ASIA PACIFIC ENERGY RESEARCH CENTRE

APEC ENERGY OVERVIEW

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FOREWORD

In the new millennium, the APEC region is faced with a variety of energy-related challenges. Due to volatile oil markets, energy security now tops the economic and political agendas of APEC members and of other economies around the world. Another issue of great importance is ensuring that there is sufficient energy supply infrastructure, especially for electricity and natural gas, to accommodate rapid energy demand growth in developing economies. Schemes to facilitate electricity and gas interconnection, investment in natural gas resource development as well as deregulation and privatisation of all aspects of the energy sector are part of a larger process to secure energy supplies and facilitate sustainable economic growth in the future.

Recognising the importance of information exchange and the necessity to monitor energy trends on an ongoing basis, the production of an annual APEC Energy Overview was first proposed at the 11th EGEDA meeting held in Tokyo in March 2000 and endorsed at the 19th EWG meeting held in Brunei Darussalam in April 2000. It was agreed that the Asia Pacific Energy Research Centre (APERC) would coordinate the work in cooperation with the Expert Group on Energy Data and Analysis (EGEDA). The goal of the APEC Energy Overview is to put current energy issues in context by providing a concise summary of the energy situation and policy directions of each member economy.

To ensure the consistency of data across the 21 APEC economies, APERC used 1999 macroeconomic and energy data provided by the Energy Data and Modelling Center of the Institute of Energy Economics, Japan (EDMC), which acts as the coordinating body for EDEDA. At the 19th EWG meeting in Brunei Darussalam and again at the 20th EWG meeting in Peru, APERC was instructed by EGEDA to use EDMC data for this project.

We would like to acknowledge the efforts of APERC and EDMC researchers for their contribution to this report and the guidance extended from EGEDA members in compiling this overview.

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LIST OF 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
bbl/d	Barrels per day
BCM	Billions of cubic metres
BD	Brunei Darussalam
CDA	Canada
CHL	Chile
CO_2	Carbon dioxide
CT	Chinese Taipei
DOE	Department of Energy (USA)
DOE	Department of Energy (the Philippines)
EDMC	Energy Data and Modelling Center (Japan)
EIA	Energy Information Administration (USA)
EWG	Energy Working Group (APEC)
GDP	Gross domestic product
GHG	Greenhouse gases
HKC	Hong Kong, China
IPP	Independent Power Producers
INA	Indonesia
JPN	Japan
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas (propane)
MAS	Malaysia
MCM	Millions of cubic metres
MEX	Mexico
MMCM	Thousands of cubic metres
Mt	Megatonne
NZ	New Zealand
PE	Peru
PNG	Papua New Guinea
PPP	Purchasing Power Parity
PRC	People's Republic of China
R&D	Research and development
RMB	Renminbi, currency of China (yuan)
ROK	Republic of Korea
RP	The Republic of the Philippines
RUS	The Russian Federation
SIN	Singapore
SDPC	State Development and Planning Commission (China)

TFEC	Total final consumption
TPES	Total primary energy supply
toe	Tonne of oil equivalent
US or USA	United States of America
VN	Viet Nam

AUSTRALIA

INTRODUCTION

The Australian continent covers approximately 7.6 million square kilometres with a total population of around 19 million. The majority of the population is located along the eastern seaboard, mainly in cities or major regional centres. Australia is a resource rich economy with a wide range of mineral, energy and other resources.

Through the 1990s, economic growth in Australia was quite robust at about 3.8 percent per annum. In 1999, GDP was US$ 464 billion (1995 US$ at PPP) and the unemployment rate was around 7 percent. Economic growth has begun to slow in 2000 and 2001 reflecting slower growth in the economies of its major trading partners, Japan, the United States and east and southeast Asian economies.

The resource sector is the largest exporting sector of the Australian economy, comprising over 35 percent of Australia's export earnings. Consequently, the Australian economy is sensitive to changes in foreign earnings arising from fluctuations in resource prices on international markets.

Table 1 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	7,600,000	Oil	461 MCM
Population (million)	18.97	Gas	1,260 BCM
GDP Billion US$ (1995 US$ at PPP)	463.6	Coal	90,400 Mt
GDP per capita (1995 US$ at PPP)	24,443		

Source: Energy Data and Modelling Center, IEEJ. * proved reserves at the end of 2000 from the BP Statistical Review.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 1999, the total primary energy supply in Australia was 110,215 ktoe. Of this total, 30 percent was crude oil, 47 percent coal, and 17 percent natural gas.

Australia is the world's largest exporter of coal, and total indigenous production in 1999 was 150,468 ktoe (284.6 million tonnes). 104,050 ktoe (69 percent) of this was exported. Much of the coal consumed domestically is used for power generation (Australia relies on coal for around 80 percent of generation), with most of the balance being used in the production of energy intensive commodities – particularly iron and steel and aluminium. 2001 has seen world coal demand exceeding supply with demand continuing to grow strongly. Spot market prices for steam coal have increased from the low US$ 20s per tonne to the low US$ 30s with recent settlements in the mid-US$ 30s. Responding to firmer prices and increased coal demand in Asia, Australian coal producers have raised production levels. A number of planned projects have been commissioned during 2001, which together have the potential to add as much as 11.5 million tonnes of capacity.

In 1999, Australia had 1,260 BCM of natural gas reserves, up from 440 BCM in 1990. At current production levels this amounts to 40.6 years of reserves. Natural gas production in 1999 was 26,865 ktoe. Of this, 8,477 ktoe was exported as liquefied natural gas (LNG) to markets in Asia and Europe. The biggest market by far for Australian LNG is Japan. Australia began exporting LNG to the Asia Pacific region at the end of the 1980s. These exports initially grew rapidly but levelled out after the 1997 Asian financial crisis.

The North West Shelf Venture partners received approval in 2000 for an AUS$ 1.6 billion fourth LNG production train to proceed to construction. This represents a major expansion of Australia's LNG export capacity. It is expected to be completed in mid-2004 and will be the largest facility of its kind in the world. Feasibility studies are in progress to evaluate the potential for LNG plants at green field gas areas in and around the North West Shelf, Northern Australia/Timor Sea, the Gorgon fields and Browse Basin.

In 1999, Australia produced 23,978 ktoe of crude oil and condensates. Although Australia exports some crude oil, total demand exceeds indigenous production, so Australia is a net importer of oil and petroleum products. Oil reserves in 1999 stood at 2,900 million barrels, up from 1,600 million barrels in 1990. The reserve to production ratio is 10.4.

Australia produced 203,107 GWh of electricity in 1999. Production was mostly from thermal sources (92 percent) with a small amount from hydro (8 percent). Of thermal fuel consumption, the bulk was coal (94 percent) followed by gas and oil. Electricity demand growth has been quite robust during the 1990s, increasing by about 3 percent per annum.

Table 2 Energy supply & consumption for 1999

Total Primary Energy Supply	**(ktoe)**	**Total Final Energy Consumption**	**(ktoe)**	**Power Generation**	**(GWh)**
Indigenous Production	208,559	Industry Sector	32,637	Total	203,107
Net Imports & Other	-98,344	Transport Sector	27,158	Thermal	186,302
TPES	110,215	Other Sectors	16,739	Hydro	16,797
Coal	51,604	TFEC	76,534	Nuclear	0
Oil	33,516	Coal	6,311	Others	8
Gas	18,388	Oil	35,733		
Others	6,707	Gas	14,064		
		Electricity & Others	20,426		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

In 1999, total end use energy consumption in Australia was 76,534 ktoe. By sector, industry consumed 43 percent of energy, the transport sector 35 percent, and other sectors (including residential and commercial) 22 percent. By fuel source, petroleum products accounted for 47 percent of consumption, natural gas for 18 percent, and coal 8 percent. Electricity accounted for 27 percent of consumption, almost all of this generated in thermal power stations burning coal and natural gas.

Between 1990 and 1999, consumption of natural gas grew at an annual rate of 2.5 percent. The impediments to more widespread use of gas domestically are large distances between main sources of supply in the far west of the continent and centres of demand on the eastern seaboard, and the very competitive price of steam coal for power generation. Despite this, it is expected that extensions of the natural gas pipeline network will continue to open up large markets, particularly in the mining, manufacturing and electricity generation sectors resulting in domestic natural gas demand accelerating to around 3.5 percent per annum over the next decade or two.

POLICY OVERVIEW

The Australian government is working to develop energy policies that recognise cross-sectoral linkages and promote a structure that maximises the economic and social potential of energy industries while working to reduce the environmental impacts of energy use. A key issue for the Australian government is ensuring that all key stakeholders, including industry, the Commonwealth and states/territories are in agreement on key energy policy objectives and their linkages to broader national goals.

In recent years, federal government reforms have focused on the development of a transparent, free and competitive energy market.

COAL

In July 1998, the Productivity Commission released its report on the Australian Black Coal Industry. The report examined productivity and performance issues within the industry with an emphasis on benchmarking the performance of the domestic coal industry in relation to international best practice. The report also reviewed the potential for micro-economic reforms within the industry. The government responded in February 1999, giving full support for all the recommendations. The government is now working with the states and other organisations to ensure the recommendations are implemented.

NATURAL GAS

In November 1997, Commonwealth, State and Territory governments signed the Natural Gas Pipeline Access Agreement. The agreement allows access to pipelines by third parties and will result in increased competition, a more integrated transmission and distribution network as well as greater security of supply in the domestic gas market.

The government launched the Liquefied Natural Gas (LNG) Action Agenda on 10 October 2000 to promote the international competitiveness of the Australian LNG industry. The LNG Action Agenda provides a framework of joint government and industry commitments for securing the future of the LNG industry. It addresses issues of greenhouse policy, customs and import tariffs, taxation arrangements, Australian industry participation, streamlined project approval processes, and marketing of LNG.

PETROLEUM PRODUCTS

In July 1998, the federal government announced a comprehensive reform package for the petroleum retailing industry – "Petroleum Marketing – A New Era of Competition" – that will improve the market environment for petroleum retailing by lifting legislative restrictions on competition and by introducing measures to assist the transition to a more efficient retail network.

In March 2001, the federal government announced a Fuel Taxation Inquiry. This Inquiry will examine the existing structure of fuel taxation in Australia, including rebates, subsidies and grants and report on the implications for economic activity, the environment, petroleum pricing, cost structures and marketing arrangements. This inquiry will report to the government in March 2002.

ELECTRICITY

The Australian electricity industry is comprised of six separate states and two territories as well as the Snowy Mountains Hydroelectric Scheme. In 1996, major reforms were instituted in the electricity generation industry. In light of these reforms, many state-owned utilities were split up and segments were privatised. In July 1998, the Australian national electricity market (NEM), a wholesale power pool, commenced operation. Annual transition phases will be completed by 2002. The market reforms will enhance competition and transparency. At present all customers using above 160 MWh per annum in the National Electricity Market (NEM) have access to the contestable market.

The Victorian Office of the Regulator General has implemented its final Determination on electricity distribution prices in Victoria for the period 2001-2005. The implementation will result in a reduction of average distribution charges in the order of 12-22 percent in 2001.

The Renewable Energy (Electricity) Bill 2000 passed into law on 8 December 2000. It will deliver an additional 9,500 GWh of electricity from renewable energy sources by 2010, increasing the share of renewables from around 10.7 percent, to 12.7 percent. This law also brings into existence a new market for the trading of renewable energy certificates.

Two new inter-connectors have been constructed between Queensland and New South Wales. The entrepreneurial inter-connector, Directlink (180 MW), became operational in late 2000. The regulated Queensland-New South Wales Inter-connector (1000 MW QLD-NSW/500 MW NSW-QLD) was completed in February 2001. Basslink, a 480 MW entrepreneurial inter-connector between Tasmania and Victoria (which will allow Tasmania to join the NEM) is currently subject to the approvals process that will be completed by the end of 2001. The inter-connector will become operational in 2003.

NOTABLE RECENT ENERGY DEVELOPMENTS

NATIONAL ENERGY POLICY

The meeting of the Council of Australian Governments (CoAG) on 8 June 2001 reaffirmed the governments' commitment to the principles and timetable for energy market reform. In addition, First Ministers called for an independent review of energy market directions to be completed within a twelve-month timeframe (late 2002). The review will identify impediments to reform, examine regulatory arrangements; consider options to reduce greenhouse emissions that are consistent with competition reform principles; explore ways to encourage wider penetration of natural gas; assess the potential for regions and small business to benefit from energy market development; and identify future strategic directions for the reform process.

CoAG also agreed to establish a Ministerial Council on Energy to provide national oversight and strategic policy guidance for the continuing reforms within the energy sector. Priority issues to be addressed include regulatory and institutional structures, harmonisation of regulatory frameworks, improving interconnection and system security, improving customer choice and demand side participation. The Council, which is expected to hold its first meeting in October 2001, will report directly to CoAG on these matters. The Forum will also be contributing to the review of national energy policy in relation to gas through the Council.

A NEM Ministers Forum was also established to address specific urgent issues affecting NEM implementation including interconnection investment, network pricing, market behaviour (rebidding and market power issues), regulatory overlap and effectiveness of regulatory arrangements in promoting efficient market outcomes, regional boundaries and DSM. The Forum will report back to CoAG out-of-session on key approaches and timetables for priority tasks.

GREENHOUSE GAS ABATEMENT PROGRAM (GGAP)

The Australian Government has committed AUS$ 400 million over four years to support projects that will reduce greenhouse gas emissions. The first round of successful projects was announced in March and April of 2001. The successful projects cover the use of coal seam methane for power generation, the production and blending of ethanol in liquid fuels, co-generation (combined heat and power), substituting natural gas for oil in industrial production and improving the efficiency of electricity generation from black coal. Registrations for the second round of GGAP closed in July 2001 and these proposals are currently being considered by government ministers.

NEW POWER STATIONS

The 478 MW gas-fired Pelican Point power station commenced operation in South Australia late last year and is now operating at full capacity. On 28 February 2001, Australia Gas Light Company announced its intention to construct a 150 MW gas peaking plant at Somerton, Victoria. It is planned for completion in time for the 2001/2002 summer. Edison Mission is considering the construction of a 300 MW gas peaking plant in the La Trobe Valley.

Queensland generation capacity was boosted by 840 MW in early 2001 with the Callide C generator becoming operational. Queensland has a further 1700 MW of committed generation projects to become operational over the next two years.

NEW URANIUM MINE

Australia is the world's second largest uranium producer after Canada. In 2000 Australia accounted for 22 percent of world uranium mine production. The new Beverley uranium mine in South Australia was officially opened on 21 February 2001. Beverley is the first new uranium mine to come into production for some time and is the first uranium mine to use the low impact in-situ leach mining technology in Australia. Production is expected to increase around 27 percent to 10,450 tonnes of U_3O_8 in 2001-02 because of this new production and an increase in production at the Ranger mine in the Northern Territory.

NEW NATURAL GAS PIPELINES

In September 2000, the 795 kilometres, AUS$ 450 million Eastern Gas Pipeline (EGP) began transporting Bass Strait gas from Longford in Victoria to Sydney on the eastern seaboard.

In September 2000, the AUS$ 400 million Tasmanian Natural Gas Project was announced. This project will bring gas to Tasmania, the only state without access to gas, from Victoria via a sub-sea pipeline. Construction could begin as early as November 2001. Another proposed project would be a AUS$ 230 million South East Australia gas pipeline from Otway Basin and Bass Basin (Yolla) to Adelaide.

AGL and Petronas have put forward a proposal to construct and operate a 2,600 kilometre gas pipeline from Papua New Guinea (PNG) to Townsville, Gladstone and Brisbane. The project has the potential to create about 1,600 jobs and is estimated to cost more than AUS$ 1.5 billion. Negotiations with PNG are currently in progress. The pipeline would encourage the development of a competitive gas market in Queensland, stimulate regional economic development, especially in mineral processing and gas-fired power generation in central and north Queensland and reduce Queensland's greenhouse gas emissions.

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BRUNEI DARUSSALAM

INTRODUCTION

Brunei Darussalam is small economy, only 5,765 square kilometres, located on the island of Borneo (which it shares with Malaysia and Indonesia) in Southeast Asia. Its population of 320,000 with an average per capita income of US$ 18,110 (1995 US$ at PPP), is quite wealthy compared to its neighbours.

In 1999, real GDP was around US$ 6 billion. Economic growth has averaged around 2.1 percent per year during in the 1990s. The Brunei economy is heavily dependent on the resource sector. Oil and gas sector, accounted for 35 percent of GDP in 1999.[1] Half of GDP is generated from crude oil and LNG export revenues. Boosted by high oil prices, economic growth in Brunei has been relatively strong in 2000 and 2001.

As of 1999, the total energy reserves in Brunei were 223 MCM of oil and 390 BCM of gas.

Table 3 Key data and economic profile (1999)

Key data		Energy reserves**	
Area (sq. km)	5,765*	Oil (Proven)	223 MCM
Population (million)	0.32	Gas (Proven)	390 BCM
GDP Billion US$ (1995 US$ at PPP)	5.82	Coal (Recoverable)	-
GDP per capita (1995 US$ at PPP)	18,110		

Source: Energy Data and Modelling Center, IEEJ. * Brunei Darussalam Statistical Year Book, 1999. **proved reserves at the end of 2000 from The BP Statistical Review.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 1999, Brunei Darussalam produced 16,229 ktoe of oil and gas. Of this total, 89 percent of production was exported. Total primary energy supply in 1999 was just 1,837 ktoe. Natural gas made up 82 percent of this total while oil was responsible for the remaining 18 percent.

The Brunei economy is expected to maintain steady growth in the near future due to stable exports of good quality crude oil and liquefied natural gas (LNG) to overseas economies. Brunei has seven offshore oil fields, the largest being Champion and Southwest Ampa, and two onshore fields. Total proven reserves are 223 MCM of crude oil. Oil is exported mostly to Japan, Korea, Singapore, Chinese Taipei and Thailand. Brunei has natural gas reserves of 390 BCM and long-term prospects for production are thought to be excellent. Most of Brunei's LNG exports go to Japan, with a small amount going to Korea.

Total installed capacity in Brunei Darussalam, including the private sector, is 707 MW. In 1999, 2,730 GWh of electricity were produced in Brunei, all of it generated using natural gas. The electrification rate is 100 percent in the urban areas and 97 percent for the rural areas.

[1] Brunei Darussalam Key Indicators, 2000.

FINAL ENERGY CONSUMPTION

In 1999, total final energy consumption was 665 ktoe. The transport sector consumed 49 percent of the total, followed by other sectors (residential/commercial and non-energy) at 37 percent and industrial sector at 14 percent. By source, petroleum products contribute the largest share with 60 percent of consumption followed by electricity at 36 percent, and gas at 4 percent.

Table 4 Energy supply & consumption for 1999

Total Primary Energy Supply	(Ktoe)	Total Final Energy Consumption	(Ktoe)	Power Generation	(GWh)
Indigenous Production	16,229	Industry Sector	94	Total	2,730
Net Imports & Other	-14,393	Transport Sector	324	Thermal	2,730
TPES	1,837	Other Sectors	246	Hydro	-
Coal	-	TFEC	665	Nuclear	-
Oil	328	Coal	-	Others	-
Gas	1,509	Oil	400		
Others	-	Gas	23		
		Electricity & Others	241		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

POLICY OVERVIEW

Since resuming full independence from Great Britain in January 1984, Brunei Darussalam has implemented three five-year National Development Plans (NDP).[2] The long-term objectives outlined in these NDPs include improvements in the quality of life of the people; maximum economic utilisation of national resources; development of non-oil industries; and promoting a clean and healthy environment. In pursuing these objectives, development plans will continue to focus on strategies, programmes and effort that will help expedite the process of industrialisation with a view to achieving more balanced socio-economic development. As well, to encourage the private sector to play an active and important role in the development of the economy, the government is working to improve the investment climate.

Measures for the promotion and development of industries, introduced in the Seventh NDP, will be reviewed and enhanced if necessary and the process of de-bureaucratisation and privatisation intensified. The government will be actively pursuing programmes to encourage industrial restructuring and technological improvements through effective technology transfer, training and development of local human resources.

OIL AND GAS

The Brunei Oil and Gas Authority (BOGA) was created on 1st January 1993. Its main responsibility is to provide advice and recommendations on policy in all matters pertaining to oil, gas, and petroleum products to His Majesty The Sultan And Yang Di-Pertuan of Brunei Darussalam. BOGA is also responsible for planning and implementation of policies with regards to the development of petroleum and its products while taking into account resource conservation

[2] Brunei Darussalam Fifth (1985-1990), Sixth (1991-1995) and Seventh National Development Plan (1996-2000).

and protection of the environment. The authority is also responsible for the negotiation of all contracts and agreements related to petroleum and its products. The Petroleum Unit, under the Office of the Prime Minister, established in 1982 is the custodian of the nation's oil, gas and coal resources. The Petroleum Unit acts as the secretariat to BOGA.

Ongoing efforts are being made to sustain current production levels through exploration, improved technology and increased capital outlays. The National Development Plan continues to emphasise sustainable development of oil and gas resources. In the private and public sector, awareness of energy conservation practices is promoted.

In 1963, the government introduced the Petroleum Mining Enactment (now known as the Petroleum Mining Act, Chapter 44) which came with its own model concessionary agreement. In 1982, amendments were made to the Petroleum Mining Act to ensure that Brunei Darussalam would derive maximum benefit from any petroleum exploration by foreign companies. Later in 1992, the Petroleum Mining Act was amended again allowing Brunei Darussalam to introduce other forms of agreements such as production sharing contracts for future petroleum mining activities.

To reduce the economy's dependence on international energy markets and to strengthen Brunei's industrial base, Brunei has embarked on a study called Brunei Darussalam Masterplan Study on Downstream Oil and Gas Industry.

To maximise returns, Brunei Darussalam adopted effective marketing policies and strategies focusing on:

- Encouraging trade with end user customers;
- Searching for new outlets on an ongoing basis;
- Maintaining long-term and stable relationships with buyers of Brunei crude; and
- Maximising commercial opportunities including price.

Brunei Darussalam has adopted a market-based pricing system, but social equity continues to play an important role in domestic energy pricing policy. To minimise price volatility, Brunei sets prices for unleaded gasoline, kerosene and diesel using a "Price Stabilisation Adjustment Mechanism" which fixes profit margins. In 1998, LPG was included under this adjustment mechanism too.

ELECTRICITY

The Department of Electrical Services (DES) is under the Ministry of Development and is charged with operating the electricity sector. The DES is both a department and an integrated electric utility monopoly. As a utility, it is responsible for planning for future generation and distribution requirements; while as a service department it sets the standards for and implements electricity usage in public buildings as well as overseeing their overall electro-mechanical maintenance.

In line with the economy's energy policies of providing a reliable, continuous, and safe supply of electric power to all consumers in the Sultanate of Brunei, the government has engaged the participation of Independent Power Utilities (IPU). Some services, such as metering and cable supply have been privatised to make these services more competitive and efficient.

The DES actively promotes its energy conservation programme by outlining technical specifications for new projects. Projects include a cogeneration power plants commissioned in 1987 and built adjacent to the Lumut BLNG, where the exhaust heat is used to generate steam for BLNG facility; an existing open cycle gas turbine was designed to allow for conversion to combined cycle in the future; a feasibility study on mini hydro and new source of energy has been recently undertaken.

ENVIRONMENT

Much has been done to maintain a clean and healthy environment. Environmental considerations have increasingly become an integral part of the economy's socio-economic development process. The government's commitment towards protection of the environment and achieving sustainable development was further emphasised with the formulation of a National Environment Strategy (NES). The NES encourages the integration of environmental considerations in economic planning and development, the expansion of urban and rural environment improvement programmes as well as increased regional international cooperation. In-line with the vision "Towards a Better Quality Environment," environment policy objectives in the National Development Plan are:

- Maintain sustainable utilisation of natural resources;
- Minimise negative impacts on the environment arising from population growth and human activities; and
- Balanced goals of socio-economic development and the need to sustain sound environmental quality.

NOTABLE ENERGY DEVELOPMENTS

MASTERPLAN STUDY ON DOWNSTREAM OIL AND GAS INDUSTRY

In an effort to diversify Brunei's oil and gas based economy, the Government of His Majesty in April 2000, commissioned a study called the *Brunei Darussalam Masterplan Study On Downstream Oil and Gas Industry*. The study which was completed in May 2001, provides a road map for long term stage by stage development of downstream industries. This road map will form the basis for future decisions by the government in its endeavour to develop a petrochemical and refinery industry. The Masterplan will also be a tool to attract local and foreign investment in the downstream oil and gas sector.

Developing the downstream oil and gas industry will broaden the current industrial base, create job opportunities, increase export income, create spin off industries, pave the way for the development of small and medium enterprise and other related service industry. In this Masterplan Study, the following industries have been identified to have good development potential: export oriented oil refining; ammonia, urea and methanol; olefins and aromatics; and energy intensive industries such as aluminium smelting. Potential spin-off industries include plastics, textiles, packaging materials, synthetic rubber, agriculture chemicals and pharmaceuticals.

LNG 6TH TRAIN EXPANSION OPPORTUNITY (BLNG MASTERPLAN)

Brunei LNG has embarked on the BLNG Masterplan Study to expand current LNG capacity from 7.2 million tonnes per year to around 11.2 million tonnes by 2008, a sixth train expansion. The Masterplan Study also recommends refurbishing the existing LNG plant to extend its operating life an extra 20 years or to 2033.

OPENING OF NEW PETROLEUM AREAS

On 29 January 2001, His Royal Highness The Crown Prince officially opened several new areas for petroleum exploration. Companies were invited to bid on exploration acreage namely Block J (5,020 sq km) and Block K (4,944 sq km) situated offshore in the deep water Exclusive Economic Zone (E.E.Z) of Brunei Darussalam and onshore in Block L (2,254 sq. km). Final bid submissions will take place in November 2001. The award of the exploration block to the successful company or consortium of companies will be based on a 'production sharing contract' and is anticipated to take place in the first half of 2002.

DEVELOPMENT OF POWER SECTOR

There are at present two major power utilities in Brunei Darussalam, namely the state-owned Department of Electrical Services (DES) and an independent power utility, the Berakas Power Company Sdn Bhd (BPC). Presently, DES has four generating plants with a total installed capacity of 448 MW (*Network 1* and *Network 2)*. BPC supplies power to its own consumers with three generating power plants and has a total installed capacity of 259 MW (*Network 3*). The three independent power transmission and distribution networks are not interconnected. Independent Power Utilities accounts for about 40 percent of total electricity supply. IPU participation in the electricity market has relieved the government of some of the administrative and financial burden of meeting power requirements in Brunei.

An assessment of the current electricity situation revealed that the Brunei electricity industry faces a major challenge: rapid growth of 6 percent per annum in electricity demand. Nationwide the peak demand in 2000 went up 4.2 percent to 398 MW compared to about 381 MW the year before. Based on current and anticipated economic activities, load growth of 6 percent per year for the next 5 to 10 years is considered reasonable implying load demand of about 550 MW by 2005.

In light of recent electricity demand projections to 2005, Brunei Darussalam has outlined a plan to install an additional 264 MW of capacity to the system. Beside the power planning programme, transmission and distribution network reinforcement projects will also be implemented to facilitate quality power distribution to consumers.

In its *Strategy for Sustainable Growth*, the Brunei Darussalam Economic Council (BDEC) recommends the privatisation of certain state industries. Therefore, state-owned DES has been instructed to look at the possibility of transforming itself into a corporate body. A working committee has been established with the task of compiling a report on the feasibility of the undertaking.

INTRODUCTION OF UNLEADED GASOLINE

In line with His Majesty Government's aspiration to protect the environment and public health, fully unleaded motor-gasoline was introduced on 1st March 2000. The three grade products are Premium ULG 97, Super ULG 92 and Regular RON 85.

PHASING OUT NATURAL GAS VENTING AND FLARING

The oil and gas industry is a major contributor to carbon dioxide emissions; therefore, to reduce emission levels, Brunei Darussalam plans to phase out the practices of continuous venting and flaring by the 2003 and 2008 respectively.

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CANADA

INTRODUCTION

Canada covers the northern part of North America and is second only to Russia in geographic size. Its small population of around 30 million, 40 percent of which live in the province of Ontario, is spread over 10 million square kilometres of territory. Canada is best known for its harsh northern climate and its wealth in natural resources. Per capita incomes are high at US$ 25,962 in 1999.

The current economic situation in Canada is very positive. GDP in 1995 dollars at PPP was US$ 792 billion in 1999 or 4.6 percent higher than 1998, inflation increased by 2.7 percent in 2000 due to higher gas and oil prices, and the unemployment rate fall to 6.8 percent by the end of 2000.

Canada is the fifth largest energy producer in the world (behind the United States, Russia, China and Saudi Arabia). It possesses abundant supplies of key energy resources such as oil, natural gas, coal, uranium and hydro potential. In 1999, energy reserves (See Table 1) included 28,552 MCM of oil (both conventional crude and oil sands[3]), 1,629 BCM of natural gas, 7,110 Mt of coal, 433 kt of uranium and power installed capacity of about 110,000 MW. Energy production is therefore very important to the Canadian economy. In 1999, the energy industry accounted for approximately 6 percent of domestic GDP, about 12 percent of total merchandise exports and employed about 290,000 Canadians in upstream and downstream operations.

Due to Canada's cold climate, high standard of living and its many energy intensive and bulk goods industries, Canadians are also large consumers of energy. Final consumption energy use per capita in the APEC region is approximately 1.5 toe. In Canada, energy use per capita in 1999 was 4 times greater at 6.2 toe.

Table 5 Key data and economic profile (1999)

Key data		Energy reserves** (Established ***)	
Area (sq. km)	9,984,670*	Oil	702 MCM
Population (million)	30.49	Oil sands	27,850 MCM
GDP Billion US$ (1995 US$ at PPP)	791.60	Gas	1,629 BCM
GDP per capita (1995 US$ at PPP)	25,962	Coal (Recoverable)	7,110 Mt

Source: Energy Data and Modelling Center, IEEJ * Statistics Canada. ** National Energy Board.
*** Established reserves are the sum of proven reserves plus half of probable reserves

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 1999, Canada's primary energy supply was 254,909 ktoe. Of this total 38 percent was crude oil and petroleum products, 27 percent natural gas, 13 percent coal, 11 percent hydro, 7 percent nuclear and 4 percent other fuels. Canada is a large net exporter of energy. In 1999, falling from 35 percent in 1998 due to unusually low prices, 31 percent of energy production was exported to

[3] Crude bitumen reserves are four times larger than the 1998 estimate because the Alberta Energy Utilities Board recently changed its definition of bitumen reserves to include not only areas under active development, but areas that could, but have not yet been accessed by in-situ recovery methods.

the United States. Through 2000 and 2001, oil and gas prices have enjoyed a strong recovery and led to increases in production and exports. The bulk of oil, gas, coal and nuclear reserves are in Western Canada while hydro resources are concentrated in Quebec, Newfoundland, Manitoba and BC. Recently, Canada has started to exploit offshore oil and gas deposits on the East Coast near Nova Scotia and Newfoundland.

In 1999, Canada produced 132,077 ktoe of crude oil and equivalent. Traditionally, Canada imports large amounts of oil in the east (51,208 ktoe in 1999) and exports even more oil from the west (86,515 ktoe in 1999, 66 percent of production) to the United States. Low oil prices and resulting declines in production in 1998 and early 1999 led to a -6 percent decline in exports in 1999. During the 1990s, to feed strong growth in the transportation sector, domestic supply grew 3.0 percent per annum while net exports increased an average of 3.6 percent. The largest source of crude production is the Western Canadian Sedimentary Basin (WCSB). Recent declines in light crude production have been offset by additional production of heavy crude. Though conventional products such as light crude, natural gas liquids and heavy crude make up the bulk of product, bitumen mined from oil sands projects in Alberta continues to grow in importance. Bitumen and synthetic crude made up 28 percent of Canadian production in 1999. Strong prices since late 1999 have buoyed conventional oil and bitumen production in mature regions like the WCSB as well as encouraged expansion in newly developed resource basins on the East Coast. Hibernia off the coast of Newfoundland came on stream in 1997 and produced 145,000 bbl/d in 2000, an increase of 45 percent from 1999. Terra Nova is slated to begin production in late 2001.

