ASIA PACIFIC ENERGY RESEARCH CENTRE

APEC ENERGY OVERVIEW

2006

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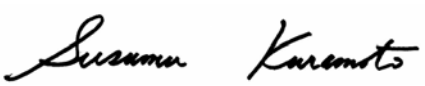
FOREWORD

Energy security has throughout 2006 taken on a greater emphasis in policy formulation and implementation in many APEC economies. Throughout most of 2005 and continuing through 2006 – achieving a peak in August 2006 – high world energy prices on international markets have led to policies orientated towards energy efficiency improvements, conservation of energy and a gradual but substantial shift towards the development and implementation of biofuels in some economies – especially as a result of high oil prices during this period. Energy security is critical for sustainable development and meeting rapidly growing energy demands while minimizing environmental effects has instigated the formation of new international energy initiatives and promoted the research and development and investment therein of cleaner technological practices and new low-carbon technologies.

In meeting future energy security, APEC economies have maintained a positive outlook as more new energy technologies are developed and frontier areas, especially for oil and gas resources are discovered away from traditional producing regions.

Individual APEC economy energy policy initiatives and notable developments particularly on energy security, upstream and downstream development, transformation and transportation, market reform, efficiency and conservation, alternative energy development, renewable energy deployment, environmental protection, and international/regional cooperation are compiled in this report.

We extend our special thanks to the efforts of APEC member economies in improving the accuracy and currency of the information provided. We also acknowledge the expert contributions of the APERC researchers, EDMC staff and a special note of appreciation to the guidance and provision of basic energy data by EGEDA members. We sincerely hope that this report would help deepen the mutual understanding among member economies on the current energy issues in the region.



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LIST OF ABBREVIATIONS

ABARE	Australia Bureau of Agriculture and Resource Economics
APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
ASEAN	Association of Southeast Asian Nations
bbl/d	Barrels per day
BCM	Billion cubic metres
BFOE	Barrels of Fuel Oil Equivalent
Bt	Billion tonnes (Thousand Mt)
CO_2	Carbon dioxide
DOE	Department of Energy (USA)
EDMC	Energy Data and Modelling Center (Japan)
EIA	Energy Information Administration (USA)
EVN	Electricity of Viet Nam
EWG	Energy Working Group (APEC)
GDP	Gross domestic product
GHG	Greenhouse gases
GW	Gigawatts (Thousand MW or Million kW)
GWh	Gigawatt-hours (Million kWh)
HKC	Hong Kong, China
IPP	Independent Power Producer
ktoe	Kilotonnes (thousand tonnes) of oil equivalent
kW	Kilowatts
kWh	Kilowatt-hour
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas (propane)
MCM	Million cubic metres
Mt	Megatonnes (Million tonnes)
mtpa	Million tonnes per annum
MW	Megawatts (Thousand kW)
NZ	New Zealand
PDOE	Department of Energy (the Philippines)
PNG	Papua New Guinea (or pipeline natural gas, depending on context)
PPP	Purchasing Power Parity
R&D	Research and development
SDPC	State Development and Planning Commission (China)
TFEC	Total final energy consumption
TPES	Total primary energy supply
toe	Tonnes of oil equivalent
TWh	Terawatt-hours (Billion kWh)
US or USA	United States of America
VND	Viet Nam Dong

AUSTRALIA

INTRODUCTION

Australia is the sixth largest country and smallest continent in the world. It is the only continent that is its own country and lies between the Indian and South Pacific Oceans. Its dry flat continent spans approximately 7.6 million square kilometres, mostly plateaus, deserts, and fertile plains and is divided into six states and two territories. Australia's population of about 20.11 million live mostly in cities or major regional centres located on the eastern and south-eastern seaboards.

Australia has maintained robust economic growth increasing on average at 3.3 percent over the period 1990 to 2004. In 2004, GDP reached US$559.80 billion (2000 US$ at PPP) from US$543.49 billion in 2003, further reducing its unemployment rate to 4.7 percent (July 2006) from 5.0 percent the previous year.

Australia is abundant in minerals, fossil fuels and other energy resources and is a major exporter of coal, LNG and uranium. The resource sector is the largest exporting sector of the economy and covers over 35 percent of Australia's export earnings. Over 70 percent of Australia's international trade is with APEC economies and Asia accounts for around 60 percent of Australian trade. However, reliance on energy export markets has made the Australian economy very sensitive to changes in foreign earnings, arising from fluctuations in international market prices.

Table 1 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	7,600,000	Oil (MCM)	670
Population (million)	20.11	Gas (BCM)	2,590
GDP Billion US$ (2000 US$ at PPP)	559.8	Coal (Mt)	78,500
GDP per capita (2000 US$ at PPP)	27,835		

Source: Energy Data and Modelling Centre, IEEJ. Economic demonstrated resources at the end of 2004 from Energy in Australia 2006

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2004-05, the total supply of primary energy net of trade in Australia reached 124 150 ktoe. Significant increases have occurred in coal, which contributed the largest share of about 43 percent, followed by oil at 31 percent, and natural gas at 20 percent. Since 1980, supply from gas exhibited the greatest growth at 4.6 percent, followed by coal 2.2 percent, and oil (the least) at 0.8 percent per annum. Supply from other sources (i.e. wood, bagasse, hydro, geothermal, solar, etc.) has also shown significant growth in recent years increasing on average at 1.4 percent over the period 1980 to 2004.

Australia is the world's largest exporter of coal and the fourth largest producer behind China, the US and India. Australia produces high quality coking and steaming coals that are high in energy content, low in sulphur, ash and other contaminants. In 2004-05, total coal production reached 304 860 ktoe, 76 percent (or 231 310 ktoe) of which was exported to other economies. Coal plays a central role in the Australian economy, accounting for approximately 10 percent of Australia's total export income of goods and services and over 76 percent of all electricity produced in Australia.

Over the past few years, Australia's production and exports of coal have grown, with exports increasing by approximately 6 percent a year.

In 2004, Australia's natural gas reserves reached 2,460 BCM, an almost four fold increase over the past two decades. Most of the increase came from the western and north-western offshore areas. Total supply from natural gas in 2004 reached 22,747 ktoe. About half of this, or 11,728 ktoe was consumed domestically, while the rest was exported, as liquefied natural gas (LNG), mostly to Japan, but more recently to South Korea and China. At current production levels, Australia's natural gas reserves should last around 70 years. Australia began exporting LNG to the Asia Pacific region in the late 1980s and is now the world's fifth largest LNG exporter.

Australia is a net importer of oil and petroleum products. Despite its 27,700 ktoe crude oil ,condensate and LPG production in 2004-05, total demand exceeded domestic supply. In 2005, import dependency for crude oil and petroleum products was around 29 percent. Oil reserves in 2004 stood at 670 million cubic metres (MCM), up from 254 MCM in 1990. The reserve to production ratio is around 20 years.

About 253000 GWh of electricity was generated in 2004-5, mostly from thermal sources (93 percent) with a modest amount (about 7 percent) from hydro sources. Most of the fuel used in thermal plants came from coal, while the rest was generated from oil and gas. Electricity demand has been growing at about 3.0 percent per year for the past two decades.

Table 2 Energy supply & consumption for 2004-05

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	282 687	Industry Sector	30 755	Total	253 117
Net Imports & Other	- 56 626	Transport Sector	31 507	Thermal	235 667
Total PES	124 150	Other Sectors	26 884	Hydro	16 200
Coal	50 830	Total FEC	89 146	Nuclear	-
Oil	27 700	Coal	5 075	Others	1 250
Gas	39 400	Oil	43 304		
Others	6 220	Gas	17 762		
		Electricity & Others	23 005		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/egeda/database/database-top.html

FINAL ENERGY CONSUMPTION

In 2004-5, the total energy consumption in Australia reached 89 146 ktoe. Total energy consumption was evenly divided between the industry (34 percent), transport (35 percent) and the other sectors (30 percent, which include residential and commercial). By fuel source, petroleum products accounted for 49 percent of consumption, natural gas for 20 percent, and coal 5 percent. Electricity accounted for 26 percent of consumption.

Impediments to the widespread use of gas domestically are the large distances between main sources of supply in the far west part of the continent and the centres of demand on the eastern seaboard, and the very competitive price of steam coal for power generation. Despite these impediments, it is expected that extensions of the natural gas pipeline network will be built in response to strong demand, particularly from the mining, manufacturing and electricity generation sectors. Since 1980, consumption of natural gas has grown at an annual rate of 3.0 percent, much faster than any other energy type and it is expected that domestic natural gas consumption will grow at a similar rate over the next decade.

POLICY OVERVIEW

NATIONAL ENERGY SECURITY[1]

Australia enjoys a high level of energy security characterised by relatively low-priced reliable energy supplies and a significant natural endowment of energy resources including coal, natural gas, crude oil and a significant potential for renewable energy. Underpinning Australia's natural energy endowments are extensive infrastructure and well-functioning domestic and international energy markets.

Notwithstanding its current energy security position, the Australian Government undertook a wide-ranging review of Australia's energy policy. This culminated in the release of the Energy White Paper Securing Australia's Energy Future in June 2004[2].

The Energy White Paper (EWP) provides the policy context for Australia's energy policy as well as Australia's energy security policy. The Australian Government's energy objectives consist of:

- prosperity – that the value of energy resources is optimised;
- security - that Australians have reliable access to competitively priced energy; and
- sustainability – that environmental issues are well managed.

