9	18.1	20.9	4.9	2.0	2.7	1.4	2.0

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**37.6 - 45.3**	**76.1 - 91.2**	**104.3 - 125.2**
Coal Production & Transportation			
Oil & Gas Production & Processing	9.04 - 11.18	13.61 - 17.69	17.40 - 23.08
Oil & Gas International Trade	1.00 - 1.51	1.63 - 2.43	2.36 - 3.38
Oil & Gas Domestic Pipeline	0.46 - 0.65	0.77 - 1.10	1.18 - 1.68
Electricity Generation & Transmission	27.15 - 31.99	60.05 - 70.00	83.34 - 97.03

THAILAND

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.7	4.2	16.4	0.7		9.4			36.4
Net Imports	4.3	31.4	5.6				0.2		41.5
TPED	**9.8**	**35.1**	**18.8**	**0.7**		**9.4**	**0.2**		**74.0**
Electricity and Heat Generation	- 4.9	- 0.6	- 16.9	- 0.7		- 0.3	8.3		- 14.9
Petroleum Refineries		- 3.3							- 3.3
Others		- 0.1	- 0.3						- 0.5
TFED	**4.9**	**31.1**	**1.6**			**9.2**	**8.6**		**55.4**
Industry	4.9	10.6	1.6			4.0	3.9		25.0
Transport		18.8							18.8
Residential		1.7				5.2	1.9		8.8
Commercial							2.7		2.7

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	7.1	8.0	26.6	1.0		11.0			53.7
Net Imports	8.4	43.5	8.5				0.5		61.0
TPED	**15.5**	**51.5**	**35.1**	**1.0**		**11.0**	**0.5**		**114.6**
Electricity and Heat Generation	- 5.8	- 0.8	- 30.4	- 1.0		- 0.5	14.5		- 23.9
Petroleum Refineries		- 3.4							- 3.4
Others		- 0.3	- 0.5						- 0.8
TFED	**9.7**	**47.0**	**4.2**			**10.6**	**15.0**		**86.5**
Industry	9.7	17.0	3.9			5.4	7.7		43.7
Transport		28.0	0.3						28.3
Residential		2.0				5.1	2.9		10.0
Commercial							4.5		4.5

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.9	6.1	26.0	0.9		15.5			54.4
Net Imports	27.2	72.7	31.2				1.5		132.6
TPED	**33.0**	**78.8**	**57.2**	**0.9**		**15.5**	**1.5**		**187.0**
Electricity and Heat Generation	- 17.2	- 0.4	- 48.8	- 0.9		- 2.0	26.5		- 42.9
Petroleum Refineries		- 3.7							- 3.7
Others		- 0.2	- 0.5						- 0.7
TFED	**15.8**	**74.5**	**7.9**			**13.4**	**28.0**		**139.7**
Industry	15.8	26.1	7.6			8.4	14.8		72.6
Transport		46.0	0.3						46.3
Residential		2.4				5.1	4.9		12.4
Commercial							8.4		8.4

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.9	6.3	16.5	0.8		20.8			50.3
Net Imports	58.8	96.6	48.5				3.6		207.5
TPED	**64.6**	**102.9**	**65.0**	**0.8**		**20.8**	**3.6**		**257.8**
Electricity and Heat Generation	- 43.6	- 0.4	- 52.9	- 0.8		- 3.7	39.0		- 62.5
Petroleum Refineries		- 4.9							- 4.9
Others		- 0.2	- 0.3						- 0.5
TFED	**21.0**	**97.4**	**11.8**			**17.1**	**42.6**		**189.9**
Industry	21.0	31.8	11.5			12.1	22.1		98.4
Transport		62.9	0.3						63.2
Residential		2.8				5.0	7.5		15.3
Commercial							13.0		13.0

THAILAND

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	126	446	681	1 128	1 632	5.9	5.4	5.2	3.8	4.7
Population (million)	47.0	62.8	65.6	69.4	72.2	1.3	0.6	0.6	0.4	0.5
GDP per capita (2000 PPP US$)	2 681	7 103	10 382	16 249	22 604	4.5	4.9	4.6	3.4	4.2
GDP in Services (2000 PPP US$ billion)	70	202	309	519	755	5.0	5.4	5.3	3.8	4.8
GDP in Industry (2000 PPP US$ billion)	41	171	327	564	825	6.8	8.4	5.6	3.9	5.8
Urbanisation level (%)	27	32	34	40	47	0.8	1.0	1.5	1.7	1.4

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**11.2**	**36.4**	**53.7**	**54.4**	**50.3**	**5.5**	**5.0**	**0.1**	**- 0.8**	**1.2**
Coal		5.7	7.1	5.9	5.9	12.7	2.8	- 1.9		0.1
		(16%)	(13%)	(11%)	(12%)					
Oil		4.2	8.0	6.1	6.3		8.4	- 2.7	0.3	1.4
		(12%)	(15%)	(11%)	(12%)					
Gas		16.4	26.6	26.0	16.5		6.2	- 0.2	- 4.4	
		(45%)	(50%)	(48%)	(33%)					
Hydro		0.7	1.0	0.9	0.8	8.5	5.0	- 0.3	- 1.2	0.9
		(2%)	(2%)	(2%)	(2%)					
NRE	10.6	9.4	11.0	15.5	20.8	- 0.5	2.0	3.5	3.0	2.9
	(95%)	(26%)	(21%)	(28%)	(41%)					
Nuclear										
Net Imports	**12.3**	**41.5**	**61.0**	**132.6**	**207.5**	**5.7**	**4.9**	**8.1**	**4.6**	**5.9**
Coal	0.1	4.3	8.4	27.2	58.8	21.6	8.7	12.4	8.0	9.8
Oil	12.2	31.4	43.5	72.7	96.6	4.4	4.2	5.3	2.9	4.1
Gas		5.6	8.5	31.2	48.5		5.5	13.8	4.5	8.0
Electricity	0.1	0.2	0.5	1.5	3.6	6.2	9.6	11.8	8.9	10.1
Total Primary Energy Demand	**22.8**	**74.0**	**114.6**	**187.0**	**257.8**	**5.5**	**5.6**	**5.0**	**3.3**	**4.6**
Coal	0.5	9.8	15.5	33.0	64.6	14.8	5.9	7.9	6.9	7.0
	(2%)	(13%)	(14%)	(18%)	(25%)					
Oil	11.5	35.1	51.5	78.8	102.9	5.2	4.9	4.3	2.7	3.9
	(50%)	(47%)	(45%)	(42%)	(40%)					
Gas		18.8	35.1	57.2	65.0		8.1	5.0	1.3	4.5
		(25%)	(31%)	(31%)	(25%)					
Hydro	0.1	0.7	1.0	0.9	0.8	8.5	5.0	- 0.3	- 1.2	0.9
	(0%)	(1%)	(1%)	(0%)	(0%)					
NRE	10.6	9.4	11.0	15.5	20.8	- 0.5	2.0	3.5	3.0	2.9
	(47%)	(13%)	(10%)	(8%)	(8%)					
Nuclear										
Input for Electricity and Heat Generation	**- 3.6**	**- 23.3**	**- 38.5**	**- 69.4**	**- 101.5**	**8.9**	**6.5**	**6.1**	**3.9**	**5.4**
Coal	- 0.4	- 4.9	- 5.8	- 17.2	- 43.6	12.6	2.2	11.5	9.7	8.1
	(10%)	(21%)	(15%)	(25%)	(43%)					
Oil	- 3.1	- 0.6	- 0.8	- 0.4	- 0.4	- 7.4	4.8	- 6.2	- 1.1	- 1.4
	(87%)	(2%)	(2%)	(1%)	(0%)					
Gas		- 16.9	- 30.4	- 48.8	- 52.9		7.6	4.8	0.8	4.2
		(73%)	(79%)	(70%)	(52%)					
Hydro	- 0.1	- 0.7	- 1.0	- 0.9	- 0.8	8.5	5.0	- 0.3	- 1.2	0.9
	(3%)	(3%)	(3%)	(1%)	(1%)					
NRE		- 0.3	- 0.5	- 2.0	- 3.7		6.4	16.0	6.3	9.7
		(1%)	(1%)	(3%)	(4%)					
Nuclear										
Other Transformation	**- 0.4**	**- 3.7**	**- 4.2**	**- 4.4**	**- 5.4**	**10.7**	**1.4**	**0.5**	**2.1**	**1.3**
Coal										
Oil	- 0.4	- 3.4	- 3.6	- 3.9	- 5.1	10.3	0.8	0.6	2.7	1.4
	(98%)	(91%)	(87%)	(88%)	(94%)					
Gas		- 0.3	- 0.5	- 0.5	- 0.3		6.2	- 0.2	- 4.4	
		(9%)	(13%)	(12%)	(6%)					
NRE										
Electricity										
Heat										

THAILAND

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**15.5**	**55.4**	**86.5**	**139.7**	**189.9**	**6.0**	**5.7**	**4.9**	**3.1**	**4.5**
Coal	0.1	4.9	9.7	15.8	21.0	19.7	8.8	5.0	2.9	5.3
	(1%)	(9%)	(11%)	(11%)	(11%)					
Oil	7.6	31.1	47.0	74.5	97.4	6.6	5.3	4.7	2.7	4.2
	(49%)	(56%)	(54%)	(53%)	(51%)					
Gas		1.6	4.2	7.9	11.8		12.8	6.5	4.1	7.4
		(3%)	(5%)	(6%)	(6%)					
NRE	6.7	9.2	10.6	13.4	17.1	1.4	1.8	2.5	2.4	2.3
	(43%)	(17%)	(12%)	(10%)	(9%)					
Electricity	1.1	8.6	15.0	28.0	42.6	9.7	7.3	6.4	4.3	5.9
	(7%)	(15%)	(17%)	(20%)	(22%)					
Heat										
Industry	**5.1**	**25.0**	**43.7**	**72.6**	**98.4**	**7.5**	**7.2**	**5.2**	**3.1**	**5.0**
Coal	0.1	4.9	9.7	15.8	21.0	19.7	8.8	5.0	2.9	5.3
	(2%)	(20%)	(22%)	(22%)	(21%)					
Oil	3.2	10.6	17.0	26.1	31.8	5.6	6.2	4.3	2.0	4.0
	(62%)	(42%)	(39%)	(36%)	(32%)					
Gas		1.6	3.9	7.6	11.5		11.7	6.9	4.2	7.3
		(6%)	(9%)	(10%)	(12%)					
NRE	1.3	4.0	5.4	8.4	12.1	5.2	3.9	4.5	3.7	4.1
	(26%)	(16%)	(12%)	(12%)	(12%)					
Electricity	0.5	3.9	7.7	14.8	22.1	9.4	8.7	6.8	4.1	6.3
	(11%)	(16%)	(18%)	(20%)	(22%)					
Heat										
Transport	**4.0**	**18.8**	**28.3**	**46.3**	**63.2**	**7.3**	**5.3**	**5.1**	**3.2**	**4.4**
Coal										
Oil	4.0	18.8	28.0	46.0	62.9	7.3	5.1	5.1	3.2	4.4
	(100%)	(100%)	(99%)	(99%)	(99%)					
Gas		0.01	0.33	0.33	0.33		68.6			16.1
		(0%)	(1%)	(1%)	(1%)					
NRE										
Electricity										
Residential	**6.0**	**8.8**	**10.0**	**12.4**	**15.3**	**1.8**	**1.6**	**2.1**	**2.2**	**2.0**
Coal										
Oil	0.4	1.7	2.0	2.4	2.8	7.5	1.9	1.8	1.2	1.7
	(6%)	(20%)	(20%)	(20%)	(18%)					
Gas										
NRE	5.4	5.2	5.1	5.1	5.0	- 0.2	- 0.1	- 0.1	- 0.1	- 0.1
	(90%)	(59%)	(51%)	(41%)	(33%)					
Electricity	0.3	1.9	2.9	4.9	7.5	9.5	5.3	5.4	4.5	5.0
	(4%)	(22%)	(29%)	(39%)	(49%)					
Heat										
Commercial	**0.4**	**2.7**	**4.5**	**8.4**	**13.0**	**9.5**	**6.4**	**6.5**	**4.5**	**5.7**
Coal										
Oil	0.1									
	(16%)									
Gas										
NRE										
Electricity	0.3	2.7	4.5	8.4	13.0	10.4	6.4	6.5	4.5	5.7
	(84%)	(100%)	(100%)	(100%)	(100%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	56	78	78	80	83
Net Energy Import Ratio (%)	52	53	53	71	80
Net Oil Import Dependency (%)	100	89	84	92	94

THAILAND

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**14**	**111**	**192**	**347**	**504**	**9.7**	**7.1**	**6.1**	**3.8**	**5.5**
Coal	1	18	23	71	190	12.3	2.8	12.1	10.3	8.7
	(10%)	(16%)	(12%)	(21%)	(38%)					
Oil	12	2	4	2	2	- 6.9	5.3	- 5.8	- 0.7	- 0.9
	(81%)	(2%)	(2%)	(1%)						
Gas		82	153	256	289		8.1	5.3	1.2	4.6
		(74%)	(80%)	(74%)	(57%)					
Hydro	1	8	11	11	10	8.5	5.0	- 0.3	- 1.2	0.9
	(9%)	(7%)	(6%)	(3%)	(2%)					
NRE		1	1	7	13		7.2	16.8	7.0	10.4
		(1%)	(1%)	(2%)	(3%)					
Nuclear										
Total Installed Generation Capacity (GW)	**4**	**23**	**33**	**59**	**91**	**8.4**	**4.7**	**6.0**	**4.4**	**5.0**
Thermal	2	20	29	54	84	10.5	5.0	6.3	4.5	5.3
	(56%)	(87%)	(88%)	(91%)	(92%)					
Coal		3	4	11	26		5.1	9.9	9.2	8.3
		(12%)	(12%)	(18%)	(28%)					
Oil		0.37	0.59	0.35	0.35		5.9	-5.2		- 0.3
		(2%)	(2%)	(1%)						
Gas		17	25	43	58		4.9	5.7	3.0	4.5
		(73%)	(74%)	(72%)	(64%)					
Hydro	1	3	3	4	4	3.7	2.2	0.7		0.9
	(33%)	(13%)	(10%)	(6%)	(4%)					
NRE	0.4	0.2	0.4	1.7	3.3	- 3.7	11.7	15.1	6.7	11.1
	(10%)	(1%)	(1%)	(3%)	(4%)					
Nuclear										

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**181**	**166**	**168**	**166**	**158**	**- 0.4**	**0.2**	**- 0.1**	**- 0.5**	**- 0.2**
Industry (toe per US$ million GDP in Industry)	126	146	134	129	119	0.7	- 1.1	- 0.4	- 0.8	- 0.7
Commercial (toe per US$ million GDP in Services)	5	13	15	16	17	4.3	0.9	1.1	0.6	0.9
Energy Intensity (kgoe per capita)	**486**	**1 179**	**1 746**	**2 693**	**3 571**	**4.1**	**5.0**	**4.4**	**2.9**	**4.0**
Industry	109	398	666	1 046	1 364	6.1	6.6	4.6	2.7	4.5
Transport	85	299	431	668	876	5.9	4.7	4.5	2.7	3.9
Residential	128	141	153	178	212	0.4	1.1	1.5	1.8	1.5
Commercial	8	43	68	121	180	8.1	5.8	5.9	4.1	5.2
CO_2 Emissions (million tonnes)	**35.7**	**192.6**	**306.7**	**516.7**	**733.6**	**8.0**	**6.0**	**5.4**	**3.6**	**4.9**
Electricity Generation	11.4	60.1	96.1	182.1	294.0	7.8	6.0	6.6	4.9	5.8
Transformation other than Electricity Generation	1.0	15.8	21.3	29.9	36.6	13.5	3.8	3.4	2.0	3.0
Industry	10.2	55.0	98.4	158.2	204.9	7.9	7.5	4.9	2.6	4.8
Transport	11.9	56.4	84.7	139.1	189.7	7.3	5.2	5.1	3.2	4.4
Residential	1.0	5.3	6.2	7.4	8.4	7.9	2.0	1.8	1.3	1.7
Commercial										
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	283.5	431.7	450.1	458.1	449.6	1.9	0.5	0.2	- 0.2	0.1
CO_2 emissions per capita (tonnes per capita)	0.8	3.1	4.7	7.4	10.2	6.5	5.4	4.8	3.2	4.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**30.9 - 41.2**	**97.2 - 124.5**	**168.0 - 211.4**
Coal Production & Transportation	0.2 - 0.3	0.4 - 0.5	0.5 - 0.7
Oil & Gas Production & Processing	11.4 - 16.7	24.7 - 35.7	34.7 - 50.2
Oil & Gas International Trade	1.8 - 2.0	13.9 - 15.8	23.6 - 26.8
Oil & Gas Domestic Pipeline	1.8 - 2.5	4.2 - 6.0	5.2 - 7.5
Electricity Generation & Transmission	15.7 - 19.6	54.0 - 66.4	104.0 - 126.3

UNITED STATES

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	551.3	359.9	460.1	22.7	203.2	79.8			1 677.1
Net Imports	- 11.5	655.6	86.9						731.0
TPED	**541.2**	**1 012.1**	**534.9**	**22.7**	**203.2**	**79.8**			**2 394.0**
Electricity and Heat Generation	- 511.5	- 24.2	- 143.4	- 22.7	- 203.2	- 30.7	310.1	5.4	- 620.3
Petroleum Refineries		- 230.5	- 20.5			- 1.2	- 4.3	- 0.9	- 257.4
Others			- 41.8			- 5.5	- 3.7		- 51.1
TFED	**29.7**	**766.8**	**329.3**			**42.3**	**302.1**	**4.6**	**1 474.8**
Industry	26.2	117.7	143.1			30.1	87.9	4.6	409.6
Transport		603.4	0.3			1.8	0.4		606.0
Residential	1.3	30.2	114.2			9.1	109.1		263.8
Commercial	2.2	15.4	71.7			1.2	104.8		195.5

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	613.1	428.8	495.0	23.7	210.7	102.7			1 874.1
Net Imports	- 20.0	703.0	100.1				1.9		785.0
TPED	**593.1**	**1 131.7**	**595.2**	**23.7**	**210.7**	**102.7**	**1.9**		**2 659.0**
Electricity and Heat Generation	- 559.7	- 24.2	- 164.5	- 23.7	- 210.7	- 47.4	361.0	5.7	- 663.5
Petroleum Refineries		- 240.3	- 20.7			- 1.3	- 4.3	- 0.9	- 267.4
Others			- 46.0			- 7.9	- 4.1		- 58.0
TFED	**33.4**	**867.2**	**364.0**			**46.2**	**354.4**	**4.8**	**1 670.1**
Industry	30.1	128.2	151.5			32.8	97.1	4.8	444.5
Transport		693.4	0.5			2.6	0.4		697.0
Residential	1.2	30.0	124.0			9.6	121.9		286.5
Commercial	2.2	15.6	88.0			1.2	135.1		242.2