Natural gas production in 1999 totalled 144,428 ktoe. Net exports to the United States accounted for 74,420 ktoe or 52 percent of production. Encouraged by unusually high gas prices in 2000, four-times higher than in 1999, production levels are expected to remain strong over the next few years. In the 1990s, domestic supply grew an average of 2.9 percent while exports increased at a substantial 9.2 percent per annum. Rapid export growth is expected to continue due to robust demand growth in the United States and expansions in pipeline capacity. Recently completed pipelines include the Alliance pipeline from Alberta to Chicago and Vector from Chicago to Southern Ontario both completed in 2000 and the Maritimes and Northeast pipeline (M&NE) from the new Sable Island gas field to New England which went into operation at the end of 1999. Additional capacity on M&NE to serve and develop domestic markets in Nova Scotia and New Brunswick is expected to go into service in 2001. Recently, another promising gas discovery was made on the East Coast in the Panuke area off of Nova Scotia. In the Northwest Territories, gas production began in the Ft Liard area in 2000. This gas flows into British Columbia where it connects with the larger pipeline grid.

In 1999, Canada produced 36,051 ktoe of coal. While oil and gas exports are primarily to the US market, Canada's biggest export customers for coal are Japan and South Korea. Due to the Asia crisis, exports of mostly metallurgical coal dropped off sharply in 1997. A glut in the international coal market has also depressed Canadian coal exports which fell from 25,318 ktoe in 1997 to 19,970 ktoe in 1999. Domestic supply, however, grew 2.4 percent per year in the 1990s, including a substantial 11 percent increase between 1998 and 1999. Almost 90 percent of domestic coal use is for electricity generation, particularly in Western Canada. In Ontario, Canada's most populous province, to compensate for the temporary shut down of eight nuclear reactors in 1997-98, coal imports from the United States for electricity generation have increased significantly.

Canada generated about 578 TWh of electricity in 1999. The sources of generation were mostly hydro at 60 percent, followed by thermal at 28 percent and nuclear at 13 percent. More and more, natural gas is favoured over coal for incremental generation. The availability of cost-effective combined-cycle generators and gas' reputation as a "clean" fuel has increased its popularity. Electricity exports to the United States are about 8 percent of production, a much smaller proportion than oil, gas or coal.

Canada chose to develop nuclear technology due to its large domestic uranium reserves. It is the world's leading producer of uranium, accounting for almost one third of world production. Nuclear's share of total generation, however, has been declining since 1994 due to aging reactors and public safety concerns. Production levels reached their lowest point in 1997-98 when Ontario

temporarily shut down eight of its 20 nuclear reactors. Coal-fired generation and some natural gas have replaced this laid-up capacity. In late 2000, Ontario Power Generation submitted to regulators a proposal to upgrade and reopen the laid-up Pickering A reactors. The company hopes to restart service by the end of 2001. Also in 2000, Ontario Power Generation leased the Bruce power station, including four reactors that are currently out of service, to a consortium led by British Energy PLC. The lease runs until 2018 and includes an option to extend. Over the next two years, this consortium plans to overhaul and restart service in at least two of the reactors.

Table 6 Energy Consumption & Supply (1999)

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	370,888	Industry Sector	74,012	Total	578,043
Net Imports & Other	-115,979	Transport Sector	54,454	Thermal	158,764
TPES	254,909	Other Sectors	60,118	Hydro	345,588
Coal	32,502	TFEC	188,585	Nuclear	73,491
Oil	96,549	Coal	4,034	Others	200
Gas	70,008	Oil	79,555		
Others	55,850	Gas	52,126		
		Electricity & Others	52,870		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

In 1999, total end use energy consumption in Canada was 188,585 ktoe. Broken down by sector: industrial consumed 39 percent of energy, followed by residential/commercial at 30 percent and the transport sector at 29 percent. The remaining 2 percent of energy was used by the agricultural sector. By fuel source, petroleum products accounted for 42 percent of consumption, natural gas for 28 percent and electricity for 22 percent. Coal and coal products made up 2 percent of consumption and other fuels were responsible for the remaining 6 percent.

In the residential and commercial sectors, space and water heating needs make up approximately 70 percent of energy use while lighting, air conditioning and electronic equipment account for the remaining 30 percent. Consumption has grown slowly at around 0.9 percent per annum in the 1990s. Improvements in the energy efficiency of buildings, HVAC (heating, ventilation and air conditioning) systems and electronic equipment have helped to offset demand growth from increases in population and GDP. Other trends that suggest higher energy consumption in this sector include the increased market penetration of household appliances and office equipment as well as a strong consumer preference for larger homes and more powerful electronic equipment.

In the industrial sector, in 1999, three industries (pulp & paper, petroleum refining and iron & steel) accounted for approximately 6 percent of GDP yet were responsible for more than 40 percent of energy consumption. Energy is used to power equipment, to generate process heat and as a raw material in the production process. Energy consumption in the industrial sector grew on average 1.3 percent during the 1990s. Strong economic growth offset by efficiency improvements in some industrial sub-sectors, were the key factors behind consumption growth.

Boosted by both the passenger and freight segments, the transportation sector experienced the strongest average growth of all end-use sectors, 2.3 percent, in the 1990s. Petroleum products, at

89 percent of consumption in 1999, were the dominant fuel in the transport sector. The mode with the largest share of demand was road transportation at 80 percent. Interesting trends on the passenger side of the market include the growing popularity of light trucks (including sport utility vehicles and minivans), which on average consume more fuel per kilometre than cars. Flat fuel efficiency improvements in new vehicles and large increases in average kilometres travelled per vehicle have also contributed to energy consumption growth. In freight, robust economic growth in recent years has increased demand for truck freight and rail services. Moreover, a shift away from rail towards more energy-intensive truck transport also pushed up demand.

POLICY OVERVIEW

In Canada, jurisdiction over energy matters is shared between the provincial and federal governments. The constitution gives the provinces authority over the conservation and management of natural resources within their borders. However, jurisdiction over international and interprovincial trade is a federal responsibility. The division of power outlined by the constitution requires the different levels of government to cooperate in important policy areas such as climate change, environmental protection and in regulating energy infrastructure systems. Through the Department of Natural Resources (NRCan), the federal government works with the provincial governments to implement national development strategies and to honour international agreements.

Energy policy in Canada is market-based. Due to its huge and diverse resource base, physical energy security is not an issue in Canada; however, sustainable development of existing resources to ensure adequate supplies for the future, is a key priority. Policies are therefore aimed at promoting economic growth while encouraging conservation of resources and minimising environmental impacts. The Department of Natural Resources intervenes in areas where the market does not adequately support its policy objectives. NRCan therefore implements policies and programmes which encourage science and technological research and provide public information in the areas of energy efficiency, renewables and alternatives, and energy resources.

OIL AND GAS

Most aspects of the oil and natural gas markets in Canada have been fully deregulated. Some retail natural gas markets and oil and gas pipelines, often referred to as natural monopolies, are still regulated by provincial and federal authorities. In 1985, the Western Accord drawn up by the federal government and producing provinces deregulated oil and natural gas prices and opened up the gas market to greater competition by permitting more exports, allowing users to buy directly from producers and unbundling marketing and transportation services. The National Energy Board (NEB), a federal regulatory body under the Minister of Natural Resources, regulates oil and gas pipelines that cross national and inter-provincial borders and approves exports of oil, gas and electricity. In 1987, the NEB adopted the Market-Based Procedure as a criterion for approving export licenses; that is, the market will be trusted to satisfy Canadian requirements for natural gas at fair market prices. Over the last decade, the NEB has changed its focus from economic regulation to safety and environmental regulation. To improve the functioning of the market, the NEB holds public hearing on applications to build or expand pipelines as well as establishes and hears complaints relating to inter-provincial transportation rates, conditions of access and terms of service on pipelines under its jurisdiction. In recent years, to avoid costly hearings, the NEB has encouraged large groups of shippers to negotiate pipeline tolls directly with pipeline companies. These rates are subject to Board approval.

For information on electricity markets, please see the Notable Energy Developments section.

END USE MARKETS

To promote energy efficiency and conservation in end use markets, Canada has generally opted for voluntary measures supplemented by information programmes such as product labelling,

market incentives for certain types of investments and energy efficiency standards for household appliances, office equipment and industrial motors. In 1998, NRCan established the Office of Energy Efficiency (OEE). The OEE manages 18 programmes aimed at improving energy efficiency in the residential, commercial, industrial and transport sectors. To track the impact of these programmes on energy consumption, the OEE is developing a set of progress indicators.

ENVIRONMENT

At the Kyoto conference in 1997, Canada agreed to reduce its greenhouse gas (GHG) emissions to 6 percent below 1990 levels by 2008-2012. In 1998, the federal, provincial and territorial governments established a National Climate Change Process to examine the impact, costs and benefits of Kyoto and the various implementation options open to Canada. The federal government allocated $150 million (CDA) over three years (1998-2001) to a Climate Change Action Fund (CCAF) which would support this process. In 1998, under the CCAF, sixteen issues tables of experts from government and the private sector worked to develop and analyse options for reducing greenhouse gas emissions in different sectors (such as the electricity sector, forestry sector, and transportation sectors).

To maintain momentum toward meeting Canada's climate change objectives, the 2000 federal budget (February 2000) provided $625 million (CDA) between 1999-2004 to respond effectively to the challenges of climate change. Initiatives included measures to develop and demonstrate new technologies like fuel cells; support climate change and atmospheric research; assist municipalities in implementing environmental programmes; expand purchases of green power in government operations; reduce emissions abroad; and to renew the Climate Change Action Fund and proven energy efficiency and renewable energy programmes for another 3-year period (2001-2004). On 6 October 2000, the government of Canada announced *Action Plan 2000 on Climate Change* which provided another $500 million (CDA) to support additional climate change initiatives over the next five years (See Notable Energy Developments section).

NOTABLE ENERGY DEVELOPMENTS

ENVIRONMENT

Drawing on input from a series of foundation papers on climate change supported by the Climate Change Action Fund and released in 1999, the federal, provincial and territorial governments prepared a national implementation strategy and a business plan for addressing climate change in Canada.

NATIONAL IMPLEMENTATION STRATEGY AND FIRST NATIONAL BUSINESS PLAN

In October 2000, Joint Ministers of Energy and the Environment (except for Ontario), unveiled the *National Implementation Strategy on Climate Change* and the *First National Climate Change Business Plan*. The Strategy provides the broad framework and key priorities under which Canada's federal, provincial and territorial governments will jointly address climate change and is part of a coordinated national response to climate change. Federal, provincial and territorial governments will implement this broad strategy through individual and joint actions, the first series of which are outlined in the First National Business Plan (2000-2003). These governments will communicate results in progress reports and detail new action in annually updated three-year business plans.

ACTION PLAN 2000 ON CLIMATE CHANGE

On 6 October 2000, the government of Canada announced *Action Plan 2000 on Climate Change*. To support the initiative over the next 5 years, funding of $500 million (CDA) was provided. This plan builds on $625 million (CDA) in climate change measures announced in Budget 2000 and is the federal government's contribution to the *First National Climate Change Business Plan.*

Some of the initiatives outlined in *Action Plan 2000* include expanding the use of low or non-emitting energy sources by four times the current level; increasing the use of ethanol for gasoline

blending; working with the United States to increase automobile fuel efficiency standards; investing in the refuelling infrastructure for fuel cells; investigating the potential for geological storage of carbon dioxide or carbon sinks; increasing interprovincial electricity trade; and improving tracking and reporting of energy efficiency and carbon emissions by industry. Taking a leadership role, the federal government outlined its commitment to reduce GHG emissions from federal government operations to 31 percent below 1990 levels by 2010. Since 1990, through retrofits, better fleet management and downsizing, the government has reduced energy use in federal buildings by 19 percent. *Action Plan 2000* is expected to reduce Canada's greenhouse gas emissions by 65 Mt per year by the period 2008-12.

PROGRESS TOWARDS KYOTO TARGETS

Since 1990, Canada's greenhouse gas emissions have grown from 607 megatonnes (Mt) of CO_2 equivalent to 705 Mt in 1999, an increase of 16 percent. Under the latest "business as usual" forecast, which incorporates current policies and programmes, emissions are projected to increase further to 770 Mt in 2010. Canada's Kyoto target is 6 percent below 1990 levels over the period 2008-2012, or roughly 571 Mt in 2010. To achieve the target will require policy actions to reduce emissions by about 200 Mt from the level projected and represents a Kyoto "gap" of approximately 26 percent. *Action Plan 2000* (described above), provides a set of programme and other initiatives which, when fully implemented are designed to reduce the "gap" by about one-third.

EAST COAST LEADERS SIGN BILATERAL PACT TO REDUCE EMISSIONS

In August 2001, premiers from five eastern Canadian provinces (Newfoundland, New Brunswick, Nova Scotia, Prince Edward Island and Quebec) and New England governors from the US signed a bilateral agreement to reduce greenhouse gases in the region at least 10 percent below 1990 levels by 2020. The resolution calls on state and provincial governments to document the emissions levels in their regions, develop plans for reducing greenhouse gases, use more environmentally friendly fuels sources and reduce their energy consumption.

ELECTRICITY DEREGULATION

Electricity markets in Canada are organised along provincial lines and have therefore developed under the authority of provincial governments. In most provinces, the industry is highly integrated with the bulk of generation, transmission and distribution provided by a few publicly-owned utilities. In the mid-1990s, driven in part by restructuring efforts in the United States, provincial governments have brought in measures to make electricity markets in Canada more competitive. Major trends include the unbundling of major utility functions into transmission, generation, distribution and marketing segments. As well, to obtain access to lucrative US export markets, British Columbia, Manitoba, Alberta, Quebec and Ontario have complied with FERC rules and opened up their transmission systems to competition.

Alberta has been the most active provinces in the drive to restructure, though Ontario has also made significant progress. In 1995, Alberta laid the groundwork for electricity deregulation. It then introduced a competitive wholesale market, including location-based rates and a power pool in 1996. In May and August 2000, the government compelled electricity producers to sell their electricity output at auction to wholesalers. It also passed legislation introducing retail competition for residential and commercial users as of 1 January 2001. Deregulation, however, has not been without its challenges. Though there was a large electricity surplus in 1995, by 2001, rapid economic growth sharply increased demand while uncertainty over rules for deregulation discouraged investment in power plants and curtailed supply. Since retail competition was introduced at the start of 2001, due to this supply shortfall, consumers have faced price hikes of 80 percent or more. Businesses are threatening to relocate. The provincial government maintains that new supply is being added and prices will come down as more power plants are built. In the meantime, to mollify consumers, the provincial government is offering temporary price rebates.

Concern over the problems with deregulation in California and Alberta has slowed down the pace of electricity restructuring in Ontario. Legislation to open the market has been in place since 1998 and investors have been invited to apply for licences to buy and sell electricity. Already,

Ontario has dismantled the provincially-owned monopoly, Ontario Hydro into 5 components. However, plans to implement wholesale and retail competition in Ontario have been delayed several times. According to the most recent announcement, these markets will open in May of 2002. Once competition is introduced, Ontario Power Generation Inc, the generation entity, has until 2010 to reduce its share of the provincial electricity market (currently about 85 percent) to 35 percent. The provincial government is confident that re-opening four laid up nuclear reactors at Pickering in 2001 or 2002 will ensure a supply surplus and improve the chances of success for deregulation in Ontario.

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CHILE

INTRODUCTION

Chile is one of the two APEC economies in South America. Its nearly 757 thousand km² are located on the continent, with small insular possessions including Easter Island in Oceania. The population lives mainly in urban areas, with nearly a third of its 15 million inhabitants residing in Santiago, the capital. Chile is a major producer and exporter of copper.

Real GDP in 1999 was US$ 129.6 billion (in 1995 US$ at PPP), and grew at an average annual rate of 6.7 percent during the period 1990 to 1999.[4] Due to its strong economic ties with Asia, Chile was adversely affected by the 1997 Asian financial crisis. The economy slowed in 1998 and experienced a minor recession in 1999. In 2000, the Chilean economy recovered, growing by 5.4 percent. The economic slowdown in the United States, sluggish Asian import demand and low copper prices are expected to dampen economic growth in 2001.

Chile is endowed with modest amounts of energy resources. Its energy reserves consist of 4.8 MCM of oil, 45 MCM of natural gas and 155 Mt of coal. In 1999, Chile imported approximately 71 percent of its energy requirements.

Table 7 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	757 000	Oil (Proven)	4.8 MCM
Population (million)	15.02	Gas	45 BCM
GDP Billion US$ (1995 US$ at PPP)	129.60	Coal	155 Mt
GDP per capita (1995 US$ at PPP)	8,630		

Source: Energy Data and Modelling Center, IEEJ. * 1999 figures from the National Energy Commission (CNE), Chile.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In the period from 1980 to 1999, the average annual increase of total primary energy supply (TPES) was 4.2 percent, reaching 23,993 ktoe in 1999. Of this total, 44 percent was crude oil, 17 percent natural gas, 16 percent coal and 23 percent others. An important development in Chilean energy markets was the introduction of natural gas from Argentina in 1997. In just two years, natural gas has increased its fuel share from 9 percent to 17 percent, making it the second most important source of primary energy in Chile. Renewable energy represented nearly a fifth of TPES in 1999: biomass supplies approximately 17 percent and hydroelectricity nearly 6 percent of TPES.

Chile's dependence on energy imports has been growing steadily. In 1980 approximately 64 percent of TPES was indigenous production and 36 percent net imports and others. By 1999 this relationship was reversed, indigenous production accounted for only 29 percent of the total. Imports have increased for several reasons. Due to dwindling reserves, domestic crude oil production peaked in 1982 (32 percent of domestic supply) and has declined to just 2 percent of domestic supply. A non-competitive coal industry has led to a six-fold increase in coal imports. Domestic coal now makes up only 9 percent of Chilean consumption. The natural gas market has

[4] EDMC, IEEJ, 2001.

been transformed by imports from Argentina in the more populous north and central regions starting in 1997. Previously, due to infrastructure constraints, gas was only available in the south.

Empresa Nacional del Petróleo (ENAP), a state-owned company, produces and refines oil in Chile. Due to dwindling domestic resources, the company is increasing exploration and production activity abroad (mainly in Latin America), through its international subsidiary SIPETROL. ENAP is working towards a goal to supply 30 percent of Chilean oil demand. Currently, oil is imported mainly from Nigeria, Gabon and Venezuela. Both the retail market for petroleum products and markets for imported oil and petroleum products operate on a competitive-basis. There are three refineries in Chile: Petrox Talcahuano (100,640 bbl/d throughput capacity, which will increase by 25 percent by the first quarter of 2002), Refinería de Petróleo de Concón (94,350 bbl/d) and Gregorio Magallanes (9,650 bbl/d).[5]

In 1999, 38,389 GWh of electricity were produced. Over the period 1980 to 1999, production increased by 6.4 percent per annum. Historically, hydropower accounted for the bulk of generation in Chile. In 1999, however, thermal generation accounted for almost 60 percent of total generation. The introduction of natural gas from Argentina has encouraged the construction of natural gas-fired combined cycle plants and increased the importance of thermal generation. Coal-fired plants make up nearly 60 percent of thermal production, followed by natural gas-fired plants with about 18 percent. Fuel oil, biomass, and other fuels account for the remainder.

Table 8 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		**Total Final Energy Consumption (ktoe)**		**Power Generation (GWh)**	
Indigenous Production	6,950	Industry Sector	5,577	Total	38,389
Net Imports & Other	17,043	Transport Sector	6,363	Thermal	22,838
TPES	23,993	Other Sectors	6,761	Hydro	15,551
Coal	3,773	TFEC	18,701	Nuclear	-
Oil	10,646	Coal	955	Others	-
Gas	4,149	Oil	10,325		
Others	5,426	Gas	707		
		Electricity & Others	6,714		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

There are four non-connected power grids in Chile.[6] Sistema Interconectado Central (SIC) (Central Interconnected System) is the most important. It serves over 90 percent of the population and more than 40 percent of the land area; its installed capacity as of December 2000 was 6,653 MW, of which 61 percent was hydro. Sistema Interconnectado del Norte Grande (SING) (Great North Interconnected System) serves mainly mining consumers; its installed capacity as of December 2000 was 3,041 MW, almost entirely thermal. Sistema Aysén and Sistema Magallanes, the other two grids, represent only a small portion of installed capacity.

Several gas pipelines have been built between Argentina and Chile since 1997. In addition to gas, the energy supply grid between Chile and Argentina consists of a power transmission line in the North, and several oil pipelines. In all cases, energy flows in one direction, from Argentina to

[5] EIA, 2001.

[6] CNE website, 2001.

Chile. The two economies are discussing further cooperation in the power sector, including measures to facilitate the integration of electricity networks in both economies. Energy sector collaboration in Chile and Argentina is part of a larger integration process in MERCOSUR[7] and other South American economies. As well, a power line from Chile to supply a Bolivian mine is under consideration.

FINAL ENERGY CONSUMPTION

Total final energy consumption (TFEC) grew at an average annual rate of more than 6 percent from 1990 to 1999, reaching 18,701 ktoe at the end of the period. The main energy consuming sectors are transport (34 percent), industrial (30 percent) and other sectors with 36 percent. By energy source, oil products account for 55 percent of final consumption, electricity and others 36 percent, coal 5 percent, and gas the remaining 4 percent.

Chile is the world's largest copper producer and is expected to account for nearly 40 percent of world production in the medium term. The copper industry is by far the most important industrial energy consumer in Chile. A major copper development project can result in a significant jump in energy demand. Changing production methods, particularly the penetration of hydrometallurgical processes, have led to an increase in electricity consumption by the copper industry.

Energy consumption in the industrial sector is highly concentrated, with four industries accounting for nearly 50 percent of final consumption.[8] The copper industry is the most important, with 25 percent of industrial energy consumption and 9 percent of TFEC. It was followed by the pulp and paper industry, with 14 percent of industrial energy consumption, the iron and steel industry with 9 percent, the cement industry with 3 percent, and fishing with 3 percent. However, in the 1990s most of the energy growth in the industrial sector (6.5 percent per annum) was driven by non-energy intensive industries (10.0 percent per annum). When total industrial energy consumption is broken down by fuel, oil products account for 39 percent, electricity for 33 percent, coal and coke for 15 percent, natural gas for 7 percent and biomass for 6 percent.

Transportation was the fastest growing end-use sector, at 7.2 percent per annum for the period 1990 to 1999. In 1999, road transport was responsible for nearly 77 percent of sectoral energy consumption. Oil products accounted for 99.7 percent of consumption, electricity for 0.2 percent and natural gas made up the remainder.

The residential/commercial/public sector exhibited the slowest growth of the three sectors mentioned above, with 4.6 percent per annum for the period 1990 to 1999. In 1999, the residential sub-sector accounted for nearly 89 percent of sectoral consumption. Biomass (mostly firewood) was the most important fuel in this sector, accounting for 53 percent of consumption while oil products made up 25 percent and electricity took 17 percent. The share of natural gas (5 percent) is expected to increase in the medium term due to the introduction of imports from Argentina.

POLICY OVERVIEW

Energy policy in Chile promotes dynamic development in the energy sector, overall economic growth and a better quality of life for its citizens.

The development of the energy sector should be consistent with the following principles:

- improving energy supply conditions as well as the quality and security of energy products and services;

[7] Mercado Común del Sur (Common Market of the South), formed by Argentina, Brazil, Paraguay and Uruguay, with Chile and Bolivia as associated members.

[8] Total energy consumption figures were taken from EDMC, while percentages (industry breakdown) were taken from the CNE (CNE, 2000a), which provides greater detail.

- within reason, reducing the price of energy products and services to adequately reflect technological and managerial advances so to improve the international competitiveness of the economy and to maintain incentives for investment, while offering consumption opportunities to the poorest segments of the population;
- to protect energy consumers by eliminating or minimising abnormal fluctuations in the prices of key products, especially those caused by temporary distortions in markets;
- focalised and transparent support, with mechanisms that guarantee efficacy and efficiency, to those sectors that do not have access to key energy resources if overcoming this exclusion is evaluated as having a high social priority or social return;
- development of and adequate compliance with regulations that protect the environment.

In other words, the main objective of energy policy is to achieve strong energy supply and economic growth, without comprising the welfare of energy consumers, key industries or the environment.

The general guidelines of Chile's energy policy are the following:

- Assure an adequate degree of regulatory stability to minimise risks to investment, while upgrading and improving the regulatory framework with prudence and timeliness;
- Strengthen local competition, increase participation in international markets, and increase energy diversification;
- Create conditions where prices and quality of energy products and services approach those theoretically obtainable in perfectly competitive markets or with minimum distortions;
- Sustainable development and efficient use of energy;
- Contribute to social equity using economically and socially transparent mechanisms;
- Monitor energy security;
- Take advantage of international opportunities and anticipate potential problems.

Examples of policies supporting these objectives include energy sector privatisation. Chile was one of the first economies in the world to restructure its power sector. The deregulation strategy developed by Chile nearly twenty years ago, has served as a model for other economies in South America. Currently, the basic law regulating this sector is being modified to increase competition and improve consumer protection.

To improve quality of life in rural areas of Chile, the government initiated the Rural Electrification National Programme (PER) in 1994. The programme has played an important role in improving access. During the year 2000, the percentage of rural homes with access to electricity increased to 78 percent, up 21 percentage points from the 1993 figure. Chile now has the third highest rural electrification rate in Latin America, after Costa Rica and Mexico. The goal is to increase coverage to 90 percent by the end of the current administration.

NOTABLE ENERGY DEVELOPMENTS[9]

MODIFICATIONS TO THE ELECTRICITY LAW

The Chilean government announced a draft bill to change the General Law of Electrical Services of 1982 on 13 September 2000. The objective of this initiative is to increase the flexibility of the existing legal framework, so that the sector has the tools to adapt successfully to the changing national and international economic climate. A favourable investment climate, a more competitive market and regulatory procedures which are stable, efficient and transparent, should improve the efficiency of the power generation sector. It is hoped that these measures will increase the reliability and quality of the electricity supply in Chile. Increasing electrification rates, particularly in rural and isolated areas, are also a priority.

The goal of proposed changes is to improve economic incentives and encourage efficiency in the competitive segments of the electricity market. Where market intervention by regulatory agencies is necessary, this intervention should increase sector efficiency, economic equality and the active participation of energy consumers in the market.

In achieving these goals, environmental law and regulations will play an important role.

As of August 2001, the government decided to separate the bill in two parts. The first one, the General Law of Electrical Services (also known as the Long Law), is almost finished and will soon be sent to Congress. Debate over this bill is expected to take several months. Some of the modifications to the law include:

- Modifications to the existing toll system are expected to facilitate interconnections and investment in transmission lines. This system will clarify toll payment procedures and prohibit vertical integration of generation and transmission services;
- Definition of the concept and valuation of ancillary services;
- Giving the government the right to buy new power in extraordinary situations where the market is not capable of providing supply. For example, in the event of a drought which could reduce hydro potential for electricity generation. These government-provided supplies will be subject to the same conditions as other power plants in the Central Interconnected System.

The second bill (known as the Short Law), which deals with a redefinition of pricing systems for isolated areas (specifically in Regions XI and XII), was expected to go to Congress during the last quarter of 2001. No delays in the approval of this bill are anticipated.

INTERNATIONAL ENERGY INTEGRATION AGREEMENTS

The Chilean government is currently finalising a draft law (regulation) on Interconnection and Commercialisation of Electricity with neighbouring economies, particularly Argentina. To facilitate this process, a bi-national energy market integration committee met in Buenos Aires on June 14 of 2001 to discuss technical details relating to the draft law. Additional energy interconnections with Peru are also being considered.

GEOTHERMAL ENERGY[10]

Law 19,653 on Geothermal Energy Concessions was issued on 7 January 2000. Supporting Decree 142 from the Ministry of Mining, was released later that year on 28 April. This legislation outlines which geothermal resources can be auctioned for exploration and/or exploitation. Concessions for these resources can be obtained at public auctions arranged by the Ministry of

[9] CNE website and CNE, 2000b.

[10] Codelco Chile, 2001.

Mining. Auctions of resources are organised to support ministerial objectives or at the request of interested parties.

In January 2001, the National Oil Company (ENAP) and the Copper Corporation (Codelco Chile), both state-owned, announced that they had formed Geotérmica del Norte S.A., a company that will explore and exploit geothermal resources located in Regions I, II and III of Chile.

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CHINA

INTRODUCTION

China is the world's most populous economy with 1.25 billion citizens. It has a geographical size of 9.6 million square kilometres. Currently China is the world's second largest energy consumer behind the United States and the third largest producer behind the United States and Russia. However, per capita energy consumption levels (at 0.577 toe) are far lower than in many developed economies and, due to the large population, lower than the world average.

China has sustained high rates of economic growth, just under 10 percent, for more than 20 years. However, in the late 1990s, growth has slowed slightly to about 8 percent per year. Energy demand, keeping pace with the overall economy, has also grown rapidly through the 1990s but dropped off since 1997. Per capita incomes are still quite low, US$ 3,547 (at 1995 US$ at PPP) in 1999.

China possesses large amounts of energy resources, particularly coal. China is the largest producer and second-largest consumer of coal in the world. In terms of oil, China was the world's seventh largest oil producer and third largest oil consumer in 1999. After decades as a net oil exporter, China became a net oil importer in 1993. Coal reserves were approximately 114.5 Gt, oil reserves were estimated to be 3,816 MCM and natural gas reserves were about 1,370 BCM. In addition, China is endowed with significant reserves of hydropower as well as other new and renewable energy resources. In terms of hydro potential, at 676 GW, China ranks first in the world. For power generation and industrial development purposes, coal and oil resources have been utilised more extensively than reserves of gas and hydro potential.

Table 9 Key data and economic profile (1999)

Key data		Energy reserves	
Area (sq. km)	9,600,000*	Oil (Proven)	3,816 MCM**
Population (million)	1,253.60*	Gas (Proven)	1,370 BCM**
GDP, Billion US$ (1995 US$ at PPP)	4,446.76*	Coal (Recoverable)	114.5 Gt**
GDP per capita (1995 US$ at PPP)	3,547*	Hydropower (Potential)	676 GW***

Sources: *Energy Data and Modelling Center, IEEJ. **proved reserves at end of 2000 from The BP Statistical Review. ***China Energy Annual Review 1997.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply (TPES) in China has experienced continuous growth over the last twenty years, but peaked in 1996 at 847,829 ktoe. Primary consumption has declined in the last few years due to slower economic growth and structural changes in the Chinese economy, as well as others factors. In 1999, TPES was 724,664 ktoe. Of this total, coal accounts for 67 percent, oil for 27 percent, natural gas for 3 percent while hydro, nuclear and other make up the remaining 3 percent.

In the past, to ensure security of supply, development of China's abundant indigenous coal reserves was given much political and financial support. In the 1990s, to reduce pollution emissions from energy use and to optimise the existing energy structure, Chinese authorities have

encouraged fuel-switching from coal to cleaner fuels and introduced energy efficiency initiatives. Since 1996 (the peak year of consumption), primary coal consumption in China has declined 25 percent. Improving the quality of coal has also helped to reduce coal consumption. In response to declining demand, coal production has also fallen. Overall, total Chinese energy production fell from 849,677 ktoe in 1996 to 691,973 ktoe in 1999. Reduced energy consumption has helped to reduce pollution and minimise harm to the environment.

After decades as a net oil exporter, China became a net oil importer in 1993. In 1998, imports accounted for 32 percent of total crude oil and petroleum product requirements.[11] In 1999, China's oil output was 160 million tonnes, a slight drop over the previous year (161 million tonnes). Most of China's oil reserves are onshore. Its largest production fields are located in northeast China at Daqing and Liaohe. These resources, however, are maturing and there are concerns that production from these fields will begin to decline in the near future.

Gas production and consumption in China are currently quite small, just 3 percent of total primary energy supply. However, in the last few years, Chinese authorities have begun to promote gas use in power generation and industry. Gas is attractive since it is a cleaner fuel than coal and because China has abundant reserves. Gas resources are located mostly in western China whereas demand is in large cities on the eastern seaboard; therefore, the government is investing in pipeline infrastructure, including a "West to East" pipeline from Xinjiang (Uygur Autonomous Region) to Shanghai, to facilitate gas use.