Within these broad energy policy objectives, the EWP establishes an energy security policy to address both short-term and long-term energy security challenges. The policy is characterised by a focus on well-functioning national and international energy markets, minimum effective regulation, meaningful public-private partnerships, and practical, intra-regional dialogue on energy security rather than viewing self-sufficiency in energy resources as synonymous with energy security.

The EWP identifies the main long-term energy security challenge as that of attracting timely large-scale investment in sustainable supply systems to meet the growing demand for energy. Accordingly, it recommended that the government undertake a biennial review of the national energy security outlook, to consider the adequacy of existing policy and Australia's international commitments and obligations. Consequently, the review, being undertaken by the Australian Government Department of Industry, Tourism and Resources, will analyse energy security from the perspective of the domestic stationary and non-stationary energy sectors, providing information on short and long-term issues that may impact on the security of Australia's energy supplies, thereby facilitating informed policy-development.

UPSTREAM ENERGY RESOURCE DEVELOPMENT

The Australian government's approach in developing the economy's energy resources is guided by the following basic principles:

- Private decision makers should be allowed to manage risk in a regulatory framework that is predictable, transparent, equitable and timely
- Energy resource development should be required to comply with standards of environmental performance which are commensurate with those imposed on other sectors of the economy
- Commercial decisions should determine the nature and timing of energy resource development, with government interventions being transparent and allowing commercial

[1] http://www.pmc.gov.au/publications/energy_future/docs/energy.pdf

[2] Australia's energy white paper is available from http://www.pmc.gov.au/energy_future/

interests to seek least-cost solutions to government objectives (e.g. environment, safety or good resource management objectives)

- Government objectives should generally be driven by sector-wide policy mechanisms rather than impose inconsistent requirements on individual projects/private investors

In November 2005, the Australian Petroleum Production and Exploration Association (APPEA) started a strategy to promote growth in the upstream petroleum sector. The aim of this strategy is to outline a sustainable upstream petroleum industry in Australia by identifying the impediments to the opportunities for realising Australia's potential and setting out the necessary actions for securing a long-term sustainable future. The areas of focus will be declining domestic oil production, skills shortages, increased costs, domestic gas supply, streamlining regulation, the need for pre-competitive data and competition for exploration investment. In March 2006, an issues paper entitled *"Australia's upstream oil and gas industry: a platform for prosperity"* was released for comment. Based on the submissions garnered the Strategic Leaders Group is expected to report to the government in early 2007.

The Offshore Petroleum Act (OPA) 2006, was passed by both houses of parliament in March 2006, but will not become law until proclamation by the States and Territories of Australia has been undertaken to update/mirror the new legislation in their local regulations. The OPA will replace the Petroleum (Submerged Lands) Act (PLSA) of 1967, with minor policy changes being made to deal with anomalies and past drafting errors that were detected in rewriting the Act or to bring provisions in line with current Australian Government legislation drafting principles. Essentially the management regime for offshore petroleum activities is unchanged from what is contained in the PSLA.

FISCAL REGIME AND INCENTIVES

The fiscal regime of an economy is one of several factors that influence foreign investors' decisions as to where to invest their capital. Other factors include:

- prospectivity (the likelihood of finding a commercial discovery);
- sovereign risk levels (political, policy and regulatory);
- access to supporting infrastructure; and
- access to commercial markets.

The large-scale nature of energy projects and its consequent need for international capital support has made the energy sector sensitive to the competitiveness of Australia's fiscal regime. In 2006, the Ministerial Council on Mineral and Petroleum Resources (MCMPR) in the report on *A Review of Australia's Resource Industry Fiscal Regimes and their International Competitiveness* concluded that while Australia's fiscal regimes are not beyond improvement, they are considered broadly appropriate when viewed together with Australia's prospectivity, sovereign risk, infrastructure and access to markets. In addition, the report concluded that a range of independent, international studies indicated that Australia generally ranks highly as a destination for investment in resource industries and that Australia's fiscal regimes are generally competitive.

The attractiveness of Australia's fiscal regime stems from two broad aspects: 1) a general taxation regime that applies to all projects; and 2) various secondary taxation regimes, which are applied to the use of community-owned underground resources. In principle, energy sector investments are treated equally with other large investments in the general taxation system. The Australian Government has implemented major reforms to business taxation to improve the economy's international competitiveness, including the reduction of company tax rate from 36 to 30 percent from 2001-2002. Secondary taxes, on the other hand, apply to underground mineral and energy resources, and are applied by both the Australian (offshore) and State and Territory (onshore) governments. The taxes are designed to compensate the community for allowing the private extraction of Australia's depletable resources.

Secondary taxation regimes vary across Australia and are applied to both energy and non energy minerals. State and Territory royalties apply to energy resources in those jurisdictions and are generally 'ad valorem'. The Petroleum Resource Rent Tax (PRRT) is applied to all petroleum projects in Australian Government waters (e.g. beyond coastal waters to the outer limits of Australia's continental shelf), except for the North-West Shelf. The North-West Shelf is subject to an excise and royalty regime which has been maintained to provide fiscal stability to the participants of the North West Shelf project.

The PRRT is a secondary profit-based tax that automatically adjusts to changes in prices and costs. The regime has performed well, owing to its international competitiveness and efficiency. In May 2005, the Government announced a number of changes to the PRRT tax regime to reduce compliance costs, improve administration and remove inconsistencies. In consultation with the petroleum industry, the Government made adjustments to the Gas Transfer Pricing (GTP) regulations to improve taxpayer certainty and simplify the calculation of the gas transfer price, with the GTP regulations commencing in December 2005. The other PRRT policy changes came into effect from July 2006.

As part of Australia's efforts to encourage the exploration and testing of petroleum prospectivity in frontier areas, a number of blocks have been nominated as "Designated Frontier Areas" attracting a PRRT tax concession. This concession takes the form of a 50 percent increase in the value of PRRT exploration expenditure tax credits. To enhance further interest in these areas Geoscience Australia, the geological research arm of government, collects seismic and sample data in a number of the frontier areas, and is expanding this activity. Data from these areas can be obtained by prospective companies for a modest fee.

NATIONAL ELECTRICITY MARKET REFORM

Restructuring of the Australian electricity industry has been an ongoing process which commenced in the 1990s through vertical separation of the vertically integrated, state-owned utilities into separate: generation, transmission, distribution, and retail supply components; privatization of electricity businesses; horizontal separation of generation sector into numerous competing businesses; separation and regulation of transmission and distribution functions; and the introduction of retail competition, amongst other reforms.

One important element of reform was the establishment of the 'National Electricity Market' (NEM) in December 1998. The NEM is composed of the Australian Capital Territory, New South Wales, Victoria, South Australia, Tasmania and Queensland. The NEM consists of the electricity generators, a competitive retail sector, and the regulated network sectors. It was created to promote competition and efficiency, both in production and consumption of electricity, and its associated services. .

The National Electricity Market Management Company (NEMMCO) is responsible for the management of the spot market and the central coordination of the dispatch of electricity from all generators to ensure sufficiency of supply to meet the demand. NEMMCO is also responsible for maintaining power system security. The NEM spot market is the mechanism for balancing electricity supply and demand. Generators with a capacity greater than 30 MW are required to sell all electricity through the spot market. The NEM's operations are governed by a set of rules and regulations contained in the National Electricity Law and the National Electricity Rules. Trading risks are hedged via financial contracts managed in secondary markets. The National Electricity Law and the National Electricity Rules also sets out rules governing access to transmission and distribution networks.

On 1 July 2005, the legislation was amended to implement new governance arrangements. Two new national regulatory bodies, the Australian Energy Regulator (AER) and the Australian Energy Market Commission (AEMC) commenced operation. The national framework currently covers transmission services. The regulation of distribution network (economic and non-economic) and retail functions, which are currently undertaken on a state by state basis, will be transferred to the national framework over the coming 12 months.

NATIONAL ENERGY POLICY FRAMEWORK

In 2001, Australian governments agreed to establish a national energy policy framework to guide future energy policy decision making by jurisdictions and to provide increased policy certainty for energy users, including households and small businesses.

The Council of Australian Governments (COAG) has agreed on the following national energy policy objectives:

- Encouraging efficient provision of reliable competitively priced energy services to Australians, underpinning wealth and job creation and improve quality of life, taking into account the needs of regional, rural and other remote areas. stronger
- Encouraging responsible development of Australia's energy resources, technology and expertise, their efficient use by industries and households and their exploitation in export markets.
- Mitigating local and global environmental impacts, notably greenhouse gas emission impacts of energy production, transformation, supply and use.

COAG also commissioned a wide-ranging review of the strategic direction of stationary energy markets in Australia. The review, which was published at the end of 2002, recommended an ambitious programme of reform. Measures included significant changes to improve and streamline governance and regulation, a market oriented approach to transmission, and new demand-side proposals. The projected impact on GDP of the review's reform programme was estimated at nearly $7 billion in net present value terms over the period 2005-2010.

The Ministerial Council on Energy (MCE) responded substantively to the COAG review proposals in December 2003 in their report to COAG on *Reform of Energy Markets*. This was followed by an Expanded Gas Program in April 2004. The energy market reform program was formalised in the *Australian Energy Market Agreement*, which was endorsed by the Prime Minister and all Premiers and Chief Ministers on 30 June 2004. The program consists of the following elements:

Governance and Institutions:

- The Ministerial Council on Energy as the single national energy market governance body, supported by a national legislative framework (effective 1 July 2004).
- Two new national institutions, the Australian Energy Market Commission and the Australian Energy Regulator will be established. These bodies will undertake market development functions and rule making and economic regulation, respectively.