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	629.2	450.6	559.0	24.4	233.9	134.2			2 031.3
Net Imports	27.7	810.4	114.5				1.2		953.8
TPED	**656.9**	**1 261.0**	**673.5**	**24.4**	**233.9**	**134.2**	**1.2**		**2 985.1**
Electricity and Heat Generation	- 620.6	- 24.5	- 201.0	- 24.4	- 233.9	- 68.9	431.4	5.7	- 736.2
Petroleum Refineries		- 245.2	- 20.3			- 1.2	- 4.2	- 0.9	- 271.9
Others			- 47.3			- 11.7	- 4.1		- 63.1
TFED	**36.3**	**991.3**	**404.9**			**52.4**	**424.3**	**4.8**	**1 914.0**
Industry	33.0	138.7	167.9			36.8	109.7	4.8	491.0
Transport		807.2	0.9			3.9	0.4		812.3
Residential	1.0	29.7	130.5			10.4	142.9		314.5
Commercial	2.2	15.7	105.5			1.2	171.4		296.1

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	744.1	430.3	559.7	23.0	235.8	173.8			2 166.7
Net Imports	63.9	965.1	121.0				1.2		1 151.1
TPED	**807.9**	**1 395.4**	**680.7**	**23.0**	**235.8**	**173.8**	**1.2**		**3 317.9**
Electricity and Heat Generation	- 770.2	- 24.1	- 171.6	- 23.0	- 235.8	- 95.7	492.7	5.7	- 821.9
Petroleum Refineries		- 259.6	- 20.6			- 1.3	- 4.3	- 0.9	- 286.7
Others			- 43.9			- 16.5	- 4.0		- 64.3
TFED	**37.7**	**1 111.7**	**444.7**			**60.4**	**485.7**	**4.8**	**2 144.9**
Industry	34.6	148.1	185.3			42.0	121.2	4.8	536.1
Transport		918.3	1.5			5.5	0.4		925.6
Residential	0.9	29.4	133.4			11.7	163.9		339.3
Commercial	2.2	15.9	124.4			1.2	200.3		344.0

UNITED STATES

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	5 162	10 075	13 108	17 722	22 855	3.1	3.3	3.1	2.6	3.0
Population (million)	228	289	310	337	361	1.1	0.9	0.8	0.7	0.8
GDP per capita (2000 PPP US$)	22 640	34 908	42 270	52 588	63 230	2.0	2.4	2.2	1.9	2.1
GDP in Services (2000 PPP US$ billion)	4 040	7 942	10 550	14 475	18 793	3.1	3.6	3.2	2.6	3.1
GDP in Industry (2000 PPP US$ billion)	1 151	2 249	2 791	3 566	4 376	3.1	2.7	2.5	2.1	2.4
Urbanisation level (%)	73	78	80	84	89	0.2	0.4	0.5	0.6	0.5

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**1 553.3**	**1 677.1**	**1 874.1**	**2 031.3**	**2 166.7**	**0.3**	**1.4**	**0.8**	**0.6**	**0.9**
Coal	447.9	551.3	613.1	629.2	744.1	0.9	1.3	0.3	1.7	1.1
	(29%)	(33%)	(33%)	(31%)	(34%)					
Oil	498.3	359.9	428.8	450.6	430.3	- 1.5	2.2	0.5	- 0.5	0.6
	(32%)	(21%)	(23%)	(22%)	(20%)					
Gas	454.6	460.1	495.0	559.0	559.7	0.1	0.9	1.2		0.7
	(29%)	(27%)	(26%)	(28%)	(26%)					
Hydro	24.0	22.7	23.7	24.4	23.0	- 0.2	0.5	0.3	- 0.6	
	(2%)	(1%)	(1%)	(1%)	(1%)					
NRE	59.1	79.8	102.7	134.2	173.8	1.4	3.2	2.7	2.6	2.8
	(4%)	(5%)	(5%)	(7%)	(8%)					
Nuclear	69.4	203.2	210.7	233.9	235.8	5.0	0.5	1.0	0.1	0.5
	(4%)	(12%)	(11%)	(12%)	(11%)					
Net Imports	**307.3**	**731.0**	**785.0**	**953.8**	**1 151.1**	**4.0**	**0.9**	**2.0**	**1.9**	**1.6**
Coal	- 57.0	- 11.5	- 20.0	27.7	63.9	- 7.0	7.2		8.7	
Oil	340.3	655.6	703.0	810.4	965.1	3.0	0.9	1.4	1.8	1.4
Gas	21.7	86.9	100.1	114.5	121.0	6.5	1.8	1.3	0.6	1.2
Electricity	2.3		1.9	1.2	1.2			- 4.0	- 0.3	
Total Primary Energy Demand	**1 811.6**	**2 394.0**	**2 659.0**	**2 985.1**	**3 317.9**	**1.3**	**1.3**	**1.2**	**1.1**	**1.2**
Coal	376.2	541.2	593.1	656.9	807.9	1.7	1.2	1.0	2.1	1.4
	(21%)	(23%)	(22%)	(22%)	(24%)					
Oil	803.9	1 012.1	1 131.7	1 261.0	1 395.4	1.1	1.4	1.1	1.0	1.2
	(44%)	(42%)	(43%)	(42%)	(42%)					
Gas	476.8	534.9	595.2	673.5	680.7	0.5	1.3	1.2	0.1	0.9
	(26%)	(22%)	(22%)	(23%)	(21%)					
Hydro	24.0	22.7	23.7	24.4	23.0	- 0.2	0.5	0.3	- 0.6	0.04
	(1%)	(1%)	(1%)	(1%)	(1%)					
NRE	59.1	79.8	102.7	134.2	173.8	1.4	3.2	2.7	2.6	2.8
	(3%)	(3%)	(4%)	(4%)	(5%)					
Nuclear	69.4	203.2	210.7	233.9	235.8	5.0	0.5	1.0	0.1	0.5
	(4%)	(8%)	(8%)	(8%)	(7%)					
Input for Electricity and Heat Generation	**- 536.2**	**- 935.8**	**-1 030.1**	**-1 173.3**	**-1 320.4**	**2.6**	**1.2**	**1.3**	**1.2**	**1.2**
Coal	- 292.0	- 511.5	- 559.7	- 620.6	- 770.2	2.6	1.1	1.0	2.2	1.5
	(54%)	(55%)	(54%)	(53%)	(58%)					
Oil	- 60.6	- 24.2	- 24.2	- 24.5	- 24.1	- 4.1		0.1	- 0.2	
	(11%)	(3%)	(2%)	(2%)	(2%)					
Gas	- 85.6	- 143.4	- 164.5	- 201.0	- 171.6	2.4	1.7	2.0	- 1.6	0.6
	(16%)	(15%)	(16%)	(17%)	(13%)					
Hydro	- 24.0	- 22.7	- 23.7	- 24.4	- 23.0	- 0.2	0.5	0.3	- 0.6	
	(4%)	(2%)	(2%)	(2%)	(2%)					
NRE	- 4.7	- 30.7	- 47.4	- 68.9	- 95.7	8.9	5.6	3.8	3.3	4.1
	(1%)	(3%)	(5%)	(6%)	(7%)					
Nuclear	- 69.4	- 203.2	- 210.7	- 233.9	- 235.8	5.0	0.5	1.0	0.1	0.5
	(13%)	(22%)	(20%)	(20%)	(18%)					
Other Transformation	**- 97.6**	**- 308.5**	**- 325.4**	**- 335.0**	**- 351.0**	**5.4**	**0.7**	**0.3**	**0.5**	**0.5**
Coal	- 2.5									
	(3%)									
Oil	- 49.7	- 230.5	- 240.3	- 245.2	- 259.6	7.2	0.5	0.2	0.6	0.4
	(51%)	(75%)	(74%)	(73%)	(74%)					
Gas	- 39.0	- 62.3	- 66.7	- 67.6	- 64.5	2.2	0.8	0.1	- 0.5	0.1
	(40%)	(20%)	(20%)	(20%)	(18%)					
NRE		- 6.8	- 9.1	- 12.9	- 17.7		3.8	3.5	3.2	3.5
		(2%)	(3%)	(4%)	(5%)					
Electricity	- 6.4	- 8.0	- 8.5	- 8.3	- 8.3	1.0	0.7	- 0.1	- 0.1	0.1
	(7%)	(3%)	(3%)	(2%)	(2%)					
Heat		- 0.9	- 0.9	- 0.9	- 0.9		0.1	- 0.2	0.2	
		(0%)	(0%)	(0%)	(0%)					

UNITED STATES

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**1 224.2**	**1 474.8**	**1 670.1**	**1 914.0**	**2 144.9**	**0.9**	**1.6**	**1.4**	**1.1**	**1.3**
Coal	51.6	29.7	33.4	36.3	37.7	- 2.5	1.5	0.8	0.4	0.9
	(4%)	(2%)	(2%)	(2%)	(2%)					
Oil	641.7	766.8	867.2	991.3	1 111.7	0.8	1.6	1.3	1.2	1.3
	(52%)	(52%)	(52%)	(52%)	(52%)					
Gas	322.7	329.3	364.0	404.9	444.7	0.1	1.3	1.1	0.9	1.1
	(26%)	(22%)	(22%)	(21%)	(21%)					
NRE	33.9	42.3	46.2	52.4	60.4	1.0	1.1	1.3	1.4	1.3
	(3%)	(3%)	(3%)	(3%)	(3%)					
Electricity	174.2	302.1	354.4	424.3	485.7	2.5	2.0	1.8	1.4	1.7
	(14%)	(20%)	(21%)	(22%)	(23%)					
Heat		4.6	4.8	4.8	4.8		0.7			0.2
		(0%)	(0%)	(0%)	(0%)					
Industry	**447.0**	**409.6**	**444.5**	**491.0**	**536.1**	**- 0.4**	**1.0**	**1.0**	**0.9**	**1.0**
Coal	48.2	26.2	30.1	33.0	34.6	- 2.7	1.7	0.9	0.5	1.0
	(11%)	(6%)	(7%)	(7%)	(6%)					
Oil	149.2	117.7	128.2	138.7	148.1	- 1.1	1.1	0.8	0.7	0.8
	(33%)	(29%)	(29%)	(28%)	(28%)					
Gas	151.5	143.1	151.5	167.9	185.3	- 0.3	0.7	1.0	1.0	0.9
	(34%)	(35%)	(34%)	(34%)	(35%)					
NRE	33.9	30.1	32.8	36.8	42.0	- 0.5	1.1	1.2	1.3	1.2
	(8%)	(7%)	(7%)	(8%)	(8%)					
Electricity	64.2	87.9	97.1	109.7	121.2	1.4	1.3	1.2	1.0	1.2
	(14%)	(21%)	(22%)	(22%)	(23%)					
Heat		4.6	4.8	4.8	4.8		0.7			0.2
		(1%)	(1%)	(1%)	(1%)					
Transport	**418.2**	**606.0**	**697.0**	**812.3**	**925.6**	**1.7**	**1.8**	**1.5**	**1.3**	**1.5**
Coal										
Oil	418.0	603.4	693.4	807.2	918.3	1.7	1.8	1.5	1.3	1.5
	(100%)	(100%)	(99%)	(99%)	(99%)					
Gas		0.3	0.5	0.9	1.5		5.7	5.5	4.7	5.3
		(0%)	(0%)	(0%)	(0%)					
NRE		1.8	2.6	3.9	5.5		4.5	4.0	3.5	4.0
		(0%)	(0%)	(0%)	(1%)					
Electricity	0.3	0.4	0.4	0.4	0.4	1.4	- 0.5			- 0.1
	(0%)	(0%)	(0%)	(0%)	(0%)					
Residential	**216.1**	**263.8**	**286.5**	**314.5**	**339.3**	**0.9**	**1.0**	**0.9**	**0.8**	**0.9**
Coal	1.6	1.3	1.2	1.0	0.9	- 1.0	- 1.0	- 1.0	- 1.0	- 1.0
	(1%)	(0%)	(0%)	(0%)	(0%)					
Oil	42.4	30.2	30.0	29.7	29.4	- 1.5	- 0.1	- 0.1	- 0.1	- 0.1
	(20%)	(11%)	(10%)	(9%)	(9%)					
Gas	110.4	114.2	124.0	130.5	133.4	0.2	1.0	0.5	0.2	0.6
	(51%)	(43%)	(43%)	(41%)	(39%)					
NRE		9.1	9.6	10.4	11.7		0.6	0.9	1.2	0.9
		(3%)	(3%)	(3%)	(3%)					
Electricity	61.7	109.1	121.9	142.9	163.9	2.6	1.4	1.6	1.4	1.5
	(29%)	(41%)	(43%)	(45%)	(48%)					
Heat										
Commercial	**142.8**	**195.5**	**242.2**	**296.1**	**344.0**	**1.4**	**2.7**	**2.0**	**1.5**	**2.0**
Coal	1.8	2.2	2.2	2.2	2.2	0.9	- 0.1	- 0.1	- 0.1	- 0.1
	(1%)	(1%)	(1%)	(1%)	(1%)					
Oil	32.2	15.4	15.6	15.7	15.9	- 3.3	0.1	0.1	0.1	0.1
	(23%)	(8%)	(6%)	(5%)	(5%)					
Gas	60.7	71.7	88.0	105.5	124.4	0.8	2.6	1.8	1.7	2.0
	(43%)	(37%)	(36%)	(36%)	(36%)					
NRE		1.2	1.2	1.2	1.2					
		(1%)	(1%)	(0%)	(0%)					
Electricity	48.1	104.8	135.1	171.4	200.3	3.6	3.2	2.4	1.6	2.3
	(34%)	(54%)	(56%)	(58%)	(58%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	80	84	84	84	84
Net Energy Import Ratio (%)	17	30	30	32	35
Net Oil Import Dependency (%)	42	65	62	64	69

UNITED STATES

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**2 427**	**3 835**	**4 404**	**5 129**	**5 851**	**2.1**	**1.7**	**1.5**	**1.3**	**1.5**
Coal	1 243	1 928	2 219	2 590	3 390	2.0	1.8	1.6	2.7	2.0
	(51%)	(50%)	(50%)	(51%)	(58%)					
Oil	263	95	97	101	101	-4.5	0.3	0.3	0.1	0.2
	(11%)	(2%)	(2%)	(2%)	(2%)					
Gas	370	682	791	973	829	2.8	1.9	2.1	-1.6	0.7
	(15%)	(18%)	(18%)	(19%)	(14%)					
Hydro	279	264	277	284	268	-0.2	0.6	0.2	-0.6	0.04
	(11%)	(7%)	(6%)	(6%)	(5%)					
NRE	6	86	211	284	358	13.1	11.8	3.0	2.3	5.2
		(2%)	(5%)	(6%)	(6%)					
Nuclear	266	780	809	897	905	5.0	0.5	1.0	0.1	0.5
	(11%)	(20%)	(18%)	(18%)	(15%)					
Total Installed Generation Capacity (GW)	**579**	**880**	**1 034**	**1 074**	**1 248**	**1.9**	**2.0**	**0.4**	**1.5**	**1.3**
Thermal	444	686	817	839	1 000	2.0	2.2	0.3	1.8	1.4
	(77%)	(78%)	(79%)	(78%)	(80%)					
Coal		315	323	355	481		0.3	1.0	3.1	1.5
		(36%)	(31%)	(33%)	(39%)					
Oil		257	293	261	281		1.6	-1.2	0.7	0.3
		(29%)	(28%)	(24%)	(22%)					
Gas		114	201	222	238		7.4	1.0	0.7	2.7
		(13%)	(19%)	(21%)	(19%)					
Hydro	82	79	79	79	79	-0.2				
	(14%)	(9%)	(8%)	(7%)	(6%)					
NRE	1	17	36	48	61	13.7	10.2	2.8	2.5	4.7
		(2%)	(4%)	(4%)	(5%)					
Nuclear	52	99	101	109	109	3.0	0.3	0.7		0.4
	(9%)	(11%)	(10%)	(10%)	(9%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**351**	**238**	**203**	**168**	**145**	**- 1.8**	**- 2.0**	**- 1.8**	**- 1.5**	**- 1.7**
Industry (toe per US$ million GDP in Industry)	389	182	159	138	123	- 3.4	-1.7	- 1.4	- 1.2	- 1.4
Commercial (toe per US$ million GDP in Services)	35	25	23	20	18	- 1.6	- 0.9	- 1.1	- 1.1	- 1.1
Energy Intensity (kgoe per capita)	**7 947**	**8 296**	**8 576**	**8 859**	**9 180**	**0.2**	**0.4**	**0.3**	**0.4**	**0.4**
Industry	1 961	1 419	1 433	1 457	1 483	- 1.5	0.1	0.2	0.2	0.2
Transport	1 835	2 100	2 247	2 411	2 561	0.6	0.9	0.7	0.6	0.7
Residential	948	914	924	933	939	- 0.2	0.1	0.1	0.1	0.1
Commercial	626	677	781	879	952	0.4	1.8	1.2	0.8	1.2
CO_2 Emissions (million tonnes)	**4 574**	**5 895**	**6 546**	**7 343**	**8 326**	**1.2**	**1.3**	**1.2**	**1.3**	**1.2**
Electricity Generation	1 535	2 393	2 629	2 951	3 461	2.0	1.2	1.2	1.6	1.3
Transformation other than Electricity Generation	245	400	424	427	446	2.2	0.7	0.1	0.4	0.4
Industry	932	740	801	876	947	- 1.0	1.0	0.9	0.8	0.9
Transport	1 223	1 777	2 046	2 387	2 721	1.7	1.8	1.6	1.3	1.5
Residential	390	363	385	399	405	- 0.3	0.7	0.4	0.1	0.4
Commercial	248	223	261	303	347	- 0.5	2.0	1.5	1.4	1.6
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	886	585	499	414	364	- 1.9	- 2.0	- 1.8	- 1.3	- 1.7
CO_2 emissions per capita (tonnes per capita)	20.1	20.4	21.1	21.8	23.0	0.1	0.4	0.3	0.6	0.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**431 - 565**	**868 - 1 150**	**1 354 - 1 751**
Coal Production & Transportation	19 - 20	37 - 40	67 - 73
Oil & Gas Production & Processing	89 - 132	164 - 241	204 - 297
Oil & Gas International Trade	14 - 19	31 - 45	52 - 78
Oil & Gas Domestic Pipeline	81 - 115	178 - 254	224 - 320
Electricity Generation & Transmission	229 - 278	459 - 570	808 - 982

VIET NAM

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	8.9	17.4	2.3	1.6		23.2			53.4
Net Imports	- 3.4	- 7.6							- 11.0
TPED	**5.5**	**9.8**	**2.3**	**1.6**		**23.2**			**42.4**
Electricity and Heat Generation	- 1.5	- 1.7	- 1.6	- 1.6			2.7		- 3.7
Petroleum Refineries									
Others		0.3	- 0.7			- 0.7			- 1.1
TFED	**4.0**	**8.4**				**22.5**	**2.6**		**37.5**
Industry	3.0	2.3					1.1		6.5
Transport		4.7							4.8
Residential	0.8	0.4				22.5	1.3		24.9
Commercial	0.3	0.9					0.2		1.3