Table 10 Energy supply & consumption in 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	691,973	Industry Sector	326,652	Total	1,239,300
Net Imports & Other	32,691	Transport Sector	55,085	Thermal	1,020,544
TPES	724,664	Other Sectors	193,879	Hydro	203,807
Coal	484,216	TFEC	575,616	Nuclear	14,949
Oil	197,619	Coal	272,239	Others	-
Gas	21,113	Oil	174,683		
Others	21,716	Gas	22,809		
		Electricity & Others	105,886		

Source: Energy Data and Modelling Center, IEEJ.
For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

The power industry in China has experienced very high growth in recent decades. Total installed capacity grew from 66 GW in 1980 to more than 300 GW by 2000. In 1999, total power generation was 1,239 TWh, up 6.3 percent from the previous year. Of this total thermal fuel, mostly coal, accounted for 82 percent of generation, hydropower generation was responsible for 16 percent and nuclear accounted for 1 percent of production. By the end of 1999, total installed hydropower capacity had reached 73 GW, only 19 percent of the total of technically exploitable resources. A number of huge hydro projects such as the Three Gorges project are under construction and will substantially increase power generation capacity.

FINAL ENERGY CONSUMPTION

Final energy consumption in China reached 575,616 ktoe in 1999. Industry was the largest user accounting for 57 percent of energy consumption, the combined residential-commercial sector was

[11] EDMC, 2001.

next with 15 percent and transportation made up 10 percent. Agriculture, non-energy and other sectors were responsible for the remaining 16 percent. In terms of fuels, coal (47 percent) was the most important end use fuel, followed by oil (30 percent), electricity (14 percent), gas (4 percent), heat and other fuel (5 percent).

Over the last two decades, China has managed to greatly reduce the energy intensity of the overall economy. To achieve this, the government has systematically used energy conservation measures to ease supply shortages. More recently, these techniques have been used to reduce energy-related air pollution.

POLICY OVERVIEW

In the last 20 years, strong economic growth in China has been supported by economic policies promoting openness and reform. Energy supply has kept pace with strong demand due to increased investment, improved management practices and the adoption of new technologies. Moreover, policies promoting greater openness have permitted energy imports to become a more significant component of domestic supply.

The government's policy of stimulating domestic economic growth through energy sector investment is expected to continue. Total investment in fixed assets in the energy sector was RMB 238.4 billion in 1999. Investment in the coal industry was RMB 8.7 billion and RMB 64 billion was invested in oil and gas exploration and pipeline construction. Investment in the power industry totalled RMB 165.7 billion where RMB 61 billion was invested in power grid construction and improvement, RMB 21.3 billion in urban areas, RMB 39.7 billion in rural areas and RMB 104.7 billion was invested in the construction of power supply focusing on large scale hydro-power projects and clean-coal pilot projects for power generation. Additional construction and improvement of the power grid have not only increased the power supply to meet growing demand, but have also improved the efficiency and reliability of the system.

China issued "The Outline of the Tenth Five-Year Plan for National Economical and Social Development" in March of 2001. The Outline defines objectives, guiding principles and major tasks for China's economic and social development over the next five years. The plan proposes that: "energy development should take China's energy resources as a basis for development, optimise the structure of the energy sector, improve energy efficiency, and intensify environmental protection."

The State Development Planning Commission issued a "Special energy development plan during the tenth five-year period" as a key special topic plan. It is a programmatic document to guide energy development during the period (2001 – 2005).

The energy strategy during the tenth Five-Year Plan period and beyond is to guarantee energy security; optimise energy structure; improve energy efficiency; protect the environment; and accelerate development of energy infrastructure in the western region of China where energy resources are abundant.

ENERGY DEVELOPMENT TARGETS FOR 10TH FIVE-YEAR PLANNING PERIOD

Based on the "Energy development special plan during the tenth five-year period", the major targets of energy development are:

- By the year of 2005, total primary energy output is expected to reach 1,320 Mtce. Coal production is expected to reach 1,170 Mt, oil production 165 Mt, natural gas production 50 BCM, and electricity generation 1,730 TWh. Hydropower is expected to provide 356 TWh, nuclear power 60 TWh, and total installed capacity is expected to reach 370 GW.

- Compared with 2000, the percentage of coal in total energy consumption is expected to drop 3.9 percent, and clean energy such as natural gas and hydropower is expected to increase to 17.88 percent of the total.
- From 2001 to 2005, energy intensity is forecast to decline 15-17 percent. This would provide a saving of 300-340 Mtce.

ENERGY SECURITY

Domestic development and production of oil and natural gas can no longer keep pace with China's economic and social development requirements, resulting in an increasing imbalance between supply and demand. Hence, the reliability of international energy supply is becoming more and more important.

Ensuring an adequate supply of energy is of primary importance to economic development. To achieve this, measures to conserve and substitute for oil, accelerate exploration and exploitation of oil and natural gas resources, and make effective use of overseas resources are being promoted. Petroleum stocking will be established and oil stockpiling will be gradually improved. Energy imports will be diversified to minimise the risk of supply disruptions. A strategic task for the tenth Five-Year Plan period and beyond will be to develop oil substitutes and to promote the application of coal liquefaction technologies, as well as promote other options to reduce reliance on imported energy.

STRUCTURAL OPTIMISATION

Optimising energy structure will be a priority in future energy development. During the tenth Five-Year Plan period, as the balance between demand and supply improves, the focus of energy sector development should be shifted to sustainable development and environmental protection. Achieving this goal will require changes in the structure of the energy industry as well as the development and application of advanced technologies.

Energy has long been considered a strategic resource and self-reliance remains a key policy goal in China. Therefore, development of China's abundant indigenous coal reserves was given much political and financial support in the past. In recent years, the historical energy shortage has lessened, and serious air pollution problems have put pressure on the government to seek cleaner alternatives to coal. Environmental protection initiatives have been introduced to force the energy industry to diversify away from coal production and towards cleaner fuels. Therefore, it is expected that coal will be used in transformation more and more, such as power generation and liquefaction. For the petroleum industry, exploration and development of domestic oil and gas resources will be stepped up. Production is expected to increase. The share of oil and gas in total energy supply should increase.

Coal will continue to be China's main source of energy. However, coal's share of total energy supply is expected to steadily decline over the next five years. To minimise pollution from coal use, producing and using coal in a cleaner way is of strategic importance. Therefore, a national clean coal development programme was initiated in early 1997 to encourage the application of clean coal technologies (CCTs). A number of large-scale projects, such as large circulating fluidised bed (CFB) power generating units, pressurised CFB (PCFB), integrated gasification combined cycle (IGCC) and coal liquefaction projects are currently being planned or implemented.

While making full use of existing power-generating capacity, China is looking to develop hydroelectric power and build large-scale thermal power plants close to coal mines, reduce the number of small thermal power stations, and undertake a modest nuclear power development programme. The building and upgrading of power grids in urban and rural areas and work to complete an economy-wide network are also priorities.

New and renewable energy is an important component of the long-term development strategy. Where conditions permit, in cities or their surrounding areas, effort will be made to develop wind power, solar heat energy, and solar photovoltaics. At the same time, taking advantage of the

Chengfeng Wind Power Programme,[12] China will establish a wind technology manufacturing industry. China plans to produce wind power equipment domestically by importing advanced technologies from foreign economies through technology transfer and trade.

IMPROVING ENERGY EFFICIENCY

Improving energy efficiency will continue to be an energy policy priority. Rational utilisation of energy and an adequate supply infrastructure are regarded as essential to improve energy utilisation efficiency. On going efforts will be made to strengthen energy conservation legislation and regulations and to bolster enforcement. Energy efficiency standards and labelling will be implemented to eliminate the production of low efficiency products. Specific efforts will be aimed at transportation and energy-intensive industries such as ferrous, non-ferrous, building materials and chemicals.

ENVIRONMENTAL PROTECTION

Acknowledging environmental degradation partly caused by energy development, China will promote the development of clean energy and clean coal technologies, avoid or mitigate environmental pollution, and promote more sustainable development practices.

WESTERN REGION DEVELOPMENT

Energy is used to achieve economic and social aims but it is also a tool to develop the resource-rich but underdeveloped western region. There are a number of major projects of strategic significance, such as the transmission of natural gas and electricity to the more developed eastern regions.

NOTABLE ENERGY DEVELOPMENTS

WEST TO EAST NATURAL GAS PIPELINE PROJECT

To increase the use of cleaner energies like natural gas, China is planning to build a gas pipeline from the western Xinjiang Uygur Autonomous Region to eastern China. The pipeline is expected to be about 4,200 kilometres long, with a gas transmission capacity of 12 billion cubic meters in Phase I. The estimated cost of Phase I is RMB 120 billion. It is expected that the pipeline project will stimulate investment in gas exploration and development, lead to the establishment of distribution networks and encourage increased gas use by industry. Companies and investors from all over the world have been invited by the Chinese government to participate in the investment, construction and management of this natural gas pipeline project. Construction is expected to begin in the second half of 2001.

WEST TO EAST ELECTRICITY PROJECT

In order to transform the West Region energy resource advantage into an economic advantage, Guizhou, Yunnan, and Guangxi provinces will export 10 GW to Guangdong province over the period 2001-2005. The west to east electricity project includes the construction of both power plants and transmission lines. The electricity will come from the Three Gorges project (3 GW), Guangxi in the Zhuang Autonomous Region (0.5 GW), Yunnan province (1.6GW), Guizhou province (4.9GW). A total of 5 transmission lines will be constructed.

RESTRUCTURING THE ELECTRIC POWER INDUSTRY

The power management system will be further reformed, gradually allowing power plants and grids to operate separately, and institute bidding for power supply.

[12] This is a central government programme for wind power promotion.

SALE OF SHARES IN STATE OWNED OIL COMPANIES

As a part of the restructuring programme of state-owned enterprises, the Chinese government has offered foreign investors the opportunity to purchase shares in China's major oil companies.

The largest state-owned petroleum company, China National Petroleum Corporation (CNPC) established a subsidiary company, PetroChina Company Limited. In April 2000, PetroChina made a successful IPO (Initial Public Offering) of its shares in both Hong Kong and New York and collected funds totalling US$ 2.89 billion. Based on proven hydrocarbon reserves in 1998, PetroChina is the world's fourth largest publicly traded oil and gas company.

China's second largest oil company, SINOPEC has established a subsidiary company – the China Petrochemical Corporation. On 19 October 2000, the China Petrochemical Corporation was listed on the Hong Kong, New York and London stock exchanges, the first Chinese enterprise listed on three overseas markets simultaneously.

CNOOC Ltd as a subsidiary of China's third largest oil company, CNOOC was listed on the New York stock exchange on 27 February 2001 and on the Hong Kong exchange on 28 February.

WHITE PAPER *"NEW AND RENEWABLE ENERGY OF CHINA"*

The State Development Planning Commission (SDPC) issued the new edition of its white paper *New and Renewable Energy of China* in April 2000. This white paper is one of many efforts by the SDPC and the Chinese government to promote new and renewable energy in China. The paper summarised the energy supply and demand situation and the necessity of renewables. It provides detailed information and policies under consideration by the Chinese government for various technologies, such as wind power, solar thermal, solar PV, ocean energy, biomass and others. The paper also outlined a national renewables programme currently being implemented.

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HONG KONG, CHINA

INTRODUCTION

Hong Kong, China is a city-economy with a population of approximately 7 million people, located on the coast of southern China. Since 1997, it has been a Special Administrative Region (SAR) of the People's Republic of China.

Hong Kong, China is a modern economy with a high per capita GDP, US$ 21,751 (1995 US$ at PPP) in 1999. The service sector is responsible for 85 percent of GDP. In the last few decades, firms in Hong Kong, China have been moving low value-added work offshore, and have concentrated on high-value, technology-based markets. This process of economic adjustment has resulted in a significant increase in trading and financial and other service activities. Hong Kong, China is a principal service centre, both in the Asia-Pacific region and globally.

All energy consumed in Hong Kong, China is imported as the city is completely without indigenous oil, gas or coal resources. The energy sector consists of investor-owned electricity and gas utility services.

Table 11 Key data and economic profile (1999)

Key data		Energy reserves	
Area (sq. km)	1,097	Oil (Proven)	-
Population (million)	6.72	Gas	-
GDP Billion US$ (1995 US$ at PPP)	146.18	Coal (Recoverable)	-
GDP per capita (1995 US$ at PPP)	21,751		

Source: Energy Data and Modelling Center, IEEJ.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 1999, total primary energy supply in Hong Kong was 16,345 ktoe. Of this total, 60 percent was oil, 22 percent coal and 14 percent gas. Electricity imports from China accounted for the remaining 4 percent. Hong Kong has no domestic energy reserves or petroleum refineries and imports all of its energy requirements save electricity.

At the end of 1995, Hong Kong began importing natural gas brought by pipeline from the South China Sea offshore gas field Yacheng. In 1996, Hong Kong opened its first gas-fired power plant. Previously gas was used only in the end use sectors.

Hong Kong, China had a total installed electricity generating capacity of 11,568 MW in 1999. This includes 70 percent of the capacity of units 1 and 2 of the Guangdong Nuclear Power Station at Daya Bay and 50 percent of the Guangzhou Pumped Storage Power Station. Power from these facilities is imported through CLP Power transmission connections to Guangdong provincial grid). Locally generated power is all thermally fired.

Table 12 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	-	Industry Sector	2,187	Total*	29,496
Net Imports & Other	16,345	Transport Sector	7,251	Thermal	29,496
TPES	16,345	Other Sectors	3,317	Hydro	-
Coal	3,549	TFEC	12,756	Nuclear	-
Oil	9,797	Coal	6	Others	-
Gas	2,219	Oil	9,228		
Others	780	Gas	531		
		Electricity & Others	2,992		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

* Total does not include electricity generated by hydro and nuclear facilities owned by HKC but located in China.

FINAL ENERGY CONSUMPTION

Total final energy consumption reached 12,756 ktoe in 1999. The bulk of energy was used in the transportation sector (57 percent), followed by the residential/commercial sector (26 percent) and the industrial sector (17 percent). Given the dominance of the transportation sector, it is not surprising that the most important end use fuel was petroleum products which accounted for 72 percent of energy consumption. Electricity was the other major energy source at 24 percent while gas accounted for only 4 percent of consumption.

Gas is supplied for domestic, commercial and industrial uses. Two main types are available: town gas distributed by the Hong Kong and China Gas Company Limited; and liquefied petroleum gas (LPG) supplied by oil companies. Town gas accounted for 73 percent of the total fuel gas sold in energy terms, and LPG for 27 percent in 1999.

POLICY OVERVIEW

The Government of the Hong Kong Special Administrative Region (SAR) pursues the following energy policy objectives:

- To ensure that the energy needs of the community are met safely, efficiently and at reasonable prices; and
- To minimise the environmental impact of energy production and promote the efficient use and conservation of energy.

In keeping with Hong Kong, China's free market economic philosophy, the SAR intervenes only when necessary to safeguard the interests of consumers, ensure public safety and protect the environment. Hong Kong, China works with the power, oil and gas companies to maintain strategic reserves of coal, diesel and naphtha. It monitors the performance of the power companies through the Scheme of Control Agreements. The government has entered into an Information and Consultation Agreement with the Hong Kong and the China Gas Company Ltd. to make the town gas tariff adjustment mechanism more transparent. In consultation with the power companies, the government also promotes energy efficiency and energy saving measures.

To help monitor the energy situation, Hong Kong, China has developed an energy end-use database and forecasting model. The database will provide useful insight into the energy supply and demand situation, including energy consumption patterns and trends and energy use

characteristics of the individual sectors and sub-sectors. A basic data set is now publicly available through the Internet.

The SAR is currently studying a consultant report on the feasibility of adopting a common carrier system for the transmission and distribution of natural gas. It is also studying a report on the state of interconnection and competition in the electricity sector.

The Electricity Ordinance and the Gas Safety Ordinance regulates the safe supply of electricity and gas. Among other things, these ordinances cover the registration of generating facilities, workers and contractors for electrical and gas installations, wiring and gas installation standards and safe distribution and use of electricity and gas. Most provisions of the Electrical Product (Safety) Regulation, which regulates the safety of household electrical products, came into effect in May 1998.

NOTABLE ENERGY DEVELOPMENTS

COMPREHENSIVE BUILDING ENERGY CODES

The set of Building Energy Codes are being implemented via "The Hong Kong Energy Efficiency Registration Scheme for Buildings." The scheme covers lighting installations, air conditioning installations, electrical installations and lift/escalator installations. A task force was set up in August 2000 to review the current implementation of the codes. A consultancy study will be commissioned by the end of 2001 to study a performance-based building energy code using total-energy-budget approach.

ENERGY EFFICIENCY LABELLING SCHEMES

The Hong Kong Voluntary Energy Efficiency Labelling Schemes include six household appliance schemes for refrigerators, room coolers, washing machines, electric clothes dryers, compact fluorescent lamps and electric storage water heaters, and one office equipment scheme for photocopiers. Two new schemes, one for household rice cookers and the other for office equipment multifunction devices (an integrated device with multifunction such as copying, printing and faxing) are scheduled to be launched in late 2001. An Energy Efficiency Labelling Scheme for motor vehicles is also under development.

DEMAND SIDE MANAGEMENT

The government signed DSM Agreements with power companies at the end of May 2000. From 1 July 2001, the power companies have implemented the first 3-year DSM programmes, which include rebate programmes for non-residential customers, as well as other education, and information programmes. The need for rebate programmes for residential customers will be reviewed in mid 2001.

ENERGY AUDIT PROGRAMME

Over the period 1993 - 2000, Energy Audits were conducted in 122 selected public buildings. By the end of 2001, it is anticipated that the Energy Audit Programme will have completed surveys of around 158 buildings with the highest potential for energy savings.

The results of the pilot scheme for trial implementation of Energy Management Opportunities (EMO) completed to date have proved satisfactory, with significant savings achieved. Hong Kong, China has published reports and application guidelines to promulgate the use of EMOs. In addition, pilot tests on innovative energy efficient equipment in the areas of lighting, air conditioning and vertical transportation have also been carried out since 1999 in government buildings. The tests were very successfully with substantial energy savings achieved, especially in the application new T5 lamps for office lighting.

ALTERNATIVE FUEL VEHICLES

In view of the success of the one-year road test carried out on 30 taxis in 1998, Hong Kong, China is working towards the eventual replacement of the fleet of 18,000 diesel taxis with LPG models by the end of 2005. Government officials are closely involved in safety control and approval of LPG vehicles, LPG filling stations and vehicle workshops as well as establishing and maintaining registers of competently trained LPG mechanics. Furthermore, the government is taking a long-term view, in identifying and establishing incentives to motivate drivers to switch to LPG vehicles and in developing the LPG filling network by building dedicated LPG stations and retrofitting suitable petrol filling stations with LPG facilities. So far, about 6,400 LPG taxis have been put on the road.

A six-month trial of 11 LPG and 4 electric public light buses has just been completed. A local gas supply company and a local electricity company are proposing to carry out a small-scale trial run of natural gas vehicles using their vehicle fleets.

RENEWABLE ENERGY

Two universities are carrying out research on integrated photovoltaic systems for buildings. One university is setting up PV arrays to monitor the performance of photovoltaic panels under Hong Kong's climatic conditions.

A consultancy study on the 'Potential Applications of Renewable Energy in Hong Kong' was commissioned in November 2000. The objective of the study is to assess the feasibility and potential for wider application of new and renewable energy technologies in Hong Kong, China. The study also includes a demonstration project to install photovoltaic panels in existing government buildings to provide technical data to assess the use of integrated photovoltaic systems for buildings and to demonstrate to the general public the applicability of new and renewable energy technologies.

CONSULTANCY STUDY ON WIDER USE OF WATER-COOLED AIR CONDITIONING SYSTEM

Three implementation studies on water-cooled air conditioning systems are currently being planned or are underway. These are the "Territory-Wide Implementation Study for Water-Cooled Air Conditioning Systems in Hong Kong", the "Implementation Study for a District Cooling Scheme in the South East Kowloon Development (SEKD)", and the "Implementation Study for a Water Cooled Air Conditioning Scheme in the Wanchai & Causeway Bay Districts (W&CD)." The objectives of these studies are:

i. (Territory-Wide Studies): to formulate plans, a programme and control requirements for the phased implementation of water-cooled air conditioning systems in Hong Kong, China; and

ii. (SEKD and W&CD Studies): to ascertain and define the technical, environmental, financial, regulatory and institutional requirements in detail and to draw up plans for the implementation of district cooling in the new SEKD development and water cooled air conditioning in the existing W&CD districts.

CONSULTANCY STUDY ON THE DEVELOPMENT OF ENERGY CONSUMPTION INDICATORS AND BENCHMARKS

A consultancy study on the development of energy consumption indicators and benchmarks for selected energy-consuming groups in Hong Kong, China was commissioned in December 2000. The study will provide in-depth data on levels of energy consumption and the extent of use of energy efficient equipment among the selected groups. Based on the indicators, benchmarks will be developed against which users can rate their own energy consumption performance. The study is scheduled for completion in 2002 and will focus on four major energy-consuming groups - private offices and commercial outlets in the commercial sector and private cars and light goods vehicles in the transport sector.

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INDONESIA

INTRODUCTION

Indonesia is an archipelago consisting of large and small islands around the equator, with a total area of about 2 million square kilometres. The population is about 200 million, the majority of which reside in Java, one of the five main islands.

Growth in GDP was severely affected by the Asian financial crisis in 1997. After reaching 8 percent annual growth in 1996, GDP grew only 5 percent in 1997 and fell –14 percent in 1998. There has been some recovery in 1999 and 2000, with 1 percent and 5 percent growth in GDP respectively.

Mining activities, especially of petroleum and tin, have expanded since 1970. Fossil energy resources, namely oil, natural gas and coal play important roles in the economy, as energy resources, industrial raw material and exchange earners. In 1999, oil reserves were estimated to be 1,590 MCM, gas reserves were 4,670 BCM and coal was 38,000 Mt. Agriculture still plays a dominant role in the economy, although the share has decreased over time.

Table 13 Key data and economic profile (1999)

Key data		Energy reserves (At end 99)	
Area (sq. km)	1,937,179	Oil (Proven)	1,590 MCM*
Population (million)	207.02	Gas	4,670 BCM*
GDP Billion US$ (1995 US$ at PPP)	556.25	Coal (Recoverable)	38,000 Mt**
GDP per capita (1995 US$ at PPP)	2,687		

Source: Energy Data and Modelling Centre, IEEJ. *Directorate General of Oil and Gas. **Directorate General of Mining.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 1999, total primary energy supply was 83,019 ktoe. Of this total 47 percent was oil, 34 percent was gas, 14 percent was coal, 4 percent was geothermal and 1 percent was from hydro sources. Indonesia is a large net energy exporter, selling approximately 50 percent of the oil, gas and coal it produces.

Major oil producing areas in Indonesia are the Duri and Minas fields in central Sumatra. Other significant oil field development and production is located offshore in northwestern Java, east Kalimantan and the Natuna Sea. In recent years these fields have started to mature leading to declines in production. In 1999, oil production in Indonesia was 59,879 ktoe, a drop of 18 percent since 1994. Moreover, reserve additions have not kept pace with production which limits Indonesia's ability to produce oil in the future. Without additional investment in oil exploration and development, Indonesia is expected to become a net oil importer in the near term.

Indonesia is currently a leading exporter of LNG. In 1999, it produced 58,375 ktoe of gas, 52 percent was exported. Despite large reserves, domestic gas demand is still limited. Gas is used mostly in the petrochemicals industry and for electricity generation. A high production-to-reserve ratio, however, has raised concerns that Indonesia is depleting its natural gas resources. The recently developed Natuna gas field in the South China Sea is thought to hold reserves of 1,303

BCM and improves the gas situation in Indonesia. In 2001, gas exports via pipeline from Natuna to Singapore began to flow.

Known coal resources total 38 billion tonnes, but the amount of economically exploitable coal, either through open-pit or underground mining, is still limited. Most of these resources, about 85 percent are classified as low-rank coal or lignite. Indonesia also produces clean coal or "envirocoal" which is low in sulphur and ash content compared with other types of coal. In 1999, Indonesia produced 42,977 ktoe of coal, 74 percent of which was exported to markets in Japan, Korea and Chinese Taipei.

Indonesia produced 84,776 GWh of electricity in 1999. Most of production came from thermal sources (83 percent) with some hydro (12 percent) and geothermal (5 percent). Hydropower potential for electricity production is found mostly outside of Java and is estimated to be around 75,625 MW. However, only about 4 percent of this total is currently being exploited. Sumatra, Jawa, Bali, East Nusa-Tenggara, West Nusa-Tenggara, the islands in the Banda Sea, Halmahera and Sulawesi are all located in volcanic regions where there is a large potential for geothermal energy. Surveys have located 70 prospective locations for geothermal energy development with a total potential of 19,658 MW. Currently, only 525 MW of this total are being utilised.

There is a great potential for renewable energy use in Indonesia. Traditional uses of biomass are widespread in rural areas. Other types of renewable energy such as biogas, solar and wind energy are currently being shown in demonstration projects. In addition, in remote areas, a number of mini hydro and micro hydro generators have been shown to be commercially viable.

Table 14 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	165,463	Industry Sector	22,724	Total	84,776
Net Imports & Other	-82,444	Transport Sector	20,815	Thermal	70,614
TPES	83,019	Other Sectors	17,202	Hydro	10,268
Coal	11,725	TFEC	60,741	Nuclear	-
Oil	39,371	Coal	5,798	Others	3,894
Gas	27,691	Oil	42,523		
Others	4,232	Gas	6,285		
		Electricity & Others	6,135		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

Due to the Asia financial crisis in 1997, total final energy consumption fell by about 1 percent between 1997 and 1998. However, in 1999 final energy consumption enjoyed a robust recovery and increased 10 percent from 55,218 ktoe in 1998 to 60,741 ktoe in 1999. The most important end use fuel was petroleum products accounting for 70 percent of consumption, followed by coal, gas and electricity which each made up 10 percent of demand. Non-commercial biomass, an important source of energy in the residential sector, is not currently taken into account due to difficulties in measuring consumption levels.

Energy consumption patterns have been changing in recent years. In 1999, for the first time, the industrial sector surpassed the transport sector as the largest consuming end-use sector.

Industrial accounted for 37 percent of final energy consumption, transportation for 34 percent, residential/commercial for 23 percent and other sectors accounted for the remaining 6 percent.

POLICY OVERVIEW

Energy policy goals in Indonesia are:

- To diversify the energy resources used by each end-use sector
- To create a climate that encourages resource exploration and development
- To encourage conservation in the upstream and downstream sector to ensure adequate resources for future generations
- To introduce market economy concepts to energy users
- To take into account the environmental impact of energy utilisation activities

NOTABLE ENERGY DEVELOPMENTS

THE SHIFT FROM CENTRAL TO REGIONAL AUTHORITY

The organisation of government is undergoing a fundamental change in Indonesia. Some decision-making power is being transferred from the central government to regional governments. The Ministry of Energy and Mineral Resources is preparing a new law of energy to take into account this recent decentralization of power. The new law will incorporate a number of existing regulations, namely:

- Law number 22 of 1999 on regional government
- Government Regulation number 25 of 2000 on the authority of regional government
- Law number 25 of 1999 on the balance of authority between the central and regional governments.

POWER SECTOR RESTRUCTURING

Another notable development is the preparation of the new electricity law, which will regulate the restructuring of the electricity industry. The electricity restructuring policy has been developed to meet the challenges posed by the Asian financial crisis and to provide a better foundation for the future development of the electricity sector. The objectives of the restructuring policy are to restore financial viability, competition and transparency to the industry.

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JAPAN

INTRODUCTION

Japan is small geographically, comprising just 377,800 square kilometres, but it is the world's second largest economy after the USA. Japan's real gross domestic product (GDP) in 1999 was US$ 3,103 billion (1995 US$ at PPP). With a population of over 126 million people, per capita income is high at US$ 24,514.

Until the early 1990s Japan had enjoyed a long period of rapid socio-economic development. Since 1992, however, there has seen a major slowdown in economic growth, with GDP growing only 0.2 percent in 1999 and 0.9 percent in 2000 after shrinking 2.5 percent in 1998. The unemployment rate peaked at 4.9 percent in June 2001 as corporations cut costs to increase operational efficiency.

Japan possesses few indigenous energy resources and therefore imports almost all the crude oil, natural gas and other energy sources, including uranium needed to sustain economic activity. In 1999 proven oil reserves were around 9 MCM, gas resources were about 40 BCM and coal was 785 Mt.

Table 15 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	377,800*	Oil (Proven)	9.4 MCM
Population (million)	126.57	Gas	39.6 BCM
GDP Billion US$ (1995 US$ at PPP)	3,102.77	Coal (Recoverable)	785 Mt
GDP per capita (1995 US$ at PPP)	24,514		

Source: Energy Data and Modelling Center, IEEJ. * Ministry of Construction, Japan 1999

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply (TPES) was 505 Mtoe in 1999. By fuel, oil represented the largest share at 51 percent, the coal share was second at 17 percent, followed by nuclear at 16 percent, natural gas at 12 percent, hydro at 2 percent and NRE, including geothermal, wind and others at 1 percent. In 1999, 80 percent of total primary energy was imported. Imports account for almost 100 percent of oil consumption, 98 percent of coal demand and 97 percent of gas use. Total primary energy supply fell slightly in 1999 after decreasing 2.5 percent in 1998, the first decline since 1986.

Japan is the world's second largest oil consumer after the United States, almost all of it imported. The bulk of these imports (84.5 percent in 1999) come from OPEC economies such as the United Arab Emirates (UAE), Saudi Arabia, Kuwait, Qatar and Iran. In 1999 primary oil supply was 258 Mtoe, a decline of 0.8 percent over the previous year.

Coal reserves, at 785 million tonnes, are limited and the small amount of ongoing production is heavily subsidised. Therefore, Japan is the world's largest importer of steam coal for power generation, paper pulp and cement production, and coking coal for steel production. Japan's main steam coal suppliers are Australia, China, the United States, South Africa, Canada and Russia.

Coking coal is imported from Australia, Canada, the United States China, Russia and South Africa. In 1999 primary coal supply was 88 Mtoe or 3.3 percent higher than the previous year.

Japan possesses limited natural gas resources. Indigenous proven reserves stand at 40 BCM, located in Niigata, Chiba and Nagano prefectures. Domestic demand is met almost totally by imports of LNG[13] mostly from Indonesia (37 percent of total import in 1998), Malaysia (21 percent) and Brunei. Natural gas is mainly used for electricity generation (71 percent of total usage in 1999), followed by reticulated city gas (28 percent) and feedstock for petrochemical plants (1 percent). In 1999 domestic supply was 62 Mtoe or an increase of 4.4 percent over the previous year. The addition of gas-fired power generation capacity was responsible for the increase in demand.

Japan generated 1,022 TWh of electricity from 253 GW of installed capacity in 1999. The generation fuel breakdown was: thermal (coal, natural gas and oil) at 60 percent, nuclear at 31 percent, hydro 9 at percent and geothermal, solar and wind comprising the remainder. Due to increased investment in nuclear and more recently, gas-fired capacity, the "oil dependence ratio[14]" in the power sector fell to 52.0 percent, its lowest level since 1963. Total demand for lighting and power in 1999 accounted for 933 TWh, an increase of 2.2 percent over 1998.

Table 16 Energy supply & consumption for 1999

Total Primary Energy Supply	**(ktoe)**	**Total Final Energy Consumption**	**(ktoe)**	**Power Generation**	**(GWh)**
Indigenous Production	101,781	Industry Sector	155,460	Total	1,022,067
Net Imports & Other	402,912	Transport Sector	87,569	Thermal	610,648
TPES	504,693	Other Sectors	110,255	Hydro	88,367
Coal	87,759	TFEC	353,283	Nuclear	317,687
Oil	257,648	Coal	36,483	Others	5,366
Gas	62,309	Oil	211,525		
Others	96,977	Gas	21,220		
		Electricity & Others	84,055		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

After the first oil crisis in 1973, Japan invested heavily in nuclear power. Energy production from nuclear sources increased dramatically from 1973 to 1998,[15] averaging 15.7 percent per year. In 1999 primary nuclear supply accounted for 83 Mtoe or 318 TWh of output, representing 16 percent of the total electricity supply. Two new nuclear units, Kashiwazaki Kariwa #7 in Niigata prefecture and Genkai #4 in Saga prefecture, started operation in July 1997. The utilisation factor for all nuclear units was about 80 percent in 1999.[16] With 51 units in operation, Japan ranks third worldwide in installed nuclear capacity after the United States and France. However, during the past few years, public opposition to nuclear development has increased due to a series of accidents.

[13] In 1998, LNG imports to Japan comprised 58.5 percent of total world LNG trade.

[14] The share of crude oil and oil products in total primary supply.

[15] There was no nuclear capacity expansion in 1999.

[16] It was 84.2 percent in 1998.