Economic Regulation:

- National approaches to energy access and distribution and retail regulation for electricity and gas will be developed.

Electricity Transmission:

- Improve the market orientation of electricity transmission arrangements through market-based incentives for transmission performance, improved assessment of regional boundaries and transmission planning, and a new regulatory test for transmission investments.

User Participation:

- Encourage increased end-user participation in the energy market through various means including enhanced demand-side response mechanisms and interval metering.

Gas Market Development:

- Improve gas access arrangements through the Ministerial Council on Energy's response to the Productivity Commission's 2004 Review of the Gas Access Regime.

- Develop principles to underpin future gas market development[3].

RENEWABLES

Australia's renewable energy currently accounts to less than 5 percent or 244 petajoules of total energy consumption. The decline is mainly from low biomass production, which was affected by its low energy content and high handling and processing costs. Hydro is largely used for electricity generation and accounts for about 95 percent of the total share of renewable electricity generated. Despite hydro's strong contribution, it is projected to grow by about 0.6 percent per year, reaching about 18 TWh by 2019 – 2020. By contrast, wind power is expected to grow from 1 TWh to 4 TWh over the same period.

In 2005 the Australian Government established the Renewable Energy Development Initiative (REDI) to support renewable energy technology innovation and commercialisation. REDI is a $100 million competitive grants program designed to stimulate innovation in renewable energy technologies. Since its commencement in 2005, grants of $A46 million have been allocated to 24 renewable energy companies nation wide. These projects demonstrate the strength of Australia's renewable energy industry across a range of technologies including: photovoltaic cells; transport fuels; geothermal power; wind turbines; biomass technologies and biofuels; cloud seeding; and other enabling technologies. In May 2005, the Australian Government announced the establishment of a Biofuels Taskforce to examine the latest scientific evidence on the impacts of ethanol and other biofuel use on human health, environmental outcomes and automotive operations. On this basis, and taking into account the most recent economic analyses of Australian fuel supplies, the Taskforce assessed the costs and benefits of bio fuel production. In response to the findings of the Taskforce announced in September 2005, the Government reaffirmed its committed to achieving the target of 350 ML of biofuels production by 2010, the progress of which has been monitored every six months from June 2006 onwards[4]

NOTABLE ENERGY DEVELOPMENTS

ENERGY EFFICIENCY OPPORTUNITIES (EEO)

A regulatory program first announced as one of a raft of measures to improve efficiency under the Energy White Paper was introduced by the government and urges business to improve their energy efficiency. The legislative basis of the programme took effect from July 2006, under the auspices of the *Energy Efficiency Opportunities Act 2006* and *Regulation 2006*.

The aim of the programme is to encourage large energy users (60% of Australian business energy use) to take a more rigorous approach to energy management and ensure company executives place a higher emphasis on reducing energy costs and improving energy management practices. The programme will be applied to all large energy using businesses and encompasses about 250 businesses in the transport, manufacturing, mining, refining and commercial sectors. EEO is expected to lead to: identification and uptake of cost-effective energy opportunities, improved productivity and reduced greenhouse gas emissions.

ENERGY TECHNOLOGY

Three technology-based initiatives have been launched by the Australian Government in the interests of reducing greenhouse gas emissions and investing in research and development to become an innovative leader in technology development. The three main programmes are:

[3] Further information on the MCE's energy market reform program can be found at www.mce.gov.au.

[4] Further information on Australia's Bio fuels Taskforce is available at: www.pmc.gov.au/biofuels/index.cfm.

Low Emissions Technology Demonstration Fund (LETDF): The Government created an AU$500 million demonstration fund to support and promote the commercialisation of technologies to deliver long-term greenhouse gas emission reductions. By the end of 2006 five projects demonstrating clean coal, carbon capture and storage and renewable energy technologies had been approved leveraging more than AU$2 billion in investment from the private sector.[5]

Advanced Electricity Storage Technologies (AEST): A five year, $20.4 million, programme announced in 2004 in the Australian Government's Energy White Paper, Securing Australia's Energy Future, this programme will identify and promote strategically important advanced storage technologies in order to increase the ability of renewable energy-based electricity generation to contribute to Australia's electricity supply system. Advanced storage technologies for electricity applications include, but are not limited to, batteries, electro-mechanical, chemical and thermal storage technologies in either on-grid or off-grid situations.[6]

NATIONAL ENERGY MARKET REFORM

Australia has made significant progress in implementing its energy market reform program, involving coordinated actions by federal and state governments through the Ministerial Council on Energy (MCE). The key objective of the MCE is to develop a competitive and efficient national energy market, for electricity and gas.

Recent progress includes:

- On 1 July 2005, National Electricity Laws, Rules and Regulations implementing new governance arrangements commenced operation.
- On 1 July 2005, two new governance bodies commenced operation, one for the electricity market, the Australian Energy Regulator (AER) and the other Australian Energy Market Commission (AEMC). The new National Electricity Laws and Rules confer the responsibility for market regulation on the AER and rule making and market development on the AEMC.
- In May 2006, the MCE released a response to the Productivity Commissions Review of the Gas Access Regime, endorsing a light-handed regulatory approach, a common objects clause and regulatory exemptions to create incentives for investment in new pipelines.
- The amended Australian Energy Market Agreement (AEMA) was endorsed by the council of Australian Governments in June 2006:
    - Confirms a national approach to energy access;
    - Establishes the national framework fro distribution and retail regulation within the AER and AEMC;
    - Transfers economic regulation of distribution networks to the AER and AEMC; and
    - Provides the basis fro phasing out retain price regulation.
- At the end of June 2006, the Gas Market Leaders Group (GMLG), an industry-led group comprising gas industry and user representatives, presented its Gas Market Development Plan report to the MCE. This report outlines key gas market development recommendations consistent with the MCE's objectives for a competitive, reliable and secure natural gas market.

Further work is progressing on:

[5] Further information on the fund and eligibility to participate can be found at www.greenhouse.gov.au/demonstrationfund/

[6] Further information can be found at www.greenhouse.gov.au/renewable/aest/

- Implementing new arrangements fro appeals and reviews of economic regulatory decisions in the electricity and gas sectors.
- Further increasing the penetration of natural gas:
    - A new National Gas Law (NGL) and Rules are being developed. These will bring the economic and non-economic regulation of gas transmission and distribution under the new governance and institutional arrangements by 2008.
    - The progressive roll out of "smart" electricity meters from 2007 to allow users to manage their demand or peak better[7].
- Improving the planning and development of electricity transmission networks to create a stable framework for efficient investment in new generation and transmission.
- Enhancing user participation in energy markets through:
    - Implementation of new national arrangements to strengthen consumer advocacy across the entire energy sector;
    - Establishment of effective demand-side response mechanisms in electricity markets from 2006, including network owner incentives, effectively valuing demand-side response, regulation and pricing of distributed and embedded generation and end user education; and
    - The progressive roll out of "smart" electricity meters from 2007 to allow users to manage their demand or peak better[8].

OFFSHORE PETROLEUM EXPLORATION ACREAGE RELEASE

The Australian Government does not undertake or finance petroleum exploration, and therefore relies upon an annual acreage release to create opportunities for exploration investment. Details of the areas released, bidding requirements and permit conditions are contained in a comprehensive information package that is widely distributed in Australia and overseas.

In April 2006, the Australian Government made available details of its annual acreage release of offshore areas for petroleum exploration. The 36 areas released this year include acreage in Commonwealth waters adjacent to Western Australia, Victoria, Tasmania, the Northern Territory and the Territory of Ashmore and Cartier Islands. This year's acreage release also includes six Designated Frontier Area blocks.[9]

NATURAL GAS

The 3.7 million tonnes per year Darwin LNG project commenced operations in February 2006. The project is utilising gas from the Bayu Undan field in the Australia-Timor Leste Joint Petroleum Development Area. Darwin LNG is destined for Japan under long-terms contracts. Total LNG capacity in Australia with the inclusion of the North West Shelf currently stands at 15.6 million tonnes per year. The expansion of the North West Shelf project will see Australia's LNG production reach 20 million tonnes per annum by the end of 2008. Currently planned projects could see annual capacity reach 60 million tonnes within a decade.

Following extensive consultation with the petroleum industry, the Australian Government decided to make adjustments to the proposed Gas Transfer Pricing (GTP) Regulations. The

[7] Further information on Australia's national energy market reform program is available at http://www.mce.gov.au

[8] Further information on Australia's national energy market reform program is available at http://www.mce.gov.au

[9] Further information on Australia's 2006 Offshore Petroleum Exploration Acreage Release is available at http://www.industry.gov.au/petexp

changes improve taxpayer certainty and simplify the calculation of a gas transfer price for an integrated gas-to-liquids project.

The implementation of the GTP Regulations will facilitate investment in Australia's natural gas resources and provide a sound basis for the development of the liquefied natural gas industry. The Regulations commenced in December 2005.

AP6 OR APP

The members (Australia, China, India, Japan, Republic of Korea and the US) of the Asia-Pacific on Clean Development and Climate (AP6) represent around half of the world's emissions, energy use, GDP and population. AP6 focuses on the development, deployment and transfer of cleaner, more efficient technologies, and provides a "novel new" approach that allows for business, government and researchers to work together to address the challenges of climate change, energy security and air pollution issues in the context of economic development.