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	18.1	18.0	6.8	2.8		23.2			69.0
Net Imports	- 6.8	- 3.1							- 9.9
TPED	**11.3**	**15.0**	**6.8**	**2.8**		**23.2**			**59.1**
Electricity and Heat Generation	- 4.5		- 4.3	- 2.8			5.7		- 6.0
Petroleum Refineries		- 0.4	- 0.1						- 0.5
Others		0.4	- 1.0			- 0.7			- 1.3
TFED	**6.8**	**15.0**	**1.4**			**22.5**	**5.7**		**51.3**
Industry	5.2	4.5	1.4				2.4		13.4
Transport		8.2							8.2
Residential	1.1	0.8				22.5	2.9		27.3
Commercial	0.5	1.5					0.4		2.4

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	26.7	23.6	10.8	4.7	3.6	25.3			94.7
Net Imports	- 7.6	5.1					0.6		- 1.9
TPED	**19.1**	**28.7**	**10.8**	**4.7**	**3.6**	**25.3**	**0.6**		**92.8**
Electricity and Heat Generation	- 7.9		- 6.6	- 4.7	- 3.6	- 2.1	11.3		- 13.6
Petroleum Refineries		- 1.3	- 0.4						- 1.7
Others		0.4	- 1.0			- 0.7			- 1.2
TFED	**11.2**	**27.8**	**2.9**			**22.5**	**11.9**		**76.2**
Industry	8.8	8.5	2.7				4.8		24.8
Transport		15.2							15.3
Residential	1.6	1.5	0.1			22.5	6.2		31.8
Commercial	0.9	2.6					0.9		4.3

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	41.7	20.0	16.7	6.0	10.8	25.8			121.1
Net Imports	- 6.6	26.6					0.6		20.6
TPED	**35.1**	**46.6**	**16.7**	**6.0**	**10.8**	**25.8**	**0.6**		**141.7**
Electricity and Heat Generation	- 18.5		- 10.6	- 6.0	- 10.8	- 2.6	20.6		- 28.0
Petroleum Refineries		- 2.6	- 0.7						- 3.3
Others		0.4	- 0.9			- 0.7			- 1.2
TFED	**16.6**	**44.4**	**4.4**			**22.5**	**21.1**		**109.1**
Industry	13.3	12.4	4.1				8.5		38.2
Transport		25.6					0.1		25.7
Residential	2.1	2.4	0.3			22.5	11.0		38.3
Commercial	1.2	4.0	0.1				1.6		6.9

VIET NAM

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	68	201	353	653	1 111	5.0	7.3	6.3	5.5	6.3
Population (million)	53.7	80.5	88.6	99.0	108.7	1.9	1.2	1.1	0.9	1.1
GDP per capita (2000 PPP US$)	1 271	2 500	3 987	6 597	10 215	3.1	6.0	5.2	4.5	5.2
GDP in Services (2000 PPP US$ billion)		70	120	232	424		7.1	6.8	6.2	6.7
GDP in Industry (2000 PPP US$ billion)		70	141	277	471		9.2	7.0	5.5	7.1
Urbanisation level (%)	19	25	29	35	43	1.2	1.9	2.0	1.9	1.9

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**18.4**	**53.4**	**69.0**	**94.7**	**121.1**	**5.0**	**3.3**	**3.2**	**2.5**	**3.0**
Coal	2.9	8.9	18.1	26.7	41.7	5.2	9.3	3.9	4.6	5.7
	(16%)	(17%)	(26%)	(28%)	(34%)					
Oil		17.4	18.0	23.6	20.0		0.4	2.7	- 1.6	0.5
		(33%)	(26%)	(25%)	(17%)					
Gas		2.3	6.8	10.8	16.7		14.5	4.7	4.5	7.3
		(4%)	(10%)	(11%)	(14%)					
Hydro		1.6	2.8	4.7	6.0	12.1	7.5	5.4	2.5	4.9
		(3%)	(4%)	(5%)	(5%)					
NRE	15.3	23.2	23.2	25.3	25.8	1.9	0.03	0.8	0.2	0.4
	(83%)	(43%)	(34%)	(27%)	(21%)					
Nuclear				3.6	10.8				11.6	
				(4%)	(9%)					
Net Imports	**1.5**	**- 11.0**	**- 9.9**	**- 1.9**	**20.6**		**- 1.3**	**- 15.1**		
Coal	- 0.4	- 3.4	- 6.8	- 7.6	- 6.6	10.9	9.0	1.1	- 1.4	2.4
Oil	1.8	- 7.6	- 3.1	5.1	26.6		- 10.8		17.9	
Gas										
Electricity				0.6	0.6				0.3	
Total Primary Energy Demand	**19.6**	**42.4**	**59.1**	**92.8**	**141.7**	**3.6**	**4.2**	**4.6**	**4.3**	**4.4**
Coal	2.3	5.5	11.3	19.1	35.1	4.1	9.5	5.4	6.3	6.9
	(12%)	(13%)	(19%)	(21%)	(25%)					
Oil	1.8	9.8	15.0	28.7	46.6	7.9	5.4	6.7	5.0	5.7
	(9%)	(23%)	(25%)	(31%)	(33%)					
Gas		2.3	6.8	10.8	16.7		14.5	4.7	4.5	7.3
		(5%)	(12%)	(12%)	(12%)					
Hydro	0.1	1.6	2.8	4.7	6.0	12.1	7.5	5.4	2.5	4.9
	(1%)	(4%)	(5%)	(5%)	(4%)					
NRE	15.3	23.2	23.2	25.3	25.8	1.9	0.03	0.8	0.2	0.4
	(78%)	(55%)	(39%)	(27%)	(18%)					
Nuclear				3.6	10.8				11.6	
				(4%)	(8%)					
Input for Electricity and Heat Generation	**- 1.1**	**- 6.4**	**- 11.7**	**- 24.9**	**- 48.6**	**8.4**	**7.9**	**7.8**	**6.9**	**7.5**
Coal	- 0.8	- 1.5	- 4.5	- 7.9	- 18.5	3.1	15.1	5.7	8.9	9.5
	(71%)	(23%)	(39%)	(32%)	(38%)					
Oil	- 0.2	- 1.7				10.6				- 16.0
	(17%)	(27%)								
Gas		- 1.6	- 4.3	- 6.6	- 10.6		13.3	4.3	4.8	7.0
		(25%)	(37%)	(27%)	(22%)					
Hydro	- 0.1	- 1.6	- 2.8	- 4.7	- 6.0	12.1	7.5	5.4	2.5	4.9
	(12%)	(25%)	(24%)	(19%)	(12%)					
NRE				- 2.1	- 2.6			46.0	2.4	
				(8%)	(5%)					
Nuclear				- 3.6	- 10.8				11.6	
				(14%)	(22%)					
Other Transformation		**- 1.1**	**- 1.8**	**- 3.0**	**- 4.6**		**6.3**	**4.9**	**4.4**	**5.1**
Coal										
Oil		0.3	0.01	- 0.9	- 2.2		- 37.3		9.1	
		- (22%)	- (1%)	(31%)	(48%)					
Gas		- 0.7	- 1.1	- 1.3	- 1.7		6.9	1.7	2.3	3.4
		(59%)	(61%)	(45%)	(37%)					
NRE		- 0.7	- 0.7	- 0.7	- 0.7					
		(63%)	(39%)	(24%)	(16%)					
Electricity										
Heat										

VIET NAM

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**17.8**	**37.5**	**51.3**	**76.2**	**109.1**	**3.4**	**4.0**	**4.0**	**3.7**	**3.9**
Coal	1.3	4.0	6.8	11.2	16.6	5.1	6.8	5.2	4.0	5.2
	(7%)	(11%)	(13%)	(15%)	(15%)					
Oil	1.5	8.4	15.0	27.8	44.4	8.0	7.6	6.4	4.8	6.1
	(9%)	(22%)	(29%)	(36%)	(41%)					
Gas			1.4	2.9	4.4			7.7	4.5	
			(3%)	(4%)	(4%)					
NRE	14.7	22.5	22.5	22.5	22.5	1.9				
	(83%)	(60%)	(44%)	(30%)	(21%)					
Electricity	0.2	2.6	5.7	11.9	21.1	11.6	10.3	7.7	5.9	7.8
	(1%)	(7%)	(11%)	(16%)	(19%)					
Heat										
Industry	**1.6**	**6.5**	**13.4**	**24.8**	**38.2**	**6.4**	**9.6**	**6.3**	**4.4**	**6.6**
Coal	0.9	3.0	5.2	8.8	13.3	5.4	7.2	5.4	4.2	5.5
	(57%)	(46%)	(39%)	(35%)	(35%)					
Oil	0.6	2.3	4.5	8.5	12.4	6.7	8.6	6.5	3.8	6.1
	(34%)	(36%)	(34%)	(34%)	(32%)					
Gas			1.4	2.7	4.1			7.2	4.1	21.1
			(10%)	(11%)	(11%)					
NRE										
Electricity	0.1	1.1	2.4	4.8	8.5	9.7	9.6	7.4	5.8	7.4
	(9%)	(18%)	(18%)	(19%)	(22%)					
Heat										
Transport	**0.6**	**4.8**	**8.2**	**15.3**	**25.7**	**9.5**	**7.1**	**6.4**	**5.3**	**6.2**
Coal	0.1									
	(10%)									
Oil	0.6	4.7	8.2	15.2	25.6	10.0	7.1	6.4	5.3	6.2
	(90%)	(99%)	(100%)	(100%)	(100%)					
Gas										
NRE										
Electricity		0.03	0.03	0.04	0.05		3.4	2.6	2.1	2.6
		(1%)	(0%)	(0%)	(0%)					
Residential	**15.3**	**24.9**	**27.3**	**31.8**	**38.3**	**2.2**	**1.1**	**1.5**	**1.9**	**1.5**
Coal	0.3	0.8	1.1	1.6	2.1	3.7	4.5	3.7	3.1	3.7
	(2%)	(3%)	(4%)	(5%)	(5%)					
Oil	0.2	0.4	0.8	1.5	2.4	4.6	7.8	6.1	4.8	6.1
	(1%)	(2%)	(3%)	(5%)	(6%)					
Gas			0.01	0.11	0.27			25.3	9.8	
			(0%)	(0%)	(1%)					
NRE	14.7	22.5	22.5	22.5	22.5	1.9				
	(96%)	(90%)	(82%)	(71%)	(59%)					
Electricity	0.1	1.3	2.9	6.2	11.0	13.3	11.0	7.9	6.0	8.1
	(1%)	(5%)	(11%)	(19%)	(29%)					
Heat										
Commercial	**0.2**	**1.3**	**2.4**	**4.3**	**6.9**	**8.5**	**7.6**	**6.2**	**4.8**	**6.1**
Coal		0.3	0.5	0.9	1.2		7.1	5.4	3.7	5.3
		(22%)	(21%)	(20%)	(18%)					
Oil	0.2	0.9	1.5	2.6	4.0	6.4	7.0	5.7	4.6	5.7
	(99%)	(65%)	(62%)	(60%)	(58%)					
Gas				0.0	0.1				9.7	
				(1%)	(2%)					
NRE										
Electricity	0.003	0.2	0.4	0.9	1.6	20.3	10.6	8.1	6.2	8.1
		(13%)	(16%)	(20%)	(22%)					
Heat										

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	36	64	80	89	92
Net Energy Import Ratio (%)	8	-26	-17	-2	15
Net Oil Import Dependency (%)	100	-77	-20	18	57

VIET NAM

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**4**	**36**	**76**	**148**	**266**	**11.1**	**9.9**	**6.9**	**6.0**	**7.4**
Coal	1	5	20	36	85	5.8	19.0	6.1	9.1	10.7
	(40%)	(14%)	(26%)	(24%)	(32%)					
Oil	1	4				9.1	- 100			- 14.4
	(18%)	(12%)								
Gas		8	23	37	62		13.8	4.7	5.2	7.4
		(23%)	(31%)	(25%)	(23%)					
Hydro	1	18	32	55	70	12.1	7.5	5.4	2.5	4.9
	(42%)	(51%)	(43%)	(37%)	(26%)					
NRE			1	6	7			27.7	0.8	
			(1%)	(4%)	(3%)					
Nuclear				14	42				11.6	
				(9%)	(16%)					
Total Installed Generation Capacity (GW)	**1**	**9**	**23**	**44**	**63**	**10.2**	**12.5**	**6.9**	**3.7**	**7.3**
Thermal	1	5	14	23	38	8.3	14.3	5.6	4.9	7.8
	(77%)	(53%)	(60%)	(53%)	(60%)					
Coal		1	6	11	22		20.9	7.0	6.8	10.7
		(14%)	(25%)	(26%)	(34%)					
Oil		1.35	1.05	0.48	0.48		- 3.1	- 7.6		- 3.7
		(15%)	(5%)	(1%)	(1%)					
Gas		2	7	12	16		16.2	5.6	3.0	7.6
		(23%)	(30%)	(27%)	(25%)					
Hydro		4	9	16	17	14.7	9.9	6.3	0.3	5.1
	(19%)	(47%)	(39%)	(37%)	(26%)					
NRE	0.04		0.22	2.25	2.50	- 99.8		25.9	1.1	
	(4%)		(1%)	(5%)	(4%)					
Nuclear				2	6				11.6	
				(5%)	(10%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**287**	**211**	**167**	**142**	**128**	**- 1.4**	**- 2.8**	**- 1.6**	**- 1.1**	**- 1.8**
Industry (toe per US$ million GDP in Industry)		92	95	90	81	0.0	0.4	- 0.6	- 1.0	- 0.5
Commercial (toe per US$ million GDP in Services)		19	20	19	16	0.0	0.5	- 0.5	- 1.3	- 0.5
Energy Intensity (kgoe per capita)	**365**	**526**	**667**	**937**	**1 303**	**1.7**	**3.0**	**3.5**	**3.4**	**3.3**
Industry	31	80	152	251	351	4.5	8.3	5.2	3.4	5.4
Transport	12	59	93	154	236	7.5	5.8	5.2	4.3	5.1
Residential	285	310	308	321	352	0.4	- 0.1	0.4	0.9	0.5
Commercial	4	16	27	44	64	6.5	6.3	5.0	3.9	5.0
CO_2 Emissions (million tonnes)	**13.4**	**56.4**	**101.5**	**177.2**	**301.0**	**6.8**	**7.6**	**5.7**	**5.4**	**6.2**
Electricity Generation	3.5	14.7	27.7	46.0	96.5	6.7	8.3	5.2	7.7	7.0
Transformation other than Electricity Generation		1.1	2.5	4.2	6.6		11.4	5.3	4.8	6.8
Industry	5.4	18.6	33.9	60.0	89.2	5.8	7.8	5.9	4.1	5.8
Transport	2.0	14.1	24.3	45.3	76.3	9.4	7.1	6.4	5.3	6.2
Residential	1.8	4.3	6.7	10.5	15.3	4.0	5.7	4.6	3.9	4.7
Commercial	0.7	3.7	6.4	11.2	17.1	8.1	7.0	5.6	4.4	5.6
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	195.6	280.3	287.4	271.3	271.0	1.6	0.3	- 0.6		- 0.1
CO_2 emissions per capita (tonnes per capita)	0.2	0.7	1.1	1.8	2.8	4.8	6.3	4.6	4.5	5.0

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**28.2 - 35.0**	**80.0 - 100.5**	**136.1 - 172.2**
Coal Production & Transportation	1.1 - 1.5	2.3 - 3.0	4.2 - 5.6
Oil & Gas Production & Processing	3.2 - 4.8	10.0 - 15.3	13.4 - 20.4
Oil & Gas International Trade			0.04 - 0.10
Oil & Gas Domestic Pipeline	0.9 - 1.3	1.7 - 2.4	2.8 - 4.1
Electricity Generation & Transmission	23.0 - 27.5	66.1 - 79.8	115.6 - 142.1

NORTHEAST ASIA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			3.1	9.6	108.6	12.7			134.1
Net Imports	166.9	411.4	103.5				0.5		682.2
TPED	**167.1**	**407.0**	**106.8**	**9.6**	**108.6**	**12.7**	**0.5**		**812.4**
Electricity and Heat Generation	- 100.4	- 35.9	- 70.8	- 9.6	- 108.6	- 9.3	130.2	3.8	- 200.5
Petroleum Refineries		- 32.1	- 0.9				- 1.0		- 34.1
Others	- 32.8	- 5.0	3.3			- 0.2	- 0.1		- 34.8
TFED	**36.7**	**335.5**	**39.4**			**3.4**	**126.9**	**3.8**	**545.7**
Industry	36.2	128.4	14.7			2.4	58.8	2.0	242.5
Transport		145.7	0.1				1.9		147.7
Residential	0.6	22.5	17.5			0.8	30.5	1.2	73.1
Commercial		38.8	7.1			0.1	35.7	0.7	82.4

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			2.6	10.4	130.3	21.5			164.8
Net Imports	190.8	427.3	137.2				0.5		755.7
TPED	**190.8**	**427.3**	**139.8**	**10.4**	**130.3**	**21.5**	**0.5**		**920.6**
Electricity and Heat Generation	- 125.6	- 21.4	- 87.1	- 10.4	- 130.3	- 18.1	153.8	6.2	- 232.9
Petroleum Refineries		- 21.2	- 1.1				- 1.1		- 23.3
Others	- 24.3	- 4.3	3.0				- 0.1		- 25.7
TFED	**40.9**	**380.4**	**54.6**			**3.4**	**153.1**	**6.2**	**638.5**
Industry	40.8	142.5	22.1			2.4	69.3	3.5	280.6
Transport		174.0	0.1				2.0		176.1
Residential	0.1	22.3	22.3			0.9	36.2	1.9	83.8
Commercial		41.5	10.0			0.1	45.7	0.8	98.0

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			0.7	10.2	155.4	31.7			198.0
Net Imports	223.0	457.8	177.3				0.5		858.6
TPED	**223.0**	**457.8**	**178.0**	**10.2**	**155.4**	**31.7**	**0.5**		**1 056.6**
Electricity and Heat Generation	- 153.0	- 17.8	- 110.9	- 10.2	- 155.4	- 28.0	187.2	8.1	- 280.1
Petroleum Refineries		- 20.4	- 1.1				- 1.0		- 22.5
Others	- 24.2	- 4.0	3.1				- 0.1		- 25.2
TFED	**45.8**	**415.7**	**69.0**			**3.6**	**186.7**	**8.1**	**728.8**
Industry	45.8	154.5	28.9			2.5	87.4	4.8	323.9
Transport		193.8	0.3				2.1		196.2
Residential		22.2	26.8			1.0	40.2	2.4	92.6
Commercial		45.1	13.0			0.1	57.0	0.9	116.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production			0.7	10.6	176.9	41.2			229.5
Net Imports	243.1	472.5	206.3				0.6		922.5
TPED	**243.1**	**472.5**	**207.1**	**10.6**	**176.9**	**41.2**	**0.6**		**1 151.9**
Electricity and Heat Generation	- 170.3	- 16.8	- 128.3	- 10.6	- 176.9	- 37.4	214.7	9.6	- 316.0
Petroleum Refineries		- 19.6	- 1.1				- 0.9		- 21.6
Others	- 23.9	- 4.0	3.2				- 0.1		- 24.8
TFED	**48.9**	**432.2**	**80.8**			**3.8**	**214.3**	**9.6**	**789.5**
Industry	48.9	160.9	34.7			2.6	102.0	5.9	355.0
Transport		206.7	0.4				2.2		209.3
Residential		21.6	30.7			1.0	42.5	2.7	98.6
Commercial		43.0	15.0			0.2	67.5	1.0	126.6