FINAL ENERGY CONSUMPTION

In 1999, final energy consumption was 353 Mtoe, slightly lower than the previous year. The industrial sector consumed 44 percent of the total, followed by the residential/commercial sector at 26 percent and the transportation sector at 25 percent. By fuel source, petroleum products accounted for 60 percent of final energy consumption, followed by electricity at 23 percent, coal at 10 percent and city gas at 6 percent.

Final energy consumption in the industrial sector increased by 3.6 percent in 1999. Energy consumption by manufacturing industries, which account for 91 percent of energy consumed in the industrial sector, increased by 4.7 percent in 1999 due to increased economic activity in Japan and in neighbouring Asian economies. Energy consumption by non-manufacturing industries, which accounted for 9 percent of energy consumption in the industrial sector, dropped by 3.5 percent in 1998.

In 1999, the residential/commercial sector electricity accounted for 46 percent of total energy consumed, followed by petroleum products at 37 percent, city gas at 14 percent, solar heat at 1 percent and coal at 1 percent. The energy consumption of the residential/commercial sector grew by 0.7 percent. In the residential sector, energy demand increased by 2.2 percent in 1999 because power demand for air-conditioning increased as a result of the hot summer in east Japan. In the commercial sector, floor space additions translated into a 0.8 percent increase in energy consumption in 1999.

In the transport sector, passengers accounted for 64 percent of energy consumption in 1999 and the freight sector was responsible for 36 percent. By transportation mode, road had the largest share at 81 percent, followed by air at 11 percent, marine at 5 percent and rail at 3 percent. In 1999, energy consumption in the transportation sector fell by 5.6 percent due to the ongoing recession that dampened demand for transportation services.

POLICY OVERVIEW

The Ministry of Economy Trade and Industry (METI)[17] is responsible for formulating energy policy. Within METI, the Agency of Natural Resources and Energy (ANRE) is responsible for rational development of mineral resources, securing a stable supply of energy, promoting efficient energy use and regulating electric power and other energy industries. Other government departments involved in the energy sector include the Science and Technology Agency, responsible for nuclear safety, and research and development, and the Ministry of Foreign Affairs responsible for formulating international policy.

The principle goal of Japanese energy policy aims at achieving the 3Es, namely energy security, economic growth and environmental protection. The 3Es are to be accomplished simultaneously, using a balanced approach and if necessary, with trade-offs between the objectives. Securing stable energy supply sources, using energy efficiently, introducing new and renewable energy sources and further strengthening nuclear utilisation will be important in achieving the 3Es.

Some of the energy issues currently facing Japan include securing stable energy supplies to satisfy growing energy demand in the residential/commercial and transportation sectors where there exists a low rate of energy self-sufficiency. Secondly, at the Kyoto Protocol negotiated at COP3, Japan committed to reducing its greenhouse gas (GHG) emissions to 6 percent below 1990 levels by the period 2008 to 2012. Thirdly, Japanese industry, including the energy sector, is currently restructuring to improve its economic efficiency and therefore increase its domestic as well as international competitiveness.

[17] Formerly it was called the Ministry of International Trade and Industry (MITI).

OIL

Given the importance of oil in Japan's energy mix and its substantial dependence on imported oil from the Middle East, the Japanese government has taken measures to secure adequate energy supplies including developing an integrated domestic oil industry with upstream and downstream sectors. The following are the specific measures that the Japanese government has undertaken:

Promotion of Oil Exploration and Production: Japan has promoted oil exploration both at home and abroad. The oil industry actively participates in projects abroad with the financial and technical assistance of the government-funded Japan National Oil Corporation (JNOC).

Possession of Stockpiles: Private oil companies are subject to the Petroleum Stockpiling Law, which requires them to stockpile[18] oil in case of emergencies and unexpected oil supply disruptions. The government also holds stockpiles through JNOC.

Strengthening Relations with Oil Producing Economies: Japan has promoted mutual understanding with oil producing economies and technological cooperation through various joint projects managed by the Petroleum Energy Centre, Japan Cooperation Centre petroleum and other organisations. These projects include training programmes, information exchanges and joint research projects.

The Provisional Measures Law on the Importation of Specific Petroleum Refined Products (PLISPP) expired in March 1996 and was not renewed. The PLISPP designated specific refining facilities as the approved importers of specified oil products such as gasoline, kerosene, and diesel, and made them responsible for securing stable supplies. This task is now open to anyone so long as stockpiling requirements and quality standards are met. There have also been recent changes to the pricing system for petroleum products. These changes have encouraged trading firms such as the National Federation of Agricultural Cooperative Associations and major dealers to import petroleum products directly. Fierce competition in the oil market has led to mergers and reorganisation among the incumbent firms.

NATURAL GAS

Since 1969 when Japan began importing LNG from Alaska, natural gas consumption has grown rapidly. Natural gas accounted for 12 percent of total primary energy in 1999. Natural gas use is expected to play an important role in mitigating greenhouse gas emissions as well as improving air quality. In anticipation of further natural gas utilisation, the Japanese government has tried to accelerate the development of natural gas resources. To secure a stable supply of natural gas, the Japan National Oil Corporation Law was revised in June 1994 to allow JNOC to provide capital and loan guarantees to Japanese companies developing gas fields or involved in liquefaction of natural gas.

In 1995, the Gas Utilities Industry Law was amended for large industrial customers with contracted amounts of more than 2 million m^3 per year. These customers were given the right to negotiate prices directly with suppliers. This revision was meant to procure further benefits for consumers and to strengthen the competitiveness of utilities. The amendments were: 1) Gas utilities can compete outside their service areas, 2) Non-city gas suppliers are allowed to supply to large industrial customers, 3) Gas tariffs shall be free of regulation in principle. The gas law was amended again in 1999 to extend competition to contracted amounts of more than 1 million m^3 per year and to waive the requirement for METI approval of gas tariff decreases. These changes were intended to minimise government involvement in the gas market and procure lower prices for consumers.

ELECTRICITY

In 1995, the Electricity Utilities Industry Law, the main legislation covering the electricity industry, was amended. The changes were meant to address global energy sector reform,

[18] Level of private oil stockpiles accounts for 70 days of annual domestic consumption.

comparatively high electricity tariffs in Japan and deteriorating load factors. The amendments permitted the entry of independent power producers (IPPs) into the Japanese electricity market. The 10 major electric utilities, each of which holds a regional monopoly, were given the right to accept tenders for IPP investment in generation to cover short-term thermal power requirements.

In 1999, the Electric Utilities Industry Law was amended again to allow the partial liberalisation of retail sales starting in March 2000. Eligible customers, either high voltage users (20kV) or users with contracted demand over 2,000 kW, can now freely contract with power suppliers, including IPPs.

NUCLEAR ENERGY

According to a declaration on reducing oil dependence issued by the Japanese government in September 1998, nuclear will play a significant role in energy supply because of its reliability, economic viability and low CO_2 emissions. The Japanese electricity supply and demand plan developed in 1998 projected nuclear expanding to 4,780 TWh, with an additional 16 to 20 units by 2010. To promote this strategy, the Japanese government is engaged in promoting a better public understanding of nuclear power, establishing a nuclear fuel cycle, ensuring the safety of plants and improving plant capability and reliability.

To ensure the effective use of uranium resources and proper radioactive waste management, Japan has established nuclear fuel cycle facilities as part of its nuclear energy programme. There are three nuclear fuel cycle facilities in operation as well as one under construction in Rokkasho Mura, Aomori prefecture. Research and development of the Fast Breeder Reactor (FBR), a technology that consumes less uranium than conventional reactors, is currently taking place.

Public opposition to nuclear development is growing due to recent nuclear incidents. One such event took place on September 30 1999 at the JCO uranium processing plant in Tokaimura, Ibaragi prefecture, when radiation levels rose to critical in part of the plant. This accident highlighted the need to strengthen emergency counter measures and to clarify the responsibilities of nuclear power operators in the area of disaster prevention. The special Law for Nuclear Disaster Measures was recently passed to address concerns raised by the incident.

ENVIRONMENT

In recognition of its commitments under the Kyoto Protocol to reduce GHG emissions 6 percent below the 1990 level, Japan established the Outline for Promotion of Efforts to Prevent Global Warming in June 1998. In October 1998, Japan passed the Law for Promotion of Efforts to Prevent Global Warming.

The Advisory Committee for Energy's Energy Supply and Demand Subcommittee produced a Long-Term Energy Supply and Demand Outlook in June 1998. The outlook projected that energy consumption in 2010 would remain almost unchanged compared with 1996 levels through the use of the following measures: (1) Keidanren's voluntary action plan, (2) equipment energy efficiency improvements through the "top-runner" programme under the Revised Law Concerning the Rational Use of Energy, and (3) influencing consumer behaviour through greater emphasis on energy conservation. Promotion of nuclear power is included in the policy as a measure to mitigate GHG emissions.

NOTABLE ENERGY DEVELOPMENTS

REGULATORY REFORM

Major structural reforms were implemented in 1999 in the oil, gas and electricity sectors to increase competition in domestic energy markets. In 2002, the current laws will be reviewed and if deemed prudent, additional measures may be implemented.

REVISIONS TO LONGTERM ENERGY SUPPLY AND DEMAND OUTLOOK

Under the 1997 Kyoto Protocol, Japan agreed to reduce its GHG emissions to 6 percent below 1990 levels by the first commitment period (2008 to 2012). In June 1998, the Advisory Committee for Energy released the "Long term Energy Supply and Demand Outlook" outlining how Japan would achieve these cuts. However, by 1999, due to changing circumstances, it was argued that some of the measures specified in the report were unrealistic and that revisions to the Outlook were necessary.

In June 2001, the Japanese government released the revised version of its "Long term Energy Supply and Demand Outlook". A key change was the scaling back of its nuclear power development plan. To meet the Kyoto targets, the previous Outlook required the construction of 20 more nuclear units. However, due to mounting public opposition following a nuclear accident in 1999, this policy target was lowered to 10 – 13 new units. According to the revised Outlook, more natural gas and coal-fired capacity, 50 percent each, will compensate for less nuclear generation. Implementing this measure is expected to result in 20 million tonnes more GHG emissions than in the previous report.

The revised Outlook also takes the view that industry will use more coal, which is cheaper than other energy sources, to improve cost competitiveness. Therefore, the revised Outlook emphasises the importance of natural gas utilisation and enhancement of new and renewable energy sources to curb GHG emissions.

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KOREA

INTRODUCTION

Korea is located in east Asia on the southern half of the Korean peninsula. It has an area of about 99,000 square kilometres and a population of around 47 million (1999). Approximately 25 percent of the population lives in Korea's largest city, the capital, Seoul.

For the last few decades, Korea has been one of Asia's fastest growing and most dynamic economies. In 1999, real GDP per capita was US$ 15,293, three times higher than its 1980 level. Its major industries include electronics, automobiles and chemicals. Korea was severely affected by the Asian financial crisis in 1997. From 1990 to 1997, average GDP growth was 7.0 percent per year, in 1998 real GDP fell –6.7 percent. Recovery came quickly and in 1999 real GDP was US$ 716 billion (1995 US$ at PPP), an increase of 10.7 percent over the previous year.

Korea has very few indigenous energy resources. It is completely without oil resources, coal reserves in 1999 were 646 Mt (anthracite), there is small amount of hydro potential and recently a small gas field was discovered offshore. To sustain its high level of economic growth, Korea imports large quantities of energy products. In 1999, Korea was the fourth largest importer of crude oil and the second largest importer of liquefied natural gas in the world.

Table 17 Key data and economic profile (1999)

Key data		Energy reserves**	
Area (sq. km)	99,408*	Oil (Proven)	-
Population (million)	46.86	Gas (Recoverable)	5.66 MCM*
GDP Billion US$ (1995 US$ at PPP)	716.62	Coal (Recoverable)	646 Mt
GDP per capita (1995 US$ at PPP)	15,293		

Source: Energy Data and Modelling Center, IEEJ. * Heat content is 10,200kcal/m^3.

** Korea National Statistical Office, website, http://www.nso.go.kr

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply in 1999 was 175 Mtoe. Oil dominated primary supply comprising 55 percent of the total, followed by coal at 20 percent, nuclear at 15 percent, gas at 9 percent with hydro and other fuels making up the remaining 1 percent. Korea imported around 82 percent of its total energy needs in 1999, including 100 percent of oil and gas requirements and 95 percent of coal consumed in the economy.

The Asian financial crisis had a notable impact on energy consumption in Korea. Primary energy supply in the early 1990s increased by over 10 percent per year and up to 1997, just below 10 percent. Consumption dropped by 7.6 percent in 1998 due to the financial crisis and the following economic downturn. However, it picked up again and recorded a 10.2 percent growth in 1999.

Korea has been importing liquefied natural gas (LNG) since 1986. Imports are managed by the state-owned monopoly LNG importer Korea Gas Corporation (Kogas). Korea buys the bulk of its LNG from Indonesia and Malaysia. In Korea, a small quantity of natural gas was recently discovered in the Dolphin 6-1 mining area offshore Ulsan in the southeast. The gas field, with 5.66

MCM of recoverable reserves, has been officially named Donghae-1 field and is expected to begin commercial operation in June 2003.

Until recently, the Korea Electric Power Corporation (KEPCO), a state-owned company, had a monopoly in electricity generation in Korea. The government has announced plans to break up and privatise the utility. In 2000, it began the process by splitting the generation assets of KEPCO into 6 separate subsidiaries. The privatisation plan, however, has been controversial. Unions fear job losses and some politicians are concerned about foreign ownership.

At the end of 1999, KEPCO had a total power generation capacity of 47 GW. Electricity production in 1999 was 239 TWh. Thermal fuels accounted for 54 percent of production, followed by nuclear at 43 percent and hydro at 3 percent. There are currently 16 nuclear power plants in Korea. Two new power stations are under construction and have expected completion dates of 2004 and 2005.

Table 18 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	30,981	Industry Sector	70,206	Total	239,325
Net Imports & Others	143,687	Transport Sector	27,201	Thermal	130,194
TPES	174,668	Other Sectors	39,058	Hydro	6,067
Coal	34,291	TFEC	136,465	Nuclear	103,064
Oil	96,026	Coal	17,574	Others	-
Gas	15,165	Oil	88,202		
Others	29,187	Gas	9,461		
		Electricity & Others	21,228		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

Final energy consumption also grew at a rapid rate in the 1990s, around 7 percent annually - except for the negative growth of -6.0 percent in 1998 reaching 136 Mtoe in 1999. In particular, the transport sector and the residential, commercial and public sector recorded sharp decreases in 1998 at -18.4 percent and -17.0 percent, respectively. However, the industrial sector, the largest final energy consumer, showed a 5.1 percent increase in the same year. Final energy consumption came back on track showing 9.6 percent growth in 1999. By and large, the growth trend in the industrial sector has become weaker since the early 1990s, while the pace of demand growth in the residential, commercial and public sector has increased.

In 1999, industrial was responsible for 51 percent of consumption followed by 24 percent in residential/commercial and 20 percent in transportation. At the end-use level petroleum products were by far the most important energy source accounting for 65 percent of demand. Electricity was responsible for 14 percent, coal for 13 percent and gas for 7 percent. Due to strong policy measures, gas consumption has increased particularly in the residential/commercial sector, from a small amount in 1990 to 7 percent of final energy consumption in 1999.

POLICY OVERVIEW

The Ministry of Energy and Resources (MOER) was created in January 1978 (Presidential Decree 8793, December 16, 1977) after the first oil shock. The current Energy and Resources

Policy Office within the Ministry of Commerce, Industry and Energy plays a role similar to its predecessor MOER. Its responsibilities include administration and policy-making for oil, gas, electricity, nuclear energy and coal, administration of short- to long-term energy demand and supply and oversight of energy price, administration of the competitiveness of the energy industry and restructuring, international cooperation on energy-related matters and the like.

Sustaining high levels of economic growth despite inadequate indigenous energy resources has been and continues to be the key driver of Korea's energy policy platform. The Korean government projects that to 2020 GDP will grow from 437 trillion won in 1999 (at a constant 1995 price) to 1,198 trillion won in 2020 or almost triple. In tandem, total energy demand is projected to increase 3.9 percent per annum between 1999 and 2010 and 2.0 percent between 2010 and 2020.

In addition to finding energy supplies to satisfy rapid demand growth, Korea is very concerned about environmental degradation, the rapid integration of world energy markets, and increasing regional energy cooperation - especially in northeast Asia. To address these challenges, the following major energy policy goals have been developed:

- Secure more stable energy supplies
- Establish a total energy demand management system
- Enhance efficiency in energy industries and markets
- Construct an energy system linked to the continent through northeast Asian energy cooperation

OIL

Due to Korea's complete dependence on oil imports, the government has tried to secure and diversify current supplies in the short and long term. To smooth short-term supply disruptions and to meet its obligations to the International Energy Agency (Korea became a member in 2001), the Korean government plans to increase its strategic oil stocks from 29 days of net imports in 2000 (58 million barrels) to 33 days (65.6 million barrels) in 2001, and to 60 days by 2006.

In the longer term, to increase energy security the Korea National Oil Corporation (KNOC) has been investing in exploration and development projects off the Korean peninsula as well as in international petroleum joint reserve projects (JSP). To date, KNOC has equity stakes in 19 overseas exploration and production projects in 12 different economies including Russia, Australia and Indonesia. To encourage private companies to invest in the development of overseas mineral resources, the Korean government has expanded its policy of supplying long-term low-interest loans through the Special Account of Energy and Resources. Korea is also an active partner with respect to Northeast Asian energy cooperation, an idea that combines the interests of both energy-consuming and energy-producing economies in the region. It has been proposed to establish an intergovernmental working group and to have the first meeting in November 2001.

NATURAL GAS AND COAL

To reduce its dependence on imported oil the Korean government has undertaken a number of measures to diversify fuel consumption. The introduction of natural gas-based city gas to the residential sector in the 1980s was promoted in order to expand the use of natural gas. Also, in order to secure a mass production system for anthracite, the only indigenous energy source, a supporting system for the coal mining industry was improved, and modernisation of mining equipment and integration of small-scale mines into large ones was promoted.

Ensuring a stabilised supply base through timely establishment of energy supply facilities is one of the important policy measures to achieve energy security goals. This includes increasing LNG storage capacity to 1,070 thousand metric tonnes in 2001 from 940 thousand metric tonnes in 2000. A success story with respect to KNOC's domestic exploration efforts was the discovery of a commercially viable gas reserve (Donghae-1 field) on the continental shelf offshore Ulsan in the south-eastern part of Korea. This field is expected to begin commercial production in 2003.

ELECTRICITY

In order to rectify an energy supply and demand structure that was overly dependent on oil, construction of oil-fired power plants was strictly controlled and development of non-oil power sources such as nuclear, coal and gas was promoted. Korea has been building nuclear reactors since the 1970s and today nuclear accounts for more than 40 percent of electricity production. Gas-fired power plants were introduced in 1986 and now account for more electricity production than oil fuelled plants.

ENERGY MARKET RESTRUCTURING

The Korean government believes that it is necessary to establish an electric power market where electricity is traded as a commodity. To this end, a programme of unbundling and privatisation for the Korea Electric Power Corporation (KEPCO) has been developed. Part of the plan has been implemented, including the establishment of the Korea Power Exchange and the Korea Power Commission in April 2001. Generating companies except for hydro and nuclear stations will be privatised step by step from 2002. Following restructuring of the electric power market, the Korean government will undertake the public interest functions of KEPCO by establishing the Electric Power Industry Foundation Fund. Along with electricity market restructuring, the Korean government developed the Basic Plan for Natural Gas Industry Restructuring in November 1999. The plan outlines a scheme to separate and sell off the import and wholesale gas business in 2002. After being reviewed by the Board of Audit and Inspection of Korea, the plan was amended to comply with the Board's recommendations (released in August 2001).

Other privatisation plans include: the sell-off of government shareholdings in the Daehan Oil Pipeline Corporation to domestic refineries in November 2000; and the floating of the government's 36 percent shareholding in the Korea District Heating Corporation to the Korea Securities Exchange by August 2001 and sell-off of the remaining shares by the end of 2001.

ENERGY EFFICIENCY PROGRAMMES

Given Korea's vulnerability to supply disruptions, the government has promoted demand management, energy conservation and enhanced efficiency at the consumption stage. In the industrial sector, in order to minimise energy losses, to rationalise energy consumption, and to achieve an energy-saving industry structure, the Korean government enforced stringent administrative regulations in combination with financial and tax incentives. Adding to this, wider use of energy-saving equipment was encouraged and a national energy conservation campaign strengthened through public education and provision of information on energy conservation. District heating and cogeneration for industrial parks, factories and large buildings were also encouraged.

Supportive measures for energy saving were developed with regard to mobilising funds and constructing railroads and harbour facilities, while more R&D on and introduction of advanced energy saving technology was supported. Also, more efficient energy price structures were continuously developed and implemented to facilitate efficient use of energy and development of indigenous energy resources. Aided by these policies, the GDP elasticity of energy consumption has been lowered to 0.85 in 1999 and to 0.70 in 2000 from 1.21 in 1998 and 1.41 for the period 1990 to 1997. To further promote energy conservation, the Korean government intends to develop voluntary agreements with large energy-consuming enterprises. The government hopes to increase these from 67 in 1999 to 567 by 2003.

Korea has recently launched several conservation programmes aimed at the residential and commercial sectors. At present there are three major energy efficiency programmes in operation: (1) the Energy Efficiency Standards and Labelling Programme which began in 1992 and targets some household appliances, lighting and automobiles; (2) the Certification of High Efficiency Energy-Using Appliance Programme implemented in December 1996; and (3) the Energy-Saving Office Equipment and Home Electronics Programme which began in April 1999. The objective of

these programmes is to encourage manufacturers to improve the energy efficiency of their products by giving incentives and to induce consumers to purchase more energy efficient products available in the market place.

NOTABLE ENERGY DEVELOPMENTS

KOREA JOINS IEA

The Board of Directors of the International Energy Agency (IEA) decided to award Korea membership on April 20, 2001 and announced the decision during the meeting of the Governing Board at Ministerial Level on May 16, 2001. Korea will be the 26th member economy of the IEA when the Korean National Assembly ratifies the agreement and the ratification is submitted to the IEA. The Korean government announced its willingness to continue with its efforts to cooperate with other member economies toward the shared goals of the IEA through holding oil stockpiles, reduction of greenhouse gas emissions, and restructuring of the electricity industry. The government also stated that it would actively participate in the cooperative activities of the IEA, such as research, development and deployment of renewable energy technologies. Korea anticipates that its IEA membership will bring great changes to its energy sector, for example, developing 90 days supply of oil stocks, coordinated utilisation of oil stocks, and implementation of IEA energy policies in the domestic market. However, it also believes that it will be able to enjoy substantial benefits such as a higher degree of energy security, more influence in the world energy market, and more efficient and flexible energy policies.

LAUNCH OF KOREA POWER EXCHANGE AND KOREA ELECTRICITY COMMISSION

April 2, 2001 was the first day when electricity was traded in the Korea Power Exchange. The six newly created generating companies had offered tenders for hourly electricity supply for April 2 by 10:00 on April 1. The Korea Power Exchange announced that marginal prices at the points of demand and supply balance were 13.39 won/kWh at 04:00 (the lowest price at a minimum demand of 23,490 MW) and 85.99 won/kWh at 23:00 (the highest price at a maximum demand level of 35,660 MW).

In parallel with the opening of the power exchange, the first session of the Korea Electricity Commission was convened on May 7. In the session, the commissioners discussed the operational code of the Commission, rules for arbitration, and regulations covering announcement of Commission orders to market participants. The separation of KEPCO's generation arm and electricity market operational rules were also discussed. Although it is in its infancy, the Commission is expected to play a substantial role in making the Korean electricity industry and market more competitive and transparent, resulting in more efficient supply and consumption of electricity.

PRICE RATIONALISATION

The government is encouraging energy conservation by rationalising energy prices. The Korean government is implementing a phase-in plan for oil product price adjustment for the period July 2001 to 2006 and has announced rationalisation plans for other energy prices.

Another policy measure to achieve a more efficient energy market is liberalisation of the price of LPG, effective January 2001. To achieve a soft-landing, refiners and oil importers are obliged to report any price change two days prior to its effective date during the first six-month period of implementation of the policy. The policy is expected to break down the long-existing walls between the businesses of refining, importing, bottling, and sale of LPG, and, as a result, to let market participants exploit economies of scale and scope.

A two-part retail tariff has been introduced for residential gas in the metropolitan Seoul area effective 1 March 2001. Under the previous regime, a customer who consumed no gas faced a 4 m^3 minimum bill. Upon consultation with the Korea Energy Economics Institute, the city government

of Seoul determined the base charge at 810 won/m^3 and commodity charge 444.85 won/m^3. As a result, a customer who does not consume gas can save about 950 won per month. Observers see this as a step toward a more efficient price structure and other local governments may follow the Seoul example.

INCENTIVES FOR CNG BUSES

The Korean government announced its plan in September 2000 to promote the substitution of diesel-powered buses with CNG (compressed natural gas). There are currently 119 buses using CNG, including 69 in Seoul as of March 2001. 944 additional buses will switch to natural gas in the near future. The plan states that 20,000 diesel buses in major cities will switch to CNG by 2007. In particular, by 2002, 5,000 CNG buses will be in service in Seoul and other cities where the 17th FIFA World Cup games will be played.

A series of fiscal and price policies will be mobilised at both central and local government levels to provide public transportation bus companies with incentives including lower gas prices at 409 won/m^3 from the current 509 won/m^3 level and tax incentives such as exemption of value added tax and acquisition tax for the purchase of CNG buses. City gas companies responsible for construction and operation of CNG supply facilities will receive long-term low-interest loans. Economic incentives and certain legal obligations will be combined from 2003 on to deploy more CNG buses nationwide.

CREATION OF DEMONSTRATION SITE FOR NEW AND RENEWABLE TECHNOLOGIES

The Ministry of Commerce, Industry and Energy is planning to promote a programme for evaluating practical uses of new and renewable energy technologies. Once established, the programme is expected to systemise and facilitate the whole process of development and deployment of technology by helping create a market and stimulate penetration of new and renewable energy products through enhanced reliability, resulting from performance tests and research of individual technologies. The programme will be located in *Green Villages* that will be supported by the central government as well as local governments. A Green Village will be established as a self-sufficient community supplied with only new and renewable forms of energy. Testing sites for solar and wind energy will be established during 2001 as a first step to test products and improve reliability and commercial viability.

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MALAYSIA

INTRODUCTION

Malaysia is located in southeast Asia. Its 329,750 square kilometres of territory consist of Peninsular Malaysia and the Sabah and Sarawak states on the island of Borneo. Malaysia has population of around 23 million people.

The Asian financial crisis in 1997 severely affected the Malaysia economy. From 1990 to 1997 GDP grew an average 9.2 percent year. In 1998, it fell sharply by –7.4 percent. In 1999, buoyed by strong oil exports, GDP recovered, growing by 5.8 percent and reaching US$ 179 billion (1995 US$ at PPP).

Malaysia is well endowed with conventional energy resources such as oil, gas and coal, as well as renewables such as hydro, biomass and solar energy. As of January 1999, total energy reserves stood at 572 million cubic metres (MCM), 2,430 billion cubic metres (BCM) of gas, 1,025 million tonnes (Mt) of coal and more than 29,000 MW capacity of hydropower. Malaysia is a net energy exporter, with 5.8 percent of its export earnings in 1999 coming from mineral fuels and petroleum products.

Table 19 Key data and economic profile (1999)

Key data		Energy reserves**	
Area (sq. km)	329,750*	Oil (Proven)	572 MCM
Population (million)	22.71	Gas (Proven)	2,430 BCM
GDP Billion US$ (1995 US$ at PPP)	178.76	Coal (Recoverable)	1,025 Mt
GDP per capita (1995 US$ at PPP)	7,871		

Source: Energy Data and Modelling Center, IEEJ *Statistics Department Malaysia 1999. ** Malaysia's Energy Balance Table 1999 (Qtr. 1 & 2).

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary supply in 1999 was 51,070 ktoe. Of this total, gas accounted for 59 percent of supply followed by oil at 37 percent, coal at 3 percent and hydro at 1 percent. Most of the coal used in Malaysia was imported. Net energy exports of oil and natural gas made up 37 percent of total indigenous energy production.

Malaysia produced 32,835 ktoe of crude oil in 1999. Almost 87 percent of production was exported to markets in Japan, Thailand, Korea, and Singapore. Most of Malaysia's oil fields are located offshore near Peninsular Malaysia. The Tapis field is the source of more than half of Malaysian production. To combat declining domestic reserves, PETRONAS, the state oil and gas company, is investing in exploration and production projects outside of Malaysia.

Gas production in Malaysia reached 47,746 ktoe in 1999, tripling since 1990. 37 percent of this gas was exported, usually in the form of liquefied natural gas (LNG), to Japan, Korea and Chinese Taipei. Gas is used domestically for electricity generation and as a feedstock in the petrochemicals industry.

In 1999, total electricity generation was 65,221 GWh. Thermal fuels, mostly natural gas, accounted for 89 percent of production and hydro for the remaining 11 percent.

Table 20 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	81,402	Industry Sector	10,239	Total	65,221
Net Imports & Other	-30,332	Transport Sector	11,393	Thermal	57,698
TPES	51,070	Other Sectors	5,108	Hydro	7,523
Coal	1,376	TFEC	26,740	Nuclear	-
Oil	18,895	Coal	608	Others	-
Gas	30,152	Oil	18,203		
Others	647	Gas	3,114		
		Electricity & Others	4,815		

Source: Energy Data and Modelling Center, IEEJ.
For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

In 1999, total final energy consumption in Malaysia was 27 Mtoe. The transport sector consumed 43 percent of the total, followed by the industrial sector at 38 percent and other sectors (agriculture, residential/commercial and non-energy) at 19 percent. By fuel source, petroleum products contribute the largest share with 68 percent of consumption followed by electricity (18 percent), gas (11 percent) and coal and coke (2 percent).

POLICY OVERVIEW

The Prime Minister's Department, the Ministry of Energy, Communications and Multimedia and the Department of Electricity and Gas Supply are responsible for formulating Malaysia's Energy Policy and for regulating the quality of energy service. Moreover, the Ministry of International Trade and Industry (MITI) and the Ministry of Domestic Trade and Consumers Affairs (MDTCA) are vested with powers to regulate downstream petroleum activities.

Malaysia's energy policies took shape during the early 1970s after the 1973 world oil crisis. The cornerstones of Malaysian petroleum policy were fleshed out in the Petroleum Development Act (PDA) of 1974 and the National Petroleum Policy of 1975. This legislation aimed to regulate the oil and gas industry to achieve economic development needs. It outlined the following policy goals:

- Making sure adequate energy supplies at reasonable prices are available to support national economic development objectives;
- Promoting greater Malaysian ownership and providing a favourable investment climate, including creating opportunities for downstream industries; and
- Developing oil and gas resources at a socially and economically optimal pace, while conserving these non-renewable assets and protecting the environment.

With the creation of PETRONAS through the PDA, the oil and gas sector was streamlined to ensure greater Malaysian participation in the ownership, management and control of oil and gas resources and activities. This was made possible through the introduction of a system of production-sharing contracts (PSC), replacing the system of concessions.

In terms of institutional arrangements, PETRONAS, established under the PDA as a state-owned enterprise, has exclusive ownership, exploration and production rights. It comes under the

direct purview of the Prime Minister and is responsible for planning, investment and regulation of all up-stream activities. As mentioned earlier, the Ministry of International Trade and Industry (MITI), as well as the Ministry of Domestic Trade and Consumer Affairs (MDTCA), through the Petroleum Regulations of 1974 (amended in 1975 and 1981), are vested with powers to regulate all downstream activities. MITI is responsible for the issue of licences for the processing and refining of petroleum and the manufacture of petrochemical products, whilst MDTCA issues licences for the marketing and distribution of petroleum products.

NATIONAL ENERGY POLICY OBJECTIVES

In 1979, Malaysia's energy policy principles were broadly defined in terms of three policy objectives. These policy objectives are instrumental in guiding the formulation of five-year development plans. These are:

- **The Supply Objective:** To ensure the provision of adequate, secure and cost-effective energy supplies through developing indigenous energy resources, both non-renewable and renewable, using least-cost options, and diversifying supply sources both within and outside the economy;
- **The Utilisation Objective:** To promote the efficient utilisation of energy and the elimination of wasteful and non-productive patterns of energy consumption; and
- **The Environment Objective:** To minimise the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment.