The inaugural meeting of AP6 was held in Sydney Australia in January 2006, bringing together key Foreign, Energy and Environment Ministers with business representatives from each of the six founding economies. At this meeting a Communiqué, Charter and Work Plan were established. At a subsequent meeting held in the US in April 2006, eight private-public sector task forces covering (1) cleaner use of fossil energy; (2) renewable energy and distributed generation; (3) power generation and transmission; (4) steel; (5) aluminium; (6) cement; (7) coal mining; and (8) buildings and appliances were established. Around 300 senior industry and government officials from each partner country attended the meeting, which produced the Action Plan and Task Force Guidelines.

DOWNSTREAM PETROLEUM

In March 2006, the Petroleum Retail Legislation Repeal Bill 2006 (the Bill) was introduced to the Australian Parliament. The bill repeals the *Petroleum Retail Marketing Sites Act 1980* and the *Petroleum Retail Marketing Franchise Act 1980*. In August this bill was passed by the House of Representatives and was passed by the Senate on 13 September 2006. The repeal bill gained Royal Assent on 23 October 2006. The repeal Act will commence on 1 March 2007.

The new Oilcode, a mandatory industry code made under the Trade Practices Act will apply to all market participants and is intended to provide industry benefits including:

- Greater flexibility in efficiently marketing products;
- A national approach to terminal gate pricing;
- Fairer contractual arrangements; and
- Access to a downstream petroleum dispute resolution scheme.

In addition, the Oilcode will provide improved tenure agreements for both commission agents and oil company franchisees, including retail operators.

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BRUNEI DARUSSALAM

INTRODUCTION

Brunei Darussalam (the Abode of Peace) is located on the northwest side of the island of Borneo. It has a total land area of about 5,765 square km and a 161 km coastline along the South China Sea. It is boarded on the north by the South China Sea and all other sides by the Malaysian state of Sarawak; which divides Brunei Darussalam into two parts. Brunei Darussalam has four districts; the eastern part is the Temburong District, and the western part consists of Brunei-Muara, Tutong and Belait Districts. This small economy is a mixture of foreign and domestic entrepreneurship, government regulation, welfare measures, and village tradition. In 2004, the population of Brunei Darussalam was about 0.37 million.

The real gross domestic product (GDP) at current price in 2004 was recorded at US$4,830 million and the GDP per capita was at US$13,208, a decrease of 0.5 percent compared to the previous year which was at US$13,278 for the GDP per capita and at the same real gross domestic product (GDP) at current price, mainly attributed to the oil and gas sector.

Brunei Darussalam's economy has heavily relied on oil and gas since their discovery in 1929. The oil and gas sector is the main source of revenue and constitutes about 90 percent of Brunei Darussalam's exports and about 37 percent of its GDP. To further sustain and strengthen the oil and gas industry, his Majesty's Government is promoting and pursuing an economic diversification policy, to actively pursue the development of new upstream and downstream activities.

Brunei Darussalam's crude oil and condensate production in 2004 averaged 211 thousand barrels per day. Similarly, gas production for 2004 was about 34 million cubic metres per day, which was exported mostly to Japan and South Korea as liquefied natural gas (LNG).

Table 3 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	5,765	Oil (MCM)	223
Population (million)	0.37	Gas (BCM)	350
GDP Billion US$ (2000 US$ at PPP)	4.83	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)*	13,208		

Source: Energy Data and Modelling Center, IEEJ. * Brunei Darussalam Key Indicators 2004.

* Proved reserves at the end of 2004 from BP Statistical Review of World Energy 2005.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Brunei Darussalam is the third-largest oil producer in Southeast Asia, and is also the ninth largest producer of liquefied natural gas in the world. In 2004, the total primary energy supply of Brunei Darussalam reached 2,033 ktoe, decreasing by 46 percent compared to 2003. Brunei's oil and gas production was 21,895 ktoe, increasing 0.6 percent over production levels in 2003 of 21,774 ktoe, of which 89 percent was exported in 2004. Natural gas represents 82 percent of the total energy supply while oil represents 18 percent.

Total proven crude oil reserves are 223 MCM. Oil is exported mostly to Australia, Japan, Korea, Thailand, Indonesia and India. Brunei Darussalam has natural gas reserves of 350 BCM,

and the long-term prospects for its production are thought to be excellent. Most of Brunei's LNG is exported to Japan, with a small amount going to South Korea. In 2004, for the first time, LNG was exported to the markets of Europe and the US, with two spot cargo sales destined for Spain and one to the US. Despite the good prospects for oil and gas export growth, Brunei Darussalam's economy is still vulnerable to volatility/fluctuation in global oil prices. Precipitous drops in global oil and gas prices (as has experienced in the past) have continued to weigh down on Brunei Darussalam's economy, including that of its trading partners, which has resulted in reduce energy demand.

However, Brunei Darussalam's economy is expected to remain strong with the implementation of the 8th National Development Plan (NDP 2001-2005), in which a US$4 billion budget is allocated for implementation. Economic growth of 5-6 percent is targeted during this period.

In 2004, the economy's total installed generating capacity under the Department of Electrical Services (DES) and the Independent Power Utility namely the Berakas Power Company (BPC), reached 810.1 MW. DES and BPC each have an installed capacity of 552.5 MW and 257.6 MW respectively. Almost all, or 99.7 percent of the total electricity generated was supplied by natural gas. Total generation for 2004 was 3,172 GWh, about 0.1 percent higher than 2003.

FINAL ENERGY CONSUMPTION

In 2004, total final energy consumption was 762 ktoe, up by 8.4 percent over 2003. The shares of the three main sectors remain unchanged. The transportation sector consumed 54 percent of the total amount, followed by the residential, commercial and non-energy combined on 34 percent and the industrial sector on 12 percent. By source, petroleum products contributed the largest share, amounting to 63 percent of consumption, followed by electricity at 35 percent and gas at 2 percent.

Table 4 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	21,895	Industry Sector	93	Total	3,172
Net Imports & Other	-19,826	Transport Sector	409	Thermal	3,172
Total PES	2,033	Other Sectors	260	Hydro	-
Coal	-	Total FEC	762	Nuclear	-
Oil	456	Coal	-	Others	-
Gas	1,574	Oil	482		
Others	3	Gas	14		
		Electricity & Others	265		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

POLICY OVERVIEW

Brunei Darussalam has so far implemented seven National Development Plans (NDPs). The long-term objectives outlined in these NDPs, particularly the current 8th NDP, place specific emphasis on programmes to strengthen and expand the oil and gas industry, economic diversification through non-oil industries, maximum economic utilisation of national resources, improvements in the quality of life of the people, and the endorsement of a clean and healthy environment. In pursuing these objectives, the development plans will continue to focus on strategies and programmes that will expedite the process of industrialisation with the goal of

achieving more balanced socio-economic development. The government is also working on improving the economy's investment climate to attract and encourage the private sector to play a more active and important role in the development of the economy.

OIL AND GAS

To extend Brunei Darussalam's oil reserves, the Brunei Oil Conservation Policy was introduced in 1980. It came into effect in 1981 and has resulted in oil production of around 150,000 barrels per day. Since November 1990, the government has removed the ceiling on production levels given under the Conservation Policy, which has allowed increased oil production over the past 20 years.

In 1992, the Petroleum Mining Act was amended with all its schedules – including repealing of the Second and the Third Schedules. The move is partly due to the government's desire to introduce other forms of agreements (non-concessionary) for future petroleum mining activities. The amended act provides for procedures where the government may invite persons to bid for a petroleum mining agreement with respect to any onshore state land or offshore state land for purposes of exploring or mining petroleum. Any person/company interested in bidding shall therefore conform to such terms and conditions as imposed by the Government in the invitation to bid.

In 2000, the Brunei Natural Gas Policy (Production and Utilisation) was introduced. It seeks to sustain current gas production levels in order to adequately satisfy export obligations. It also seeks to open new areas and encourage more exploration activities by new and existing operators. This policy also provides that priority shall always be given to domestic utilisation of gas, especially for power generation.

Amendments to the Petroleum Mining Act, made in January 2002, recognise the formation of Brunei National Petroleum Company Sdn Bhd (Petroleum Brunei). The company has the right to perform both commercial and regulatory functions. One of its regulatory functions is to act as a state party in negotiations, conclusion and implementation of petroleum mining agreements. New petroleum areas such as the deepwater Blocks J and K are to be awarded under Production Sharing Contracts (PSC) with Petroleum Brunei's participation.

NOTABLE ENERGY DEVELOPMENTS

DEVELOPMENT OF DOWNSTREAM OIL AND GAS INDUSTRY

In an effort to diversify Brunei Darussalam's oil and gas based economy, the government commissioned an international consultant to conduct the Brunei Darussalam Master Study Plan on the downstream oil and gas industries. The study was completed in 2001 and has identified the following potential industries to be developed in Brunei Darussalam:

- Gas based industry such as ammonia, urea and methanol;
- Derivatives of olefins and aromatics from naphtha cracker with the possibility of integration with a refinery; and
- Energy intensive industry such as aluminium smelters.