NORTHEAST ASIA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	2 236	4 576	5 700	7 140	8 498	3.3	2.8	2.3	1.8	2.2
Population (million)	178	204	208	207	203	0.6	0.2	- 0.04	- 0.2	- 0.03
GDP per capita (2000 PPP US$)	12 561	22 396	27 419	34 476	41 925	2.7	2.6	2.3	2.0	2.3
GDP in Services (2000 PPP US$ billion)	1 403	3 257	3 974	4 964	6 005	3.9	2.5	2.2	1.9	2.2
GDP in Industry (2000 PPP US$ billion)	726	1 416	1 759	2 235	2 725	3.1	2.7	2.4	2.0	2.4
Urbanisation level (%)	54	71	73	75	78	1.3	0.2	0.3	0.4	0.3

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**58.4**	**134.1**	**164.8**	**198.0**	**229.5**	**3.9**	**2.6**	**1.8**	**1.5**	**1.9**
Coal	20.7									
	(35%)									
Oil	0.7	0.05	0.04	0.05	0.05	- 11.6	- 1.4	0.7	0.4	
	(1%)									
Gas	3.5	3.1	2.6	0.7	0.7	- 0.5	- 2.3	- 12.3	0.3	- 5.1
	(6%)	(2%)	(2%)	(0%)	(0%)					
Hydro	8.0	9.6	10.4	10.2	10.6	0.8	1.0	- 0.2	0.4	0.3
	(14%)	(7%)	(6%)	(5%)	(5%)					
NRE	0.8	12.7	21.5	31.7	41.2	13.1	6.8	3.9	2.7	4.3
	(1%)	(9%)	(13%)	(16%)	(18%)					
Nuclear	24.6	108.6	130.3	155.4	176.9	7.0	2.3	1.8	1.3	1.8
	(42%)	(81%)	(79%)	(78%)	(77%)					
Net Imports	**380.4**	**682.2**	**755.7**	**858.6**	**922.5**	**2.7**	**1.3**	**1.3**	**0.7**	**1.1**
Coal	54.1	166.9	190.8	223.0	243.1	5.3	1.7	1.6	0.9	1.4
Oil	306.8	411.4	427.3	457.8	472.5	1.3	0.5	0.7	0.3	0.5
Gas	19.5	103.5	137.2	177.3	206.3	7.9	3.6	2.6	1.5	2.5
Electricity		0.5	0.5	0.5	0.6		- 0.9	1.0	1.0	0.5
Total Primary Energy Demand	**421.8**	**812.4**	**920.6**	**1 056.6**	**1 151.9**	**3.0**	**1.6**	**1.4**	**0.9**	**1.3**
Coal	76.9	167.1	190.8	223.0	243.1	3.6	1.7	1.6	0.9	1.3
	(18%)	(21%)	(21%)	(21%)	(21%)					
Oil	288.4	407.0	427.3	457.8	472.5	1.6	0.6	0.7	0.3	0.5
	(68%)	(50%)	(46%)	(43%)	(41%)					
Gas	23.0	106.8	139.8	178.0	207.1	7.2	3.4	2.4	1.5	2.4
	(5%)	(13%)	(15%)	(17%)	(18%)					
Hydro	8.0	9.6	10.4	10.2	10.6	0.8	1.0	- 0.2	0.4	0.3
	(2%)	(1%)	(1%)	(1%)	(1%)					
NRE	0.9	12.7	21.5	31.7	41.2	13.0	6.8	3.9	2.7	4.3
	(0%)	(2%)	(2%)	(3%)	(4%)					
Nuclear	24.6	108.6	130.3	155.4	176.9	7.0	2.3	1.8	1.3	1.8
	(6%)	(13%)	(14%)	(15%)	(15%)					
Input for Electricity and Heat Generation	**- 136.8**	**- 334.6**	**- 392.9**	**- 475.4**	**- 540.3**	**4.1**	**2.0**	**1.9**	**1.3**	**1.7**
Coal	- 12.9	- 100.4	- 125.6	- 153.0	- 170.3	9.8	2.8	2.0	1.1	1.9
	(9%)	(30%)	(32%)	(32%)	(32%)					
Oil	- 75.0	- 35.9	- 21.4	- 17.8	- 16.8	- 3.3	- 6.3	- 1.8	- 0.6	- 2.7
	(55%)	(11%)	(5%)	(4%)	(3%)					
Gas	- 15.6	- 70.8	- 87.1	- 110.9	- 128.3	7.1	2.6	2.4	1.5	2.1
	(11%)	(21%)	(22%)	(23%)	(24%)					
Hydro	- 8.0	- 9.6	- 10.4	- 10.2	- 10.6	0.8	1.0	- 0.2	0.4	0.3
	(6%)	(3%)	(3%)	(2%)	(2%)					
NRE	- 0.8	- 9.3	- 18.1	- 28.0	- 37.4	11.9	8.7	4.5	2.9	5.1
	(1%)	(3%)	(5%)	(6%)	(7%)					
Nuclear	- 24.6	- 108.6	- 130.3	- 155.4	- 176.9	7.0	2.3	1.8	1.3	1.8
	(18%)	(32%)	(33%)	(33%)	(33%)					
Other Transformation	**- 22.2**	**- 68.8**	**- 49.1**	**- 47.7**	**- 46.4**	**5.3**	**- 4.1**	**- 0.3**	**- 0.3**	**- 1.4**
Coal	- 3.4	- 32.8	- 24.3	- 24.2	- 23.9	10.8	- 3.7		- 0.1	- 1.1
	(15%)	(48%)	(50%)	(51%)	(52%)					
Oil	- 17.3	- 37.1	- 25.5	- 24.4	- 23.5	3.5	- 4.6	- 0.5	- 0.3	- 1.6
	(78%)	(54%)	(52%)	(51%)	(51%)					
Gas	- 0.6	2.3	1.9	2.0	2.1		- 2.5	0.4	0.5	- 0.4
	(3%)	-(3%)	-(4%)	-(4%)	-(4%)					
NRE		- 0.2					- 18.7			- 5.7
		(0%)								
Electricity	- 0.9	- 1.1	- 1.1	- 1.1	- 1.0	0.9	0.4	- 0.4	- 0.7	- 0.3
	(4%)	(2%)	(2%)	(2%)	(2%)					
Heat										

NORTHEAST ASIA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**264.9**	**545.7**	**638.5**	**728.8**	**789.5**	**3.3**	**2.0**	**1.3**	**0.8**	**1.3**
Coal	33.2	36.7	40.9	45.8	48.9	0.5	1.3	1.1	0.7	1.0
	(13%)	(7%)	(6%)	(6%)	(6%)					
Oil	169.6	335.5	380.4	415.7	432.2	3.2	1.6	0.9	0.4	0.9
	(64%)	(61%)	(60%)	(57%)	(55%)					
Gas	11.1	39.4	54.6	69.0	80.8	5.9	4.1	2.4	1.6	2.6
	(4%)	(7%)	(9%)	(9%)	(10%)					
NRE		3.4	3.4	3.6	3.8	22.6	0.2	0.5	0.5	0.4
		(1%)	(1%)	(0%)	(0%)					
Electricity	50.9	126.9	153.1	186.7	214.3	4.2	2.4	2.0	1.4	1.9
	(19%)	(23%)	(24%)	(26%)	(27%)					
Heat	0.1	3.8	6.2	8.1	9.6	17.9	6.3	2.7	1.8	3.4
	(0%)	(1%)	(1%)	(1%)	(1%)					
Industry	**141.0**	**242.5**	**280.6**	**323.9**	**355.0**	**2.5**	**1.8**	**1.4**	**0.9**	**1.4**
Coal	24.2	36.2	40.8	45.8	48.9	1.8	1.5	1.2	0.7	1.1
	(17%)	(15%)	(15%)	(14%)	(14%)					
Oil	80.2	128.4	142.5	154.5	160.9	2.2	1.3	0.8	0.4	0.8
	(57%)	(53%)	(51%)	(48%)	(45%)					
Gas	3.8	14.7	22.1	28.9	34.7	6.3	5.2	2.7	1.9	3.1
	(3%)	(6%)	(8%)	(9%)	(10%)					
NRE		2.4	2.4	2.5	2.6		- 0.1	0.3	0.3	0.2
		(1%)	(1%)	(1%)	(1%)					
Electricity	32.7	58.8	69.3	87.4	102.0	2.7	2.1	2.3	1.6	2.0
	(23%)	(24%)	(25%)	(27%)	(29%)					
Heat		2.0	3.5	4.8	5.9		7.5	3.2	2.0	4.0
		(1%)	(1%)	(1%)	(2%)					
Transport	**62.6**	**147.7**	**176.1**	**196.2**	**209.3**	**4.0**	**2.2**	**1.1**	**0.7**	**1.3**
Coal										
Oil	61.2	145.7	174.0	193.8	206.7	4.0	2.2	1.1	0.6	1.3
	(98%)	(99%)	(99%)	(99%)	(99%)					
Gas		0.1	0.1	0.3	0.4		9.1	5.7	5.0	6.4
		(0%)	(0%)	(0%)	(0%)					
NRE										
Electricity	1.4	1.9	2.0	2.1	2.2	1.5	0.7	0.5	0.7	0.6
	(2%)	(1%)	(1%)	(1%)	(1%)					
Residential	**37.1**	**73.1**	**83.7**	**92.6**	**98.6**	**3.1**	**1.7**	**1.0**	**0.6**	**1.1**
Coal	8.9	0.6	0.1	0.02	0.002	- 11.8	- 17.0	- 18.1	- 19.3	- 18.2
	(24%)	(1%)	(0%)	(0%)	(0%)					
Oil	11.2	22.5	22.3	22.2	21.6	3.2	- 0.1	- 0.04	- 0.3	- 0.1
	(30%)	(31%)	(27%)	(24%)	(22%)					
Gas	5.8	17.5	22.3	26.8	30.7	5.2	3.1	1.9	1.4	2.0
	(16%)	(24%)	(27%)	(29%)	(31%)					
NRE		0.8	0.9	1.0	1.0	15.0	0.9	0.7	0.6	0.7
		(1%)	(1%)	(1%)	(1%)					
Electricity	11.3	30.5	36.2	40.2	42.5	4.6	2.1	1.1	0.6	1.2
	(30%)	(42%)	(43%)	(43%)	(43%)					
Heat		1.2	1.9	2.4	2.7		6.4	2.1	1.5	3.1
		(2%)	(2%)	(3%)	(3%)					
Commercial	**24.3**	**82.4**	**98.0**	**116.2**	**126.6**	**5.7**	**2.2**	**1.7**	**0.9**	**1.5**
Coal	0.1									
	(0%)									
Oil	17.0	38.8	41.5	45.1	43.0	3.8	0.8	0.8	- 0.5	0.4
	(70%)	(47%)	(42%)	(39%)	(34%)					
Gas	1.5	7.1	10.0	13.0	15.0	7.3	4.3	2.7	1.4	2.7
	(6%)	(9%)	(10%)	(11%)	(12%)					
NRE		0.1	0.1	0.1	0.2		2.3	2.4	1.9	2.2
		(0%)	(0%)	(0%)	(0%)					
Electricity	5.5	35.7	45.7	57.0	67.5	8.9	3.1	2.2	1.7	2.3
	(23%)	(43%)	(47%)	(49%)	(53%)					
Heat	0.1	0.7	0.8	0.9	1.0	8.8	1.8	1.7	1.5	1.7
	(0%)	(1%)	(1%)	(1%)	(1%)					

Note: Net imports include intraregional trade

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	52	77	81	85	87
Net Energy Import Ratio (%)	87	84	82	81	80
Net Oil Import Dependency (%)	100	100	100	100	100

NORTHEAST ASIA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**665**	**1 587**	**1 854**	**2 249**	**2 562**	**4.0**	**2.0**	**2.0**	**1.3**	**1.7**
Coal	63	496	631	783	893	9.8	3.1	2.2	1.3	2.1
	(10%)	(31%)	(34%)	(35%)	(35%)					
Oil	332	183	101	81	75	- 2.7	- 7.1	- 2.2	- 0.8	- 3.1
	(50%)	(12%)	(5%)	(4%)	(3%)					
Gas	81	342	412	538	637	6.8	2.4	2.7	1.7	2.3
	(12%)	(22%)	(22%)	(24%)	(25%)					
Hydro	93	101	120	115	114	0.4	2.1	- 0.4		0.4
	(14%)	(6%)	(6%)	(5%)	(4%)					
NRE	1	11	48	78	95	11.9	20.7	5.0	2.0	8.1
		(1%)	(3%)	(3%)	(4%)					
Nuclear	94	454	542	655	747	7.4	2.2	1.9	1.3	1.8
	(14%)	(29%)	(29%)	(29%)	(29%)					
Total Installed Generation Capacity (GW)	**166**	**344**	**416**	**488**	**549**	**3.4**	**2.4**	**1.6**	**1.2**	**1.7**
Thermal	115	221	261	311	355	3.0	2.1	1.8	1.3	1.7
	(70%)	(64%)	(63%)	(64%)	(65%)					
Coal		72	97	124	148		3.7	2.5	1.7	2.6
		(21%)	(23%)	(25%)	(27%)					
Oil		63	60	54	52		- 0.6	- 1.1	- 0.5	- 0.7
		(18%)	(14%)	(11%)	(9%)					
Gas		86	104	133	155		2.5	2.5	1.6	2.1
		(25%)	(25%)	(27%)	(28%)					
Hydro	32	53	60	61	64	2.3	1.5	0.2	0.4	0.7
	(20%)	(15%)	(14%)	(13%)	(12%)					
NRE		3	16	25	29	17.4	21.1	4.9	1.5	8.0
		(1%)	(4%)	(5%)	(5%)					
Nuclear	18	67	79	90	101	6.2	2.1	1.3	1.2	1.5
	(11%)	(19%)	(19%)	(18%)	(18%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**189**	**178**	**161**	**148**	**136**	**- 0.3**	**- 1.2**	**- 0.9**	**- 0.9**	**- 1.0**
Industry (toe per US$ million GDP in Industry)	194	171	160	145	130	- 0.6	- 0.9	- 1.0	- 1.1	- 1.0
Commercial (toe per US$ million GDP in Services)	17	25	25	23	21	1.7	- 0.3	- 0.5	- 1.0	- 0.6
Energy Intensity (kgoe per capita)	**2 370**	**3 976**	**4 428**	**5 101**	**5 683**	**2.4**	**1.4**	**1.4**	**1.1**	**1.3**
Industry	792	1 187	1 350	1 564	1 751	1.9	1.6	1.5	1.1	1.4
Transport	352	723	847	947	1 033	3.3	2.0	1.1	0.9	1.3
Residential	209	358	403	447	486	2.5	1.5	1.0	0.8	1.1
Commercial	136	403	472	561	625	5.1	2.0	1.8	1.1	1.6
CO_2 Emissions (million tonnes)	**987**	**1 982**	**2 244**	**2 539**	**2 727**	**3.2**	**1.6**	**1.2**	**0.7**	**1.1**
Electricity Generation	293	686	761	899	1 004	3.9	1.3	1.7	1.1	1.4
Transformation other than Electricity Generation	60	53	53	51	48	- 0.5	0.1	- 0.4	- 0.7	- 0.4
Industry	318	565	643	715	760	2.6	1.6	1.1	0.6	1.1
Transport	182	432	516	576	613	4.0	2.3	1.1	0.6	1.3
Residential	80	112	121	130	137	1.5	1.0	0.8	0.5	0.7
Commercial	54	135	150	168	166	4.2	1.3	1.1	- 0.1	0.7
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	441	433	394	356	321	- 0.1	- 1.2	- 1.0	- 1.0	- 1.1
CO_2 emissions per capita (tonnes per capita)	5.5	9.7	10.8	12.3	13.5	2.6	1.3	1.3	0.9	1.2

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**157 - 188**	**320 - 389**	**460 - 560**
Coal Production & Transportation			
Oil & Gas Production & Processing	14 - 19	26 - 35	34 - 46
Oil & Gas International Trade	17 - 19	32 - 37	41 - 49
Oil & Gas Domestic Pipeline	3 - 4	6 - 8	8 - 11
Electricity Generation & Transmission	123 - 146	257 - 309	377 - 453

SOUTHEAST ASIA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	91.2	134.6	147.8	4.3		98.7			476.6
Net Imports	- 46.8	32.8	- 52.2				0.2		- 66.0
TPED	**43.7**	**168.7**	**92.4**	**4.3**		**98.7**	**0.2**		**408.0**
Electricity and Heat Generation	- 23.0	- 12.0	- 43.1	- 4.3		- 16.4	31.0		- 67.8
Petroleum Refineries		- 25.6	- 1.1				- 0.2		- 26.9
Others	- 4.0	- 0.6	- 30.4			- 0.7			- 35.8
TFED	**16.5**	**129.9**	**17.5**			**81.6**	**30.7**		**276.1**
Industry	15.5	36.0	17.3			10.0	13.7		92.4
Transport		74.9	0.1				0.1		75.0
Residential	0.8	14.6	0.1			71.4	9.0		95.8
Commercial	0.3	4.4				0.2	7.9		12.9

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	155.2	144.2	221.8	6.1		109.0			636.3
Net Imports	- 65.0	78.1	- 74.7				0.7		- 60.9
TPED	**90.2**	**222.3**	**147.1**	**6.1**		**109.0**	**0.7**		**575.4**
Electricity and Heat Generation	- 51.1	- 7.0	- 70.3	- 6.1		- 20.6	51.1		- 103.9
Petroleum Refineries		- 30.3	- 1.4				- 0.2		- 32.0
Others	- 10.5	- 0.6	- 46.0			- 0.7			- 57.7
TFED	**28.7**	**184.4**	**29.4**			**87.6**	**51.5**		**381.7**
Industry	27.1	54.2	28.8			12.4	23.3		145.7
Transport		108.7	0.5				0.1		109.3
Residential	1.1	15.7	0.1			75.0	15.7		107.6
Commercial	0.5	5.9	0.1			0.2	12.4		19.1