THE SUPPLY OBJECTIVE

In pursuing the Supply Objective, Malaysia has implemented polices to extend the life of non-renewable energy resources such as oil and gas and to reduce dependence on oil by encouraging the use of other energy forms.

The National Depletion Policy of 1980 was developed to preserve declining oil reserves. The policy, aimed at major oil fields of over 400 million barrels of oil initially in place (OIIP), restricted production to 1.75 percent of OIIP. However, the initial restriction proved too conservative and in 1985, the ceiling was raised to 3 percent. Due to this policy, total production of crude oil is currently limited to about 650,000 barrels per day. At the current production rate, proven oil reserves are expected to last another 10 years. The National Depletion Policy was later extended from crude oil to include natural gas reserves. An upper limit of 56.6 MCM per day (2,000 million standard cubic feet per day) has been imposed in Peninsular Malaysia. At the current rate of production, known natural gas reserves are expected to last for about 60 years.

In 1981, to complement the national depletion policy and ensure the reliability of supply, the government adopted the Four-Fuel Strategy. The goal of the plan is to achieve a balanced energy supply mix of oil, gas, hydropower and coal. This strategy was designed to reduce the economy's dependence on oil. As much as possible, development of domestic resources is encouraged to enhance security of supply. Under this initiative, oil share has fallen significantly. Consumers have substituted away from oil towards natural gas which is available domestically and is "environmentally-friendly" compared to other fossil fuels. In June 1999, the Prime Minister announced that the Four-Fuel Strategy would be revised to become a Five Fuel-Strategy. Recognising the potential for renewable energy resources and emphasising its commitment to promote renewables and preserve the environment, Malaysia adopted renewables as its "fifth fuel."

THE UTILISATION OBJECTIVE

There have been limited initiatives to pursue the utilisation objective. Demand side management initiatives by the utilities, particularly through tariff incentives, have encouraged more efficient use of energy. Most energy efficiency initiatives are aimed at large energy consumers such as industry. The Malaysian Industrial Energy Efficiency Improvement Programme launched in July 1999 is a collaborative effort between the government of Malaysia and the UNDP/Global

Environmental Facility (GEF). This 4-year project aims to remove energy efficiency barriers, encourage rational use and improve energy efficiency in Malaysian industries. Other industrial energy efficiency initiatives currently being planned include an energy auditing programme, an energy service companies support programme and a technology demonstration programme.

In 1998 the Malaysia Energy Centre (MEC) was established as an independent non-profit entity to formulate, coordinate and manage energy-related research and development programmes and promote the development of indigenous technologies. Officially launched by the Prime Minister during the World Renewable Energy Congress in June 1999, in Kuala Lumpur, one important role of MEC is to promote renewable energy and energy efficiency programmes in Malaysia and to formulate innovative financing mechanisms to make these projects commercially viable.

THE ENVIRONMENT OBJECTIVE

The environment objective too, is supported by few policy initiatives. However, all major energy development projects are subjected to a mandatory environmental impact assessment (EIA) requirement. Recently, Malaysia was evaluated to be the third cleanest economy in Asia behind Japan and Singapore.

NOTABLE ENERGY DEVELOPMENTS

ESTABLISHMENT OF THE ENERGY COMMISSION

The Energy Commission was established in May 2001, but is not yet fully operational. Once a number of related laws are approved by Parliament, the Energy Commission will take on the responsibilities of the existing Department of Electricity and Gas Supply (DEGS). The Commission's role is to regulate the electricity and gas supply industries as well as to enforce energy supply laws and safeguard public health and safety standards. It will also advise the Minister on national policy for energy supply activities. Promoting renewable energy use and energy efficient technologies is also a responsibility of the Energy Commission.

NEW INCENTIVES FOR ENERGY EFFICIENCY & RENEWABLE ENERGY PROMOTION

In the 2001 Budget, the Malaysian government announced financial measures to encourage renewable energy use and energy efficiency improvements by energy conservation and biomass-based generating companies, energy service companies and firms that voluntarily implement energy conservation measures. The incentives include income tax exemptions, investment tax allowances, reductions in import duty and sales taxes, and accelerated capital depreciation allowances for three to five years.

ROBUST ENERGY PLAN AND TARGET IN THE EIGHT MALAYSIA PLAN (2001 – 2005)

Under the Eight Malaysia Plan, Malaysia will make a concerted effort to ensure the sustainable development of energy resources, both depletable and renewable, in meeting the energy needs of the economy. Efforts will be intensified to ensure adequacy, quality and security of energy supply; to encourage greater use of natural gas and renewable energy; as well as to provide adequate electricity generation capacity. In addition, the government will support the development of industries that produce energy-related products and services for both the domestic and export markets.

Goals for this five-year period include the following:

- Overall energy demand annual growth rate (AAGR) of 7.8 percent of from 27,837 ktoe (1,167 PJ) in 2000 to 40,600 ktoe (1,700 PJ) in 2005;
- Per capita energy consumption growth of 5.8 percent annually from 1.20 toe (50.1 GJ) in 2000 to 1.59 toe (66.4 GJ) in 2005.

- Electricity demand growth of 9.3 percent per annum, thus raising its share of the total energy demand to 18.8 percent in 2005;

In electricity generation, an additional 8,800 MW of generation capacity will be commissioned during the Plan period, most of which will be installed by the independent power producers (IPPs) in Peninsular Malaysia. Development of the 2,400 MW Bakun hydroelectric project will also continue during the Plan, with the electricity to be consumed in east Malaysia. To supplement energy supplies from conventional sources, efforts to use renewable energy (biomass, biogas, municipal waste, solar and mini-hydro), the fifth fuel, will be intensified.

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MEXICO

INTRODUCTION

Mexico is located in North America, bordering the US to the north and Belize and Guatemala to the south. Mexico is one of the most populous economies in Latin America, with a total population about 97 million people in 1999. Due to industrialisation and urbanisation in recent years, around 75 percent of the population lives in urban areas. Mexico City has the largest urban concentration of people in the world, with around 18 million people within the city limits.

In the last twenty years, the economy has suffered three economic downturns - in 1982, 1988 and in 1995. As a result, and due to the declining value of the Peso, real average GDP growth rate at purchasing power parity was just 1.7 percent from 1980 to 1995. With continuing economic and political reform, the Mexican economy has recovered rapidly in the last few years. The average growth rate was 5.5 percent between 1996 and 2000.

Mexico is a major non-OPEC oil producer. The oil industry plays a crucial role in the economy, accounting for about one third of government revenues. Mexico also has abundant natural gas resources, with several projects under development. In 1999 total oil reserves were 3,927 MCM, gas holdings were 819 BCM and coal resources were 1,211 Mt.

Table 21 Key data and economic profile (1999)

Key data		Energy reserves	
Area (sq. km)	1,964,375*	Oil (Proven)	3,927 MCM**
Population (million)	96.59	Gas	819 BCM**
GDP Billion US$ (1995 US$ at PPP)	803.00	Coal (Recoverable)	1,211 Mt***
GDP per capita (1995 US$ at PPP)	8,314		

Sources: Energy Data and Modelling Center, IEEJ

* INEGI, Acerca de México, Aspectos Geográficos. http://www.inegi.gob.mx

** Pemex, Anuario Estadístico 2000. http://www.pemex.gob.mx

*** Handbook of Energy & Economic Statistics in Japan 2001, EDMC

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply in Mexico was 149 Mtoe in 1999. Oil (56 percent) and gas (27 percent) dominate primary energy supply with a combined share of 83 percent. The remaining fuel sources are coal (5 percent), geothermal (3 percent), hydro (2 percent), nuclear (2 percent) and other fuels (5 percent).

OIL

Mexico has the second largest proven oil reserves in the Western Hemisphere. In 1999, Mexican oil production was 153 Mtoe, of which approximately 48 percent was consumed domestically. The US is the largest customer for Mexican oil exports. The state oil company, Pemex, is one of the ten largest oil companies in the world, both in terms of assets and income, and by law is the sole producer of oil in Mexico from upstream exploration to final distribution. In the gas industry, storage, transportation, distribution and sales segments of the market have been opened to the private sector. Foreign investors are limited to services and specified contracts.

Offshore oil sites in the Campeche Sound of the Gulf of Mexico contribute around 77 percent to total Mexican oil production. Currently, Mexico is concentrating on the Cantarell heavy oil project, which has consumed approximately half of Pemex's 3-year investment budget for exploration and production. In 2000, Mexico and United States settled the maritime boundary dispute over the Western Gap area in the centre of the Gulf of Mexico. It was agreed that 62 percent of the region belonged to Mexico and 38 percent to the United States. Due to technological advances in deep water (10,000 feet) drilling over the last few years, oil exploration and development in this area has become feasible.

A 700-mile pipeline under construction between offshore sites in Veracruz and refinery installations will allow Pemex to upgrade its oil transport infrastructure.

Pemex also controls the downstream oil sector. It has six major refineries which are currently being upgraded to increase the volume and improve the quality of gasoline and distillate production.

NATURAL GAS

Indigenous production of natural gas in Mexico was 45 Mtoe in 1999. Though Mexico's net exports to the United States were 136 Mcfd, it is a small net importer of gas from the United States. Currently, domestic natural gas demand is growing more quickly than production. Therefore, imports from the US are likely to continue in the coming years. To increase gas supply, plans are underway to focus investments on gas exploration activities and transportation infrastructure. Gas production in Mexico is expected to reach 226 MCMd by 2009. Demand projections are very robust, particularly in the power sector. Gas consumption is expected to be 2.6 times higher in 2009 than in 1999 while, over the same period, power sector demand is expected to grow 5.2 times.

Natural gas markets in Mexico are less well developed than oil markets, a major problem being the lack of pipeline infrastructure. Natural gas is mostly produced in the south of Mexico while markets are located in the inland and northern areas. With increasing market demand and environmental considerations, natural gas consumption is expected to grow substantially in the coming decades. In anticipation of this growth, new projects are underway in field development, gas processing, transport and distribution.

Mexico is analyzing the possibility of building a liquid natural gas receiving terminal at Altamira, Tamaulipas on the Gulf coast. This terminal would receive gas imports from South America, Asia and Africa and is expected to cost US$ 260 million.

COAL

Coal consumption accounted for around 5 percent of total primary energy in 1999. The power and steel sectors are the main consumers. Coal resources, which have a high ash content, are located in the north of Mexico. Minera Carbonífera Rio Escondido (MICARE), which used to be state-owned, is the biggest coal producer in Mexico. It is now owned by Mission Energy, a US based company.

Coal consumption in 1999 was 6.8 Mtoe while indigenous bituminous coal production was 4.8 Mtoe. Indigenous coal production is expected to decline in the future, because imported coal is 38 percent cheaper than domestic coal for power generation. Coal is imported from the United States, Canada, and Colombia.

ELECTRICITY

Electricity demand has grown rapidly over the past decade, with an average growth rate of 5.1 percent. Electricity consumption in 1999 reached 156 TWh, and is expected to increase by about 6.6 percent per year over the next decade. In 1999, 95 percent of the population had access to electricity.

Electricity generation capacity in 1999 was 35,667 MW, thermal accounts for 67 percent. Conventional thermal power plants contributed 73 percent of electricity produced in 1999, while hydropower contributed 18 percent, 6 percent came from a lone nuclear power plant, and 3 percent

from geothermal and other sources. Mexico also imported some electricity from the US to accommodate sharply increasing demand in the border area, and similarly exported a small amount to Belize in the southern border. For environmental reasons, Mexico plans to encourage combined cycle natural gas power plant construction in the future.

Mexico is thought to have large reserves of renewable energy resources. To date, attention has focused on developing hydro and geothermal resources. Hydropower (with 9,618 MW currently operating) accounts for 27 percent of total installed electricity capacity. Installation of a further 2,516 MW of hydropower is expected in the next ten years. There are currently 750 MW of installed geothermal power generation capacity, and an additional 230 MW will be constructed in the next ten years. Wind and biomass power generation are currently being evaluated for future power production potential. As well, solar energy is currently being promoted as a power source for isolated, rural communities.

Table 22 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	220,690	Industry Sector	30,555	Total	180,917
Net Imports & Other	-71,569	Transport Sector	37,184	Thermal	132,570
TPES	149,121	Other Sectors	29,203	Hydro	32,715
Coal	6,773	TFEC	96,942	Nuclear	10,002
Oil	83,613	Coal	2,186	Others	5,629
Gas	40,306	Oil	60,814		
Others	18,429	Gas	13,345		
		Electricity & Others	20,596		

Source: Energy Data and Modelling Center, IEEJ.

For full details of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

As a result of the periodic economic downturns, energy consumption has fluctuated significantly over the last twenty years. However, the average growth rate in energy demand was 2.3 percent over the period 1980 to 1998. Total energy consumption in 1999 was 97 Mtoe, with the transport sector consuming the biggest share – 38 percent. This is followed by the industry sector at 32 percent, the residential/service sector at 21 percent, agriculture at 3 percent and non-energy uses at 6 percent.

ENERGY POLICY OVERVIEW

The energy sector has traditionally been controlled by state-owned monopolies, but liberalisation programmes have been carried out in recent years. The natural gas market is the most deregulated of Mexico's energy sectors. Though Pemex maintains a monopoly in upstream exploration and production, since the passage of the Natural Gas Law in 1995, private and foreign investors have been allowed to invest in downstream activities such as natural gas transportation, storage and distribution as well as gas imports and exports. However, to prevent vertical integration within the industry, companies are not permitted to operate in more than one segment of the market.

For environmental and economic reasons, the federal government's fuel policy promotes the use of natural gas technologies, especially combined-cycle plants, for electricity generation. This

policy is two-pronged: most new capacity additions are expected to be gas-powered and where viable, thermal plants should be converted from fuel oil to natural gas.

In the electricity sector, private investors are allowed to participate in power generation as independent power producers, autoproducers and cogenerators. The electricity transmission and distribution systems are still controlled by state-owned Comision Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LFC). Mexico plans to continue with reforms that will allow private investment to help increase the electricity supply, improve the transmission and distribution systems and increase efficiency.

NOTABLE ENERGY DEVELOPMENTS

OIL POLICY REFORMS

As a result of low oil prices, Pemex's operating profits fell significantly in 1998. Instead of exporting oil while prices remained low, Pemex planned to refine more crude oil domestically and reduce oil product imports. In hopes of boosting prices, Mexico has actively worked with other non-OPEC oil producers to reduce oil production. Mexico lowered its export targets in February 2001 and again in April 2001. The current target for 2001 is 1.71 million bbl/day, similar to export levels at the end of 2000, but lower than the 1.825 planned in the 2001 budget. High oil prices can be a double-edged sword for Mexico. Government revenues may increase substantially, but higher energy costs are a hindrance for Mexican industry and have a negative impact on the US economy, Mexico's largest trading partner and an important oil importer. An economic slowdown in the United States would be certain to spread to Mexico.

The government has ambitious plans to further restructure and modernise the Mexican energy sector in an effort to make the economy less financially reliant on oil exports. There are also plans to liberalise parts of the energy industry in hopes of boosting foreign investment in the under funded oil and electricity sectors. Other initiatives under consideration include permitting the state oil company to allocate more resources to oil production and refining capacity while permitting state power companies to increase investment in installed capacity for power generation and transmission facilities. The government is exploring the possibility of using innovative concessions and permits schemes to encourage the participation of local and international private investors in energy activities now reserved for the state, such as oil refining, petrochemicals and even exploration and production of natural gas.

ELECTRICITY DEREGULATION

Like PEMEX in the oil and gas industry, for many years the state power companies Comision Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LFC) enjoyed monopolies in the electric power sector. Though legislative reforms in 1992 permitted independent power producers (IPPs), autoproducers and cogenerators to sell power, CFE still owns most of Mexico's installed electric generating capacity and generates over 90 percent of electricity consumed in Mexico. Electricity demand is expected to grow very quickly over the next two decades while infrastructure investment by CFE is expected to decline. To facilitate required infrastructure development, an electricity privatisation bill that would allow private investors to generate and distribute electricity in the wholesale market was introduced in 1999 and is currently being debated in Congress. Under this proposed scheme, the state would retain control over the national transmission grid and electricity dispatch.

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NEW ZEALAND

INTRODUCTION

New Zealand is a small island nation in the southern Pacific with a population of approximately 4 million in 1999. GDP has grown around 2.7 percent per annum through the 1990s reaching about US$ 70 billion in 1999.

New Zealand had modest energy resources including 20 MCM in oil, 165 BCM of gas and 8,600 Mt of coal. Except for oil, New Zealand has adequate resources to meet its energy needs. Energy contributes about 3 percent to New Zealand's Gross Domestic Product (GDP), and directly employs about 9,000 people, or around 0.5 percent of the workforce.

Table 23 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	268,680*	Oil (Proven)	20.4 MCM
Population (million)	3.81	Gas	164.5 BCM
GDP Billion US$ (1995 US$ at PPP)	70.38	Coal (Recoverable)	8,600 Mt
GDP per capita (1995 US$ at PPP)	18,469		

Source: Energy Data and Modelling Center, IEEJ. * Ministry of Economic Development (New Zealand)

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

New Zealand's total primary energy supply in 1999 was 17,903 ktoe. A variety of energy sources are used to meet these needs including oil (34 percent), gas (27 percent), geothermal (14 percent), hydro (11 percent), coal (7 percent) and other (7 percent). New Zealand is self-sufficient in all energy forms apart from oil.

New Zealand was 35 percent self-sufficient in oil in 1999. New Zealand's estimated remaining crude oil and condensate reserves comprise the Maui field (containing 71 percent of reserves at December 1999) and the Kapuni, Kupe and McKee fields. Production of crude oil and condensate was 2,210 ktoe in 1999, all from the Taranaki region. Although crude and condensate production has increased steadily since the early 1980s, there have been significant declines in the last two years, suggesting that this may have peaked (in the absence of new discoveries). About one-third of local production is used for refinery feedstock, and about two-thirds is exported. New Zealand's only oil refinery is located at Marsden Point, near Whangarei. It produces petrol, diesel, aviation kerosene, fuel oils and bitumen.

Natural gas production in 1999 was 4,809 ktoe. It is mainly produced in the Taranaki region and is only distributed in the North Island. There are currently eight fields producing oil and gas, with the Maui field continuing to dominate (78 percent of gross production). Gas reserves are estimated to last until about 2014, with the Maui field possibly running out around 2006. The bulk of New Zealand's gas is used in the production of chemical methanol and petrochemicals and for electricity generation.

New Zealand's total in-ground coal resources are estimated to be about 15 billion tonnes, of which 8.6 billion tonnes is judged to be economically recoverable. Coal production in 1999 was about 2,211 ktoe, mainly sub-bituminous. In 1999, around 43 percent of production was exported

to Japan with other markets being China, India, Chile and Australia. In 1999 the main user of coal in New Zealand was industry.

In 1999, New Zealand generated 36,204 GWh of electricity, around 70 percent of this supply was met by renewable resources. Hydro (about 64 percent) was the most important source of generation followed by thermal (26 percent), geothermal (7 percent) and other (3 percent). Around 70 percent of hydro electricity is generated in the South Island, and all geothermal electricity is generated in the North Island. The balance, almost all of which is generated in the North Island is met by natural gas (23 percent), coal, wind and landfill gas. Around 63 percent of consumption occurs in the North Island. The largest electricity-using sector is industry (chief among which is an aluminium smelter, iron and steel works, several pulp and paper mills and large dairy factories) which accounted for 39 percent in 1999.

New Zealand expects to exhaust its existing gas reserves in the next 15 years. Since imports are not available, finding a replacement for gas-fired generation may mean increased coal-fired generation over the next two decades. It may also mean a greater role for renewables. Wood, "wastes", biogas and wind already make a small contribution to primary supply. Landfill gas is used to produce electricity in small-scale plants in Auckland and the Hutt Valley. Wind power generation from better sites at 6 to 8 cents per kWh is the non-traditional renewable resource that is already commercially competitive in some instances. New Zealand's first commercial wind farm (4 MW) began generating electricity in June 1996. A 32.7 MW wind farm in the Tararua Ranges began operating in mid-1999.

Table 24 Energy supply & consumption for 1999

Total Primary Energy Supply	(ktoe)	Total Final Energy Consumption	(ktoe)	Power Generation	(GWh)
Indigenous Production	14,861	Industry Sector	3,404	Total	36,204
Net Imports & Other	3,042	Transport Sector	4,673	Thermal	9,537
TPES	17,903	Other Sectors	4,927	Hydro	23,218
Coal	1,256	TFEC	13,003	Nuclear	-
Oil	6,142	Coal	802	Others	3,449
Gas	4,809	Oil	5,679		
Others	5,696	Gas	2,619		
		Electricity & Others	3,904		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

Total energy consumption was 13,003 ktoe in 1999. Consumer energy is dominated by oil, comprising 5,679 ktoe per annum (44 percent), with electricity 2,859 ktoe (22 percent), gas 2619 ktoe (20 percent), coal 802 ktoe (6 percent) and renewables such as geothermal, wastes and wood making up the remainder (8 percent).

Transportation is the largest end use accounting for 36 percent of final consumption. The bulk of petroleum products used in New Zealand are consumed by this sector. The industrial sector is next with 26 percent, the residential/commercial with 18 percent, the non-energy sector with 17 percent and agriculture for the remaining 3 percent. Energy consumption growth is strongest in the transportation and residential sectors.

POLICY OVERVIEW

New Zealand has undertaken, over the last decade or so, a comprehensive reform of the energy sector. Former government owned and operated electricity and gas monopolies have been either corporatised or sold to the private sector. The former vertical integration in both gas and electricity sectors has been dismantled to separate natural monopoly elements from those that are competitive, and a wholesale electricity market established. Historical electricity tariff cross-subsidies have disappeared, and consumers now pay an energy price more closely reflective of the true cost of supply - with increasing competition driving costs down. Areas where government interventions are still in place include: natural monopolies (e.g. electricity and gas transmission and distribution lines), environmental impacts, and barriers to energy efficiency uptake.

OIL

Deregulation of the petroleum industry in the late 1980s removed price control, government involvement in the refinery, licensing of wholesalers and retailers, and restrictions on imports of refined products. Petroleum distribution and retailing, which has always been run by the private sector, is dominated by four international oil companies: BP, Caltex, Mobil and Shell. Each international oil company has a stake in the New Zealand Refining Company Limited, which operates New Zealand's sole refinery at Marsden Point. They also own the bulk storage facilities as well as most of the retail outlets.

NATURAL GAS

Reform of the gas industry began in 1987 when the Crown publicly floated 30 percent of Petrocorp, through which the government had managed its interests in the production, transmission and distribution of gas. The government's remaining interest in Petrocorp, including the Natural Gas Corporation Limited (NGC), was sold in 1988. NGC operates the gas transmission network and owns two-thirds of the 2600 km of high-pressure gas pipelines. Maui Development Limited (MDL) and NGC are the two transmission owners (with NGC operating MDL's pipeline). There are five distribution companies and six retailers in New Zealand.

The gas (and electricity) industries were deregulated in 1993 with, *inter alia*, the removal of gas franchise areas and the lapsing of wholesale gas price controls (retail price control had already lapsed). In 1998, the industry successfully concluded a voluntary third party access regime for the natural gas pipeline network.

ELECTRICITY

Overall reform of the electricity sector is well advanced. Recent reforms have been designed to increase competition in generation and to give smaller consumers a choice of electricity supplier in order to provide more competitive prices and improved services.

For the decade commencing in 1987, the electricity reforms included: corporatisation of the monopoly generator ECNZ (later split into two competing entities in 1995); elimination of the statutory government monopoly on generation – as well as obligation to supply; vertical separation of the natural monopoly transmission system from competitive elements; corporatisation and privatisation of distribution and retail; establishment of a wholesale electricity market (which became fully operational in October 1996); and establishment of a "light-handed" regulatory regime to control the natural monopolies.

The Electricity Industry Reform Act 1998 instituted two further significant changes: (1) Local electricity companies were required to separate their distribution from retailing and generation activities into different companies by 2004; (Companies complied with the ownership separation requirements much more rapidly than the Act required with most companies having achieved this by 1 April 1999); and (2) ECNZ was further split into three competing State Owned Enterprises (Meridian Energy, Genesis Power and Mighty River Power) on 1 April 1999 to increase competition in generation. In addition, the Act required the industry to introduce a low cost

system for consumers to change electricity supplier. Arrangements (called profiling) were put in place on 1 April 1999 to facilitate switching between suppliers and ensure that small consumers can benefit from competition.

Over the decade or so since the beginning of the reform process, the price paid by domestic consumers for electricity has risen steadily in real terms (a 22 percent increase from 1987 to 1999). Rather than representing a failure of the reform process to achieve its basic objective, this represents the rebalancing necessary as historical cross subsidies were eliminated (the commercial sector, which had historically subsidised the residential sector, saw prices drop by 35 percent over this period). The overall national average price of electricity over the period of the reforms has remained relatively constant, declining by around 1 percent (real prices).

NOTABLE RECENT ENERGY DEVELOPMENTS

ELECTRICITY SECTOR

The winter of 2001 has seen significant electricity shortages in New Zealand. The shortages have been caused by low rainfall and inflows into New Zealand's hydro-dominant generation system that are the lowest since records began 75 years ago.

Spot (wholesale) prices have risen considerably. This has caused distress for those retailers who were unhedged and also for customers who were either unhedged or whose contracts have expired and are due for renewal. In terms of hydro storage, the hydro lakes have not yet reached the crisis levels they sank to during the shortage of 1992. New non-hydro capacity installed since then has provided some respite on the supply side although the failure of any thermal unit(s) will prove costly. Forecast low rainfall in the medium term suggests that the tight supply situation and hence high prices may persist into 2002.

The government has responded to the shortage by asking for 10 percent (voluntary) savings from consumers. While this target has been achieved on some occasions, cold weather conditions means that savings have often been lower. Unlike California, the New Zealand market does not have price caps and the government has rejected the imposition of them. However, for competitive reasons, some retailers are unable to fully pass on the increase in wholesale prices to consumers.

The shortage with its concomitant high prices has caused discomfort in all consuming sectors. It has increased focus in a number of areas. Chief among these is a re-evaluation of the structure and workings of the wholesale market that has been evolving since its inception some 5 years ago, and has seen three winters (1999, 2000 and 2001) in its present form since the further splitting of ECNZ on 1 April 1999. Some retailers and major consumers also need to reassess their (lack of) hedging policies. Thirdly, the shortage has forced consumers to re-focus their efforts on conservation and energy efficiency with suggestions that the market should include much better demand side participation.

In general, while the electricity industry is seen as one that is in transition from the radical reforms of the 1990s, it is expected that the future is one of evolution rather than revolution. As part of this evolution, the Electricity Industry Bill, described in last year's Overview, was enacted into law in August 2001.

ENERGY EFFICIENCY

In March 2001, Cabinet approved the release of a Draft National Energy Efficiency and Conservation Strategy (NEECS), for a statutory process of public consultation, under the Energy Efficiency and Conservation Act 2000. The Strategy sets out the government's policies in relation to the promotion of energy efficiency, energy conservation and the use of renewable sources of energy. The Act requires the Strategy to include objectives and targets and requires that it state the means by which policies, objectives and any targets are to be achieved.

The draft Strategy specified a voluntary energy efficiency and conservation target of at least a 20 percent improvement in economy-wide energy efficiency by 2012. Regulation, other than Minimum Energy Performance Standards, Minimum Energy Performance labeling and the Building Code, would require legislative changes.

The energy efficiency target will be verified (following public consultation) and a renewable energy target will be added in the final Strategy expected to be issued by 1 October 2001. This Strategy would have a five-year term and the target looks forward 10 years to 2012.

It is thought that ratification of the Kyoto Protocol will help drive a significant expansion in New Zealand's use of renewable energy sources. Electricity legislation recently passed significantly opens up the scope for that expansion, particularly by lines companies. The government policy statement puts on some pressure, requiring the market rules to facilitate the use of new electricity technologies and renewables.

GHG AND CLIMATE CHANGE

New Zealand is a signatory to the Kyoto Protocol undertaking to reduce emission of greenhouse gases during 2008-2012 to levels prevailing in 1990 and has stated its intention to ratify the Kyoto Protocol by September 2002. The agreement achieved at the recent World Conference on Climate Change in Bonn has made it possible for New Zealand to proceed with the domestic policy development necessary for ratification.

Greenhouse gas (GHG) and climate change issues are expected to significantly impact upon the New Zealand energy scene with the relative cost of fuels and the economics of electricity generation technologies shifting. Input cost structures in industry will change and these continue to cause concerns within the business community. Both carbon sinks and carbon trading feature in New Zealand's policy response to GHG mitigation.

PAPUA NEW GUINEA

INTRODUCTION

Papua New Guinea, an island nation in the South Pacific, is geographically located north of Australia and is comprised of more than 600 islands, several habitable ones including half of the main island of New Guinea with West Papua, Indonesia. PNG has a population of more than four and half million people who are spread across a land area of 462,840 square kilometres.

The PNG economy is currently recovering from an economic downturn that began in 1994 with current per capita GDP (US$ 2,297 per capita) still slightly below the level of 1994. In 1999, real GDP at 1995 US dollars at PPP was estimated to be US$ 10.81 billion. Inflation is around 13 percent.

Energy use per capita in PNG at 0.2 toe per capita is far below the APEC average of 1.5 toe per capita. Energy exports are very important for raising foreign exchange and as a source of funds for national development projects. In 1998, the energy industry accounted for approximately 12 percent of domestic GDP, about 66.1 percent of total merchandise exports and employed about 1000 Papua New Guineans in upstream and downstream operations.

Table 25 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	462,840	Oil (Proven)	61.1 MCM
Population (million)	4.70	Gas	39.7 BCM
GDP Billion US$ (1995 US$ at PPP)	10.81	Coal (Recoverable)	-
GDP per capita (1995 US$ at PPP)	2,297		

Source: Energy Data and Modelling Center, IEEJ. *UN Energy statistics Yearbook and IMF Staff Country Report No. 99/66 Jul 1999.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 1999, PNG's net primary energy supply was 1,145 ktoe (up 1.6 percent from 1998). Light crude oil and petroleum products accounted for 80 percent, gas for 10 percent while hydro and other fuels comprised the remaining 10 percent. Around 75 percent or 3,409 ktoe of indigenous energy production is exported to other economies. An annual budget of US$ 20 million supports oil and gas exploration in PNG.

PNG has a small oil field, which has produced 100,000 bbl/day of light crude since 1992. As the field matures, production levels have begun to decline. The light crude is mainly for export. In September 2000, the government approved a Petroleum Development Licence for Moran Oil to begin production of 13,000 bbl/day by the end of 2000 to supplement the Kutubu project. There are plans for two small oil refineries, in Port Moresby and in Lae, to transform some of this domestic oil into petroleum products.

PNG also has a natural gas field with estimated reserves of 39.7 BCM. In 1999, a small amount of gas was produced, 113 ktoe, and used for electricity generation. PNG is currently negotiating to sell this gas to Australia.

In 1998, total power installed capacity was 451.31 MW. PNG produced 2,293 GWh of electricity in 1999. The sources of generation were hydro at 40 percent and thermal (gas and fuel oil) at 60 percent. In 1999, 80 ktoe of energy were produced from hydro sources. There is little potential for expansion of economic large hydro due to a lack of significant demand near supply sources. However, there is greater potential for smaller schemes. Most power stations, hydro are owned and operated by the government owned monopoly, the PNG Electricity Commission.

Table 26 Energy Supply & Consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	4,554	Industry Sector	360	Total	2,293
Net Imports & Other	-3,409	Transport Sector	262	Thermal	1,373
TPES	1,145	Other Sectors	202	Hydro	920
Coal	-	TFEC	824	Nuclear	-
Oil	921	Coal	-	Others	-
Gas	113	Oil	651		
Others	110	Gas	-		
		Electricity & Others	173		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

In 1999, total end use energy consumption in PNG was 824 ktoe (an increase of 8 percent from the previous year). By sector, industrial at 44 percent is the largest end use, followed by transport at 32 percent, with agriculture at 12 percent and residential/commercial at 11 percent. By fuel source, petroleum products accounted for 79 percent of consumption, electricity and others for 21 percent and natural gas appears to be zero.

In PNG about 85 percent of the population live in rural areas and electrification rates remain low. Petroleum products such as diesel or petrol are used in the transport sector and for the generation of electricity. Renewable energies such as small hydro, wind power and solar energy are not widely used, as they are expensive to install for general electricity use. In recent years, however, solar water heating equipment has been installed in more new buildings. Organisations such as Telikom and the Civil Aviation Authority also use photovoltaics for telecommunications and navigational aids purposes.