In 2002, Petroleum Brunei called for expressions of interest for investment in the petrochemical projects to be located at the Sungai Liang Industrial site in the Belait District from which investors were short listed to conduct Detailed Feasibility Study (DFS) on their proposals. The DFS reports were submitted in the third quarter of 2003 from which selection for project implementation was made in October 2004. At this time a 271 hectare site in Sungai Liang was gazetted to the BEDB by the government to be developed into a world-class site. The location for

this site was due to its adjacent position to Brunei Darussalam's well established oil and natural gas industry.

In January 2003, the Brunei Economic Development Board (BEDB) announced a "two-pronged strategy" that included plans for the development of Sungai Liang, Pulau Muara Besar and the identification of other industry clusters for foreign direct investment, as well as for local investment. BEDB has reviewed one of its current policies and procedures with approval being granted by His Majesty's Government for the change of policy on the ownership and lending of industrial land. This would enable the BEDB to lease, sublease or sublet industrial land and buildings to investors, and for the assets to be utilised as collateral for bank financing.

In September 2004, the BEDB announced that it had entered into final negotiations to establish a US$620 million ammonia/urea plant and a US$300 million methanol plant in the Sungai Liang Industrial site. The ammonia/urea consortium consists of Incitec Pivot Ltd (an ASX-listed company), Mitsubishi Corporation and Westside Ltd (a privately held Australian majority owned company).

BEDB is also looking at building a 500 MW power plant, a new jetty, and a container port in the Sungai Liang area both to tap into the country's natural gas resources as well as to help establish new aluminium smelting and elastomer industries in the near future.

LNG SIXTH TRAIN EXPANSION OPPORTUNITY

Brunei LNG has embarked on a program to expand its present LNG capacity of 7.2 million tonnes per year to 11.2 million tonnes per year by 2010. Brunei LNG will also refurbish existing capacity to extend its operating life to 20 years, or up to 2033. It is also aiming for continued LNG sales beyond 2013. Around B$2.4 billion is earmarked for investment over the next 13 years to support these activities. The feasibility study will begin early 2003, and a final investment decision is expected in 2005.

OPENING OF NEW PETROLEUM AREAS

Both onshore blocks L and M with sizes of 2,250 km² and 3,010 km² respectively, were opened for bidding to international oil and gas companies in October 2005. Early in 2006, Block L was awarded to Loon Energy Inc. and QAF Brunei Sdn Bhd. In addition, Block M was awarded to China Oil USA (Macao) Company Ltd (China Oil), Valiant International Petroleum Ltd and Jana Corporation Sdn Bhd. [10].

POWER SECTOR

There are 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 Private Limited (BPC). The existence of BPC has actually relieved the Department of Electrical Services of the administrative and financial burden of supplying power to several strategic loading (areas). BPC today supplies about 40 percent of the total loads in Brunei Darussalam.

From 2002 to 2005, the total installed capacity of DES and BPC are about 553MW and 258MW respectively. The total installed capacity is about 811MW. In 2004, the maximum demand recorded by DES and BPC were about 256 MW and 198 MW respectively, an increase of about 2.8 percent over the previous year. As of 2006, almost 100 percent of the population is provided with electricity supply from the national grid. However, Brunei Darussalam's electricity industry may

[10] In 2003, the government officially awarded Block J to a joint venture of TotalFinaElf, BHP Billiton, and Amerada Hess Corporation. TotalFinaElf (the designated operator) holds a 60 percent interest, while BHP Billiton and Amerada Hess hold the remaining 25 percent and 15 percent respectively. The government has also awarded the exploration rights to Block K to a consortium comprising Shell Deepwater Borneo, Mitsubishi and Conoco-Phillips.

face a major challenge in meeting the increase in electricity demand as a result of the various industrial projects being considered by BEDB.

To this end the Department of Electrical Services has formulated plans to fulfil the increase in energy demand at the same time as increasing economic development. To accomplish its mission of providing electricity supply in an efficient, reliable, safe, as well as economical manner in order to improve the standard of living of the people and further the economic development of the country, the department has embarked on several major projects in its power development plan in the current 8th NDP (2001-2005). In this 8th NDP, the electricity sector has been allocated B$529.7 million or 7.3 percent of total development funds.

Natural demand growth and scheduled retirement of generating assets, necessitates the department to undertake the construction of various additional capacity to maintain the supply and demand profile in the most secure and effective manner[11]. In April 2005 a contract has been awarded on for the construction of a 116 MW Combined Cycle Power Plant (Phase I) at Bukit Panggal with construction expected to be completed in July 2007.

REDUCING THE OIL AND GAS INDUSTRY'S CONTRIBUTION TO GLOBAL WARMING

The oil and gas industry is one of the major contributors to greenhouse gases through the emission of methane and carbon dioxide (CO_2). The main sources of methane emissions are process venting, instrument gas and fugitive emissions. Major sources of CO_2 emissions include process flaring, atmospheric gas flaring (where recovery is uneconomic), fuel gas combustion (gas turbines and other prime mover exhausts), and transport.

As part of Brunei Darussalam's environmental initiatives, there are plans for the major oil and gas producers to reduce the disposal of gas by continuous venting and flaring by 2003 and 2008 respectively. Projects undertaken to reduce venting include:

- Simplifying and rationalising old facilities, centralising processes at main complex facilities, and improving operations to reduce venting from compressor trips, fugitive losses, atmospheric gas disposal and from the use of instrument gas;
- Converting existing vent stacks to flare stacks; and
- Simplifying and rationalising facilities to recover and recompress vented flash gas from surge vessels and to reduce instrument gas consumption.

Realising that national gas combustion contributes a large percentage of CO_2 emissions; production companies intend to focus more on improving the energy efficiency of gas turbines. Furthermore, new facilities will not be designed that allow continuously venting and flaring of gas for disposal, and the use of instrument gas in new projects will be prohibited unless it is able to be recovered. However, venting and flaring cannot be totally phased out. Venting and flaring will be limited only to atmospheric gas disposal, instrument gas in old facilities, fugitives (minimised), safeguarding measures (purge and pilot gas, and emergency relief) and process deviations (like compressor trips, or oil production during plant shutdown and maintenance), and will take place under strict controls.

DIRECTIVE ON THE SALE OF PETROLEUM PRODUCTS

In December 2005, the Prime Minister's Office issued a Directive on the Sale of petroleum Products Premium 97, Super 92, Regular 85 and Diesel aimed to cap domestic increase in the demand for petroleum products. The Directive limits the purchase of gasoline and diesel to a maximum purchase of one full tank – not exceeding 250. For every purchase where gasoline or

[11] In 2001, two 3 MW diesel-generating units were installed and commissioned in the Temburong District and 99 MW of additional generation capacity was commissioned at the Gadong I Power Station in 2002.

diesel is filled into a container, the container to be used must be a container that has been approved by Brunei Shell Marketing Sendirian Berhard (BSM), and the amount sold should not exceed 100 litres. In addition, purchases are limited to Brunei Darussalam's Identity card Holders only. The Directive became effective from January 2006.

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CANADA

INTRODUCTION

Canada covers the northern part of North America and is second only to Russia in geographic size. Canada has a population of around 31 million, of which some 40 percent is concentrated in the province of Ontario. Canada is known for its wealth of energy and other natural resources. In 2004, its GDP amounted to roughly US$904 billion (in 2000 US$ at PPP), or US$28,566 per capita. Due to high standard of living, cold climate, long distances between major cities, and many energy intensive and bulk good industries, Canadians are large energy consumers. Canada's primary energy consumption per capita in 2004 was 8.5 toe or about four times the APEC average. Canada's real GDP increased by 3.2 percent over the period 2000 to 2004, boosted by high energy prices and was 5.5 percent in 2004 compared with the previous year. Inflation remained low and stable, with consumer prices increasing 1.9 percent in 2004 and 2.2 percent in 2005. Unemployment averaged 7.2 percent in 2004.

Canada is the fifth largest energy producer in the world (behind the US, Russia, China and Saudi Arabia) and is a major energy exporter, being the most important source of US energy imports. Canada has abundant reserves of oil, natural gas, coal and uranium in its western provinces and huge hydropower resources in Quebec, Newfoundland, Manitoba and British Columbia. It also has significant offshore oil and gas deposits near Nova Scotia and Newfoundland. Installed electricity generation capacity amounted to some 113 GW. Energy production is very important to the Canadian economy, accounting for 6 percent of GDP and 300,000 jobs in upstream and downstream operations, representing 1.8 percent of the Canadian labour force, in 2004.

Table 5 Key data and economic profile (2004)

Key data		Energy Reserves**	
Area (square km)*	9,984,670	Oil (MCM)	2,623
Population (million)	31.63	Gas (BCM)	1,590
GDP Billion US$ (2000 US$ at PPP)	903.56	Coal (Mt)	6,578
GDP per capita (2000 US$ at PPP)	28,566	Oil Sands (MCM)***	27,730

Source: Energy Data and Modelling Center, IEEJ. * Statistics Canada. ** BP World Energy Statistics.
*** Oil sands remaining established reserves, by Alberta Energy and Utilities Board (EUB).

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2004, Canada's primary energy production exceeded 398 Mtoe. Natural gas and oil accounted for most of the supply at 38 percent each, coal (8 percent), hydropower (7 percent), nuclear power (6 percent) and other sources (3 percent). Historically, Canada is a net exporter of the main petroleum products, including motor gasoline and middle distillates. Net oil and gas exports account for more than 58 percent of Canada's production. Total exports of non-processed liquid hydrocarbons, which is conventional crude oil, natural gas liquids, synthetic oil and others, are estimated at 87 million tonnes for 2004, an increase of 4.8 percent over 2003, while exports of the main petroleum products has increased by 1.1 millions tonnes, or by 5.6 percent. On the other hand, in 2004 crude oil imports were 45.8 million tonnes and represented 57 percent of the total refinery feedstock requirements for Canada.