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	176.2	138.4	226.2	8.8	3.6	121.0			674.2
Net Imports	- 26.2	174.4	- 23.3				2.6		127.5
TPED	**150.0**	**312.8**	**202.9**	**8.8**	**3.6**	**121.0**	**2.6**		**801.8**
Electricity and Heat Generation	- 92.9	- 4.6	- 108.4	- 8.8	- 3.6	- 23.0	86.4		- 155.0
Petroleum Refineries		- 36.5	- 2.0				- 0.2		- 38.7
Others	- 11.7	- 0.5	- 43.6			- 0.7			- 56.5
TFED	**45.4**	**271.3**	**48.9**			**97.3**	**88.7**		**551.6**
Industry	43.0	79.8	47.9			17.0	40.7		228.3
Transport		166.6	0.6				0.1		167.2
Residential	1.6	17.1	0.3			80.0	27.0		125.9
Commercial	0.9	7.9	0.2			0.3	20.9		30.1

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	199.1	130.9	201.7	11.0	10.8	137.1			690.6
Net Imports	32.7	287.8	49.9				4.7		375.0
TPED	**231.8**	**418.7**	**251.6**	**11.0**	**10.8**	**137.1**	**4.7**		**1 065.6**
Electricity and Heat Generation	- 156.1	- 4.7	- 138.4	- 11.0	- 10.8	- 29.0	130.4		- 219.6
Petroleum Refineries		- 45.5	- 2.7				- 0.3		- 48.5
Others	- 12.4	- 0.4	- 38.5			- 0.7			- 52.0
TFED	**63.3**	**368.1**	**72.0**			**107.4**	**134.8**		**745.5**
Industry	59.9	102.8	70.4			22.9	61.8		317.9
Transport		236.6	0.7				0.1		237.4
Residential	2.1	18.6	0.5			84.2	41.0		146.4
Commercial	1.2	10.1	0.4			0.3	31.8		43.8

SOUTHEAST ASIA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	699	2 018	3 032	4 878	7 452	4.9	5.2	4.9	4.3	4.8
Population (million)	313	464	513	570	616	1.8	1.3	1.1	0.8	1.0
GDP per capita (2000 PPP US$)	2 231	4 349	5 911	8 555	12 088	3.1	3.9	3.8	3.5	3.7
GDP in Services (2000 PPP US$ billion)	271	874	1 369	2 279	3 580	5.5	5.8	5.2	4.6	5.2
GDP in Industry (2000 PPP US$ billion)	201	717	1 152	1 913	2 917	6.0	6.1	5.2	4.3	5.1
Urbanisation level (%)	26	43	50	57	63	2.3	1.8	1.3	1.0	1.4

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**203.7**	**476.6**	**636.3**	**674.2**	**690.6**	**3.9**	**3.7**	**0.6**	**0.2**	**1.3**
Coal	3.7	91.2	155.2	176.2	199.1	15.7	6.9	1.3	1.2	2.8
	(2%)	(19%)	(24%)	(26%)	(29%)					
Oil	107.2	134.6	144.2	138.4	130.9	1.0	0.9	- 0.4	- 0.6	- 0.1
	(53%)	(28%)	(23%)	(21%)	(19%)					
Gas	25.9	147.8	221.8	226.2	201.7	8.2	5.2	0.2	- 1.1	1.1
	(13%)	(31%)	(35%)	(34%)	(29%)					
Hydro	0.9	4.3	6.1	8.8	11.0	7.7	4.3	3.8	2.2	3.4
	(0%)	(1%)	(1%)	(1%)	(2%)					
NRE	66.0	98.7	109.0	121.0	137.1	1.8	1.3	1.1	1.3	1.2
	(32%)	(21%)	(17%)	(18%)	(20%)					
Nuclear				3.6	10.8				11.6	
				(1%)	(2%)					
Net Imports	**- 58.5**	**- 66.0**	**- 60.9**	**127.5**	**375.0**	**0.5**	**- 1.0**		**11.4**	
Coal	- 0.1	- 46.8	- 65.0	- 26.2	32.7		4.2	- 8.7		
Oil	- 42.0	32.8	78.1	174.4	287.8		11.4	8.4	5.1	8.1
Gas	- 16.5	- 52.2	- 74.7	- 23.3	49.9	5.4	4.6	- 11.0		
Electricity	0.1	0.2	0.7	2.6	4.7	6.2	13.5	14.5	6.1	11.2
Total Primary Energy Demand	**139.6**	**408.0**	**575.4**	**801.8**	**1 065.6**	**5.0**	**4.4**	**3.4**	**2.9**	**3.5**
Coal	3.3	43.7	90.2	150.0	231.8	12.4	9.5	5.2	4.4	6.1
	(2%)	(11%)	(16%)	(19%)	(22%)					
Oil	59.9	168.7	222.3	312.8	418.7	4.8	3.5	3.5	3.0	3.3
	(43%)	(41%)	(39%)	(39%)	(39%)					
Gas	9.4	92.4	147.1	202.9	251.6	10.9	6.0	3.3	2.2	3.6
	(7%)	(23%)	(26%)	(25%)	(24%)					
Hydro	0.9	4.3	6.1	8.8	11.0	7.7	4.3	3.8	2.2	3.4
	(1%)	(1%)	(1%)	(1%)	(1%)					
NRE	66.0	98.7	109.0	121.0	137.1	1.8	1.3	1.1	1.3	1.2
	(47%)	(24%)	(19%)	(15%)	(13%)					
Nuclear				3.6	10.8				11.6	
				(0%)	(1%)					
Input for Electricity and Heat Generation	**- 16.7**	**- 98.8**	**- 155.0**	**- 241.4**	**- 350.0**	**8.4**	**5.8**	**4.5**	**3.8**	**4.6**
Coal	- 1.2	- 23.0	- 51.1	- 92.9	- 156.1	14.5	10.5	6.2	5.3	7.1
	(7%)	(23%)	(33%)	(38%)	(45%)					
Oil	- 12.7	- 12.0	- 7.0	- 4.6	- 4.7	- 0.3	- 6.5	- 4.1	0.2	- 3.3
	(76%)	(12%)	(5%)	(2%)	(1%)					
Gas	- 0.2	- 43.1	- 70.3	- 108.4	- 138.4		6.3	4.4	2.5	4.3
	(1%)	(44%)	(45%)	(45%)	(40%)					
Hydro	- 0.9	- 4.3	- 6.1	- 8.8	- 11.0	7.7	4.3	3.8	2.2	3.4
	(5%)	(4%)	(4%)	(4%)	(3%)					
NRE	- 1.8	- 16.4	- 20.6	- 23.0	- 29.0	10.6	2.9	1.1	2.3	2.1
	(11%)	(17%)	(13%)	(10%)	(8%)					
Nuclear				- 3.6	- 10.8				11.6	
				(1%)	(3%)					
Other Transformation	**- 7.2**	**- 62.6**	**- 89.8**	**- 95.1**	**- 100.5**	**10.3**	**4.6**	**0.6**	**0.5**	**1.7**
Coal		- 4.0	- 10.5	- 11.7	- 12.4	23.6	12.6	1.1	0.5	4.1
		(6%)	(12%)	(12%)	(12%)					
Oil	- 5.1	- 26.2	- 30.9	- 36.9	- 45.9	7.7	2.1	1.8	2.2	2.0
	(72%)	(42%)	(34%)	(39%)	(46%)					
Gas	- 1.9	- 31.5	- 47.4	- 45.5	- 41.3	13.5	5.3	- 0.4	- 1.0	1.0
	(27%)	(50%)	(53%)	(48%)	(41%)					
NRE		- 0.7	- 0.7	- 0.7	- 0.7					
		(1%)	(1%)	(1%)	(1%)					
Electricity	- 0.1	- 0.2	- 0.2	- 0.2	- 0.3	5.7	1.3	0.2	0.2	0.5
	(1%)	(0%)	(0%)	(0%)	(0%)					
Heat										

SOUTHEAST ASIA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**102.0**	**276.1**	**381.7**	**551.6**	**745.5**	**4.6**	**4.1**	**3.8**	**3.1**	**3.6**
Coal	1.8	16.5	28.7	45.4	63.3	10.5	7.1	4.7	3.4	4.9
	(2%)	(6%)	(8%)	(8%)	(8%)					
Oil	40.0	129.9	184.4	271.3	368.1	5.5	4.5	3.9	3.1	3.8
	(39%)	(47%)	(48%)	(49%)	(49%)					
Gas	2.4	17.5	29.4	48.9	72.0	9.4	6.7	5.2	3.9	5.2
	(2%)	(6%)	(8%)	(9%)	(10%)					
NRE	53.6	81.6	87.6	97.3	107.4	1.9	0.9	1.1	1.0	1.0
	(53%)	(30%)	(23%)	(18%)	(14%)					
Electricity	4.2	30.7	51.5	88.7	134.8	9.5	6.7	5.6	4.3	5.4
	(4%)	(11%)	(13%)	(16%)	(18%)					
Heat										
Industry	**23.3**	**92.4**	**145.7**	**228.3**	**317.9**	**6.5**	**5.9**	**4.6**	**3.4**	**4.5**
Coal	1.4	15.5	27.1	43.0	59.9	11.5	7.2	4.7	3.4	5.0
	(6%)	(17%)	(19%)	(19%)	(19%)					
Oil	15.2	36.0	54.2	79.8	102.8	4.0	5.3	3.9	2.6	3.8
	(65%)	(39%)	(37%)	(35%)	(32%)					
Gas	2.4	17.3	28.8	47.9	70.4	9.4	6.5	5.2	3.9	5.1
	(10%)	(19%)	(20%)	(21%)	(22%)					
NRE	2.2	10.0	12.4	17.0	22.9	7.2	2.7	3.2	3.0	3.0
	(9%)	(11%)	(8%)	(7%)	(7%)					
Electricity	2.2	13.7	23.3	40.7	61.8	8.8	6.9	5.7	4.3	5.5
	(9%)	(15%)	(16%)	(18%)	(19%)					
Heat										
Transport	**17.2**	**75.0**	**109.3**	**167.2**	**237.4**	**6.9**	**4.8**	**4.3**	**3.6**	**4.2**
Coal	0.1									
	(0%)									
Oil	17.2	74.9	108.7	166.6	236.6	6.9	4.8	4.4	3.6	4.2
	(100%)	(100%)	(100%)	(100%)	(100%)					
Gas		0.1	0.5	0.6	0.7		28.6	2.3	2.0	9.1
		(0%)	(0%)	(0%)	(0%)					
NRE										
Electricity		0.1	0.1	0.1	0.1		2.0	1.3	1.1	1.4
		(0%)	(0%)	(0%)	(0%)					
Residential	**59.9**	**95.8**	**107.6**	**125.9**	**146.4**	**2.2**	**1.5**	**1.6**	**1.5**	**1.5**
Coal	0.3	0.8	1.1	1.6	2.1	3.7	4.5	3.7	3.1	3.7
	(1%)	(1%)	(1%)	(1%)	(1%)					
Oil	7.2	14.6	15.7	17.1	18.6	3.3	0.9	0.9	0.9	0.9
	(12%)	(15%)	(15%)	(14%)	(13%)					
Gas	0.1	0.1	0.1	0.3	0.5	1.4	5.8	8.4	6.5	6.9
	(0%)	(0%)	(0%)	(0%)	(0%)					
NRE	51.4	71.4	75.0	80.0	84.2	1.5	0.6	0.7	0.5	0.6
	(86%)	(74%)	(70%)	(64%)	(57%)					
Electricity	0.9	9.0	15.7	27.0	41.0	11.1	7.2	5.6	4.3	5.6
	(1%)	(9%)	(15%)	(21%)	(28%)					
Heat										
Commercial	**1.5**	**12.9**	**19.1**	**30.1**	**43.8**	**10.1**	**5.0**	**4.7**	**3.8**	**4.5**
Coal		0.3	0.5	0.9	1.2		7.1	5.4	3.7	5.3
		(2%)	(3%)	(3%)	(3%)					
Oil	0.4	4.4	5.9	7.9	10.1	11.1	3.7	3.0	2.5	3.0
	(28%)	(34%)	(31%)	(26%)	(23%)					
Gas		0.04	0.1	0.2	0.4		9.4	10.0	6.8	8.7
			(0%)	(1%)	(1%)					
NRE		0.2	0.2	0.3	0.3		1.3	1.0	1.0	1.1
		(2%)	(1%)	(1%)	(1%)					
Electricity	1.1	7.9	12.4	20.9	31.8	9.3	5.7	5.4	4.3	5.1
	(72%)	(62%)	(65%)	(69%)	(73%)					
Heat										

Note: Net imports include intraregional trade

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	64	82	85	86	86
Net Energy Import Ratio (%)	-40	-16	-11	16	35
Net Oil Import Dependency (%)	-70	19	35	56	69

SOUTHEAST ASIA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**61**	**409**	**673**	**1 117**	**1 668**	**9.0**	**6.4**	**5.2**	**4.1**	**5.1**
Coal	3	79	189	376	683	16.0	11.5	7.1	6.2	8.0
	(5%)	(19%)	(28%)	(34%)	(41%)					
Oil	46	50	32	21	22	0.4	- 5.3	- 4.1	0.3	- 2.9
	(75%)	(12%)	(5%)	(2%)	(1%)					
Gas	0.4	209	354	565	743		6.8	4.8	2.8	4.6
	(1%)	(51%)	(53%)	(51%)	(45%)					
Hydro	10	50	71	103	127	7.7	4.3	3.8	2.2	3.4
	(16%)	(12%)	(10%)	(9%)	(8%)					
NRE	2	21	28	39	51	11.0	3.8	3.2	2.8	3.3
	(3%)	(5%)	(4%)	(3%)	(3%)					
Nuclear				14	42				11.6	
				(1%)	(2%)					
Total Installed Generation Capacity (GW)	**16**	**99**	**154**	**259**	**367**	**8.6**	**5.7**	**5.3**	**3.6**	**4.8**
Thermal	12	81	127	214	312	9.0	5.9	5.3	3.8	5.0
	(74%)	(81%)	(82%)	(83%)	(85%)					
Coal		17	41	83	137		11.6	7.4	5.1	7.7
		(17%)	(26%)	(32%)	(37%)					
Oil		19	16	13	13		- 1.6	- 2.2	- 0.4	- 1.4
		(19%)	(11%)	(5%)	(3%)					
Gas		45	70	118	162		5.7	5.3	3.3	4.7
		(45%)	(45%)	(45%)	(44%)					
Hydro	3	15	21	33	36	7.1	4.3	4.4	1.0	3.1
	(21%)	(15%)	(14%)	(13%)	(10%)					
NRE	1	3	6	10	13	6.6	6.8	5.5	2.9	4.9
	(5%)	(3%)	(4%)	(4%)	(4%)					
Nuclear				2	6				11.6	
				(1%)	(2%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**200**	**202**	**190**	**164**	**143**	**0.1**	**- 0.8**	**- 1.4**	**- 1.4**	**- 1.2**
Industry (toe per US$ million GDP in Industry)	116	129	127	119	109	0.5	- 0.2	- 0.6	- 0.9	- 0.6
Commercial (toe per US$ million GDP in Services)	6	15	14	13	12	4.4	- 0.7	- 0.5	- 0.8	- 0.7
Energy Intensity (kgoe per capita)	**445**	**879**	**1 122**	**1 406**	**1 729**	**3.1**	**3.1**	**2.3**	**2.1**	**2.4**
Industry	74	199	284	400	516	4.6	4.5	3.5	2.6	3.5
Transport	55	162	213	293	385	5.0	3.5	3.3	2.8	3.1
Residential	191	206	210	221	237	0.4	0.2	0.5	0.7	0.5
Commercial	5	28	37	53	71	8.2	3.7	3.6	3.0	3.4
CO_2 Emissions (million tonnes)	**192**	**810**	**1 227**	**1 849**	**2 582**	**6.8**	**5.3**	**4.2**	**3.4**	**4.2**
Electricity Generation	43	226	383	628	943	7.8	6.8	5.1	4.2	5.2
Transformation other than Electricity Generation	14	92	120	134	144	8.9	3.5	1.1	0.8	1.6
Industry	59	207	327	504	685	5.9	5.9	4.4	3.1	4.4
Transport	51	223	325	498	707	6.9	4.8	4.4	3.6	4.2
Residential	23	48	52	58	65	3.4	1.2	1.2	1.1	1.1
Commercial	2	15	20	28	36	10.4	4.0	3.3	2.7	3.3
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	274	401	405	379	346	1.8	0.1	- 0.7	- 0.9	- 0.5
CO_2 emissions per capita (tonnes per capita)	0.6	1.7	2.4	3.2	4.2	4.9	4.0	3.1	2.6	3.2

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**189 - 242**	**451 - 572**	**732 - 927**
Coal Production & Transportation	8 - 10	12 - 16	16 - 21
Oil & Gas Production & Processing	49 - 73	97 - 142	144 - 210
Oil & Gas International Trade	30 - 33	51 - 58	67 - 76
Oil & Gas Domestic Pipeline	6 - 9	12 - 17	17 - 25
Electricity Generation & Transmission	96 - 117	279 - 339	488 - 595

OCEANIA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	177.5	36.9	32.6	3.3		8.8			259.0
Net Imports	- 133.3	12.5	- 8.9						- 129.6
TPED	**48.1**	**48.9**	**23.7**	**3.3**		**8.8**			**132.8**
Electricity and Heat Generation	- 44.5	- 1.3	- 9.1	- 3.3		- 3.2	20.4		- 41.0
Petroleum Refineries		- 2.5	- 0.2				- 0.1		- 2.9
Others		- 0.5	- 0.1				- 0.4		- 1.1
TFED	**3.7**	**40.7**	**13.9**			**5.5**	**19.5**		**83.3**
Industry	3.4	6.5	9.6			3.3	9.1		31.8
Transport	0.1	33.4					0.2		33.6
Residential		0.4	2.9			2.2	5.5		11.0
Commercial	0.2	0.4	1.4				4.8		6.8

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	255.2	30.4	54.7	3.9		12.6			356.8
Net Imports	- 202.6	21.9	- 25.2						- 205.9
TPED	**52.6**	**52.3**	**29.5**	**3.9**		**12.6**			**150.9**
Electricity and Heat Generation	- 48.3	- 1.1	- 13.4	- 3.9		- 6.2	24.8		- 48.2
Petroleum Refineries		- 2.9	- 0.2				- 0.2		- 3.3
Others		- 0.8	- 0.1			- 0.1	- 0.6		- 1.5
TFED	**4.3**	**47.5**	**15.8**			**6.3**	**24.1**		**98.0**
Industry	4.1	7.3	10.6			4.0	11.4		37.4
Transport		39.2					0.2		39.5
Residential		0.5	3.5			2.3	6.3		12.6
Commercial	0.1	0.5	1.8				6.1		8.4

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	314.2	28.1	98.3	4.1		17.5			462.1
Net Imports	- 253.9	34.0	- 61.4						- 281.2
TPED	**60.4**	**62.1**	**36.9**	**4.1**		**17.5**			**180.9**
Electricity and Heat Generation	- 55.9	- 1.3	- 16.6	- 4.1		- 10.5	30.9		- 57.5
Petroleum Refineries		- 3.1	- 0.3				- 0.2		- 3.6
Others		- 1.0	- 0.1			- 0.1	- 0.7		- 1.8
TFED	**4.5**	**56.7**	**20.0**			**6.9**	**30.0**		**118.1**
Industry	4.3	8.9	13.5			4.6	14.6		45.9
Transport		46.7	0.1				0.2		47.0
Residential		0.5	4.2			2.3	7.5		14.5
Commercial	0.1	0.5	2.2				7.8		10.6