POLICY OVERVIEW

In PNG, the national government has jurisdiction over energy matters including overall energy policy. The PNG Electricity Commission controls the generation and distribution of electricity, energy policy matters are determined by the Department of Petroleum and Energy, and exploration and development of petroleum resources are overseen by the Ministry of Petroleum and Energy.

The Department of Finance and Treasury is responsible for setting prices or tariffs for electricity and petroleum products. The provincial governments work with the PNG Electricity Commission, the Energy Division of Department of Petroleum and Energy and/or private companies to organise new projects such as grid extensions or the development of hydro and other renewable resources.

Parliament is currently reviewing the PNG National Energy Policy Statement. Previous acts of Parliament such as the Electricity Commission Act, gave authority to the Electricity Commission for the generation, distribution and sale of electricity. The Petroleum Act of 1972 and the Oil and Gas Act of 1998 gave the Ministry and Department of Petroleum and Energy authority over the licensing and development of petroleum resources. The Price Control Act authorises the Ministry and Department of Finance and Treasury to set fuel prices and electricity tariffs.

The Energy Division of the Department of Petroleum and Energy implements policies and programmes, which are aimed at encouraging the diffusion of new and affordable renewable energy technologies. It also works closely with the PNG Electricity Commission to increase the available amount of electricity capacity as and when demand growth justifies it.

NOTABLE ENERGY DEVELOPMENTS

- The Rural Electrification Policy Document, completed in June 2001 and awaiting approval from the government, is aimed at improving rural access to electricity.
- The government is to privatise the State utility – PNG Electricity Commission.
- The PNG to Queensland (Australia) Gas pipeline project is still under negotiation.
- Inter Oil of Canada has been given the go-ahead for the installation of a 32,500 barrels per day oil refinery.
- UNESCO has approved a US$ 10 million Pacific Regional Renewable Energy Training Centre to be established in Port Moresby, PNG to serve the South Pacific Island economies.

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PERU

INTRODUCTION

Peru is located on the western coast of South America, and borders Colombia, Brazil and Bolivia. It has an area of 1.3 million square kilometres and has a population of more than 25 million in 1999. Incomes are still quite low at US$ 4,556 (1995 US$ at PPP).

The Peruvian government has enacted laws to promote investment from both domestic and foreign sources. Foreign investment played a very important role in sustaining GDP growth during the Asian financial crisis. However, recent El Niño weather patterns have undermined the economy. Fish stocks have declined in the warm Pacific Ocean water, harming the fishing industry and other sectors. However, the economy is starting to recover from these setbacks, the GDP growth rate for 2000 was 3.1 percent.

Peru is a small net importer of energy. It has energy reserves of oil (51 MCM), gas (245 BCM), coal (58 Mt) as well as some hydro.

Table 27 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	1,285,216*	Oil (Proven)	51.4 MCM
Population (million)	25.23	Gas	245.1 BCM
GDP Billion US$ (1995 US$ at PPP)	114.95	Coal (Recoverable)**	57.6 Mt
GDP per capita (1995 US$ at PPP)	4,556		

Source: Energy Data and Modelling Center, IEEJ

* Ministry of Energy and Mines/Energy Technical Office (Peru) ** Proven reserves in 1999

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply in 1999 was 9,369 ktoe, of which oil contributed the biggest share (67 percent). Natural gas (16 percent), hydro (13 percent) and coal (4 percent) were the other main sources of energy. Peru imported about 15 percent of its energy requirements (mostly oil) in 1999.

In 2000, Peru produced 100,000 bbl/d of crude oil. Current production areas are located in the northern jungle and offshore. Argentina's Pluspetrol, Peru's Perupetro, US-based Petro-Tech and Barrett Resources Corporation are the major contributors to domestic production. Oil production in Peru has been declining over time, while internal consumption has been rising rapidly. To fill the gap, Peru became a significant net oil importer in 1995. Prospects for additional domestic production are not promising. Peru estimates it will require US$ 100 million per year in drilling investments over the next five years to maintain proven oil reserves. Moreover, initial exploration efforts in Peru's offshore coastal basins have yielded poor results and discouraged further investment by oil companies.

The Norperuano pipeline running from the Amazon to the Pacific Ocean, with a capacity of 200,000 bbl/d, is currently being used to supply domestic demand. The pipeline, however, is only working at around 30 percent capacity. A scheme to use this line to import crude oil from southern Ecuador is currently being considered.

Peru has the largest natural gas field in South America, the Camisea field. The two reservoirs in this area are estimated to contain approximately 230 BCM of gas and over 90.1 MCM of condensate. The Camisea project has been divided into two contracts: a 40-year contract for exploration and production, and a 33-year contract for transportation and distribution. In February 2000 the contract for upstream work was awarded to a consortium led by Argentina's Pluspetrol and in October 2000, a consortium led by Argentina's Tecgas submitted a proposal to build pipelines for transportation and distribution. It is estimated that the Camisea field will produce 10 MCM/d of gas and 4 MMCM/d of condensate once fully operational, and generate revenues for Peru of around US$ 5-6 billion in the form of royalties and taxes over the next 30 years. The power generation and industrial sectors are expected to be major gas consumers. Peru is also considered to be an important potential gas exporter.

Table 28 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	7,918	Industry Sector	2,941	Total	19,049
Net Imports & Other	1,451	Transport Sector	3,406	Thermal	4,508
TPES	9,369	Other Sectors	2,215	Hydro	14,541
Coal	413	TFEC	8,563	Nuclear	-
Oil	6,232	Coal	343	Others	-
Gas	1,473	Oil	6,800		
Others	1,250	Gas	1		
		Electricity & Others	1,418		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

As of December 2000, installed generation capacity in Peru was 6,070 MW, up from 2,388 MW in 1985. Although it still accounts for the bulk of power generation (81 percent), hydro makes up only 47 percent of installed capacity, down sharply from 59 percent in 1985. After hydro, power is generated from residual fuel oil at 7 percent, diesel 6 percent, natural gas 4 percent and coal 2 percent.

In October 2000 a new north-south transmission line unified the former central-north (SICN) and southern (SIS) grids to form the National Interconnected Electrical System (SEIN). This system together with several smaller isolated systems (SSAA) deliver power to the economy. In 2000, 90 percent of the 19,923 GWh of power generated was produced in the National Interconnected Electrical System. The smaller isolated systems account for the remaining 10 percent of production. The electrification rate in December 2000 was 73.5 percent.

FINAL ENERGY CONSUMPTION

Final energy consumption increased by 38 percent over the period 1980 to 1999 while energy production fell by 30 percent. In 1999, final energy consumption in Peru was 8,563 ktoe, where the industrial sector consumed 34 percent. The transportation sector accounted for the largest share, at 40 percent. The residential/commercial sector was responsible for 18 percent while 2 percent was consumed by agriculture. Petroleum products dominated end use consumption, accounting for 79 percent of demand in 1999.

POLICY OVERVIEW

With the elimination of virtually all trade, investment and foreign exchange controls since 1990 and the partial privatisation of the mining, electricity, hydrocarbons and telecommunication industries, the economy is becoming more market-oriented. Several laws affirm that "national and foreign investment are subject to the same terms" and have permitted foreign companies to participate in almost all economic sectors. The state oil company, Petroperu, was partially privatised in 1993 and has become Perupetro.

The Electricity Concessions Law, passed in 1992, allows the private sector to invest in power generation, transportation and distribution. The state utility ElectroLima and the bulk of ElectroPerú were privatised soon after the law was implemented. To enhance competition in the electric power sector, the Peruvian Congress passed a law in 1997 that prohibited firms from controlling more than 15 percent of the power generation, transportation or distribution markets. As well, the government has the right to block acquisitions in order to ensure private companies do not gain excessive market power. Today, the private sector, including foreign companies, controls about 80 percent of generation capacity and 70 percent of the distribution system. However, the government still maintains ownership of key hydroelectric plants.

The Andean Community (ANCOM) was established by Bolivia, Colombia, Ecuador, Peru and Venezuela in 1996. The purpose of this organisation is to create a common market similar to the European Union. This initiative may bring about a more integrated regional energy market among Andean economies.

NOTABLE ENERGY DEVELOPMENTS

PRIVATISATION PROGRAMME

The new government which took office in July 2001, is expected to carry on with privatisation initiatives in the energy sector. On 20 July 2001, the Electroandes Power company, which holds the assets of the former Sistema Eléctrico de Centromín Perú was privatised. The government is investigating the possibility of privatising distribution, generation and transmission facilities across Peru.

ENCOURAGING GAS CONSUMPTION

With one of the development contracts for the Camisea project in place, and work already in progress, the government expects gas and condensates to reach customers between December 2003 and June 2004. In anticipation of these new supplies, the government has launched information campaigns to educate the public on the benefits of natural gas in different applications, including transportation. By encouraging consumers to substitute domestically produced gas for oil-derived fuels, the government hopes to reduce Peru's dependence on oil imports.

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THE PHILIPPINES

INTRODUCTION

The Philippines is a tropical archipelago located in the western rim of the Pacific Ocean. It is composed of 7,107 islands and islets spread over a distance of 1,854 kilometres from the boundaries of Chinese Taipei in the north and the Indonesian archipelago in the south.[19] Total land area is about 300,000 square kilometres with a population of over 74 million in 1999.

Gross domestic product in 1999 was recorded at US$ 283.27 billion dollars at 1995 purchasing power parity (PPP). Agriculture is still plays an important role in the economy. Manufacturing industries are basically light; the largest sector is food, tobacco and beverages, a spin off of agriculture. Despite a slight recession after the Asian financial crisis, GDP increased by 3.2 percent in 1999.

Proven indigenous energy resources are small with only about 37-45 million cubic metres (MCM) of crude oil, 82 to 130 billion cubic metres (BCM) of natural gas and 300 million metric tonnes of coal (lignite). These resources are distributed across the archipelago in small quantities rendering exploration, development and production economic or feasible only in some cases.

GDP per capita is still quite low at US$ 3,815 (1995 US$ at PPP) and energy consumption per capita is one of the lowest in the APEC region highlighting the potential for rapid growth in the energy market.

Table 29 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	300,000	Oil (Proven)	37-45 MCM
Population (million)	74.26	Gas	82-130 BCM
GDP Billion US$ (1995 US$ at PPP)	283.27	Coal (Recoverable)	297 Mt
GDP per capita (1995 US$ at PPP)	3,815		

Source: Energy Data and Modelling Centre, IEEJ. *Philippine Department of Energy (DOE)

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

The total primary energy supply (excluding traditional fuels) in 1999 amounted to about 30 Mtoe. The main energy sources were oil at 57 percent, geothermal at 30 percent and coal at 10 percent. The bulk of energy requirements, 65 percent, were imported. Indigenous energy production reached 10.4 Mtoe, coming mostly from hydro and geothermal electricity generation. 99.7 percent of the total oil supply was sourced from abroad.

Oil production in the 1980s and early 1990s gave some hope that the dependence on imports would be reduced, but early production levels have not been sustained, falling from around 3,000 barrels of oil per day in 1992 to about 400 barrels per day in 1999.

Coal production has also declined as a result of competition from cheaper and higher quality imported coal. Domestic production accounted for just 16 percent of demand in 1999.

[19] Department of Tourism, (1998), Philippines, My Country, My Home, http://www.tourism.gov.ph/welcome/phil-his.htm.

Recoverable coal reserves are mostly low quality coal. While some bituminous coal reserves exist, extraction has proven costly, as most cannot be mined through open-pit methods.

Gas production and use was small, just 63 ktoe in 1999. Development of natural gas reserves in the Malampaya-Camago fields are currently in progress and gas use for electricity generation is expected to increase sharply in the next few years. In November 2000, service contractor Shell Philippines Exploration BV (SPEX) completed the construction of a gas pipeline that will be used to transport natural gas from the wellhead to the demand site, an electricity generation plant, some 500 kilometres away. Drillings are also being carried out to delineate deposits of gas in other fields.

Electricity production in the Philippines was about 41,295 GWh in 1999. The bulk of generation came from thermal sources (mostly coal and fuel oil) at 55 percent, geothermal at 26 percent and hydro at 19 percent. Total installed power generating capacity stands at around 12,000 MW. With the economy still suffering from the 1997 financial crisis, new capacity additions remain under-utilised, leading to a current surplus of capacity. Additional generation capacity is projected to be needed starting in 2005.

Of the 12,000 MW of potential hydropower capacity, only 2,300 MW have been harnessed. Development of other potential sites is not promising due to high capital, environmental and social costs. Further development of geothermal resources is also unlikely due to unfavourable geographical locations, the relatively small size of remaining fields and unfavourable geochemical properties such as high acidity and low enthalpy of some of the fields. The Philippines is a world leader in geothermal energy development. To date, the total installed capacity is around 2,000 MW, the second highest installed capacity in the world (after the United States).

The Philippines is just starting to use gas for electricity generation purposes, these new facilities are expected to replace some oil-fired capacity. The first 1,000 MW (of the scheduled 2,700 MW) of combined cycle gas turbine (CCGT) power facility is already completed and is currently running with naphtha and bunker-C fuels. It is expected to run on natural gas by January 2002. The groundbreaking for the next 1,200 MW took place in November 1999.

Table 30 Energy supply & consumption for 1999

Total Primary Energy Supply	(ktoe)	Total Final Energy Consumption	(ktoe)	Power Generation	(GWh)
Indigenous Production	10,373	Industry Sector	3,682	Total	41,295
Net Imports & Other	19,580	Transport Sector	8,274	Thermal	22,861
TPES	29,953	Other Sectors	5,157	Hydro	7,840
Coal	2,968	TFEC	17,112	Nuclear	-
Oil	17,137	Coal	695	Others	10,594
Gas	63	Oil	13,523		
Others	9,785	Gas	-		
		Electricity & Others	2,894		

Source: Energy Data and Modelling Centre, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

Given the island geography of the Philippines, building an energy infrastructure is often challenging. Complementing the electricity generation facilities are a number of inter-island submarine power interconnections. To date, six interconnection lines have integrated the power systems of seven islands including Luzon, the largest and most populated island of the archipelago. These facilities have enabled the transmission of geothermal electricity from the island of Leyte to the demand centres in Luzon, Cebu and Bohol. Another interconnection project that will be

implemented is the Leyte-Mindanao interconnection. This facility will form the final phase of interconnection, which will fully integrate the major islands of the economy into a single grid.

FINAL ENERGY CONSUMPTION

Final energy consumption was about 17 Mtoe in 1999. Transportation was the largest end use consumer accounting for 48 percent of energy, followed by residential-commercial at 26 percent and industry at 22 percent. Due to the importance of the transportation sector, petroleum products dominated final energy use making up 79 percent of demand. Electricity was next with 17 percent.

After declining slightly from 1996 to 1998, petroleum demand increased by 19 percent in 1999. The residential-commercial sector and transportation are behind this demand growth. Between 1998 and 1999, electricity demand increased minimally by 0.01 percent due to 0.5 percent and 0.8 percent declines in industrial and residential consumption, which were offset by the 1.7 percent increase in the commercial sector.

POLICY OVERVIEW

The Department of Energy (DOE) is primarily responsible for the formulation of policies in the energy sector. It is mandated by law to prepare, integrate, coordinate, supervise, and control all plans, programmes, projects, and activities of the government pertaining to energy exploration, development, utilisation, distribution, and conservation. The DOE endeavours to ensure that "energy supply must be adequate, reliable and affordable: to industries to enable them to provide continuous employment and low cost goods and services; and to ordinary citizens to enable them to achieve decent lifestyles. Energy should be produced and used in a manner that will promote sustainable development and utilisation of the economy's natural resources but at the same time maintain the economy's overall economic competitiveness."

It is the declared policy of the State, as administered by the DOE, to ensure a continuous, adequate, and economic supply of energy to ultimately achieve self-reliance with respect to the economy's energy requirements. This is to be achieved through intensive exploration, production, management and development of the economy's indigenous energy sources, and judicious conservation, renewal, and efficient utilisation of energy to keep pace with the economy's economic development. The active participation of the private sector has been sought in various areas of energy resource development. It is also a goal to integrate and coordinate the various programmes of the government towards self-sufficiency and enhanced productivity in power and energy without sacrificing environmental values.

To increase the competitiveness of the Philippine economy, the government launched a series of structural reforms in 1992 which have liberalised almost all sectors of the economy, including energy. Deregulation of the energy industry and privatisation of state-owned energy corporations are currently making progress in the Philippines and are expected to reduce prices through competition as well as increase the security of energy supplies.

OIL

Oil imports represent a significant percentage of the total import bill, so rising crude oil prices in world markets can lead to substantial increases in local pump prices and are a serious issue for the Philippines. To help reduce oil dependence in the near term, the government is implementing a policy to retire ageing oil-fired electric power plants and switch to alternative power sources such as gas.

In order to increase the availability of domestic energy supplies, the Philippine National Oil Company (PNOC) mandate has been to explore and develop the economy's oil and gas resources through its Exploration Corporation (PNOC-EC), to develop geothermal areas through the Energy Development Corporation (PNOC-EDC), and to develop local coalmines and to facilitate coal trade through the Coal Corporation (PNOC-CC).

To introduce competition and attract more investment to the industry, after the privatisation of state-owned Petron Corporation in 1994, the downstream oil industry was deregulated in February 1998. In preparation for passage of the law, the government sold a majority of its shares to a strategic partner and to the general public through an initial public offering (IPO) in the stock market. Since then, as envisioned during the early stages of its preparation, new participants have entered the refinery sector. By the end of 1999 there were 57 firms involved, 10 of which are either foreign-owned or are foreign joint venture partners. The amount of capital injected by both local and foreign investors amounted to around US$ 250 million, with the foreign component accounting for a major share. In a span of two years new participants have garnered 10.5 percent of petroleum product market share, notwithstanding the existing presence of three major oil firms in the economy.

NATURAL GAS

The development of gas resources in the Philippines is in its infancy. To put in place a regulatory framework for gas development, recently a Gas Sector Policy and Regulatory Project was completed with the assistance of the Asian Development Bank (ADB). The project recommended sets of rules and regulations covering downstream regulations, particularly with respect to pipeline construction, operation, and maintenance, gas transport and commodity pricing as well as health and safety standards. Another project aimed to promote the use of natural gas in various areas of the Philippines will be carried out through the assistance of the Japan International Cooperation Agency (JICA).

ELECTRICITY

The Philippine National Power Corporation (NPC) was the sole authority for the production and high voltage transmission of electricity until 1987 when the power sector was opened to private sector participation by virtue of Executive Order No. 215 (EO 215) issued by the Aquino administration. It also has the mandate to develop the economy's hydro resources. Currently, NPC owns and operates more than three-quarters of the economy's total generating capacity. Independent power producers (IPPs) either selling to NPC or to electricity distribution utilities, have continuously increased their share of the market since 1989.

The Philippines is also one of several APEC economies with a large proportion of the population that does not yet have access to electricity. Hence, the government plans to complete electrification of all the economy's barangays (villages) by 2004 through the extension of the grid wherever feasible and the installation of distributed generation to remote and isolated barangays.[20] The use of new and renewable energy systems is being considered for distributed generation.

The National Electrification Administration (NEA) is in charge of the government's programme of total electrification of the economy through 119 electric cooperatives, which are owned by member-consumers. NPC through its Strategic Power Utilities Group (SPUG) is responsible for extending electricity service to remote areas. SPUG installs decentralised diesel generators and assists local distribution utilities in the installation of distribution lines. The government subsidises electricity prices in order to reduce the burden on the local population.

ENERGY PRICING

After the deregulation of the downstream oil industry, the DOE signed a Memorandum of Agreement (MoA) with the Department of Justice (DoJ) to investigate and act upon any report of prohibited acts such as cartelisation and predatory pricing to safeguard the interest of the consuming public. A Memorandum of Understanding (MoU) with the Department of Trade and Industry (DTI) and Department of Interior and Local Government were also signed to further safeguard the interests of consumers.

[20] Department of Energy (DOE), (2000), Philippine Energy Plan 2000-2009, Manila.

A quasi-judicial regulatory body independent of the DOE, the Energy Regulatory Board (ERB), is in charge of fixing energy prices. Before the implementation of the Downstream Oil Deregulation Law in 1998, ERB's powers include fixing petroleum prices. To date, its main mandate has been in setting electricity prices.

NOTABLE ENERGY DEVELOPMENTS[21]

The Philippines has been reviewing existing policies and formulating appropriate structural reforms that subscribe to the principles of sustainable development and global competitiveness. Structural reforms will be pursued in the power and downstream oil and gas sectors to create an environment that is market-friendly and conducive to private sector investment. These initiatives have resulted in the following notable developments in the Philippine energy sector.

DEVELOPMENT OF THE NATURAL GAS INDUSTRY

The Malampaya-Camago Gas-to-Power Project (MCGPP) is currently underway and is progressing according to schedule. The project is expected to become the catalyst for a natural gas industry. It is also expected to reduce the economy's dependence on oil-based power generation by 30 percent by 2004 and will generate employment, foreign exchange savings and substantial revenues for the economy.

The US$ 2 billion upstream project is by far the largest single infrastructure investment in the economy. It is being financed through public-private sector partnership. Government involvement is through the participation of the state-owned PNOC-Exploration Company with Shell Philippines Exploration BV (SPEX) and Texaco Philippines as the private sector participants.

RESTRUCTURING THE POWER INDUSTRY

In June 2001, the two chambers of Congress enacted the Republic Act 9136 (or RA 9136), entitled "An Act Ordaining Reforms in the Electric Power Industry, Amending for the Purpose Certain Laws and for Other Purposes." The Act provides for the restructuring of the power sector to promote competition and improve efficiency in the industry. It also calls for the privatisation of the state-owned National Power Corporation (NPC). Private companies from within the economy and abroad are expected to vie for ownership of the seven companies that will be spun-off from the state-owned power company by June 2004.

The issues currently addressed include: the cross-ownership restriction across the different segments of the industry particularly between competitive and monopoly elements, the recovery of stranded costs, and the timing for implementation of open access to the transmission and retail distribution systems. Necessary preparations are already underway to ensure a smooth transition to a competitive market structure. These include the unbundling of electricity tariffs, implementation of the one-day ahead power sales system, realignment of NPC's corporate structure, and the drafting of the necessary rules and regulations.

ENVIRONMENTAL IMPACT MITIGATION MEASURE – THE CLEAN AIR ACT OF 1999

The Clean Air Act of 1999 provides for a comprehensive policy on air pollution abatement, prevention and control for both stationary and mobile sources of pollutants.

Environmentalists have applauded the passage of the Act as it provides for environmental considerations in energy activities, even though it has an unfavourable impact on energy prices. One of the most important provisions of the Act is the complete phase out of lead in gasoline by January 2001 and the setting of emission standards from both mobile and stationary sources. Likewise, the Act bans the use of waste incineration, as it is believed to be a source of toxic gases.

[21] Most of the information is taken from: DOE, (2001), Notable Developments in the Energy Sector Since EWG 20 (submitted to EWG 21), May.

PHILIPPINE CLIMATE CHANGE MITIGATION PROGRAM (PCCMP)

The PCCMP is a US Agency for International Development-assisted programme for climate change mitigation. In the Philippines, three major groups of activities were prioritised for the 2000/2001 workplan. The first group of activities fall under the Electric Power Industry Restructuring and Modernisation Program of the government. This consists of activities related to the conduct of research and analysis of the existing legal and regulatory framework to substantiate and firm up the relevant policy measures for the upcoming restructuring of the sector. An institutional capability-building seminar for DOE, its attached agencies and the various electric distribution utilities in the areas of integrated resource planning was conducted.

The second major group of activities is the barangay electrification programme. Activities are divided mainly into micro- or field-focused activities and the macro- or institutional activities. The Renewable Energy Action Plan under that details the joint efforts of the Philippines and the USAID in promoting the adoption of new and renewable energy (NRE) technologies was published under this group of activities. A concept paper for the establishment of a NRE Centre is being drafted in coordination with the University of the Philippines Solar Laboratory. The proposed centre is intended to support the DOE's capacity to promote the adoption of NRE technology for electrification using academic and non-governmental organisations (NGOs) as partners. As part of institutional support to the DOE, the development of a database for the barangay electrification management information system (MIS) and training on planning tools and financial evaluation of NRE projects were undertaken.

The third major group of activities is the Special Activities. Activities under this group are mostly information sharing and dissemination programmes. The Philippine Climate Change Information Centre (PCCIC) conducted briefings on climate change to various organisations. PCCIC also continues to enhance its website for wider domestic and regional linkages. In October 2000, PCCMP provided substantial inputs to the ASEAN Senior Officials Energy Workshop on Climate Change. The workshop covered topics on the science, physical and economic impacts, and opportunities of climate change as well as policy responses.

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RUSSIA

INTRODUCTION

Russia has the largest land area of any economy in the world – over 17 million square kilometres. The overall population density is low – only 9 persons per square kilometre, with the northern and eastern regions very sparsely populated. During the 1990s the population declined from 148.3 million in 1990 to 146.2 million in 1999. Energy consumption per capita is around 4.4 toe per capita, compared with an APEC average of 1.5 toe per capita.

After a decade of economic contraction (around 40 percent) compared to the 1990 GDP level, the Russian economy began to grow again at the beginning of 1999, boosted by higher oil prices and the stimulating effect of the 1998 rouble devaluation. In 2000, GDP grew 7.3 percent, industrial production grew 10.3 percent and investments were up 17.2 percent. GDP in 1999 was estimated to be US$ 1,023 billion (at 1995 purchasing power parity dollars). Inflation has been kept under control with an official target of 18 percent for 2000. The official unemployment rate is about 8 percent.

Russia has abundant natural energy resources, possessing the world's largest proven reserves of gas (48.14 TCM – 32.1 percent of the world total in 2000), 4.6 percent of the world's proven oil reserves (6.7 billion tonnes in 2000) and 15.9 percent of the world's coal reserves (157.01 billion tonnes in 2000). The economic potential of hydropower is estimated at 852 TWh per year, almost 20 percent of which has been developed. Economic reserves of uranium ore comprise about 14 percent of the world total.

The energy sector is very important to Russian economic development. In 2000, the energy industry accounted for approximately 10 percent of domestic GDP. At the same time its share of federal budget revenues was about 50 percent. The employment share was only 3 percent of the total workforce. Oil and gas exports comprised 52 percent of total merchandise exports in 2000.

Table 31 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	17,000,000	Oil (Proven)	7,774 MCM
Population (million)	146.20	Gas	48,140 BCM
GDP Billion $ (1995 $ at PPP)	1023.35	Coal (Recoverable)	157,010 Mt
GDP per capita (1995 US$ at PPP)	7,000		

Source: Energy Data and Modelling Center, IEEJ. *proved reserves at end of 2000 from The BP Statistical Review.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 1999, Russia's primary energy supply was 592 Mtoe. This total comprised 53 percent natural gas, 22 percent crude oil and petroleum products, 17 percent coal, 5 percent nuclear and 2 percent hydro. Russia is a large net exporter of energy. In 1999, 37 percent of energy production was exported, mainly to Eastern and Western Europe. Currently, Russia is developing new energy export routes in eastern (Asia) and southern directions.

OIL

In 1999, Russia produced 305 Mtoe of crude oil and gas condensate. Net exports of crude and petroleum products totalled 175 Mtoe (57 percent). Currently, the oil industry is buoyant because of high world oil prices. The main oil province of West Siberia produces 68 percent of total crude oil, although this share will decline as exploitation is mature and output is falling. The second important oil province is the Ural-Volga basin, an area exploited since the late 1940s. New prospective oil provinces are located in the Timano-Pechora region, East Siberia, the Far East and North Caspian offshore. Oil extraction levels have exceeded newly discovered reserves since 1994. In 1998 new additions comprised 232.1 Mt, or 71.3 Mt less than production.

Annually averaged refinery capacity was 261 Mt. The load factor is unusually low at 58 percent, the optimal level is 80-85 percent. This factor is the main reason for high oil processing costs. The degree of refining in Russian enterprises is 63-65 percent, compared to, for instance, 90 percent in the US. The main reasons for this are the traditionally high domestic demand for fuel oil (for heating) and the ageing physical capital stock.

GAS

Natural gas production in 1999 totalled 477 Mtoe. Net exports accounted for 162 Mtoe or 34 percent of production. Currently, 36 percent of exports go to the Commonwealth of Independent States (CIS) economies Ukraine, Belarus, Kazakhstan, Moldavia, and 64 percent to Eastern and Western European economies. In mid-2000, the gas price in European markets rose to US$ 150 per thousand cubic metres from US$ 90 in mid-1999. Taking advantage of this rise, which was linked to oil price dynamics, Gazprom increased export volumes to West European markets by about 2 percent in 2000 while simultaneously reducing gas deliveries to the neighbour CIS states by 19 percent.

The Russian gas industry is beset by a number of problems. Since the 1990s production has exceeded reserve additions due to insufficient investment in the development of new fields and pipelines. The main West Siberian gas fields of Urengoy (67 percent of reserves depleted) and Medvezhye (78 percent depleted) have gone into a final declining phase and only the third actively exploited giant deposit Yamburg (46 percent depleted) is maintaining steady output levels. To maintain current supply levels, Gazprom started buying gas from Turkmenistan in 2000. Gazprom is currently pushing Turkmenistan for a long-term deal involving 50 BCM of annual purchases for 30 years.

Russis still has significant gas reserves, but adequate investment remains a barrier to development. New West Siberian fields in the Yamal region, which are relatively close to existing infrastructure, require nearly 10 times more capital investment than fields developed in the 1980s (in comparable monetary terms). As well, new resource bases in other regions - the Barents Sea offshore (Schtokmanof field), East Siberia (Kovykta), Yakutia and Sakhalin offshore – have significantly lower recoverable volumes than the West Siberian fields and lack transporation infrastructure. Bringing this gas to market would therefore require significant inflows of capital.

Another issue is unpaid gas off-takes. Existing export pipelines to the West go through Ukrainian territory where, on an ongoing basis, gas from the pipeline is downloaded but not paid for. The problem arose in the early 1990s after the Soviet Union break-up, and still persists. The Russian gas monopoly 'Gazprom' is actively seeking alternative export routes to the West – through Poland and Slovakia, and to the South – across the bottom of the Black Sea to Turkey (the 'Blue Stream' project).

COAL

In 1999, Russia produced 111 Mtoe of coal, 70 percent of the 1990 level. Hard coal production was 66 percent of the total with the balance of 34 percent being lignite. The main coal basins are located in the south of Western Siberia – the Kansk-Achinsk and Kuznetsk regions, possessing combined reserves of about 140 billion tonnes. Rail transportation accounts for a large part of the final delivered price of coal, currently transportation costs exceed production cost.

Prospective coal basins have been found in more remote areas – Eastern Siberia, South Yakutia, and the Far East.

The Russian coal industry is in deep crisis, with the closing of inefficient old shaft mines and insufficient new capital to develop new ones. Despite these problems, the government considers coal to be a strategic fuel necessary for diversifying domestic energy supplies. Gazprom's decision to redirect gas currently used in power generation to higher value export markets will likely result in sharp increases in coal production to fill the gap.

ELECTRICITY

Russia produced 845,430 GWh of electricity in 1999. Almost 67 percent was produced from thermal fuels (gas and coal), 19 percent by hydro and 14 percent by nuclear. Hydropower plays a significant role in regulating peak loads in the unified power grid. The largest stations and the most prospective resources are located in southern Siberia; however, the capital costs of new hydro are prohibitively high. Only a few projects are now under consideration: the Boguchanskaya station in East Siberia, the Bureya, Ust'-Srednekanskaya, and Vilyi stations in the Far East and some medium-size stations in the North Caucasus region. Russia operates 29 nuclear reactors with installed capacity of about 21 GW. The bulk of power in the European part of Russia comes from nuclear sources.

Table 32 Energy Consumption & Supply (1999), ktoe

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	939,032	Industry Sector	87,768	Total	845,430
Net Imports & Other	-346,917	Transport Sector	18,011	Thermal	562,600
TPES	592,115	Other Sectors	380,154	Hydro	160,800
Coal	102,585	TFEC	485,933	Nuclear	122,000
Oil	130,156	Coal	46,712	Others	30
Gas	314,938	Oil	103,036		
Others	44,436	Gas	137,800		
		Electricity & Others	198,385		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

ENERGY DEMAND

In 1999, total final energy consumption in Russia was 486 Mtoe. By sector, 18 percent was industry, 16 percent residential and commercial, 4 percent transport and 3 percent agriculture. Almost 55 percent of energy consumed at the secondary level has not been assigned to a sector or was labelled as other. Fuel shares for total final energy consumption were 10 percent coal, 21 percent petroleum products, 28 percent gas and 12 percent for electricity and 29 percent for heat. From early 2000, plans have been made to decrease the gas share in national energy consumption. Due to the harsh climate, the most important energy use is for space heating, comprising about 40 percent of total final consumption.[22]

There are some clear signs of inefficient energy use in the national economy. The energy intensity of GDP rose by 16 percent from 1990 to 1999 (using comparable economic activity data).