Canada's domestic primary energy demand in 2004 reached a total of 270 Mtoe. The largest source of crude production is the Western Canadian Sedimentary Basin (WCSB). Declining WCSB reserves were nearly offset by reserve additions from the East Coast offshore and oil sands. Recent declines in light crude production have been offset by additional production of heavy crude. Conventional crude oil and natural gas liquids made up the bulk of oil production, but some 60 percent of production in 2004 came from unconventional forms including bitumen and synthetic crude, almost equally produced by in situ and mining methods. As the oil sands industry is heavily reliant upon water and natural gas, any increase in natural gas prices or sharp reduction in natural gas supply would have critical repercussions for the oil sands industry. Environmental issues also arise as water consumption has increased. In 2004, crude oil production reached 150 Mtoe, where 60 percent was exported mainly from western Canada. Meanwhile, nearly 47 Mtoe of oil was imported into eastern Canada, so that net oil exports were equivalent to just 28 percent of production. The oil pipeline infrastructure is being strained to the limit and plans are being made for both expansions and new pipelines to accommodate growing oil sands production. Construction of a pipeline from Edmonton to deepwater ports in British Columbia is being considered to facilitate the export of oil sands to Asia and California.

Natural gas production decreased by 0.3 percent between 2003 and 2004, due mainly to the increased consumption of natural gas for synthetic oil production from oil sands. Gas production in 2004 totalled more than 150 Mtoe, of which net natural gas exports totalled around 77 Mtoe, which is equivalent to 52 percent. Many analysts predict that conventional natural gas production in the WCSB has reached its peak. While the existing natural gas transportation infrastructure has some spare capacity, applications for new pipelines to deliver production from new sources continue to be investigated.

Table 6 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	398,523	Industry Sector	76,997	Total	598,403
Net Imports & Other	-134,071	Transport Sector	55,676	Thermal	165,633
Total PES	270,017	Other Sectors	68,730	Hydro	340,952
Coal	28,716	Total FEC	201,403	Nuclear	90,387
Oil	98,729	Coal	3,315	Others	1,431
Gas	78,062	Oil	91,380		
Others	64,445	Gas	52,674		
		Electricity & Others	54,035		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

Canada generated about 600 TWh of electricity in 2004, 1.4 percent more than in 2003. As Canada is the world's largest producer of hydroelectricity, hydropower dominated with a 57 percent share, followed by thermal plants with 28 percent and nuclear power at 15 percent. Quebec's La Grande plant is one of the world's largest hydroelectric facilities, with an installed capacity of 15 GW. Canada and the US have an extensive electricity trade, and the electricity networks of the two economies are heavily integrated. In 2004, Canada exported 33.3 TWh of electricity to the United States while importing 22.4 TWh. However net electricity exports to the US in 2004 declined to roughly 1.8 percent of production.

Canada's coal production in 2004 reached 66 million tonnes, and increased by about 6.4 percent from 2003. Canada's net coal exports increased to 6.4 million tonnes in 2004, while net exports of coking coal amounted to 20 million tonnes and net imports of 14.4 million tonnes of steam coal. Canada exports over half its coal production, mostly to Asia, with the rest going chiefly to Europe and Latin America. These exports are overwhelmingly coking coal. On the other hand, Canada imports some steam and coking coal, mostly from the United States.

Canada remains the world's leading producer and exporter of uranium, of which it accounts for about 29 percent of global mineral production in 2004.

In 2004, alternative and renewable energy production increased by 7.3 percent over 2003 and accounted for nearly 3 percent of total energy consumption in Canada.

FINAL ENERGY CONSUMPTION

In 2004, total end use energy consumption in Canada exceeded 201 Mtoe. Industry accounted for 38 percent of energy use, residential and commercial buildings 31 percent, transport 28 percent, and agriculture 3 percent. By energy source, petroleum products accounted for 45 percent, natural gas 26 percent, electricity 27 percent, and coal 2 percent.

In the residential and commercial sectors, space and water heating accounted for about 72 percent of energy use while lighting, air conditioning and electronic equipment accounted for the other 28 percent. Growth in consumption has been slow, averaging just 1.8 percent per annum since 2000. Significant improvements in the energy efficiency of buildings, HVAC (heating, ventilation and air conditioning) and electronic equipment have occurred. But these efficiency gains have been offset by demand growth associated with increases in population and GDP, by greater market penetration of household appliances and office equipment and by a strong preference for larger homes.

Energy consumption in the industrial sector grew at 3.1 percent in 2004, and at 3.2 percent for transportation, while total final energy consumption grew at 2.2 percent. Petroleum products dominated the transportation sector, accounting for 93 percent of energy consumption in 2004. Modest fuel efficiency improvements in new vehicles, strong market preferences for enhanced performance and significant increases in average distance travelled per vehicle have contributed to energy consumption growth. In freight transport, energy use has been boosted by growing demand and a shift away from railways towards more energy-intensive truck transport.

POLICY OVERVIEW

In Canada, jurisdiction over energy matters is shared between the provincial and federal governments. The constitution gives the provinces ownership of natural resources, which thus have authority over the conservation, and management of these resources within their borders, while jurisdiction over international and inter-provincial trade is a federal responsibility. Through Natural Resources Canada (NRCan) and other government departments including Environment Canada, the Department of Fisheries and Oceans, and Indian and Northern Affairs Canada, the federal government works with 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 the sustainable development of resources and limiting environmental impacts. NRCan intervenes in areas where the market does not adequately support these policy objectives: policies and programmes which encourage scientific and technological research promote energy efficiency and assist the development of renewable and alternative energy sources.

Federal law banned offshore exploration and production activities in the Pacific Ocean, while the provincial government of British Columbia has continually lobbied to lift this ban.

OIL AND GAS MARKETS

Wellhead oil and natural gas prices in Canada have been fully deregulated since the Western Accord between the federal government and energy-producing provinces was reached in 1985. The

Accord opened up the gas market to greater competition by permitting more exports, allowing users to buy directly from producers and unbundling production and marketing from transportation services. Oil and gas pipeline networks continue to be regulated as natural monopolies. The National Energy Board (NEB), a federal regulatory body under the Minister of Natural Resources, have the main responsibility for regulating long-distance transport networks, as well as exports, while provincial authorities have the main responsibility for regulating local and regional distribution networks. Under the Canada Oil and Gas Operations Act (COGO), the NEB will continue to develop and maintain regulations regarding exploration and development activities.

ELECTRICITY MARKETS

Electricity markets in Canada are organised along provincial lines and regulated by provincial governments. Province-owned utility companies dominate generation, transmission, and distribution activities. Most provinces allow open access to the electricity grid, but they are marginal to the overall market.

There have been efforts to restructure the Canadian energy sector, with an eventual aim to privatize the industry. Alberta began deregulation in 2001, followed by Ontario in 2002. However, in both places, electricity prices surged following initial deregulation efforts, causing the provinces to initiate price caps on residential utility rates. Both provinces have plans to remove these caps in the near future. Privatization of province-owned utility companies has also stalled, facing pressure from organized labour and consumer groups.

Quebec has pursued a different path on electricity market reform. Hydro Quebec's low cost resource power is protected for domestic use, by legislation. Rates for Quebec retail customers are fixed at a level that is below Northeast market prices. The role of Hydro Quebec's regulator, the Regie de l'energie, was reduced as a result of the legislation.

ENERGY END USE EFFICIENCY

To promote energy efficiency and conservation in end use markets, the government of Canada relies on a variety of policy instruments. These include leadership by example, voluntary measures, equipment and product labelling, financial incentives for certain types of investments, and energy efficiency standards for household appliances, office equipment and industrial motors.

Programmes aimed at improving energy efficiency are jointly sponsored by the federal, provincial and territorial governments, municipalities, utilities and some non-governmental organisations. An annual assessment of trends in energy use is published by the Office of Energy Efficiency (OEE) under the NRCan in a technical report entitled *Energy Efficiency Trends in Canada.*

ENERGY AND ENVIRONMENT

In December 2002, the federal government officially ratified the Kyoto Protocol. This decision reconfirmed Canada's strong commitment to addressing climate change and to working with the international community in dealing with this global problem. Under the Kyoto Protocol, Canada's target is to reduce its greenhouse gas emissions to 6 percent below their 1990 level by the first commitment period between 2008 and 2012. To achieve the Kyoto target, Canada will have to reduce its 'business-as-usual' emissions by 29 percent or 240 million tonnes. To support its ratification decision, the federal government released the *Climate Change Plan for Canada*, which is a road map for Canada to follow in order to achieve its Kyoto target. The Plan established that measures underway at the time of its release were expected to achieve 80 Mt of emissions reductions. These include carbon sinks of 30 million tonnes from existing forestry and agricultural practices. As a second step, the Plan highlighted measures to reduce emissions by an additional 100 million tonnes. At the heart of this second step are the negotiations of covenants with large final emitters to reduce industrial emissions by 55 million tonnes. Also proposed was a series of measures targeted at sectors not covered under the covenant approach. As a third step, the Plan suggests further emissions reductions of 60 million tonnes from various sources such as new technologies and initiatives by provincial and territorial governments.