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	371.2	27.6	124.7	4.1		22.6			550.3
Net Imports	- 302.3	44.9	- 80.9						- 338.4
TPED	**68.9**	**72.5**	**43.8**	**4.1**		**22.6**			**211.9**
Electricity and Heat Generation	- 64.3	- 1.5	- 19.7	- 4.1		- 15.1	37.4		- 67.2
Petroleum Refineries		- 3.4	- 0.3				- 0.2		- 3.9
Others		- 1.1				- 0.1	- 0.8		- 2.1
TFED	**4.6**	**66.5**	**23.8**			**7.5**	**36.3**		**138.8**
Industry	4.5	10.6	16.2			5.1	17.5		53.8
Transport		54.8	0.1				0.2		55.2
Residential		0.6	4.8			2.4	9.0		16.7
Commercial	0.1	0.6	2.7				9.6		13.0

OCEANIA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	315	631	793	1 003	1 244	3.2	2.9	2.4	2.2	2.5
Population (million)	21.0	29.1	32.1	35.8	39.2	1.5	1.2	1.1	0.9	1.1
GDP per capita (2000 PPP US$)	14 949	21 695	24 708	28 016	31 712	1.7	1.6	1.3	1.2	1.4
GDP in Services (2000 PPP US$ billion)	190	415	539	713	913	3.6	3.3	2.8	2.5	2.9
GDP in Industry (2000 PPP US$ billion)	88	162	201	263	332	2.8	2.7	2.7	2.3	2.6
Urbanisation level (%)	75	76	77	77	78	0.1	0.1	0.1	0.1	0.1

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**91.6**	**259.0**	**356.8**	**462.1**	**550.3**	**4.8**	**4.1**	**2.6**	**1.8**	**2.7**
Coal	53.7	177.5	255.2	314.2	371.2	5.6	4.6	2.1	1.7	2.7
	(59%)	(69%)	(72%)	(68%)	(67%)					
Oil	21.7	36.9	30.4	28.1	27.6	2.4	- 2.4	- 0.8	- 0.1	- 1.0
	(24%)	(14%)	(9%)	(6%)	(5%)					
Gas	8.3	32.6	54.7	98.3	124.7	6.4	6.7	6.0	2.4	4.9
	(9%)	(13%)	(15%)	(21%)	(23%)					
Hydro	2.8	3.3	3.9	4.1	4.1	0.8	1.9	0.6		0.8
	(3%)	(1%)	(1%)	(1%)	(1%)					
NRE	5.2	8.8	12.6	17.5	22.6	2.4	4.6	3.4	2.6	3.5
	(6%)	(3%)	(4%)	(4%)	(4%)					
Nuclear										
Net Imports	**- 12.5**	**- 129.6**	**- 205.9**	**- 281.2**	**- 338.4**	**11.2**	**6.0**	**3.2**	**1.9**	**3.5**
Coal	- 28.5	- 133.3	- 202.6	- 253.9	- 302.3	7.3	5.4	2.3	1.8	3.0
Oil	16.0	12.5	21.9	34.0	44.9	- 1.1	7.2	4.5	2.8	4.7
Gas		- 8.9	- 25.2	- 61.4	- 80.9		13.9	9.3	2.8	8.2
Electricity										
Total Primary Energy Demand	**80.2**	**132.8**	**150.9**	**180.9**	**211.9**	**2.3**	**1.6**	**1.8**	**1.6**	**1.7**
Coal	28.3	48.1	52.6	60.4	68.9	2.4	1.1	1.4	1.3	1.3
	(35%)	(36%)	(35%)	(33%)	(32%)					
Oil	35.7	48.9	52.3	62.1	72.5	1.4	0.8	1.7	1.6	1.4
	(44%)	(37%)	(35%)	(34%)	(34%)					
Gas	8.3	23.7	29.5	36.9	43.8	4.9	2.8	2.2	1.7	2.2
	(10%)	(18%)	(20%)	(20%)	(21%)					
Hydro	2.8	3.3	3.9	4.1	4.1	0.8	1.9	0.6		0.8
	(3%)	(3%)	(3%)	(2%)	(2%)					
NRE	5.2	8.8	12.6	17.5	22.6	2.4	4.6	3.4	2.6	3.5
	(6%)	(7%)	(8%)	(10%)	(11%)					
Nuclear										
Input for Electricity and Heat Generation	**- 27.6**	**- 61.4**	**- 73.0**	**- 88.4**	**- 104.6**	**3.7**	**2.2**	**1.9**	**1.7**	**1.9**
Coal	- 20.3	- 44.5	- 48.3	- 55.9	- 64.3	3.6	1.0	1.5	1.4	1.3
	(74%)	(72%)	(66%)	(63%)	(61%)					
Oil	- 1.4	- 1.3	- 1.1	- 1.3	- 1.5	- 0.2	- 1.9	1.5	1.0	0.3
	(5%)	(2%)	(2%)	(1%)	(1%)					
Gas	- 1.9	- 9.1	- 13.4	- 16.6	- 19.7	7.5	5.0	2.2	1.7	2.8
	(7%)	(15%)	(18%)	(19%)	(19%)					
Hydro	- 2.8	- 3.3	- 3.9	- 4.1	- 4.1	0.8	1.9	0.6		0.8
	(10%)	(5%)	(5%)	(5%)	(4%)					
NRE	- 1.2	- 3.2	- 6.2	- 10.5	- 15.1	4.5	8.7	5.4	3.7	5.7
	(4%)	(5%)	(9%)	(12%)	(14%)					
Nuclear										
Other Transformation	**- 4.7**	**- 4.0**	**- 4.8**	**- 5.4**	**- 6.0**	**- 0.8**	**2.2**	**1.2**	**1.1**	**1.4**
Coal	- 0.5									
	(10%)									
Oil	- 3.0	- 3.1	- 3.6	- 4.1	- 4.5	0.1	2.1	1.1	1.0	1.4
	(64%)	(77%)	(77%)	(76%)	(76%)					
Gas	- 0.8	- 0.3	- 0.3	- 0.3	- 0.4	- 4.4	0.7	0.6	0.6	0.6
	(17%)	(8%)	(7%)	(6%)	(6%)					
NRE		- 0.1	- 0.1	- 0.1	- 0.1		0.2	0.2		0.1
		(1%)	(1%)	(1%)	(1%)					
Electricity	- 0.3	- 0.5	- 0.7	- 0.9	- 1.0	3.0	3.8	1.9	1.5	2.3
	(6%)	(14%)	(16%)	(17%)	(17%)					
Heat	- 0.1									
	(3%)									

OCEANIA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**52.4**	**83.3**	**98.0**	**118.1**	**138.8**	**2.1**	**2.0**	**1.9**	**1.6**	**1.8**
Coal	5.0	3.7	4.3	4.5	4.6	- 1.4	2.0	0.4	0.3	0.8
	(10%)	(4%)	(4%)	(4%)	(3%)					
Oil	29.2	40.7	47.5	56.7	66.5	1.5	2.0	1.8	1.6	1.8
	(56%)	(49%)	(48%)	(48%)	(48%)					
Gas	5.7	13.9	15.8	20.0	23.8	4.1	1.6	2.3	1.8	1.9
	(11%)	(17%)	(16%)	(17%)	(17%)					
NRE	4.0	5.5	6.3	6.9	7.5	1.5	1.6	1.0	0.8	1.1
	(8%)	(7%)	(6%)	(6%)	(5%)					
Electricity	8.6	19.5	24.1	30.0	36.3	3.8	2.6	2.3	1.9	2.2
	(16%)	(23%)	(25%)	(25%)	(26%)					
Heat										
Industry	**22.2**	**31.8**	**37.4**	**45.9**	**53.8**	**1.6**	**2.0**	**2.1**	**1.6**	**1.9**
Coal	4.5	3.4	4.1	4.3	4.5	- 1.3	2.3	0.5	0.3	1.0
	(20%)	(11%)	(11%)	(9%)	(8%)					
Oil	7.6	6.5	7.3	8.9	10.6	- 0.8	1.6	2.0	1.7	1.8
	(34%)	(20%)	(20%)	(19%)	(20%)					
Gas	4.1	9.6	10.6	13.5	16.2	3.9	1.2	2.5	1.8	1.9
	(19%)	(30%)	(28%)	(29%)	(30%)					
NRE	2.2	3.3	4.0	4.6	5.1	1.8	2.4	1.4	1.1	1.6
	(10%)	(10%)	(11%)	(10%)	(9%)					
Electricity	3.7	9.1	11.4	14.6	17.5	4.2	2.9	2.4	1.8	2.4
	(17%)	(29%)	(31%)	(32%)	(32%)					
Heat										
Transport	**20.0**	**33.6**	**39.5**	**47.0**	**55.2**	**2.4**	**2.0**	**1.8**	**1.6**	**1.8**
Coal		0.1	0.1	0.1	0.1		- 1.8			- 0.5
		(0%)	(0%)	(0%)	(0%)					
Oil	19.9	33.4	39.2	46.7	54.8	2.4	2.0	1.8	1.6	1.8
	(100%)	(99%)	(99%)	(99%)	(99%)					
Gas		0.03	0.04	0.1	0.1		5.4	3.8	1.7	3.5
				(0%)	(0%)					
NRE										
Electricity	0.1	0.2	0.2	0.2	0.2	3.7	2.3	0.5	0.9	1.1
	(0%)	(1%)	(1%)	(0%)	(0%)					
Residential	**7.1**	**11.0**	**12.6**	**14.5**	**16.7**	**2.0**	**1.6**	**1.4**	**1.4**	**1.5**
Coal	0.2					-10.5				
	(3%)									
Oil	0.8	0.4	0.5	0.5	0.6	- 3.0	1.0	0.9	0.9	0.9
	(12%)	(4%)	(4%)	(3%)	(3%)					
Gas	1.1	2.9	3.5	4.2	4.8	4.3	2.4	1.8	1.5	1.9
	(16%)	(26%)	(28%)	(29%)	(29%)					
NRE	1.7	2.2	2.3	2.3	2.4	1.2	0.3	0.2	0.2	0.2
	(24%)	(20%)	(18%)	(16%)	(14%)					
Electricity	3.2	5.5	6.3	7.5	9.0	2.5	1.8	1.7	1.8	1.8
	(45%)	(50%)	(50%)	(52%)	(54%)					
Heat										
Commercial	**3.1**	**6.8**	**8.4**	**10.6**	**13.1**	**3.6**	**2.8**	**2.3**	**2.1**	**2.4**
Coal	0.3	0.2	0.1	0.1	0.1	- 1.9	- 2.5	- 1.9	- 1.4	- 1.9
	(9%)	(3%)	(2%)	(1%)	(1%)					
Oil	0.8	0.4	0.5	0.5	0.6	- 3.0	1.9	1.5	1.5	1.6
	(25%)	(6%)	(5%)	(5%)	(5%)					
Gas	0.4	1.4	1.8	2.2	2.7	5.5	2.8	2.3	1.9	2.3
	(14%)	(21%)	(21%)	(21%)	(20%)					
NRE										
Electricity	1.6	4.8	6.1	7.8	9.6	5.1	3.0	2.5	2.2	2.5
	(52%)	(71%)	(72%)	(73%)	(74%)					
Heat										

Note: Net imports include intraregional trade

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	75	81	83	84	85
Net Energy Import Ratio (%)	-16	-100	-136	-155	-160
Net Oil Import Dependency (%)	45	26	42	55	62

OCEANIA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**118**	**258**	**315**	**389**	**469**	**3.6**	**2.5**	**2.2**	**1.9**	**2.2**
Coal	70	173	194	233	277	4.2	1.4	1.8	1.7	1.7
	(60%)	(67%)	(62%)	(60%)	(59%)					
Oil	5	5	5	6	6		- 1.7	1.9	1.5	0.7
	(4%)	(2%)	(1%)	(1%)	(1%)					
Gas	9	36	56	78	104	6.6	5.8	3.5	2.9	3.9
	(7%)	(14%)	(18%)	(20%)	(22%)					
Hydro	32	39	45	48	48	0.9	1.9	0.6		0.8
	(27%)	(15%)	(14%)	(12%)	(10%)					
NRE	2	5	15	25	34	4.5	14.1	5.5	3.0	7.0
	(2%)	(2%)	(5%)	(6%)	(7%)					
Nuclear										
Total Installed Generation Capacity (GW)	**31**	**58**	**73**	**97**	**112**	**2.9**	**3.0**	**2.9**	**1.5**	**2.4**
Thermal	20	43	52	71	83	3.5	2.4	3.2	1.6	2.4
	(66%)	(74%)	(71%)	(73%)	(74%)					
Coal		28	31	41	48		1.3	2.8	1.6	1.9
		(49%)	(43%)	(42%)	(43%)					
Oil		2	2	2	3		1.0	2.5	1.2	1.6
		(3%)	(3%)	(3%)	(2%)					
Gas		13	19	27	33		4.5	3.9	1.7	3.3
		(23%)	(26%)	(28%)	(29%)					
Hydro	10	13	16	18	18	1.1	2.5	0.9	0.2	1.1
	(34%)	(23%)	(22%)	(18%)	(16%)					
NRE	0.2	2	5	9	11	9.1	14.6	6.0	2.3	7.0
	(1%)	(3%)	(7%)	(9%)	(10%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**255**	**211**	**190**	**180**	**170**	**- 0.9**	**- 1.3**	**- 0.5**	**- 0.6**	**- 0.8**
Industry (toe per US$ million GDP in Industry)	252	196	186	174	162	- 1.1	- 0.7	- 0.6	- 0.7	- 0.7
Commercial (toe per US$ million GDP in Services)	16	16	16	15	14	0.0	- 0.6	- 0.5	- 0.4	- 0.5
Energy Intensity (kgoe per capita)	**3 814**	**4 567**	**4 699**	**5 053**	**5 404**	**0.8**	**0.4**	**0.7**	**0.7**	**0.6**
Industry	1 056	1 095	1 165	1 283	1 372	0.2	0.8	1.0	0.7	0.8
Transport	950	1 157	1 232	1 314	1 407	0.9	0.8	0.6	0.7	0.7
Residential	337	379	391	405	427	0.5	0.4	0.3	0.5	0.4
Commercial	148	234	263	297	333	2.1	1.5	1.2	1.1	1.3
CO_2 Emissions (million tonnes)	**221**	**381**	**438**	**522**	**607**	**2.5**	**1.8**	**1.8**	**1.5**	**1.7**
Electricity Generation	84	198	222	259	300	3.9	1.5	1.6	1.5	1.5
Transformation other than Electricity Generation	14	16	21	30	36	0.5	4.0	3.5	1.9	3.1
Industry	54	55	63	75	87	0.1	1.6	1.8	1.5	1.6
Transport	58	99	116	139	163	2.4	2.1	1.8	1.6	1.8
Residential	6	8	10	11	13	1.5	2.0	1.7	1.4	1.7
Commercial	4	5	6	7	9	0.8	1.9	1.9	1.6	1.8
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	702	604	552	520	488	- 0.7	- 1.1	- 0.6	- 0.6	- 0.8
CO_2 emissions per capita (tonnes per capita)	10.5	13.1	13.6	14.6	15.5	1.0	0.5	0.7	0.6	0.6

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**69 - 86**	**156 - 191**	**223 - 275**
Coal Production & Transportation	13 - 15	26 - 30	41 - 46
Oil & Gas Production & Processing	10 - 14	19 - 27	27 - 38
Oil & Gas International Trade	8 - 9	23 - 25	28 - 31
Oil & Gas Domestic Pipeline	9 - 13	17 - 24	23 - 33
Electricity Generation & Transmission	28 - 34	71 - 85	104 - 126

LATIN AMERICA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	5.6	180.1	34.7	5.7	2.5	18.8			247.4
Net Imports	6.9	- 78.9	5.3						- 66.7
TPED	**11.3**	**101.6**	**40.0**	**5.7**	**2.5**	**18.8**			**180.0**
Electricity and Heat Generation	- 9.1	- 19.5	- 19.1	- 5.7	- 2.5	- 5.3	21.4		- 39.8
Petroleum Refineries		- 12.6	- 0.4				- 0.3		- 13.3
Others			- 9.5			- 0.2			- 9.7
TFED	**2.2**	**74.9**	**10.6**			**13.3**	**19.6**		**120.7**
Industry	2.2	15.9	9.3			2.4	12.9		42.7
Transport		47.4					0.1		47.6
Residential		9.4	0.9			10.9	4.3		25.5
Commercial		2.2	0.3			0.1	2.3		4.9

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	6.3	167.1	40.8	6.6	2.6	20.4			243.8
Net Imports	8.3	- 44.5	18.8				0.6		- 16.9
TPED	**14.6**	**122.6**	**59.6**	**6.6**	**2.6**	**20.4**	**0.6**		**226.9**
Electricity and Heat Generation	- 12.1	- 16.0	- 35.1	- 6.6	- 2.6	- 6.6	28.4		- 50.7
Petroleum Refineries		- 13.8	- 0.5				- 0.4		- 14.7
Others			- 8.5			- 0.2			- 8.7
TFED	**2.4**	**92.8**	**15.6**			**13.5**	**28.6**		**152.9**
Industry	2.4	19.1	13.0			2.4	19.0		56.0
Transport		60.5	0.1				0.1		60.7
Residential		10.5	1.8			11.0	6.1		29.5
Commercial		2.6	0.6			0.1	3.3		6.6

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	7.3	189.7	47.7	8.1	2.7	21.2			276.8
Net Imports	18.2	- 40.9	38.7				0.1		16.1
TPED	**25.5**	**148.8**	**86.4**	**8.1**	**2.7**	**21.2**	**0.1**		**292.9**
Electricity and Heat Generation	- 22.5	- 13.6	- 55.2	- 8.1	- 2.7	- 7.4	41.5		- 68.0
Petroleum Refineries		- 12.1	- 0.5				- 0.4		- 13.0
Others			- 9.1			- 0.2			- 9.3
TFED	**3.0**	**123.1**	**21.6**			**13.6**	**41.2**		**202.6**
Industry	3.0	24.5	17.0			2.9	27.6		75.0
Transport		83.4	0.2				0.1		83.8
Residential		12.0	3.2			10.6	8.8		34.6
Commercial		3.1	1.2			0.1	4.8		9.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	8.5	213.9	72.0	9.2	2.7	21.9			328.2
Net Imports	30.5	- 30.2	43.2				0.8		44.2
TPED	**39.0**	**183.6**	**115.2**	**9.2**	**2.7**	**21.9**	**0.8**		**372.4**
Electricity and Heat Generation	- 35.0	- 11.2	- 77.8	- 9.2	- 2.7	- 8.0	56.9		- 87.0
Petroleum Refineries		- 11.6	- 0.5				- 0.4		- 12.5
Others			- 9.8			- 0.2			- 10.0
TFED	**4.0**	**160.9**	**27.1**			**13.7**	**57.3**		**262.9**
Industry	4.0	30.0	21.0			3.5	38.6		97.1
Transport		113.5	0.4				0.1		114.0
Residential		13.9	4.1			10.0	11.9		39.9
Commercial		3.5	1.6			0.2	6.7		12.0