[22] Fuel and Energy of Russia. Ministry of Fuel and Energy of Russia. Moscow. 2000.

The traditional energy intensive industrial structure with its ageing capital stock has not changed greatly, due to the lack of structural reforms and investment. Structural shifts to less energy intensive services and high technology industries are considered as a major policy direction to encourage energy savings, along with energy efficiency measures in existing industries. According to various estimates, Russia has an untapped energy savings technical potential of 35 - 45 percent of total energy consumption. A significant part of this potential is cost effective, meaning that the avoided cost of saved energy is less than the cost of energy production. The energy sector accounts for about 40 percent of this potential, other industries 30 percent, the residential sector 20 percent, transport 7 percent and agriculture 3 percent. The realisation of savings potential would be more economically efficient than additional energy production.

POLICY OVERVIEW

The new realities of economic development of the economy and the international situation, including the environmental concerns embodied in the Kyoto Protocol, has stimulated the development of a new version of the Russian Energy Strategy to 2020. The main long-term objectives of state energy policy are:

- The energy sector should perform an appropriate role in the achievement of the main socio-economic development targets – increase of general wealth and revival of the national economy;
- A radical cut in overall expenditures on energy supply to enhance the competitiveness of the national economy;
- To ensure national and regional energy security, and the development of a state energy sector monitoring system.

The basic policy priority is enhancement of energy efficiency as a means of sustainable energy development. Priorities in structural, regional, research and environmental aspects of energy policy have been identified.

STRUCTURAL POLICY

- Development of a stimulating economic environment for large financial-industrial groups, corporations and small- and medium-sized businesses.
- Completion of structural reforms of energy sector natural monopolies and restructuring of the coal industry.
- Optimisation of the national energy matrix based on structural reforms in the energy sector.
- Improving residential end-use energy efficiency.

The basic priorities should be: an optimal mix of different organisational modes in the energy sector, efficient management of state assets and natural monopolies, accelerating the pace of nuclear and coal industry development, the promotion of renewable energy, and optimal sharing of centralised/decentralised heat supply.

REGIONAL ENERGY POLICY

Regional energy policy should balance regional aims in terms of maintaining an adequate energy supply consistent with the national fuel-energy strategy:

- A consensus between regional and federal authorities, energy producers and consumers on the paths and rates for 'economy-energy-environment' sustainable development.
- The division of rights and responsibilities in energy supply management between federal and regional governments. Federal functions should include the

establishment of an adequate legal base and coordination of interregional and export energy interconnections. Regional governments should be responsible for their energy supply.

- Efficient use of energy produced in the region and delivered outside as a means of boosting economic development and the wealth of the population.

The main priorities are: a legal distinction between federal and regional governments 'roles, and the development of regional laws that are consistent with federal laws in areas of subsoil energy use and taxation.

RESEARCH AND DEVELOPMENT

- Development of technologies for accelerated capital renovation and investment in new projects.
- Safe operation of existing nuclear power stations, and ensuring that new generation nuclear installations are managed with advanced safety parameters.
- Creation of commercial production facilities for energy saving and renewable energy equipment.
- Higher efficiency in exploration and development of new energy resources, helping to ensure environmental standards.
- High degree of energy resource processing.

The main priorities are to: encourage innovation, involvement of national science and military industries, stimulate development of energy efficient and environmentally friendly equipment, technical renovation and modernisation of existing energy enterprises.

ENVIRONMENTAL POLICY

- Creation of a state regulatory system to deal with economy-environment issues, including environmentally oriented taxation.
- Stimulation of environmentally friendly energy technology development.
- Higher penetration of renewable energy to reduce negative environmental impacts and to conserve non-renewable energy resources for future generations.
- Establishment of a unified environmental information system, based on local and regional monitoring systems.
- Development of co-processing technologies for oil, gas and shaft methane utilisation with 6-8 BCM annual potential.
- Land recultivation in energy production sites.

The main priorities are: an environmentally friendly energy sector, stimulation of recycling technologies, waste-to-energy technologies, water recycling management, installation of pollution gas/dust absorbers, collection of royalties for natural resource use, environmental damage insurance, development of environmental and energy savings legislation.

The main instrument for new energy policy implementation is considered to be governmental regulation of energy market development. Such regulation includes:

- Pricing, fiscal and custom policies, targeted to regulate domestic energy prices to promote an adequate energy supply, competitiveness of domestic producers and financial stability; to provide investment opportunities for energy companies; to protect the domestic energy market; diversification of the national fuel-energy balance; elimination of price distortions between oil products, coal and artificially low state regulated gas prices; tax burden decrease in energy industries, to be levied partially on end-users; competitive conditions for different energy resources;

stimulation of innovation, investment and energy saving activities; a flexible customs policy, meeting world energy market requirements and general energy taxation.

- Institutional reform of sectors, accompanied by anti-monopolistic control of wholesale and retail energy prices and natural monopoly regulation.
- Development of energy legislation, standardisation, certification and licensing for energy producers.

NOTABLE ENERGY DEVELOPMENTS

NEW MINISTRY OF ENERGY

The former Ministry of Fuel and Energy of Russia was re-organised to become the new Ministry of Energy in July 2000. A new energy minister, Igor Yusufov, was appointed in June 2001. Some functions, such as subsoil energy reserve development and production sharing law implementation, have been transferred to other ministries, namely the Ministry of Natural Resources and the Ministry of Economics.

RESTRUCTURING IN THE ENERGY SECTOR

The new Russian government adopted a short-term programme of economic development in 2000. According to the new state socio-economic policy for 2000/2001, a number of restructuring measures are planned for the oil sector. These include: fiscal reform including the introduction of royalties; taxes on oil companies' profits; and taxation of low debit wells as per Production Sharing Agreements (PSA). In the gas sector, it is planned to: implement a programme of steady price increases to eliminate energy price distortions and encourage diversification.

Russia is currently planning to restructure certain aspects of the gas industry. They intend to separate transport and delivery services; to create a competitive environment for new gas companies with non-discriminatory access to the major pipelines and distribution networks; separate the financial activities of transport and distribution companies; introduce limits to horizontal and vertical integration in the gas sector; enhance control of investment programmes; and create a wholesale gas market.

In the power sector, it is planned to develop markets by: separating the natural monopoly power transmission, distribution and dispatch systems from the competitive generation components; introducing competition to generation and supply and encourage the entry of independent power producers; and create a competitive market environment to encourage efficient pricing and ensure adequate supply.

It is hoped that these reforms will attract more private and foreign investment in the energy sector. A lack of new investment threatens the energy sector's ability to meet the growing demand generated by economic recovery in 1999 and 2000.

PRODUCTION SHARING AGREEMENTS

A former Russian energy minister has been appointed as a special representative for energy diplomacy in the Caspian Basin to negotiate joint project developments and disputes associated with offshore fields.

The responsibility for legislative and implementation issues for production sharing agreements (PSA) was transferred to the Economics Ministry at the end of August 2000. The PSA legislation package was adopted in 1996 and implemented for a number of upstream development projects – Sakhalin 1, Sakhalin 2, Kharyaga and the Samotlor oil deposits in Western Siberia. Under this scheme, an investor is required to pay a profits tax, royalties and social security fees. The new taxation regime for natural resource development with a single tax 16.5 percent on revenues will become effective on 1 January 2005.

GAS DEVELOPMENT AND EXPORTS

Gazprom production volumes dropped in 1999, constrained by the lack of new upstream capacity. The 'Southern Strategy' emerged in Gazprom's international activities – new gas import contracts have been signed with Turkmenistan, Uzbekistan, and Kazakhstan to maintain a stable supply. Gazprom has developed the 'Blue Stream' project to, annually, export 16 BCM of natural gas to Turkey under the Black Sea. The company is collaborating with TotalFina-Elf and Petronas in the giant Southern Pars gas field development in Iran. Production is scheduled to begin in the fourth quarter of 2001.

The Russian oil company YUKOS has supplied 1 Mt of crude oil to China in 2000 by rail. A feasibility study has been carried out for a 30 Mt per year oil pipeline development between Russian East Siberia and China.

BP Amoco is involved in a natural gas export project from the giant Kovykta field (Irkutsk region) to China through its stakes in Russia Petroleum and Petro-China (a CNPC affiliate). The Russian Parliament and President have confirmed the PSA regime for the field development.

SETTLMENT IN GAS PAYMENTS DISPUTE

The non-payments issue between the electricity monopoly UES (United Energy Systems) of Russia and Gazprom has been largely resolved over the last 2 years. Gazprom announced at the beginning of 2000 a programme of potential decreases in gas supplies to Russia's power sector, in an effort to switch feedstocks for power generation to coal and fuel oil. The action is designed to enhance revenues by reducing domestic gas sales at artificially low prices and to maintain or increase exports , which have more favourable prices and payments terms. Domestic gas prices are roughly a tenth of prices for exports to Europe.

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SINGAPORE

INTRODUCTION

Singapore is a small island nation located between Malaysia and the Strait of Malacca. The total area of the island is 647.5 square kilometres and the population in 1999 was about 4 million. However, despite its small size and population, Singapore is one of the more highly industrialised and urbanised economies in the Southeast Asia region.

In 1999, real GDP in 1995 dollars and 1995 purchasing power parity were US$ 84.42 billion. Per capita GDP was US$ 21,360. Due to its strategic location on the Strait of Malacca, Singapore is an important shipping centre and has a large petroleum refining industry. Singapore is completely without indigenous resources and relies on imports to meet its energy requirements.

Table 33 Key data and economic profile (1999)

Key data		Energy reserves	
Area (sq. km)	647.5	Oil (Proven)	-
Population (million)	3.95	Gas	-
GDP Billion US$ (1995 US$ at PPP)	84.42	Coal (Recoverable)	-
GDP per capita (1995 US$ at PPP)	21,360		

Source: Energy Data and Modelling Center, IEEJ

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Singapore is very dependent on oil. This fuel accounted for 100 percent of total primary energy supply in 1999. Most of this imported energy was used for power generation or as feedstock in the refining and petrochemical industries.

All of electricity generation in Singapore is thermal, mostly oil. From 1990 to 1999, electricity demand increased by 7.2 percent per annum. The total amount of electricity consumed in 1999 was 28,690 GWh. Manufacturing and services industries accounted for most of this consumption. Electricity demand is currently projected to grow at 4-6 percent per annum over the next 10 years.

To meet the growing demand for electricity, Tuas Power Ltd is building a new power station, Tuas "A" in two stages. The first stage of the project which has a combined capacity of 1,200 MW, began operation in 1999. Work on the second stage is in progress. SembCorp Cogen Pte Ltd is developing a co-generation plant with an expected generation capacity of 650 MW. The plant is expected to come on stream in 2001. In addition to building new power stations, Singapore is active in upgrading power stations with newer and bigger generation units. These equipment upgrades have improved Singapore's overall system thermal efficiency to about 39 percent in 1999.

FINAL ENERGY CONSUMPTION

In 1999, total final energy consumption was 3,560 ktoe. Electricity accounts for 65 percent of consumption while oil makes up 32 percent and gas contributes 3 percent.

Table 34 Energy supply & consumption for 1999[23]

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	-	Industry Sector	-	Total	28,690
Net Imports & Other	19,734	Transport Sector	-	Thermal	28,690
TPES	19,734	Other Sectors	-	Hydro	-
Coal	-	TFEC	3,560	Nuclear	-
Oil	19,733	Coal	-	Others	-
Gas	-	Oil	1,137		
Others	-	Gas	94		
		Electricity & Others	2,329		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

POLICY OVERVIEW

There are no energy subsidies in Singapore. Allowing the price of energy to reflect the current international market price of fuel ensures that energy is being used efficiently. Electricity tariffs are reviewed periodically to ensure that they reflect true costs. Prices for the other forms of energy, such as piped gas supplied by PowerGas Ltd and petroleum products which are supplied by the oil companies, are set by the individual private companies and reflect international market prices of fuel.

NATURAL GAS

The government is actively working to reduce Singapore's dependence on oil. Since January 1992, natural gas from Malaysia has been used for electricity generation as a first step towards energy supply diversification. Gas imports from Indonesia were introduced in 2001.

The government plans to restructure the gas industry by separating the ownership of the gas transportation business, which is a natural monopoly, from the contestable sectors of gas imports, trading and retailing. The gas distribution and transmission network will be owned by a gas grid company, PowerGas Ltd, which will allow players open and non-discriminatory access to the network.

ELECTRICITY

The Public Utilities Board (PUB) was formed in 1963, and was responsible for the supply of electricity, piped gas and water to the entire population of Singapore. The PUB was reorganised in October 1995 to continue supplying water, and to take on the new role of regulating the electricity and piped gas industries.

The vertically integrated electricity industry was restructured in 1995 to introduce competition in electricity generation and supply. Two generation companies (PowerSenoko Ltd and PowerSeraya Ltd), a transmission and distribution company (PowerGrid Ltd) and a supply

[23] There are some problems with the energy balance for Singapore in 1999. The EDMC is working with Singapore officials to resolve these issues.

company (Power Supply Ltd) were formed under Singapore Power Ltd. The third generation company, Tuas Power, took over the development and operation of the Tuas Power Station.

The Singapore Electricity Pool (SEP), a wholesale electricity market, began operation on 1 April 1998. This pool facilitates the trade of wholesale electricity in a competitive environment. Generation companies compete to sell electricity through the Pool. Electricity suppliers then purchase electricity at competitive prices from the Pool for retail sale to consumers. As competition in electricity generation and supply develops, there will be less reliance on regulation.

In September 1999, the government of Singapore carried out a comprehensive review of the electricity industry. The key objective of the review was to implement an electricity market structure and regulatory framework that would support a competitive electricity industry in Singapore, while ensuring that reliability and security of supply are maintained. Following the review, the government decided in March 2000 to press on with further deregulation of the electricity industry so to obtain the full benefits of competition. It was decided to introduce competition in generation, competition for large industrial and commercial consumers and to establish an independent system operator. Retail competition for smaller consumers is to be introduced later. PowerGrid will continue to be subject to performance-based regulation by the state since its transmission and distribution business is a natural monopoly.

ENERGY CONSERVATION

Energy conservation has been actively promoted and pursued at a national level through a series of fiscal and non-fiscal policies with the objective of improving overall system efficiency through better load management. The PUB provides advisory services in efficient use of electricity to consumers in the industrial and commercial sectors. A set of energy conservation standards for building design has been incorporated into the Building Regulations administered by the Building and Construction Authority. A multi-agency committee is continuously looking into ways to increase energy efficiency and conservation in various areas, such as its land transport system.

NOTABLE ENERGY DEVELOPMENTS

ARRIVAL OF GAS IMPORTS FROM INDONESIA

In January 2001, after a 656-kilometre gas pipeline from Indonesia's West Natuna gas field to Singapore was completed, Singapore received its very first shipments of gas from Indonesia. Under the current contract, Indonesia's Pertamina is delivering 9.1 MCM per day. Another contract with Pertamina signed in 2000, will increase gas imports by an additional 9.8 MCM per day starting in 2003. Most of this imported gas is to be used for power generation. Singapore also imports gas from Malaysia.

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CHINESE TAIPEI

INTRODUCTION

Chinese Taipei is an isolated island off the southeast coast of China. It has an area of about 36,000 square kilometres and a total population of about 22 million. Chinese Taipei's main industries are electronics and petrochemicals. It is also an important trading centre with one of the world's busiest ports, Kaohsiung.

Chinese Taipei sustained high levels of economic growth, 7.7 percent per year, between 1980 and 1995. Growth rates have slowed due to the Asian financial crisis in 1997, but are still relatively strong compared with its neighbours. GDP per capita was US$ 14,611 in 1999 and the GDP growth rate is projected to be 3 percent for 2001.

Chinese Taipei has very limited domestic energy resources and relies on imports for most of its energy requirements. Oil reserves are less than 1 MCM and coal reserves are 1 Mt. Gas reserves are larger at around 77 BCM. In 1999, electricity generation capacity was around 26,000 MW.

Table 35 Key data and economic profile (1999)

Key data		Energy reserves**	
Area (sq. km)	36,000	Oil (Proven)	0.636 MCM
Population (million)	22.03	Gas	76.5 BCM
GDP Billion US$ (1995 US$*)	321.93	Coal (Recoverable)	1.0 Mt
GDP per capita (1995 US$ at PPP)	14,611		

Source: Energy Data and Modelling Center, IEEJ. *purchasing power parity (PPP) figures are not available for Chinese Taipei **EIA (USA)

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply in Chinese Taipei was 76,086 ktoe in 1999. Of this total 48 percent was oil, 31 percent was coal, then 13 percent nuclear and 7 percent natural gas. Almost 85 percent of energy requirements were imported, including the bulk of natural gas and nearly all oil and coal consumption.

Chinese Petroleum Corporation (CPC), the state oil company, is the dominant player in all sectors of the Chinese Taipei's petroleum industry, including exploration, refining, storage, transportation, and marketing. The main supplier of crude oil to Chinese Taipei is the Middle East. In January 1999, Chinese Taipei liberalised the domestic oil market by freeing up importation regulations for some oil products (fuel oil, jet fuel, and LPG). Significant competition began in August 2000 when the first stage of the oil refinery facility in Mailiao owned by Formosa Petrochemical Corp., the first private refinery, went into commercial production. The company aims to capture half of the Chinese Taipei gasoline market by 2001.

Besides oil, CPC also is responsible for domestic natural gas exploration, production and imports. CPC operates Chinese Taipei's only liquefied natural gas (LNG) receiving terminal at Yungan, Kaohsiung. In anticipation of increased gas demand for power generation and in light of market liberalisation in the gas market, the government has granted permits to import LNG to companies other than CPC and is currently accepting bids to build additional LNG terminals from

both CPC and private firms. Chinese Taipei imports LNG from Indonesia (since 1990) and Malaysia (since 1995).

Chinese Taipei produces a small quantity of coal, but the vast majority is imported, primarily from Australia and Indonesia. In Chinese Taipei, coal is used for electric power generation as well as in the steel, cement and petrochemical industries.

In 1999, Chinese Taipei produced 169,473 GWh of electricity. The fuels used to generate electricity were 72 percent thermal, 23 percent nuclear and 5 percent hydro. The Taiwan Power Company (Taipower), the state-owned electric power utility, currently dominates the electric power sector. However, since 1994 independent power producers (IPP's) have been allowed to participate in the market. The first major IPP was the Mai-Liao coal-fired power plant that began commercial operation on 31 May 1999. Owned by Formosa Plastics, this plant has an installed capacity of 1,800 MW. The first private natural gas-fired power plant, the Hai-Hu power plant, began production on 24 July 2000. It has an installed capacity of 450 MW. Five other IPP projects are under currently construction.

After a third round of IPP bidding, Chinese Taipei approved four private power plants (with a total capacity of 2,910 MW) in June 2000. The power plants licensed in this round were restricted to gas-fired units, in compliance with the existing policy to increase the use of clean fuel. They are expected to begin production in 2003 and 2004.

Table 36 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	11,560	Industry Sector	24,961	Total	169,473
Net Imports & Other	64,526	Transport Sector	12,472	Thermal	122,115
TPES	76,086	Other Sectors	11,111	Hydro	8,942
Coal	23,691	TFEC	48,544	Nuclear	38,416
Oil	36,395	Coal	7,659	Others	-
Gas	5,221	Oil	26,883		
Others	10,780	Gas	1,607		
		Electricity & Others	12,395		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

Due to the rapid growth of technology-intensive industries, energy conservation measures and relatively sluggish growth in energy-intensive industries, total energy consumption in 1999 reached 48,544 ktoe, a moderate increase of 3.3 percent over 1998. The industrial sector consumed 51 percent of total energy, the transportation sector 26 percent, and other sectors 23 percent.

Oil is the dominant fuel in the energy mix accounting for about 55 percent of final energy consumption. Electricity was responsible for 26 percent, coal with around 16 percent and gas for the remaining 3 percent.

POLICY OVERVIEW

The Energy Commission under the Ministry of Economic Affairs (MOEA) was established in November 1979 to formulate and implement national energy policy, including the "Energy

Management Law", the "Electricity Law", "Regulations Governing Import, Export, Production and Sale of Petroleum Products", "Regulations Governing the Installation and Administration of LPG and Petroleum Filling Stations", "Regulations Governing Administration of Gas Utilities", and other energy-related regulations. The Commission also guides the operations of energy enterprises, and carries out tasks such as the evaluation of energy supply and demand, the establishment of an energy database system, the promotion of energy conservation programmes, the implementation of research and development, and the promotion of international energy cooperation.

The liberalisation and privatisation of energy related enterprises has been promoted in recent years to permit the private sector to build power plants and oil refineries, to promote transparency and systemisation of domestic fuel prices and electricity rate adjustments, strengthen the management of energy supply and demand, and address energy-related environmental impacts.

In order to alleviate the threat of power shortages, in 1994, Chinese Taipei decided to deregulate the power market and open it up to private investment. IPPs, however, were required by law to sell power only to Taipower, the state monopoly. A law to privatise the generation assets of Taipower and open the generation market to competition is currently being considered by the government. Reforms are also being considered in the oil market. In September 1998, the MOEA submitted a draft of the Petroleum Administration Law to the legislature for review. After the legislature approves the Petroleum Administrative Law, Chinese Taipei is scheduled to fully liberalise the oil market.

NOTABLE ENERGY DEVELOPMENTS

LIBERALISATION OF THE POWER INDUSTRY

The Chinese Taipei government is currently considering a new electricity law. An important aspect of the new electricity policy is a clear shift from an emphasis on nuclear power to an emphasis on LNG. The government published the "Programme for the Private Sector to Apply to Construct Power Plants in the Current Stage" on 21 January 1999. It outlined a policy to approve only the construction of LNG power plants in the future and to increase the share of LNG in electricity generation to one-third by 2010.

The new electricity law also outlines a plan to privatise Taipower. The Taipower monopoly in generation will be eliminated in order to establish a competitive structure and enhance the operating efficiency of power generation. Taipower, however, will retain its monopoly over transmission and distribution facilities. The major concepts of the revision of the Electricity Law are as follows:

- Electric utilities will include integrated utilities, or separate transmission and distribution utilities. They will have an obligation to supply power and their electricity tariffs will be regulated to control monopoly power.
- Power generation companies can wholesale generated electricity to any utility or sell directly to customers through their own transmission lines or through a grid dispatched by the Independent System Operator (ISO). Their electricity tariffs will not be regulated.
- Gradually, consumers will be allowed to purchase electricity from any utility.

The expected date for privatisation of Taipower was originally 2001, but the timing is now uncertain due to the delays in passing the enabling legislation.

FOURTH NUCLEAR POWER PLANT

In 2000, the MOEA commissioned "The Re-evaluation Committee for the No.4 Nuclear Power Plant (NPP) Project." In response to the committee's findings, the MOEA proposed a halt to construction of the No 4 NPP on 30 September 2000. The Administrative Yuan announced on 27 October 2000, a halt to construction of the plant. However, the Legislative Yuan did not agree

with this action, so the Administrative Yuan requested the Judicial Yuan to produce a constitutional interpretation on the dispute, with a report sent to the Legislative Yuan. This was done on 15 February 2001 through the No 520 "Interpretation of the Council of Grand Justices." Both the Legislative and Administrative Yuans after considering the issues of political stability, economic development, the welfare of the people, and the spirit of the constitution, finally agreed to re-instate the construction budget for the project, including related legal costs. The Kungliao nuclear power plant is owned by the Taipower and will have a generation capacity of 2,700 MW.

PROMOTION OF RENEWABLE ENERGY

In order to achieve the goal of 3 percent of total energy consumption from renewable sources by year the 2020, some aggressive renewable programmes were begun in Chinese Taipei in the year 2000. For example, consumers can now receive a subsidy for installing solar heaters. Also, users of photovoltaic and wind turbines can receive a down payment subsidy of up to 50 percent. Further, geothermal rights have been deregulated to allow private companies to invest in this form of energy development. During the period 2000 - 2004, 0.8 million square metres of solar heating, 18 MW of wind power, 7 MW of photovoltaic, and 10 MW of geothermal power are expected to be put into operation. This will lay a good foundation for the development of renewable energy in Chinese Taipei.

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THAILAND

INTRODUCTION

Thailand is located in southeast Asia and shares borders with Malaysia to the south and Myanmar, Laos and Cambodia to the north. It has an area of 513,115 square kilometres and a population of about 60 million.

Over the past decade, facilitated by strong economic growth to 1997, Thailand has made significant progress in increasing energy consumption and developing its energy sector. However, in 1997, an economic recession in Thailand caused by the Asian financial crisis, resulted in negative economic growth and a decline in energy demand. In the first part of 1999, the economic recession weakened domestic purchasing power; however, by the second half of 1999, economic countermeasures taken by the government began to take effect and a gradual recovery, particularly in the industrial export sector, took hold. Currency levels stabilised and the inflation rate declined. In 1999 GDP was US$ 357.5 billion (at US$ 1995 at PPP), an increase of 4.2 percent from the previous year.

Thailand is highly dependent on energy imports, particularly oil. In 1999, net imports accounted for 56 percent of energy supply in the economy; down significantly from 96 percent in 1980. Thailand produces a modest amount of crude oil and is self-sufficient in natural gas.

Table 37 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	513,115	Oil (Proven)	23 MCM
Population (million)	60.25	Condensate (Proven)	33 MCM
GDP Billion US$ (1995 US$ at PPP)	357.46	Gas (Proven)	346 BCM
GDP per capita (1995 US$ at PPP)	5,933	Coal (Recoverable)	1,618 Mt (Lignite)

Source: Energy Data and Modelling Centre, IEEJ. * Petroleum and Coal Activity in Thailand 1999, Department of Mineral Resources.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 1999, the primary energy supply was 60,363 ktoe. Oil was responsible for 58 percent of primary supply, gas for 28 percent, coal for 13 percent and other for 1 percent. Energy imports accounted for 56 percent of primary energy supply in 1999. Crude oil made up 93 percent of total net energy imports.

In 1999, Thailand imported 89 percent of the oil it consumed; net oil imports amounted to 31,364 ktoe. This high level of import dependence is expected to continue in the foreseeable future. The major source of crude oil is the Middle East, though oil is also imported from ASEAN economies, the Asia-Pacific, and North America. Thailand does produce a small amount of oil, 3,919 ktoe in 1999. Domestic crude oil production in 1999 jumped 7 percent due to higher output in the Benchamas field. In 1999, Thailand's total proven reserves of crude oil were 23 MCM. Onshore reserves in Nam Phong and Sirikit fields account for 11.8 MCM while offshore reserves mainly in the Benchamas, Pakakrong, Maliwan and Tantawan fields make up the remaining 12 MCM. For condensate, total proven reserves are 33 MCM. All deposits are located offshore with major pools in the Erawan, Pailin, Bongkot and JDA areas.

The lingering effects of the Asia crisis and high oil prices led to a drop in domestic petroleum product consumption in 1999 meaning certain domestic refineries could not operate at full capacity. Utilisation rates in 1999 were 88 percent. To minimise losses, Thai refineries were forced to export more of their products. Exports of petroleum products were 5,072 ktoe in 1999, an increase of 19 percent from the previous year. Thailand has a combined refinery capacity of 817,000 barrels per day.

Unlike oil, Thailand is largely self-sufficient with respect to natural gas. Gas production increased by 8 percent in 1999 due to the additions of new offshore fields: Benchamas, Trat, and Pailin. Several offshore gas reserves have been reported in recent years, including natural gas offshore development in the Thailand-Malaysia Joint Development Area (JDA) and two additional natural gas and condensate production fields in the Gulf of Thailand, the Pladang and the Plamuk fields. In 1998, Pladang supplied 0.391 BCM (13.810 Tcf) of natural gas and 596,182 barrels of condensate and Plamuk supplied 0.130 BCM (4.593 Tcf) of natural gas and 33,297 barrels of condensate. Natural gas is used largely for electricity generation.

Coal in Thailand is used for electricity generation and in the industrial sector. Most of Thailand's proven coal reserves have low calorific value and are of lignite type. The total volume of reserves is 1,617 Mt and most are located in the Mae Moh basin.

Total electricity generation in 1999 was 89,246 GWh, slightly lower than in 1998. Almost all domestic generation was produced using thermal energy (96 percent). The remaining 4 percent was supplied by hydro, geothermal, solar cell and wind turbine energy. Natural gas is the most important thermal fuel source for electricity generation, accounting for 60 percent of thermal consumption. Other important thermal fuels were fuel oil, lignite coal and lastly diesel. In 1999, the Electricity Generation Authority of Thailand (EGAT) reduced its use of fuel oil for power generation, substituting natural gas which is cleaner and relatively cheaper. To supplement domestic production and balance peak loads, Thailand imports electricity from the Lao Peoples Democratic Republic, Malaysia, Myanmar and the Kingdom of Cambodia. In 1999, imports totalled 1,623 GWh, 99 percent from Lao PDR. At the same time, Thailand also exports electricity to Lao PDR, Myanmar and Cambodia.

Table 38 Energy supply & consumption for 1999

Total Primary Energy Supply	**(ktoe)**	**Total Final Energy Consumption**	**(ktoe)**	**Power Generation**	**(GWh)**
Indigenous Production	26,579	Industry Sector	12,347	Total	90,067
Net Imports & Other	33,784	Transport Sector	18,991	Thermal	86,531
TPES	60,363	Other Sectors	8,955	Hydro	3,534
Coal	7,915	TFEC	40,293	Nuclear	-
Oil	35,283	Coal	3,876	Others	2
Gas	16,682	Oil	28,359		
Others	483	Gas	1,117		
		Electricity & Others	6,941		

Source: Energy Data and Modelling Centre, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

Thailand's total final energy consumption for 1999 was 40,293 ktoe, an increase of 2 percent over the previous year. Petroleum products accounts for the highest proportion of secondary

demand (70 percent), followed by electricity (17 percent), lignite coal (10 percent), and gas (3 percent). Demand for natural gas, and coal/lignite increased by, 25 and 19 percent respectively. On the other hand, petroleum demand grew by only 0.3 percent. High oil prices since 1999 have pushed up end-use petroleum prices; as a result, residential and certain commercial and industrial sub-sectors have reduced their consumption. Demand for electricity edged up slightly (0.3 percent) in 1999.

The transportation sector was the largest energy consumer and accounted for 47 percent of total final energy consumption. The transport and industry sectors consumed 18,991 and 12,347 ktoe in 1999, a decline of –0.2 percent and an increase of 12 percent from previous year. Energy consumption in the residential and commercial sectors fell slightly due to high and unstable prices for crude oil and petroleum products in 1999.

POLICY OVERVIEW

DEREGULATION AND PRIVATISATION PROGRAMME

In accordance with the objectives outlined in the Eighth National Economic and Social Development Plan (1997-2001), the Thai government has endeavoured to deregulate energy prices and the energy market since 1996. Thus far, the oil market has been deregulated and was completely liberalised in 1996. Several government resolutions have pushed forward deregulation in other energy markets. A cabinet resolution on 16 September 1997 sped up privatisation of the energy sector. On 4 November 1997, a resolution approving the sale of shares in state-owned monopolies Electricity Generating Public Company Ltd (EGCO) and the Petroleum Authority of Thailand Exploration and Production Pcl. (PTTEP) was passed. Another on 1 September 1998 approved the Master Plan for State Enterprise Sector Reform. On 16 February 1999 a resolution was approved to privatise the Ratchaburi power plant and push forward the natural gas deregulation programme.

In compliance with the strategy outlined in the National Development Plan, the electricity supply industry is now being deregulated to allow private sector investment in the form of Independent Power Producers (IPP) and Small Power Producers (SPP), in power generation projects. These private generators will sell their electricity to the Electricity Generation Authority of Thailand (EGAT). To date, EGAT is expected to purchase power from seven IPP projects, with a total capacity of 5,944 MW, and from approximately 55 SPP projects, with an estimated total sale of 2,500 MW. Power purchase from IPPs and SPPs will reduce the amount of power generation infrastructure investment required by EGAT.