The *Moving Forward on Climate Change*, which was building on the *2002 Climate Change Plan for Canada*, was released in April 2005. To combat climate change, in the 2005 Budget a foundation for the Plan providing funds for the Clean Fund, Partnership Fund, Renewable Energy, and existing programs was laid out. Associated with the federal investment, the overall funding is in the range of CAN$10 billion through to 2012. It is estimated that the Plan could reduce GHG emissions by about 270 million tonnes annually over the period 2008 to 2012.

NOTABLE ENERGY DEVELOPMENTS

NUCLEAR DEVELOPMENT

In November 2006, the Ministry of Natural Resources announced that Atomic Energy of Canada (AECL) had signed an agreement with Nucleoeléctrica Argentina that will advance co-operation in Canadian-developed CANDU nuclear power. The agreement covers the refurbishment of Argentina's first CANDU power station (five reactors) and includes a feasibility study for the construction of an additional sixth 700-megawatt CANDU nuclear reactor. AECL's agreement with Argentina sets out the framework for a program that will greatly enhance peaceful nuclear energy co-operation, with resulting commercial opportunities for both countries. The agreement specifies a number of nuclear-related projects for joint co-operation. These include the refurbishment of Embalse, a feasibility study for the next CANDU station to go into service around 2015 and assistance to Nucleoeléctrica Argentina S.A. to help complete a reactor originally supplied by Germany. The agreement will also create commercial opportunities for Argentina to supply services and heavy water to international CANDU markets.

The new Government of Canada's long-term strategy reflects several important changes including the acceleration in timing of the decommissioning activities and the inclusion of the construction and operational costs of new infrastructure and treatment facilities required to permit waste processing, storage and long-term management of nuclear power plants. AECL's newly formed Liability Management Unit will implement the new plan on behalf of the federal government.

Five nuclear technology and engineering companies signed a four-year agreement in March 2006 to work together as Team CANDU to provide a turn-key service and competitive solutions for the building of new nuclear power plants in Ontario. A report released by the Ontario Power Authority in December, 2005 states that two-thirds of Ontario's base-load generation will need replacement in the next 15 years. Team CANDU is strategically aligned to provide Ontario with a clean, safe, economical and reliable base-load option.

Ontario province's 20-year electricity supply strategy was unveiled in June 2006; to avoid a future energy shortage this strategy largely focuses on energy conservation and renewable energy technologies. However it also includes refurbishment of nuclear reactors at the Darlington and Pickering generating plants and construction of some new reactors at existing nuclear sites, to provide at least 14 GW of generation capacity. Nuclear energy is expected to continue to be the single-largest electricity source for Ontario in 2025.

INNOVATION IN OIL SANDS PROCESSING

Shell Canada in November 2006 announced a froth treatment technology, the first commercial application of an innovative high temperature froth treatment processing technology that will reduce costs and improve energy efficiency in oil sands production. Developed by Shell Canada with the help of government scientists at Natural Resources Canada's CANMET Energy Technology Centre facility in Devon, Alberta, Shell's enhanced froth treatment technology uses high temperatures in the paraffinic froth treatment process and is more efficient at removing sand, fine clay particles and other impurities from oil sands. By processing froth at a higher temperature, Shell Canada will be able to use smaller equipment, less water and less energy per barrel than

conventional low temperature paraffinic processes. By saving energy, greenhouse gas (GHG) emissions associated with oil sands production will also be reduced. Compared to current paraffinic froth treatment processes, new technologies offer the following benefits:

- improves energy efficiency by 10 per cent
- uses plot space 35 per cent smaller and essential equipment 75 per cent smaller
- uses 10 per cent less water, and
- can be modularised, generating construction efficiencies and reducing costs.

Shell's enhance froth treatment technology will be utilised in the first expansion of the Athabasca Oil Sands Project (AOSP), which was formally launched in November 2006. Completed in 2003, the AOSP was the first new integrated oil sands project in more than 25 years and uses innovative technology in its oil sands extraction and upgrading processes. AOSP consists of the Muskeg River Mine located north of Fort McMurray, Alberta and the Scotford upgrader located near Edmonton, and is a joint venture between Shell Canada Limited (60 per cent), Chevron Canada Limited (20 per cent) and Western Oil Sands L.P. (20 per cent).

FINAL REPORT ON 2003 POWER OUTAGE

The final report on the largest power outage in North American history that affected 50 million people in August 2003 in both Canada and the US was released in October 2006. The report outlines all of the needed actions to prevent or minimize the likelihood of future blackouts, reduce the scope of those that do occur and improve the security of the North American electric power grid. Much has been accomplished in the more than three years since the blackout. Mandatory reliability standards are being implemented in jurisdictions across Canada and in the US. In September 2006, the National Energy Board (NEB), responsible for international power lines, became the first jurisdiction in Canada to recognize the North America Electric Reliability Council (NERC) as the Electric Reliability Organization. The US Federal Energy Regulatory Commission (FERC) certified the NERC as the Electric Reliability Organization in July 2006. NERC has submitted 118 reliability standards to FERC and appropriate authorities in Canada for review and approval.

The governments of Canada and the US have also established the Bilateral Electric Reliability Oversight Group as a forum in which the US Department of Energy, FERC, Natural Resources Canada and provincial energy ministries can discuss issues of mutual concern.

CANADA MOVES FORWARD TO ESTABLISH LIMITS OF IT'S CONTINENTAL SHELF

In July 2006, the Canadian government announced the award of a $2 million contract to identify the outer edge of the continental shelf beyond the 200 mile limit on the Nose and Tail of the Grand Banks and the Flemish Cap. This mapping will enable Canada to establish with certainty where Canada's continental shelf begins and ends, which will give Canada undisputed international recognition for sovereign rights over any seabed resources in those areas beyond the 200 mile limit.[12] Establishing the limits of the extended continental shelf will allow Canada to delineate precisely the full extent of the area over exploration and exploitation of natural resources can be undertaken.

Coastal states with a continental shelf beyond 200 nautical miles have 10 years from ratification of UNCLOS to determine the outer edge – Canada ratified UNCLOS in 2003. Canada's extended continental shelf in the Atlantic and Arctic Oceans is approximately 1,750,000 km^2. The Ministry of Natural Resources Canada is quoted as saying that "in order to provide certainty for future economic development of seabed resources, it is important to gain international recognition of their full extent".

[12] The United Nations Convention on the Law of the Sea (UNCLOS) establishes coastal state rights to an exclusive economic zone that is 200 nautical miles. It also allows for countries to identify the outer edge of the continental shelf where it extends beyond this zone.

CONSTRUCTION BEGINS ON WIND FARM

Construction of a large wind power generating facility in southern Alberta's Taber municipality was begun in May 2006 and is to be completed in the first quarter of 2007. Initial work will include building a temporary facilities area and a permanent substation. Once the facilities area and access right-of-ways are in place, the foundations for the 37 turbines will be excavated and concrete poured. The Taber Wind Farm will employ a technologically advanced wind turbine design supplied by ENERCON, a German manufacturer. A key element of the ENMAX[13] Corporation's wind power generating facility is a 20-year supply agreement with The City of Calgary. The wind farm will have a total power output of over 80MW, enough to power 75 per cent of The City's operations. The agreement is the largest green power usage commitment of any municipality in North America.

LNG PROJECTS PROGRESS

While Canada does not yet import LNG, there are eight proposals to construct LNG import facilities on Canada's Atlantic seaboard, including, Quebec, British Columbia and Nova Scotia, many of which are currently involved in the environmental assessment (EA)/regulatory review process. The proposed facilities, from west to east, are:

- WestPac LNG (Prince Rupert, British Columbia);
- Kitimat LNG (Kitimat, British Columbia);
- Gaz Métro/Enbridge / Gaz de France (Beaumont, Quebec – Rabaska);
- Énergie Grande-Anse (Saguenay, Quebec – Project Grande-Anse);
- TransCanada/Petro-Canada (Gros Cacouna, Quebec – Cacouna Energy Project);
- Irving Oil/Repsol (Saint John, New Brunswick – Canaport LNG);
- Keltic Petrochemicals and Maple LNG (Goldboro, Nova Scotia); and,
- Anadarko Petroleum Corporation (Canso Strait, Nova Scotia – Bear Head LNG).

Three LNG projects – Canaport LNG located at Saint John, New Brunswick, Bear Head LNG near Port Hawkesbury, Nova Scotia and Kitimat LNG in British Columbia – have received federal and provincial EA approval. If proponents continue to advance these projects, these LNG facilities could be in service by 2008 or 2009. Four other Canadian LNG projects are at various stages of the EA/regulatory review process and could be in service by 2009 or 2010. The final project – sponsored by WestPac LNG Corporation (WestPac) in British Columbia – initiated the EA/regulatory review process in June 2006. WestPac has indicated its LNG import terminal could be in-service by 2011. The LNG projects being contemplated for Atlantic Canada are, for the most part, "import-for-re-export projects," as the demand for natural gas in Atlantic Canada is met entirely by natural gas production in offshore Nova Scotia. The Quebec LNG projects would provide an alternative source of natural gas supply to markets in eastern Canada, as Quebec is almost entirely dependent on natural gas supply from western Canada. The projects being proposed in British Columbia are largely to supply natural gas to domestic consumers.