LATIN AMERICA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	725	1 269	1 736	2 654	3 954	2.6	4.0	4.3	4.1	4.1
Population (million)	95	143	159	175	189	1.9	1.3	1.0	0.8	1.0
GDP per capita (2000 PPP US$)	7 602	8 852	10 912	15 155	20 911	0.7	2.6	3.3	3.3	3.1
GDP in Services (2000 PPP US$ billion)	496	789	1 097	1 681	2 521	2.1	4.2	4.4	4.1	4.2
GDP in Industry (2000 PPP US$ billion)	210	342	459	693	1 028	2.3	3.7	4.2	4.0	4.0
Urbanisation level (%)	68	76	78	82	84	0.5	0.4	0.4	0.3	0.4

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**167.9**	**247.4**	**243.8**	**276.8**	**328.2**	**1.8**	**- 0.2**	**1.3**	**1.7**	**1.0**
Coal	2.5	5.6	6.3	7.3	8.5	3.6	1.5	1.5	1.5	1.5
	(2%)	(2%)	(3%)	(3%)	(3%)					
Oil	127.0	180.1	167.1	189.7	213.9	1.6	- 0.9	1.3	1.2	0.6
	(76%)	(73%)	(69%)	(69%)	(65%)					
Gas	22.7	34.7	40.8	47.7	72.0	1.9	2.1	1.6	4.2	2.6
	(14%)	(14%)	(17%)	(17%)	(22%)					
Hydro	2.7	5.7	6.6	8.1	9.2	3.4	1.8	2.1	1.3	1.7
	(2%)	(2%)	(3%)	(3%)	(3%)					
NRE	12.9	18.8	20.4	21.2	21.9	1.7	1.0	0.4	0.3	0.5
	(8%)	(8%)	(8%)	(8%)	(7%)					
Nuclear		2.5	2.6	2.7	2.7		0.3	0.3	0.2	0.2
		(1%)	(1%)	(1%)	(1%)					
Net Imports	**- 48.2**	**- 66.7**	**- 16.9**	**16.1**	**44.2**	**1.5**	**- 15.8**		**10.6**	
Coal	1.3	6.9	8.3	18.2	30.5	7.7	2.3	8.2	5.3	5.5
Oil	- 47.2	- 78.9	- 44.5	- 40.9	- 30.2	2.4	- 6.9	- 0.8	- 3.0	- 3.4
Gas	- 2.4	5.3	18.8	38.7	43.2		17.1	7.5	1.1	7.8
Electricity	0.1		0.6	0.1	0.8			- 13.0	18.5	
Total Primary Energy Demand	**118.4**	**180.0**	**226.9**	**292.9**	**372.4**	**1.9**	**2.9**	**2.6**	**2.4**	**2.6**
Coal	3.7	11.3	14.6	25.5	39.0	5.2	3.2	5.8	4.3	4.5
	(3%)	(6%)	(6%)	(9%)	(10%)					
Oil	78.7	101.6	122.6	148.8	183.6	1.2	2.4	2.0	2.1	2.1
	(66%)	(56%)	(54%)	(51%)	(49%)					
Gas	20.3	40.0	59.6	86.4	115.2	3.1	5.1	3.8	2.9	3.8
	(17%)	(22%)	(26%)	(30%)	(31%)					
Hydro	2.7	5.7	6.6	8.1	9.2	3.4	1.8	2.1	1.3	1.7
	(2%)	(3%)	(3%)	(3%)	(2%)					
NRE	12.9	18.8	20.4	21.2	21.9	1.7	1.0	0.4	0.3	0.5
	(11%)	(10%)	(9%)	(7%)	(6%)					
Nuclear		2.5	2.6	2.7	2.7		0.3	0.3	0.2	0.2
		(1%)	(1%)	(1%)	(1%)					
Input for Electricity and Heat Generation	**- 18.2**	**- 61.2**	**- 79.0**	**- 109.4**	**- 143.9**	**5.7**	**3.2**	**3.3**	**2.8**	**3.1**
Coal	- 0.5	- 9.1	- 12.1	- 22.5	- 35.0	14.4	3.7	6.4	4.5	4.9
	(3%)	(15%)	(15%)	(21%)	(24%)					
Oil	- 11.2	- 19.5	- 16.0	- 13.6	- 11.2	2.5	- 2.4	- 1.6	- 2.0	- 2.0
	(62%)	(32%)	(20%)	(12%)	(8%)					
Gas	- 2.9	- 19.1	- 35.1	- 55.2	- 77.8	8.9	7.9	4.6	3.5	5.1
	(16%)	(31%)	(44%)	(50%)	(54%)					
Hydro	- 2.7	- 5.7	- 6.6	- 8.1	- 9.2	3.4	1.8	2.1	1.3	1.7
	(15%)	(9%)	(8%)	(7%)	(6%)					
NRE	- 0.9	- 5.3	- 6.6	- 7.4	- 8.0	8.7	2.8	1.1	0.8	1.5
	(5%)	(9%)	(8%)	(7%)	(6%)					
Nuclear		- 2.5	- 2.6	- 2.7	- 2.7		0.3	0.3	0.2	0.2
		(4%)	(3%)	(2%)	(2%)					
Other Transformation	**- 15.0**	**- 23.0**	**- 23.4**	**- 22.3**	**- 22.5**	**2.0**	**0.2**	**- 0.5**	**0.1**	**- 0.1**
Coal	- 0.1					- 6.1				
	(0%)									
Oil	- 10.7	- 12.6	- 13.8	- 12.1	- 11.6	0.8	1.2	- 1.3	- 0.4	- 0.3
	(71%)	(55%)	(59%)	(54%)	(52%)					
Gas	- 4.2	- 9.9	- 9.0	- 9.6	- 10.3	3.9	- 1.2	0.7	0.7	0.1
	(28%)	(43%)	(38%)	(43%)	(46%)					
NRE		- 0.2	- 0.2	- 0.2	- 0.2					
		(1%)	(1%)	(1%)	(1%)					
Electricity		- 0.3	- 0.4	- 0.4	- 0.4	12.6	2.4	- 0.1	- 0.5	0.5
		(1%)	(2%)	(2%)	(2%)					
Heat										

LATIN AMERICA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**70.1**	**120.7**	**152.9**	**202.6**	**262.9**	**2.5**	**3.0**	**2.9**	**2.6**	**2.8**
Coal	2.2	2.2	2.4	3.0	4.0		1.1	2.4	2.7	2.1
	(3%)	(2%)	(2%)	(2%)	(2%)					
Oil	36.9	74.9	92.8	123.1	160.9	3.3	2.7	2.9	2.7	2.8
	(53%)	(62%)	(61%)	(61%)	(61%)					
Gas	13.1	10.6	15.6	21.6	27.1	- 0.9	4.9	3.3	2.3	3.4
	(19%)	(9%)	(10%)	(11%)	(10%)					
NRE	11.9	13.3	13.5	13.6	13.7	0.5	0.2	0.1	0.04	0.1
	(17%)	(11%)	(9%)	(7%)	(5%)					
Electricity	6.1	19.6	28.6	41.2	57.3	5.5	4.8	3.7	3.3	3.9
	(9%)	(16%)	(19%)	(20%)	(22%)					
Heat										
Industry	**33.5**	**42.7**	**56.0**	**75.0**	**97.1**	**1.1**	**3.4**	**3.0**	**2.6**	**3.0**
Coal	2.1	2.2	2.4	3.0	4.0	0.2	1.1	2.4	2.7	2.1
	(6%)	(5%)	(4%)	(4%)	(4%)					
Oil	12.5	15.9	19.1	24.5	30.0	1.1	2.3	2.5	2.0	2.3
	(37%)	(37%)	(34%)	(33%)	(31%)					
Gas	12.4	9.3	13.0	17.0	21.0	- 1.3	4.2	2.7	2.1	2.9
	(37%)	(22%)	(23%)	(23%)	(22%)					
NRE	2.5	2.4	2.4	2.9	3.5	- 0.3	0.1	1.8	2.0	1.4
	(8%)	(6%)	(4%)	(4%)	(4%)					
Electricity	4.0	12.9	19.0	27.6	38.6	5.5	5.0	3.8	3.4	4.0
	(12%)	(30%)	(34%)	(37%)	(40%)					
Heat										
Transport	**21.0**	**47.6**	**60.7**	**83.8**	**114.0**	**3.8**	**3.1**	**3.3**	**3.1**	**3.2**
Coal	0.1									
	(0%)									
Oil	20.9	47.4	60.5	83.4	113.5	3.8	3.1	3.3	3.1	3.2
	(99%)	(100%)	(100%)	(100%)	(100%)					
Gas			0.1	0.2	0.4		11.7	8.5	4.8	8.1
			(0%)	(0%)	(0%)					
NRE										
Electricity	0.1	0.1	0.1	0.1	0.1	3.5	1.3	0.7	0.4	0.8
	(0%)	(0%)	(0%)	(0%)	(0%)					
Residential	**13.8**	**25.5**	**29.5**	**34.6**	**39.9**	**2.8**	**1.8**	**1.6**	**1.4**	**1.6**
Coal										
Oil	2.6	9.4	10.5	12.0	13.9	6.0	1.4	1.3	1.4	1.4
	(19%)	(37%)	(36%)	(35%)	(35%)					
Gas	0.6	0.9	1.8	3.2	4.1	1.8	8.8	5.8	2.6	5.5
	(5%)	(4%)	(6%)	(9%)	(10%)					
NRE	9.3	10.9	11.0	10.6	10.0	0.7	0.2	- 0.4	- 0.6	- 0.3
	(68%)	(43%)	(37%)	(31%)	(25%)					
Electricity	1.2	4.3	6.1	8.8	11.9	6.1	4.5	3.6	3.1	3.7
	(8%)	(17%)	(21%)	(25%)	(30%)					
Heat										
Commercial	**1.8**	**4.9**	**6.6**	**9.2**	**12.0**	**4.5**	**4.0**	**3.3**	**2.7**	**3.3**
Coal										
Oil	0.9	2.2	2.6	3.1	3.5	4.0	2.5	1.7	1.3	1.8
	(49%)	(45%)	(40%)	(34%)	(29%)					
Gas	0.03	0.3	0.6	1.2	1.6	10.7	9.4	6.4	3.3	6.1
	(2%)	(6%)	(9%)	(13%)	(13%)					
NRE		0.1	0.1	0.1	0.2		5.0	5.0	5.0	5.0
		(1%)	(1%)	(1%)	(2%)					
Electricity	0.9	2.3	3.3	4.8	6.7	4.4	4.4	3.8	3.4	3.8
	(49%)	(48%)	(50%)	(52%)	(55%)					
Heat										

Note: Net imports include intraregional trade

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	54	68	69	72	73
Net Energy Import Ratio (%)	-40	-37	-7	5	12
Net Oil Import Dependency (%)	-60	-78	-36	-28	-16

LATIN AMERICA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**89**	**283**	**377**	**545**	**743**	**5.4**	**3.6**	**3.8**	**3.2**	**3.5**
Coal	2	35	48	91	145	14.2	4.0	6.6	4.7	5.2
	(2%)	(12%)	(13%)	(17%)	(20%)					
Oil	43	82	69	60	51	3.0	- 2.2	- 1.4	- 1.7	- 1.7
	(49%)	(29%)	(18%)	(11%)	(7%)					
Gas	11	82	161	272	410	9.7	8.8	5.4	4.2	5.9
	(12%)	(29%)	(43%)	(50%)	(55%)					
Hydro	32	66	77	94	107	3.4	1.8	2.1	1.3	1.7
	(36%)	(23%)	(20%)	(17%)	(14%)					
NRE	1	8	12	16	19	9.2	6.1	2.9	1.7	3.3
	(1%)	(3%)	(3%)	(3%)	(3%)					
Nuclear		10	10	10	10		0.3	0.2	0.2	0.2
		(3%)	(3%)	(2%)	(1%)					
Total Installed Generation Capacity (GW)	**21**	**58**	**78**	**112**	**138**	**4.8**	**3.7**	**3.7**	**2.2**	**3.1**
Thermal	11	39	55	83	107	5.8	4.4	4.2	2.5	3.7
	(54%)	(67%)	(70%)	(74%)	(77%)					
Coal		6	8	16	24		3.8	7.0	4.0	5.0
		(10%)	(10%)	(14%)	(17%)					
Oil		19	19	17	14		- 0.2	- 0.6	- 2.1	- 1.0
		(32%)	(24%)	(16%)	(10%)					
Gas		14	28	50	69		9.2	5.8	3.3	5.9
		(24%)	(36%)	(45%)	(50%)					
Hydro	9	17	19	24	26	2.7	1.8	2.0	0.9	1.5
	(45%)	(29%)	(25%)	(21%)	(19%)					
NRE	0.2	1	2	4	4	8.9	7.5	4.6	1.7	4.4
	(1%)	(2%)	(3%)	(3%)	(3%)					
Nuclear		1	1	1	1					
		(2%)	(2%)	(1%)	(1%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**163**	**142**	**131**	**110**	**94**	**- 0.6**	**- 1.0**	**- 1.7**	**- 1.6**	**- 1.5**
Industry (toe per US$ million GDP in Industry)	160	125	122	108	94	- 1.1	- 0.3	- 1.2	- 1.4	- 1.0
Commercial (toe per US$ million GDP in Services)	4	6	6	5	5	2.3	- 0.2	- 1.0	- 1.3	- 0.9
Energy Intensity (kgoe per capita)	**1 242**	**1 255**	**1 427**	**1 673**	**1 970**	**0.0**	**1.6**	**1.6**	**1.6**	**1.6**
Industry	352	298	352	429	513	- 0.8	2.1	2.0	1.8	2.0
Transport	220	332	382	479	603	1.9	1.8	2.3	2.3	2.2
Residential	144	178	186	198	211	1.0	0.5	0.6	0.6	0.6
Commercial	19	34	42	52	64	2.6	2.6	2.3	1.9	2.3
CO_2 Emissions (million tonnes)	**216**	**450**	**558**	**747**	**973**	**3.4**	**2.7**	**3.0**	**2.7**	**2.8**
Electricity Generation	41	139	178	258	352	5.8	3.1	3.8	3.2	3.4
Transformation other than Electricity Generation	29	51	55	57	60	2.7	0.8	0.4	0.6	0.6
Industry	73	79	98	127	156	0.3	2.7	2.6	2.1	2.5
Transport	61	141	180	248	337	3.9	3.1	3.3	3.1	3.2
Residential	9	33	38	46	53	6.0	1.9	1.8	1.5	1.7
Commercial	3	7	9	12	14	3.1	3.6	2.6	2.0	2.6
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	298	355	321	281	246	0.8	- 1.2	- 1.3	- 1.3	- 1.3
CO_2 emissions per capita (tonnes per capita)	2.3	3.1	3.5	4.3	5.1	1.5	1.4	2.0	1.9	1.8

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**68 - 87**	**166 - 215**	**265 - 349**
Coal Production & Transportation	0.32 - 0.42	0.51 - 0.68	0.72 - 0.98
Oil & Gas Production & Processing	14 - 19	36 - 51	60 - 87
Oil & Gas International Trade	9 - 11	16 - 20	20 - 24
Oil & Gas Domestic Pipeline	9 - 13	21 - 30	36 - 52
Electricity Generation & Transmission	35 - 44	92 - 114	148 - 184

NORTH AMERICA

ENERGY BALANCE TABLES

2002

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	583.9	493.2	610.4	52.9	225.8	91.4			2 057.6
Net Imports	- 10.3	610.5	14.3				- 6.1		608.4
TPED	**575.0**	**1 100.2**	**612.6**	**52.9**	**225.8**	**91.4**	**- 6.1**		**2 651.8**
Electricity and Heat Generation	- 542.4	- 27.8	- 154.7	- 52.9	- 225.8	- 32.9	360.4	6.3	- 669.7
Petroleum Refineries		- 237.0	- 21.5			- 1.2	- 4.8	- 0.9	- 265.4
Others	- 0.1	- 1.5	- 59.2			- 5.5	- 5.5		- 71.9
TFED	**32.6**	**843.3**	**377.4**			**51.7**	**344.0**	**5.4**	**1 654.3**
Industry	29.1	135.7	165.8			37.8	106.2	5.4	480.0
Transport		651.9	0.4			1.8	0.4		654.6
Residential	1.3	33.3	128.1			10.9	121.3		294.9
Commercial	2.2	22.4	83.0			1.2	116.0		224.9

2010

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	653.4	634.4	634.8	56.3	231.5	117.7			2 328.0
Net Imports	- 36.8	597.8	54.5				0.4		616.0
TPED	**616.6**	**1 232.3**	**689.3**	**56.3**	**231.5**	**117.7**	**0.4**		**2 944.0**
Electricity and Heat Generation	- 580.3	- 27.6	- 180.6	- 56.3	- 231.5	- 51.2	413.4	6.7	- 707.4
Petroleum Refineries		- 247.7	- 21.9			- 1.3	- 4.9	- 0.9	- 276.5
Others	- 0.1	- 2.2	- 68.8			- 7.9	- 6.6		- 85.6
TFED	**36.2**	**954.8**	**418.1**			**57.3**	**402.3**	**5.8**	**1 874.6**
Industry	32.8	149.6	177.0			42.0	118.8	5.8	526.0
Transport		749.5	0.6			2.6	0.4		753.1
Residential	1.2	32.7	139.7			11.5	135.8		320.9
Commercial	2.2	23.0	100.9			1.2	147.3		274.6

2020

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	669.8	681.4	684.2	58.2	253.1	153.6			2 500.3
Net Imports	10.6	694.2	100.6				- 0.1		805.3
TPED	**680.4**	**1 375.5**	**784.8**	**58.2**	**253.1**	**153.6**	**- 0.1**		**3 305.5**
Electricity and Heat Generation	- 641.2	- 28.1	- 225.9	- 58.2	- 253.1	- 75.1	491.0	6.8	- 783.8
Petroleum Refineries		- 252.8	- 21.5			- 1.2	- 4.8	- 0.9	- 281.1
Others	- 0.1	- 2.4	- 70.8			- 11.7	- 6.6		- 91.6
TFED	**39.1**	**1 091.9**	**466.6**			**65.6**	**479.5**	**6.0**	**2 148.6**
Industry	35.8	162.3	196.6			48.0	135.7	6.0	584.3
Transport		873.7	1.0			3.9	0.4		879.0
Residential	1.1	32.1	148.8			12.4	158.6		353.1
Commercial	2.2	23.7	120.3			1.2	184.8		332.2