The natural gas supply industry (GSI) currently operates as a state-owned monopoly. Plans outlined in the National Development Plan to introduce third party access to PTTEP's natural gas pipeline system are still in the development stages. Third party access would allow gas traders, other than PTTEP, to access transportation services and would facilitate direct gas sale between gas producers and gas users.

To facilitate its programme of privatisation and deregulation in the energy sector and to promote competition in liberalised energy markets, the government has introduced the State Enterprise Corporatisation bill. A number of state enterprises could be privatised without any change in law. In these cases, privatisation can be implemented without delay. In other cases, state enterprises need to be turned into corporations first. The new bill, which is expected to become law in the near future, will speed up this process.

DEALING WITH VOLATILE OIL MARKETS

High, volatile oil prices since 1999 have presented a formidable challenge to a Thai economy, struggling to recover from the 1997 financial crisis. At the Eighth APEC Economic Leaders Meeting in Brunei Darussalam Thailand, in collaboration with other APEC member economies, addressed the issue of oil security. Thailand is highly dependent on oil imports. To protect the

economy from oil price shocks it is considering several different strategies. On the demand side, the government intends to promote energy conservation and the efficient use of energy. It also advocates diversifying energy use away from oil towards less volatile energy markets like natural gas, orimulsion, coal and renewable sources. Recognising the importance of emergency preparedness in the case of an oil shortage or crisis, Thailand is also considering establishing official oil stockpiles. The National Energy Policy Office (NEPO) is studying the national oil stockpiling strategy and is considering stockpiling options for Thailand. In addition, NEPO closely cooperates with other ASEAN economies to improve the ASEAN Petroleum Security Agreement (APSA) and to strengthen energy security in Asia.

ENVIRONMENT

In accordance with the objectives outlined in the Eighth National Economic and Social Development Plan (1997-2001), Thailand is working to minimise air pollution from energy production and usage. In 1999, to correspond with vehicle emission standards, Thailand made the sale of low sulphur diesel (sulphur content of 0.05 percent or less) mandatory. Sulphur content in fuel oil for electricity generation and industry was also reduced, in this case, to 2 percent in Bangkok, Samut Prakarn and other provinces where a large number of industrial factories are located. The government is also promoting the use of clean fuels, such as natural gas and LPG, as substitutes for oil in power plants, industrial factories as well as in commercial vehicles in the Bangkok Metropolitan area.

NOTABLE ENERGY DEVELOPMENTS[24]

ENERGY CONSERVATION

In 2000, under the newly established government, Thailand declared "energy conservation" a crucial component of energy policy. The policy aims to achieve sustainable development; that is, to promote the efficient use of energy without depleting domestic natural resources or harming the environment. Efforts are also being made to reduce dependence on foreign energy sources. In accordance with this policy, the government continues to promote the use and exploitation of domestic natural gas and alternative energy sources. The government also promotes the research and development of innovative energy sources. Lastly, the government is emphasising energy management to increase the competitiveness of the industrial sector and to enhance the stability of energy prices through appropriate monetary, fiscal and managerial measures.

[24] APEC EWG 21. (2000). *Notable Energy Developments in Thailand.*

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UNITED STATES

INTRODUCTION

The United States (US) is the world's largest and most influential economy. In 1999, total GDP was US$ 8.8 trillion (in 1995 US$ at PPP) or 39 percent of the APEC total. The US is located in North America between Canada and Mexico, has a population of 278 million people (1999) and a geographical size of 9.3 million square kilometres.

The United States has enjoyed steady economic growth of about 3.5 percent per annum since the recession of 1991. Growth has been particularly robust from 1995 to 2000, expanding by 4 percent per annum. Both inflation and unemployment were low at 3.4 percent and 4.1 percent respectively in 2000. However, in the latter part of 2000 the economy began to weaken, with annual quarterly rates dropping from 5.8 percent to only 0.8 percent at year's end. The US economy has continued to wane in 2001 (growing at roughly 1 percent) and the economic outlook is uncertain. As the world's largest economy, a slowdown in the US economy is expected to have a detrimental impact on economies around the world.

The United States is by far, the world's largest producer, consumer, and importer of energy. It is endowed with great energy resource wealth. At the beginning of 2000, proven oil reserves were 3,460 MCM and estimated natural gas reserves were 4,740 BCM. Recoverable coal reserves at the end of 1998 were 249,567 Mt of coal and peak power generation capacity at the end of 1999 was 793,957 MW (Energy Data and Modelling Center, IEEJ). However, due to its large population, extensive industrial base and the relative wealth of its citizens, US energy consumption far exceeded production. The US economy consumed 5.8 toe (FEC) per capita in 1999, this level is much larger than the APEC average of 1.5 toe.

Table 39 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	9,372,610*	Oil (Proven)	3,460.4 MCM**
Population (million)	278.23	Gas	4,740.4 BCM**
GDP Billion US$ (1995 US$ at PPP)	8,757.21	Coal (Recoverable)	249,567 Mt
GDP per capita (1995 US$ at PPP)	31,475		

Source: Energy Data and Modelling Center, IEEJ. *US Energy Information Administration. **reserves as of 1 January 2000.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 1999, primary energy supply in the United States was 2,254 Mtoe. Broken down by fuel type: 40 percent was crude oil and petroleum products, 23 percent was coal, 23 percent was natural gas and 8 percent was nuclear. The remaining 6 percent of primary energy came from hydro, geothermal and other fuels. The United States imported approximately 24 percent of its energy requirements in 1999.

In 1999, the United States consumed almost 894 Mtoe of crude oil and equivalent. Though oil supply has grown 1.4 percent per annum during the 1990s, production levels have declined by -3.1 percent per year as oil exploration and production companies have turned their attention to

cheaper, less mature basins in Africa, Asia and the Middle East. In 1990, 46 percent of oil demand was met by imports, by 1999, this share had climbed to 56 percent. Almost half of imported oil came from OPEC economies, while Canada, Venezuela and Mexico were the next largest suppliers. Growth in the transportation and industrial sectors has been driving demand for petroleum products. Louisiana is the leading producer of oil in the United States followed by Texas, California and Alaska.

Natural gas supply in 1999 was 517 Mtoe. The United States proven gas reserves account for 3.2 percent of world reserves (6th economy). In 1999, total gas consumption exceeded domestic supply by approximately 16 percent. Gas shortfall in the US is met almost exclusively by Canadian imports; therefore, natural gas markets in these two economies are linked by an extensive network of gas pipelines. Since 1998, to meet rapid gas demand in the United States, there has been a surge in pipeline expansion and new construction. Most recently, in December 2000, the Alliance Pipeline from western Canada to the Chicago area went into service with a capacity of 1.3 Bcf/day. Several other pipeline projects are being considered or are under construction, as are a range of domestic exploration and LNG projects. Gas use in the industrial and electricity generation sectors has increased in recent years, partly because it is the "cleanest" of the fossil fuels. As well, since deregulation in the 1980s and until about 2000, gas prices have been falling while access through the pipeline network has been expanding.

During the winter (October 2000-March 2001), natural gas wellhead prices averaged around US$ 5.77/mcf, spiking to US$ 10.24/mcf at one point. Several factors, some of them short term, sharply reversed the downward trend in gas prices over the last decade: 1) US gas production fell from 1994 through 1999, in part due to declining prices; 2) demand for gas has increased, especially for power generation (90 percent of planned power generating capacity over the next few years are gas-fired); 3) winter gas storage levels were below normal; and 4) inevitable delay between increased gas drilling response and the arrival of new supplies to market. New gas supplies have relieved pressure on gas markets and pushed down summer prices. In June 2001 gas prices were estimated to be US$ 3.88/mcf.

Table 40 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption* (ktoe)		Power Generation (GWh)	
Indigenous Production	1,703,352	Industry Sector	582,971	Total	3,699,043
Net Imports & Other	550,914	Transport Sector	602,273	Thermal	2,643,785
TPES	2,254,266	Other Sectors	437,112	Hydro	313,383
Coal	522,243	TFEC	1,622,356	Nuclear	725,036
Oil	894,207	Coal	32,253	Others	16,839
Gas	516,629	Oil	857,078		
Others	321,187	Gas	366,056		
		Electricity & Others	366,969		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

* Represents "site energy" that does not account for generation and distribution losses attributed to that sector. Since the building's sector is heavily dependent upon electricity, this disproportionately shows a reduced impact by that sector.

Coal use in the United States was 522 Mtoe in 1999. US coal reserves are found in Appalachia and in states west of the Mississippi. Wyoming, West Virginia and Kentucky are the main producers. In 2000, coal production increased slightly in the West, but fell sharply in the interior United States, and decreased slightly in Appalachia. Low-sulphur western coal production surpassed relatively higher-cost, higher-sulphur, Appalachian coal for the first time in 1998. Phase

1 of the Clean Air Act Amendments of 1990 (CAAA) has been a strong incentive for low-sulphur coal development and has prompted robust growth since 1994.

The United States is the third largest coal exporter in the world behind Australia and South Africa. US coal exports have fallen significantly since 1996 due mainly to lower world coal prices and increased competition from other coal-producing nations (Australia, South Africa, Indonesia, Venezuela and Colombia). Moreover, many economies, particularly in Europe, are substituting cleaner-burning natural gas for coal in electricity generation capacity additions. Both steam coal and metallurgical coal exports declined sharply in 1999, by 15 percent and 32 percent, respectively. Export markets for metallurgical coal have been declining over the past few years because of the penetration of new steel-making technologies that require less high-grade coking coal. In light of these long-term demand trends, US coal exports are likely to decline further in coming years.

The United States produced over 3.7 million GWh of electricity in 1999 with approximately 54 percent coming from coal, 20 percent nuclear, 17 percent natural gas, 8 percent hydro, and the remainder from geothermal and other sources. Electricity prices fell every year between 1993 and 1999; however, due to higher natural gas, electricity prices have levelled out in 2000. The average price of electricity during 2000 averaged 6.68 cents per kWh.

Since 1977, no new nuclear power units have been commissioned in the United States, and none are currently planned. The 1979 Three Mile Island accident raised concerns about nuclear power plant safety and deterred further expansion. Recently attitudes have started to change. In March 2000, the first-ever operating license extension was granted to the 1,700 MW Calvert Cliffs nuclear plant in Maryland. The 20-year extension will allow the two reactors to run until 2034 and 2036, respectively. Many nuclear plants have achieved utilisation rates of over 90 percent, up significantly from decades ago.

Despite these positive developments, the nuclear power industry and regulators must address problems such as negative public opinion and finding a site for a permanent nuclear waste storage facility. In 2000, President Clinton vetoed a Congressional bill permitting an interim nuclear waste storage site at Yucca Mountain (north of Las Vegas). Meanwhile, nuclear power plants are exceeding their wet storage capacity and are resorting to "dry cask" storage. The DOE, which is responsible for building a long-term waste storage facility, has continually delayed the project due to political and public opposition. According to estimates by the Nuclear Energy Institute, due to these costly delays, the DOE may be liable for damages exceeding US$ 50 billion.

FINAL ENERGY CONSUMPTION

In 1999, total end use energy consumption in the United States was 1,622 Mtoe. Broken down by sector: transport consumed 37 percent, industrial accounted for 36 percent, followed by buildings (residential/commercial) at 27 percent. By fuel source, petroleum products accounted for 53 percent of consumption, natural gas for 23 percent and electricity for 18 percent. Coal and coke products made up 2 percent of consumption and other fuels were responsible for the remaining 4 percent.

POLICY OVERVIEW

Energy policy in the United States is very supportive of market mechanisms. The government intervenes in areas where the market does not adequately address national priorities and objectives. Some areas where the government has been proactive include: achieving energy security, ensuring reasonable energy prices and supporting research and development of new technologies. To achieve these goals, the Department of Energy (DOE) is responsible for recommending and formulating policy as well as implementing programmes in the United States.

With respect to oil policy, the DOE is very concerned about security of supply. The United States currently imports more than half of its oil requirements and this heavy dependence on foreign imports is expected to continue in the future.

ENERGY SECURITY AND THE NORTHEAST HOME HEATING OIL RESERVE

The United States established its Strategic Petroleum Reserve (SPR) in 1977 in response to the oil crisis of the early 1970s. Crude oil is stored mainly in four underground salt caverns near the Gulf Coast in Texas and Louisiana. Facilities include a large distribution system. The US Department of Energy manages the facilities and conducts test sales and releases from the SPR. The SPR has a capacity of 700 million barrels and its current stock is approximately 542 million barrels, below the peak level of 592 million barrels in 1994. The current SRS inventory protection will last 53 days, down from its highest level of 118 days in 1985. Current US public and private inventories combined account for approximately 150 days of stock, which exceeds the International Energy Agencies requirement of 90 days.

The SPR represents a total investment of about US$ 20 billion with an annual requirement of US$ 158 million for maintenance and operation. The average price paid for oil in the reserve is approximately US$ 27 per barrel. If ordered by the President, oil can be delivered to the US market within 15 days at a maximum rate of 4.1 million barrels per day. This is significantly higher than the maximum US import peak of approximately 10 million barrels per week.[25] In the late 1990s, the SPR was upgraded to ensure its full and safe operation until at least 2025.

In 1991, due to supply and price concerns associated with the Persian Gulf War, the US withdrew oil for the first time in a non-test scenario. A total of 17.3 million barrels were released through competitive sales to private oil companies, less than initially authorised. Most recently, in September and October of 2000, 2.6 million barrels of oil were withdrawn from the SPR to pay for the 2.0 million barrel Northeast Home Heating Oil Reserve (NHHOR). This new reserve was established to avoid supply disruptions and high price spikes such as those that occurred in December 1996, and January and February 2000. The Northeast region was singled out because, compared to other regions of the US, it is heavily dependent upon home heating oil. In March of 2001, Secretary Abraham formally established the NHHOR as a separate legal entity from the SPR. This reserve will serve the following Northeast States: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

US ENERGY SANCTIONS

The United States has imposed energy sanctions on several economies, including Iran, Iraq, and Libya (an oil embargo against Serbia was lifted by President Clinton on October 12, 2000). Iran and Libya are affected by the Iran-Libya Sanctions Act (ILSA), passed unanimously by the US Congress and signed into law by President Clinton in August 1996. ILSA imposes mandatory and discretionary sanctions on non-US companies that invest more than US$ 20 million annually in the Iranian oil and gas sectors.

In early 1995, President Clinton signed two Executive Orders that prohibited US companies and their foreign subsidiaries from conducting business with Iran. The Orders also banned any "contract for the financing of the development of petroleum resources located in Iran." On 13 March 2001, President Bush, citing threats posed by Iran to US national security, extended Clinton's two Executive Orders on Iran for another 6 months, and on August 3, 2001, Bush signed a bill to extend the sanctions an additional 5 years. Many foreign governments are opposed to the ILSA. The European Union passed a resolution in 1996 directing its members not to comply with the sanctions. In 1998, the EU and US reached agreement on a package of measures to resolve the ILSA dispute, but full implementation will require congressional approval. So far, no firms have been prosecuted under the ILSA though several investors have chosen to abandon projects in Iran due to the law. As well, the US has approved at least one waiver to a joint venture by France, Russia and Malaysia for the development of a gas field in southern Iran.

[25] Most data are from Office of Fossil Energy (http://www.fe.doe.gov/) and current US crude oil import data are from Energy Information Administration (http://www.eia.doe.gov).

TECHNOLOGIES AND POLICIES TO MITIGATE CARBON EMISSIONS

A significant number of activities are underway to further improve the efficiency of the US economy and to introduce new technologies to market. The US federal government, state governments, and private entities have many programmes in place to improve efficiency and mitigate carbon emissions. A few examples of recent activity by the US Department of Energy are provided:

CLEAN COAL TECHNOLOGY

The Department of Energy recently announced the "kick off" of a new EnviroPower Facility in Hindman, Kentucky using clean coal technology. The new 524 MW power plant will use state-of-the-art circulating fluidised bed technology and will be operational in 2004. Clean coal technology is an integral part of the National Energy Policy and the programme is expected to receive funding of US$ 2 billion over the next 10 years. The long-term goals of the programme include the pollution free use of coal using carbon sequestration and other advanced techniques.

FUEL CELL RESEARCH

Recently the Department of Energy has decided to increase the amount it invests in advanced research on fuel cells. Using hydrogen as a fuel source, fuel cells produce heat and electricity with only water as a waste product. Fuel cells can be used for a broad range of applications including transportation and power generation for large and small applications. The DOE provided US$ 85.7 million in research funds to 18 organisations. The organisations selected include joint DOE/industrial partnerships along with educational and institutional entities.

WIND POWER

In 2001 the Department of Energy announced plans to increase wind power capacity in the US. The second largest wind power facility in the United States will be built at the Nevada Test Site that is located 104 km northwest of Las Vegas. The wind farm will be built in three phases and will eventually have 325 wind turbines with 260 MW of electricity capacity.

The Bonneville Power Administration also announced that it would sign pre-development agreements to fund the construction of seven wind power projects with a combined total electricity capacity of 830 MW. The agreements were selected on a competitive basis from 25 proposals offering projects with capacity of 2,600 MW. The approved projects offer power generation that is cost competitive with coal and natural gas generation even after factoring in intermittent wind resources.

In 1999, a record 550 MW of wind generation capacity was installed, this rate however, was not sustained, only 90 MW were installed in 2000. In 2001, however, another record year is forecast as a result of the Federal Production Tax Credit.

TRANSPORTATION CAFE STANDARDS

During the last five years Congress has imposed restrictions on the Department of Transportation preventing regulatory action to assess the possibility of more stringent Corporate Average Fuel Economy (CAFE) standards on automobiles. Recently, as a result of the new National Energy Policy with its focus on increased domestic supply and conservation, many people believe that increases in the CAFE standards are very likely. Leading politicians that have previously fought increases to the CAFE standards, have been quoted saying that they will give up the fight. Current standards for personal automobiles and light trucks have not been changed since 1985 and 1996, respectively. However, through the 1990s, increased sales of sport utility vehicles (SUVs) and mini-vans that are categorised as light-weight trucks, have reduced the average efficiency of all personal automobiles.

If CAFE standards are made more stringent, the current law would allow manufacturers to continue to sell highly profitable but energy intensive SUVs and minivans so long as sales of high efficiency vehicles raised the average fuel economy of total sales to the appropriate level. Hybrid

gasoline-electric vehicles were recently introduced to the US market and are selling well. The adoption of new technologies such as hybrid-electric vehicles may make it easier for manufacturers to meet more stringent standards.

ENERGY CONSERVATION STANDARDS

In January 2001, the Clinton Administration issued new minimum efficiency standards for consumer products including central air-conditioners and heat pumps, commercial heating and cooling equipment, water heaters, and clothes washers. These standards require manufacturers and importers to meet specific efficiency requirements by a prescribed date. The avoided electricity consumption made possible by these standards is expected to eliminate the necessity for building 91 new 400 MW power plants. This avoided electric generation capacity is greater than the current thermal power plant capacity of all APEC economies excluding China, Japan, and Russia.

The Bush administration conducted a review of the Clinton issued standards after taking office in January 2001. The Bush administration concluded that the clothes washer, commercial heating and cooling equipment, and water heater standards should remain in effect. However, the Bush administration has indicated that the residential central air-conditioner standard should be less stringent to reduce the burden (or purchase cost) to low-income consumers and has directed that the efficiency level increase be set at a seasonal energy efficiency rating (SEER) of 12 up from 10, instead of the Clinton rule set at 13.

NOTABLE ENERGY DEVELOPMENTS

US WITHDRAWS FROM KYOTO PROTOCOL

Shortly after taking office in 2001, President Bush stated that the Kyoto Protocol was "fundamentally flawed" because it failed to establish a long-term goal based on science and did not require the participation of developing economies. Furthermore, he asserted that implementing the protocol could seriously damage the US and world economies. These statements culminated in an announcement by the Bush administration on 27 March 2001 that the United States had "no interest" in implementing or ratifying the Kyoto treaty, since it would be too harmful to the US economy, and that it would pursue other ways of addressing the climate change issue.

Though they have chosen not to adhere to the Kyoto treaty, the Bush administration acknowledges that global warming is an important issue. Recently, President Bush called for further research to fully understand the impacts of carbon emission, climate change, and global warming. Moreover, the Bush administration believes that technological solutions will play a major role in mitigating climate change and has pledged more money for research and development programmes. As well, the President is supportive of voluntary market-based programmes to reduce emissions. The National Energy Policy, released in May, includes several initiatives geared to improving conservation and increasing the use of renewable energy.

The international community has been extremely critical of the US decision not to ratify the Kyoto Protocol. Since the US is the world's largest contributor to carbon dioxide emissions, there are fears that its withdrawal from the treaty could lead to the collapse of the agreement.

NATIONAL ENERGY POLICY

George W. Bush was inaugurated as President on January 20, 2001. The new Administration developed a new National Energy Policy that was released in May 2001. The policy describes the current energy situation as an "impending energy crisis" and uses the recent California shortfall of electricity supply as an example of the problem. The policy advocates increasing domestic supply by encouraging domestic oil and gas exploration and development. National Parks and Federal lands are not exempt from this policy; however, if drilling were to take place in these areas, it would be in an environmentally friendly manner with improved drilling techniques. The policy also calls for energy conservation, additional supply infrastructure such as gas pipelines and electricity grid

flexibility, investment in renewable energy, greater use of nuclear power and more power plant construction. Please see http://www.energy.gov/HQPress/releases01/maypr/energy_policy.htm for the full policy document.

The administration's plans to drill on federal lands have been undermined by proposed bills in the House of Representatives and Senate which would restrict oil and gas extraction from these areas. Debate and passage of this legislation is currently a high priority on the Congressional agenda.

CALIFORNIA ELECTRICITY SUPPLY SHORTAGE

Since the summer of 2000, California has been experiencing an on-going electricity supply crisis, including "rolling blackouts," that has received national and international attention. In 1996, the electricity industry in California was restructured. Initially the policy seemed to work well; however, in the late 1990s surging electricity demand coupled with stagnant supply growth highlighted serious flaws in California's electricity legislation. First, the restructuring law capped retail electric prices while wholesale fuel prices were allowed to fluctuate with market conditions; therefore, when wholesale price increased sharply, power distributors could not curb demand by passing these higher prices on to their retail customers. Further, utilities were forced to buy electricity exclusively from spot markets. Restructuring legislation prevented them from reducing price risk by holding medium and long-term contracts with suppliers. To make a bad situation worse, electricity supply was further curtailed and prices were pushed higher by short-term factors such as hot weather, insufficient rainfall which sharply reduced hydro potential in the Northwest, high natural gas prices and lingering problems from the August 2000 El Paso natural gas pipeline explosion.

Record high wholesale electricity prices which could not be recouped from retail customers, have threatened the financial viability of California's two largest utilities. In April 2001, Pacific Gas and Electric filed for bankruptcy protection while Southern California Edison warned its creditors that it would not be able to pay many of its outstanding debts. Despite vocal opposition from consumer groups, California's Public Utility Commission responded by sharply increasing (over 40 percent) retail power prices. Additional revenue from its customer base, cooler weather in the summer of 2001 and some new capacity additions have helped to relieve the pressure on supply, however the crisis is far from over. The problems with the 1996 restructuring law have still not been remedied, strict environmental regulations make it difficult to get approval for capacity additions and California's utilities have accumulated billions of dollars in debt that threaten their financial health.

The crisis is California has dampened enthusiasm for electricity deregulation in the United States and around the world. Despite examples of successful market reform in Pennsylvania and Texas, many governments are delaying the deregulation process or commissioning additional studies in response to the problems in California.

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VIET NAM

INTRODUCTION

Viet Nam is located in southeast Asia and sharing borders with Cambodia, Laos and China. It has an area of 331,111 square kilometres and a population of about 78 million people (1999). Viet Nam has experienced strong economic growth, about 8 percent per year, since 1991. Over the same period, final energy consumption growth has been even more robust at 12 percent annum.

Energy is a key component in Viet Nam's economy, underpinning recent industrialisation, and contributing to exports earnings. Viet Nam is well endowed with fossil energy resources such as oil, gas and coal, as well as renewables like hydro, biomass and solar energy. As of 1999, total energy reserves stood at 390 Mt of oil, 617 BCM of gas, 3,325 Mt of coal and more than 17,000 MW capacity of hydropower. Natural gas and crude oil are found mainly in the southern region, while coal reserves (mostly anthracite) are located in the northern region.

Table 41 Key data and economic profile (1999)

Key data		Energy reserves*	
Area (sq. km)	331,111	Oil (Proven)	390 Mt
Population (million)	77.52	Gas	617 BCM
GDP Billion US$ (1995 US$ at PPP)	144.24	Coal (Recoverable)	3,325 Mt
GDP per capita (1995 US$ at PPP)	1,861		

Source: Energy Data and Modelling Center, IEEJ * Institute of Energy, Viet Nam, Research Project 09-03,1999

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 1999, total primary energy supply was 12,878 ktoe. Oil, at 59 percent was the most important fuel, followed by coal at 25 percent, hydro at 9 percent and gas at 7 percent. Only about of half of energy produced in Viet Nam was used domestically, 43 percent of indigenous energy production, mostly coal and crude oil, was exported.

Viet Nam produced 15,316 ktoe of oil in 1999, almost 4 times the 1991 level. Most oil exploration and development in Viet Nam occurs offshore in the Cuu Long and Nam Con Son Basin. Though its first major refinery is under construction and should be completed in 2002, Viet Nam currently exports all of its crude. Its largest customers are Japan, Singapore, the US and Korea. Imports of petroleum products accounted for 49 percent of production in 1999.

Gas production in Viet Nam only began in 1995 and is still very low at 920 ktoe in 1999. Rapid growth in production and potentially exports are expected in the next few years as new fields go into production. Most gas production comes from the Cuu Long basin and is associated gas from oil production. There is currently inadequate pipeline capacity to move available gas from the basin and any surplus is flared.

In Viet Nam about 5,098 ktoe was produced, double its level in 1991. Of this total, 36 percent is exported, mostly to Japan. The government is currently promoting the use of coal for electricity generation and is expected to build several power plants in the few years.

Electricity demand totalled 23,559 GWh in 1999. The bulk of generation 58 percent came from hydro sources. Thermal (coal, gas and fuel oil) accounted for the remaining 42 percent. To

keep pace with expected rapid electricity demand growth over the next 20 years, the government is looking at building several new hydro and gas plants as well as a nuclear power plant.

Table 42 Energy supply & consumption for 1999

Total Primary Energy Supply (ktoe)		Total Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	22,518	Industry Sector	2,908	Total	23,559
Net Imports & Other	-9,640	Transport Sector	4,549	Thermal	9,785
TPES	12,878	Other Sectors	3,017	Hydro	13,774
Coal	3,232	TFEC	10,475	Nuclear	-
Oil	7,541	Coal	2,195	Others	-
Gas	920	Oil	6,598		
Others	1,185	Gas	-		
		Electricity & Others	1,681		

Source: Energy Data and Modelling Center, IEEJ, Institute of Energy of Viet Nam
For full detail of the energy balance table see http://www.ieej.or.jp/apec/database/selecttable.html

FINAL ENERGY CONSUMPTION

In 1999, total final energy consumption of oil, natural gas, coal and electricity was 10,672 ktoe. The transport sector consumed 43 percent of the total, followed by industry (28 percent) and other sectors (29 percent). By source, oil contributed the largest share representing 63 percent of consumption followed by coal at 21 percent, and electricity at 16 percent.

Energy consumption for end uses has grown very quickly during the 1990s. Though starting from a low level, between 1991 and 1999 consumption increased by 11.4 percent per annum. Fuelled by the process of industrialisation and increased living standards, energy demand is expected to maintain this rapid pace over the next decade.

POLICY OVERVIEW

The Prime Minister's Office, Ministry of Planning and Investment (MPI) and the Ministry of Industry (MOI) are responsible for formulating Viet Nam's energy policy and for regulating the quality of energy services. The Prime Minister approves policy statements.

Viet Nam is currently implementing reforms in the energy sector. The government is focusing on institutional restructuring, energy pricing and energy finance. Viet Nam is also trying to diversify its consumption of energy products. By developing regional indigenous resources and expanding regional cooperation, Viet Nam hopes to minimise its dependence on oil. Another priority is to ensure that Viet Nam has adequate energy supplies to meet the needs of a growing population and to support socio-economic development. To meet this goal, energy conservation and efficient use of energy are encouraged. Another benefit of using energy wisely is that it supports sustainable economic development and minimises harm to the environment.

Viet Nam has devised an energy development strategy with the following goals:

- To make natural gas exploitation and utilisation a priority.
- To enhance production of crude oil and petroleum products to 25-30 million tonnes and to 18-20 million tonnes by 2020 respectively.

- To raise the share of electricity production generated from gas-fired power plants in order to improve the efficiency and stability of electricity supply.
- To promote energy trade through power system and gas pipeline interconnections with economies in the region.
- To diversify the ownership of energy production, retail supply and distribution companies.
- To study and make use of new and renewable energy, particularly on islands and in remote areas.
- To study and use nuclear power as an alternative energy resource in the economy

OIL AND GAS

The Viet Nam Oil and Gas Corporation (PetroViet Nam) is a state-owned enterprise established in 1975 and controlled by the Prime Minister's Office. PetroVietNam is responsible for crude oil and gas exploration, production and transportation.

The Ministry of Trade and Tourism (MTT) is responsible for the export of crude oil, the import of petroleum products and the distribution of these products to consumers through its Petrolimex and Petechim companies. There are also other state-owned and joint venture enterprises involved in trading petroleum products. However, Petrolimex and Petechim supply about 60 percent of domestic consumption in these products.

The State Price Committee (SPC) is responsible for evaluating oil prices and submitting them to the government for approval.

COAL

The Viet Nam National Coal Company (VINACOAL) produces most of the coal in Viet Nam. The Prime Minister established VINACOAL in Decision No. 563/TTg on October 10, 1994. The company operates under a Charter approved by the government in Decree No. 27/CP of May 6, 1996.

VINDACOAL sets the sale price for domestic coal at a level where costs are equal to revenues or where firms break-even. The State Price Committee (SPC) is responsible for evaluating coal prices and submitting them to the government for approval. Apart from this, market forces determine prices.

ELECTRICITY

Electricity of Viet Nam (EVN), established in 1995, reports to the Ministry of Industry (MOI). EVN determines electricity policy and strategy for the sector. In 1998, EVN controlled seven distribution companies, four transmission companies, thirteen power plants and an energy research institute. However, an independent power producer (IPP) began generating electricity in 1998. In 1999, it sold 1,484 GWh to EVN.

The State Price Committee (SPC) is responsible for evaluating electricity price and submitting it to the government for approval.

NOTABLE ENERGY DEVELOPMENTS

ENERGY PRICE INCREASES

Energy prices in Viet Nam are determined by the government.

Electricity prices in Viet Nam are currently lower than real cost. As part of a plan to gradually increase electricity prices to long run average cost (US$ 0.075-0.08/kWh), a new electricity tariff, introduced on 1 October 1999, increased average prices by 3.6 percent compared to 1998.

With respect to natural gas prices, the Prime Minster has approved a proposal from the State Pricing Committee to increase the price of associated gas in the Bach Ho gas field from US$ 2.00/million Btu to US$ 2.20/million Btu. The decision came into effect June 2000. Gas in Viet Nam is used mostly for electricity generation. At the same time, the PM also agreed to a proposal for a price ceiling of US$ 296/tonne for LPG from the Dinh Co plant.

On 2 March 2001 the Prime Minister approved a proposal to increase the price of coal to VN$ 20,000 per tonne. This price increase affects the electricity, chemical and cement industries.

DECISION TO BUILD TRANSMISSION LINE

Construction on a new 500 kV power transmission line from Pleiku to Ho Chi Minh City is to begin in 2001. The 650 km Pleiku-HCM City supply line will require an investment of US$ 107 million and is expected to be completed by mid-2002.

ELECTRICITY SALES TO CAMBODIA

In July 2001, Viet Nam's Minister of Industry and Cambodia's Minister of Industry, Energy and Mines signed a 5-year electricity deal. Starting in 2003, Viet Nam will provide electricity to Cambodia's capital, Phnom Penh, and a number of provinces along the Cambodia-Viet Nam border. Electricity sales are expected to account for 80 MW of capacity in 2003 and 200 MW in 2005

AMENDMENTS TO PETROLEUM LAW

Amendments to the Petroleum Law of Viet Nam were announced in June 2000. These amendments will bring Viet Nam's regulations in line with international practices in the petroleum industry. It is hoped that these changes will attract investment capital from foreign companies, Vietnamese organisations and even individuals to develop the domestic petroleum industry.

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