2030

Mtoe

	Coal	Oil	Gas	Hydro	Nuclear	NRE	Electricity	Heat	Total
Production	786.2	666.1	669.0	56.5	253.0	198.1			2 628.8
Net Imports	46.0	853.9	136.5				- 0.3		1 036.1
TPED	**832.2**	**1 519.9**	**805.5**	**56.5**	**253.0**	**198.1**	**- 0.3**		**3 664.9**
Electricity and Heat Generation	- 791.6	- 27.4	- 204.4	- 56.5	- 253.0	- 104.9	558.5	7.0	- 872.3
Petroleum Refineries		- 267.3	- 21.8			- 1.3	- 4.9	- 0.9	- 296.1
Others	- 0.1	- 2.3	- 66.2			- 16.5	- 6.4		- 91.5
TFED	**40.5**	**1 222.9**	**513.1**			**75.5**	**546.9**	**6.1**	**2 405.0**
Industry	37.3	173.2	216.3			55.0	151.1	6.1	639.0
Transport		993.7	1.6			5.5	0.4		1 001.1
Residential	1.0	31.7	154.5			13.8	180.8		381.7
Commercial	2.2	24.4	140.7			1.2	214.6		383.1

NORTH AMERICA

MACRO ASSUMPTIONS

	1980	2002	2010	2020	2030	Growth Rate (% per annum) 80-02	02-10	10-20	20-30	02-30
GDP (2000 PPP US$ billion)	5 680	11 035	14 303	19 238	24 647	3.1	3.3	3.0	2.5	2.9
Population (million)	252	320	343	372	399	1.1	0.9	0.8	0.7	0.8
GDP per capita (2000 PPP US$)	22 499	34 494	41 643	51 659	61 850	2.0	2.4	2.2	1.8	2.1
GDP in Services (2000 PPP US$ billion)	4 337	8 527	11 292	15 447	20 002	3.1	3.6	3.2	2.6	3.1
GDP in Industry (2000 PPP US$ billion)	1 335	2 531	3 141	4 009	4 901	2.9	2.7	2.5	2.0	2.4
Urbanisation level (%)	74	78	81	84	89	0.2	0.4	0.4	0.5	0.5

ENERGY PROJECTIONS

	Mtoe 1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Production	**1 760.7**	**2 057.6**	**2 328.0**	**2 500.3**	**2 628.8**	**0.7**	**1.6**	**0.7**	**0.5**	**0.9**
Coal	468.4	583.9	653.4	669.8	786.2	1.0	1.4	0.2	1.6	1.1
	(27%)	(28%)	(28%)	(27%)	(30%)					
Oil	582.0	493.2	634.4	681.4	666.1	- 0.7	3.2	0.7	- 0.2	1.1
	(33%)	(24%)	(27%)	(27%)	(25%)					
Gas	518.2	610.4	634.8	684.2	669.0	0.7	0.5	0.8	- 0.2	0.3
	(29%)	(30%)	(27%)	(27%)	(25%)					
Hydro	45.6	52.9	56.3	58.2	56.5	0.7	0.8	0.3	- 0.3	0.2
	(3%)	(3%)	(2%)	(2%)	(2%)					
NRE	66.7	91.4	117.7	153.6	198.1	1.4	3.2	2.7	2.6	2.8
	(4%)	(4%)	(5%)	(6%)	(8%)					
Nuclear	79.8	225.8	231.5	253.1	253.0	4.8	0.3	0.9	-0.01	0.4
	(5%)	(11%)	(10%)	(10%)	(10%)					
Net Imports	**295.3**	**608.4**	**616.0**	**805.3**	**1 036.1**	**3.3**	**0.2**	**2.7**	**2.6**	**1.9**
Coal	- 56.7	- 10.3	- 36.8	10.6	46.0	- 7.5	17.2		15.9	
Oil	348.7	610.5	597.8	694.2	853.9	2.6	- 0.3	1.5	2.1	1.2
Gas	3.3	14.3	54.5	100.6	136.5	6.9	18.2	6.3	3.1	8.4
Electricity		- 6.1	0.4	- 0.1	- 0.3	25.0			15.6	- 9.9
Total Primary Energy Demand	**2 004.6**	**2 651.8**	**2 944.0**	**3 305.5**	**3 664.9**	**1.3**	**1.3**	**1.2**	**1.0**	**1.2**
Coal	397.5	575.0	616.6	680.4	832.2	1.7	0.9	1.0	2.0	1.3
	(20%)	(22%)	(21%)	(21%)	(23%)					
Oil	892.8	1 100.2	1 232.3	1 375.5	1 519.9	1.0	1.4	1.1	1.0	1.2
	(45%)	(41%)	(42%)	(42%)	(41%)					
Gas	522.3	612.6	689.3	784.8	805.5	0.7	1.5	1.3	0.3	1.0
	(26%)	(23%)	(23%)	(24%)	(22%)					
Hydro	45.6	52.9	56.3	58.2	56.5	0.7	0.8	0.3	- 0.3	0.2
	(2%)	(2%)	(2%)	(2%)	(2%)					
NRE	66.7	91.4	117.7	153.6	198.1	1.4	3.2	2.7	2.6	2.8
	(3%)	(3%)	(4%)	(5%)	(5%)					
Nuclear	79.8	225.8	231.5	253.1	253.0	4.8	0.3	0.9	-0.01	0.4
	(4%)	(9%)	(8%)	(8%)	(7%)					
Input for Electricity and Heat Generation	**- 588.4**	**-1 036.4**	**-1 127.4**	**-1 281.6**	**-1 437.7**	**2.6**	**1.1**	**1.3**	**1.2**	**1.2**
Coal	- 307.1	- 542.4	- 580.3	- 641.2	- 791.6	2.6	0.8	1.0	2.1	1.4
	(52%)	(52%)	(51%)	(50%)	(55%)					
Oil	- 63.7	- 27.8	- 27.6	- 28.1	- 27.4	- 3.7	- 0.1	0.2	- 0.2	- 0.1
	(11%)	(3%)	(2%)	(2%)	(2%)					
Gas	- 87.3	- 154.7	- 180.6	- 225.9	- 204.4	2.6	2.0	2.3	- 1.0	1.0
	(15%)	(15%)	(16%)	(18%)	(14%)					
Hydro	- 45.6	- 52.9	- 56.3	- 58.2	- 56.5	0.7	0.8	0.3	- 0.3	0.2
	(8%)	(5%)	(5%)	(5%)	(4%)					
NRE	- 4.9	- 32.9	- 51.2	- 75.1	- 104.9	9.0	5.7	3.9	3.4	4.2
	(1%)	(3%)	(5%)	(6%)	(7%)					
Nuclear	- 79.8	- 225.8	- 231.5	- 253.1	- 253.0	4.8	0.3	0.9	-0.01	0.4
	(14%)	(22%)	(21%)	(20%)	(18%)					
Other Transformation	**- 109.7**	**- 337.3**	**- 362.1**	**- 372.7**	**- 387.6**	**5.2**	**0.9**	**0.3**	**0.4**	**0.5**
Coal	- 2.5	- 0.1	- 0.1	- 0.1	- 0.1	- 13.7	2.1	- 0.3	- 0.2	0.4
	(2%)	(0%)	(0%)	(0%)	(0%)					
Oil	- 56.0	- 238.5	- 249.9	- 255.2	- 269.6	6.8	0.6	0.2	0.6	0.4
	(51%)	(71%)	(69%)	(68%)	(70%)					
Gas	- 44.4	- 80.8	- 90.6	- 92.2	- 88.0	2.8	1.4	0.2	- 0.5	0.3
	(40%)	(24%)	(25%)	(25%)	(23%)					
NRE		- 6.8	- 9.1	- 12.9	- 17.7		3.8	3.5	3.2	3.5
		(2%)	(3%)	(3%)	(5%)					
Electricity	- 6.8	- 10.3	- 11.4	- 11.4	- 11.3	1.9	1.4		- 0.1	0.3
	(6%)	(3%)	(3%)	(3%)	(3%)					
Heat		- 0.9	- 0.9	- 0.9	- 0.9		0.1	- 0.2	0.2	
		(0%)	(0%)	(0%)	(0%)					

NORTH AMERICA

	Mtoe					Growth rate (% per annum)				
	1980	2002	2010	2020	2030	80-02	02-10	10-20	20-30	02-30
Total Final Energy Demand	**1 372.7**	**1 654.3**	**1 874.6**	**2 148.6**	**2 405.0**	**0.9**	**1.6**	**1.4**	**1.1**	**1.3**
Coal	55.8	32.6	36.2	39.1	40.5	- 2.4	1.3	0.8	0.4	0.8
	(4%)	(2%)	(2%)	(2%)	(2%)					
Oil	717.2	843.3	954.8	1 091.9	1 222.9	0.7	1.6	1.4	1.1	1.3
	(52%)	(51%)	(51%)	(51%)	(51%)					
Gas	357.3	377.4	418.1	466.6	513.1	0.2	1.3	1.1	1.0	1.1
	(26%)	(23%)	(22%)	(22%)	(21%)					
NRE	41.4	51.7	57.3	65.6	75.5	1.0	1.3	1.4	1.4	1.4
	(3%)	(3%)	(3%)	(3%)	(3%)					
Electricity	200.1	344.0	402.3	479.5	546.9	2.5	2.0	1.8	1.3	1.7
	(15%)	(21%)	(21%)	(22%)	(23%)					
Heat	1.0	5.4	5.8	6.0	6.1	7.8	0.8	0.3	0.2	0.4
	(0%)	(0%)	(0%)	(0%)	(0%)					
Industry	**505.8**	**480.0**	**526.0**	**584.3**	**639.0**	**- 0.2**	**1.2**	**1.1**	**0.9**	**1.0**
Coal	52.3	29.1	32.8	35.8	37.3	- 2.6	1.5	0.9	0.4	0.9
	(10%)	(6%)	(6%)	(6%)	(6%)					
Oil	166.1	135.7	149.6	162.3	173.2	- 0.9	1.2	0.8	0.7	0.9
	(33%)	(28%)	(28%)	(28%)	(27%)					
Gas	170.3	165.8	177.0	196.6	216.3	- 0.1	0.8	1.1	1.0	1.0
	(34%)	(35%)	(34%)	(34%)	(34%)					
NRE	39.4	37.8	42.0	48.0	55.0	- 0.2	1.3	1.4	1.4	1.4
	(8%)	(8%)	(8%)	(8%)	(9%)					
Electricity	76.5	106.2	118.8	135.7	151.1	1.5	1.4	1.3	1.1	1.3
	(15%)	(22%)	(23%)	(23%)	(24%)					
Heat	1.0	5.4	5.8	6.0	6.1	7.9	0.8	0.3	0.2	0.4
	(0%)	(1%)	(1%)	(1%)	(1%)					
Transport	**461.3**	**654.6**	**753.1**	**879.0**	**1 001.1**	**1.6**	**1.8**	**1.6**	**1.3**	**1.5**
Coal										
Oil	461.0	651.9	749.5	873.7	993.7	1.6	1.8	1.5	1.3	1.5
	(100%)	(100%)	(100%)	(99%)	(99%)					
Gas		0.4	0.6	1.0	1.6		5.6	5.3	4.6	5.1
		(0%)	(0%)	(0%)	(0%)					
NRE		1.8	2.6	3.9	5.5		4.5	4.0	3.5	4.0
		(0%)	(0%)	(0%)	(1%)					
Electricity	0.3	0.4	0.4	0.4	0.4	2.3	- 0.4			- 0.1
	(0%)	(0%)	(0%)	(0%)	(0%)					
Residential	**244.6**	**294.9**	**320.9**	**353.1**	**381.7**	**0.9**	**1.1**	**1.0**	**0.8**	**0.9**
Coal	1.6	1.3	1.2	1.1	1.0	- 1.1	- 1.1	- 1.1	- 1.0	- 1.1
	(1%)	(0%)	(0%)	(0%)	(0%)					
Oil	52.8	33.3	32.7	32.1	31.7	- 2.1	- 0.2	- 0.2	- 0.1	- 0.2
	(22%)	(11%)	(10%)	(9%)	(8%)					
Gas	119.2	128.1	139.7	148.8	154.5	0.3	1.1	0.6	0.4	0.7
	(49%)	(43%)	(44%)	(42%)	(40%)					
NRE	1.9	10.9	11.5	12.4	13.8	8.2	0.6	0.8	1.0	0.8
	(1%)	(4%)	(4%)	(4%)	(4%)					
Electricity	69.0	121.3	135.8	158.6	180.8	2.6	1.4	1.6	1.3	1.4
	(28%)	(41%)	(42%)	(45%)	(47%)					
Heat										
Commercial	**161.1**	**224.9**	**274.6**	**332.2**	**383.1**	**1.5**	**2.5**	**1.9**	**1.4**	**1.9**
Coal	1.8	2.2	2.2	2.2	2.2	0.9	- 0.1	- 0.1	- 0.1	- 0.1
	(1%)	(1%)	(1%)	(1%)	(1%)					
Oil	37.2	22.4	23.0	23.7	24.4	- 2.3	0.3	0.3	0.3	0.3
	(23%)	(10%)	(8%)	(7%)	(6%)					
Gas	67.7	83.0	100.9	120.3	140.7	0.9	2.5	1.8	1.6	1.9
	(42%)	(37%)	(37%)	(36%)	(37%)					
NRE		1.2	1.2	1.2	1.2					
		(1%)	(0%)	(0%)	(0%)					
Electricity	54.3	116.0	147.3	184.8	214.6	3.5	3.0	2.3	1.5	2.2
	(34%)	(52%)	(54%)	(56%)	(56%)					
Heat	0.03					- 5.2				
	(0%)									

Note: Net imports include intraregional trade

ENERGY SECURITY

	1980	2002	2010	2020	2030
Diversity of Primary Energy Demand (Rated between 1 and 100)	80	85	85	85	85
Net Energy Import Ratio (%)	14	23	21	24	28
Net Oil Import Dependency (%)	39	55	49	50	56

NORTH AMERICA

ELECTRICITY GENERATION

	1980	2002	2010	2020	2030	Growth rate (% per annum) 80-02	02-10	10-20	20-30	02-30
Total Electricity Generation (TWh)	**2 801**	**4 436**	**5 031**	**5 840**	**6 634**	**2.1**	**1.6**	**1.5**	**1.3**	**1.4**
Coal	1 303	2 045	2 302	2 678	3 487	2.1	1.5	1.5	2.7	1.9
	(47%)	(46%)	(46%)	(46%)	(53%)					
Oil	277	109	110	115	115	- 4.2	0.2	0.4		0.2
	(10%)	(2%)	(2%)	(2%)	(2%)					
Gas	380	716	847	1 076	982	2.9	2.1	2.4	- 0.9	1.1
	(14%)	(16%)	(17%)	(18%)	(15%)					
Hydro	530	615	656	677	657	0.7	0.8	0.3	- 0.3	0.2
	(19%)	(14%)	(13%)	(12%)	(10%)					
NRE	7	96	235	326	422	12.5	11.9	3.3	2.6	5.4
		(2%)	(5%)	(6%)	(6%)					
Nuclear	304	856	881	968	971	4.8	0.4	0.9		0.5
	(11%)	(19%)	(18%)	(17%)	(15%)					
Total Installed Generation Capacity (GW)	**661**	**1 002**	**1 165**	**1 221**	**1 411**	**1.9**	**1.9**	**0.5**	**1.5**	**1.2**
Thermal	473	726	860	891	1 062	2.0	2.1	0.4	1.8	1.4
	(71%)	(72%)	(74%)	(73%)	(75%)					
Coal		332	340	374	500		0.3	0.9	2.9	1.5
		(33%)	(29%)	(31%)	(35%)					
Oil		265	300	269	289		1.6	- 1.1	0.7	0.3
		(26%)	(26%)	(22%)	(20%)					
Gas		129	219	248	273		6.9	1.3	1.0	2.7
		(13%)	(19%)	(20%)	(19%)					
Hydro	130	148	150	152	154	0.6	0.1	0.1	0.1	0.1
	(20%)	(15%)	(13%)	(12%)	(11%)					
NRE	1	19	41	56	73	12.5	10.3	3.2	2.7	5.0
		(2%)	(4%)	(5%)	(5%)					
Nuclear	58	110	115	122	122	3.0	0.6	0.7		0.4
	(9%)	(11%)	(10%)	(10%)	(9%)					

ENERGY INTENSITY & CO_2 EMISSIONS

	1980	2002	2010	2020	2030	Growth Rates (% per annum) 80-02	02-10	10-20	20-30	02-30
Energy Intensity (toe per US$ million GDP)	**353**	**241**	**207**	**173**	**151**	**- 1.7**	**- 1.9**	**- 1.8**	**- 1.4**	**- 1.7**
Industry (toe per US$ million GDP in Industry)	379	190	167	146	130	- 3.1	- 1.5	- 1.4	- 1.1	- 1.3
Commercial (toe per US$ million GDP in Services)	37	26	24	22	19	- 1.5	- 1.0	- 1.2	- 1.2	- 1.1
Energy Intensity (kgoe per capita)	**7 941**	**8 290**	**8 573**	**8 877**	**9 198**	**0.2**	**0.4**	**0.3**	**0.4**	**0.4**
Industry	2 003	1 500	1 532	1 569	1 604	- 1.3	0.3	0.2	0.2	0.2
Transport	1 827	2 046	2 193	2 360	2 512	0.5	0.9	0.7	0.6	0.7
Residential	969	922	934	948	958	- 0.2	0.2	0.1	0.1	0.1
Commercial	638	703	799	892	961	0.4	1.6	1.1	0.7	1.1
CO_2 Emissions (million tonnes)	**4 995**	**6 469**	**7 153**	**8 030**	**9 078**	**1.2**	**1.3**	**1.2**	**1.2**	**1.2**
Electricity Generation	1 605	2 550	2 756	3 100	3 631	2.1	1.0	1.2	1.6	1.3
Transformation other than Electricity Generation	280	470	512	517	533	2.4	1.1	0.1	0.3	0.5
Industry	1 038	855	931	1 020	1 099	- 0.9	1.1	0.9	0.7	0.9
Transport	1 349	1 919	2 210	2 582	2 943	1.6	1.8	1.6	1.3	1.5
Residential	443	405	430	449	461	- 0.4	0.8	0.4	0.3	0.5
Commercial	280	271	314	361	411	- 0.2	1.9	1.4	1.3	1.5
CO_2 Emissions Intensity										
CO_2 emissions per GDP (tonnes per US$ million)	879	586	500	417	368	- 1.8	- 2.0	- 1.8	- 1.2	- 1.6
CO_2 emissions per capita (tonnes per capita)	19.8	20.2	20.8	21.6	22.8	0.1	0.4	0.3	0.6	0.4

ENERGY INVESTMENT REQUIREMENTS

(Cumulative from 2003 -)	2010	2020	2030
Total (2000 US$ billion)	**579 - 778**	**1 124 - 1 510**	**1 689 - 2 215**
Coal Production & Transportation	21 - 23	40 - 43	71 - 78
Oil & Gas Production & Processing	178 - 266	308 - 453	379 - 554
Oil & Gas International Trade	36 - 51	66 - 95	99 - 143
Oil & Gas Domestic Pipeline	89 - 127	195 - 278	247 - 353
Electricity Generation & Transmission	255 - 311	516 - 642	893 - 1 088