In March 2006, the Canadian energy major Petro-Canada signed an agreement with Russian energy giant Gazprom on preliminary engineering studies to provide cost and schedule estimates for the construction of an LNG plant on the Baltic Sea near St. Petersburg. LNG from the plant would be supplied to Petro-Canada's proposed LNG re-gasification facility in Gros-Cacouna, Quebec.

[13] ENMAX Corporation (ENMAX) is an energy distribution, supply and service company. A wholly owned subsidiary of The City of Calgary, headquartered in Calgary, Canada. ENMAX operates and competes in Alberta's restructured electricity industry.

New pipeline construction was approved in June 2006 by both the Canadian and the US governments. The pipeline will interconnect the planned Canaport LNG import terminal in New Brunswick, Canada to Maritimes at the US-Canada border.

REPORT ON GROWTH IN NATURAL GAS DELIVERATILITY

The National Energy Board (NEB) released a report on "Short-term Canadian Natural Gas Deliverability" in October. The report says that Canadian natural gas deliverability will rise from 177 BCM in 2005 to 179 BCM in 2008, an increase of approximately one percent. The flow of conventional natural gas from the maturing Western Canada Sedimentary Basin (WCSB) is expected to decrease from 169 BCM in 2006 to 164 BCM in 2008. This decrease will be more than offset by the growth in coal bed methane production from Alberta. Deliverability from coal bed methane or unconventional gas found in coal deposits is expected to more than triple from 3 BCM in 2005 to 10 BCM in 2008.

Fuelled by the addition/commissioning of new gas fields in offshore Nova Scotia and a new pipeline for onshore access to New Brunswick production, natural gas supplies from Atlantic Canada should increase from an average of 3.7 BCM in 2006 to 5 BCM in 2007.

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CHILE

INTRODUCTION

Chile is one of the two APEC economies in South America. Located in southern South America, it stretches along the South Pacific Ocean coastline for 6,435 km and lies between the economies of Argentina Bolivia and Peru, covering an area of nearly 757,000 square kilometres. Most of the 16.1 million population (as of December 2004) live in urban areas, with nearly one-third residing in Santiago, the capital city. Chile is a largest producer and exporter of copper in the World.

Chile's GDP in 2004 reached nearly US$163 billion, and US$10,118 per capita, both in terms of purchasing power parity, PPP, in 2000 US$. The economy grew at an average annual rate of 4.9 percent a year during the period 1980-2004. The global economy recovery has helped boost export demand, particularly for copper. In 2003, Korea and Chile ratified a Free Trade Agreement (FTA) between both governments; becoming the first FTA agreement in place between an Asian and an American country and others have subsequently been signed with the European Union and China in 2005. Chile expects to sign similar agreements with India and Japan in the near future.

Chile has very limited indigenous energy resources and has to rely on imports to meet all of its energy needs. In 2004, its energy reserves consisted of 23.8 MCM of oil, 99 BCM of natural gas and 1,302 Mt of coal. In 2004, roughly 27 percent of total primary energy supply was produced indigenously. Natural gas is the main import fuel for electricity production, which comes entirely from Argentina through pipelines (located in the north, central and south parts of economy) connecting both economies.

Table 7 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	757 000	Oil (MCM) - Proved*	23.8
Population (million)	16.12	Gas (BCM) - Proved*	99
GDP Billion US$ (2000 US$ at PPP)	163.15	Coal (Mt)	1,302
GDP per capita (2000 US$ at PPP)	10,118		

Source: Banco Central de Chile, Energy Data and Modelling Center, IEEJ. *2005 figures from Oil & Gas Journal.

Chile's main concern in 2005 was the decision by Argentina to continually reduce natural gas exports to Chile. This decision has forced Chile to switch from a relatively cheap natural gas to a more costly diesel for electricity generation. In addition; plans for an LNG import depot were decided in order to stabilize the supply of natural gas in the near future. The economy is currently pursuing preliminary LNG supply agreements with Indonesia and other economies of the APEC region. The government has also promoted the establishment of an "energy ring" in South America by building a natural gas pipeline connecting Peru (Pisco) and Chile (Tocopilla), and integrating the Camisea natural gas field with the existing pipelines in Argentina, Brazil and Chile.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Chile's total primary energy supply (TPES) grew at an average annual growth rate of 4.2 percent from 1980 to 2004. In 2004, TPES reached 29,284 ktoe, approximately 40 percent of

which comes from crude oil, 26 percent from natural gas, 13 percent from coal and 21 percent from other sources, mainly biomass and hydropower. Natural gas and other sources (renewable energy - hydropower and biomass) together contributed almost half of TPES. The introduction of natural gas from Argentina in 1997 has led to a slight change in Chile's TPES mix (more gas use). Oil however remained the major energy source, 40 percent of the share in 2004 compared with 44 percent in 1990. This change has subsequently caused a reduction in coal, the share decreasing from 18 percent in 1990 to 11 percent in 2004.

Chile's dependence on imported energy had been increasing for many years. In 1980, approximately 58 percent of TPES was supplied by indigenous production and 42 percent from net imports. However in 2004, this proportion has reversed, with 72 percent from imports and the remainder from indigenous production. The change is caused mainly by an increase in gas and oil imports.

For the past two decades, imports have increased for several reasons. One is dwindling oil reserves. Crude oil production peaked at 32 percent of domestic supply in 1982, declining to only 3 percent of total oil supply in 2002. The lack of competitiveness in the domestic coal industry has also led to an increase in coal imports. Domestic coal production accounted for only 10 percent of Chile's consumption in 2002, down from nearly 66 percent in 1980. Gas market reforms (which started in 1997) have also increased imports from Argentina to the most populous regions in the northern and central parts of Chile while previously, due to infrastructure constraints, gas was only available in the south. However in April 2004, Argentina began curbing natural gas exports to almost half of the contracted volumes on some occasions; and these restrictions have continued through to 2006.

Empresa Nacional del Petróleo (ENAP), a state-owned enterprise, is the major oil producer and refiner in Chile. Because of decreasing domestic energy resources, ENAP has increased its exploration and production operations abroad, mainly in Latin America and North Africa, through its international subsidiary, SIPETROL. ENAP is working towards supplying at least 30 percent of Chile's total oil demand, which comes mostly from Argentina (44 percent), Brazil (15 percent), Angola (13 percent), Nigeria (11 percent) and 17 percent from others. Both the retail and wholesale markets for petroleum products trade are maintained on a competitive basis. There are three refineries in Chile: Petrox Talcahuano (113,400 B/D throughput capacity), Refinería de Petróleo de Concón (97,650 B/D) and Gregorio Magallanes (15,750 B/D).

In 2004, Chile's power generation, in the primary systems was 48,881 GWh. During the period 1980 to 2004, generation increased consistently at around 6.4 percent per year. Over the last two decades hydropower has accounted for most of the installed capacity. However, thermal is becoming more significant, and in 2004, thermal generation reached 27,907 GWh, 57 percent of total generation, mainly from natural gas and coal, 59 and 17 percent of the total respectively and production from fuel oil, biomass, and other fuels (6.6 percent). The use of petroleum coke (petcoke) is allowed in some plants, but under strict restrictions for environmental control of air pollution. In 2005, Chile's power generation, in the primary systems was 50,920 GWh.

Table 8 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	10,699	Industry Sector	8,303	Total	48,881
Net Imports & Other	19,382	Transport Sector	7,318	Thermal	27,907
Total PES	29,284	Other Sectors	6,033	Hydro	20,969
Coal	3,675	Total FEC	21,653	Nuclear	0
Oil	11,811	Coal	921	Others	5
Gas	7,509	Oil	11,133		
Others	6,289	Gas	1,534		
		Electricity & Others	8,065		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

There are four separate power grids in Chile: Sistema Interconectado Central (SIC), Sistema Interconectado del Norte Grande (SING), Sistema Aysen and Sistema Magallanes. Sistema Interconectado Central (SIC – Central Interconnected System) is the most important. It serves over 93 percent of the population and more than 40 percent of the land area. Sistema Interconectado del Norte Grande (SING – Great North Interconnected System), on the other hand, serves mainly mining consumers. Sistema Aysén and Sistema Magallanes, the other two grids, represent only a small portion of the overall installed capacity.

These systems are largely autonomous since long geographic distances make integration difficult, the SIC is by far the largest, the installed capacity, in 2005 was 8,288 MW (57 percent is hydroelectric) while peak demand reaches around 5,764 MW, however, in adverse hydrological conditions, the system could face the risk of power shortages. The SING has excess installed capacity (3597 MW including 643 MW in Argentina, for demand of 1644 MW) the gas supply restrictions increase generating costs (around US$190/MWh vs. US$33.1/MWh) and could cause problems in terms of increasing costs and also produce environmental restrictions due to the greater use of coal and diesel, for technical reasons dual-fuel (gas-diesel) plants can operate only for limited periods exclusively on diesel.

FINAL ENERGY CONSUMPTION

Chile's total final energy consumption (TFEC) grew at an average annual rate of 4.1 percent from 1980 to 2004 and reached 21,653 ktoe in 2004. The growth rate increased by 0.3 percent compared with 2003. The main energy consuming sectors were transport (34 percent) and industry (38 percent); with residential, commercial and public sectors consuming 28 percent. By energy source, oil products accounted for 51 percent of final consumption, with electricity and "other" sources, natural gas and coal at 37 percent, 7 percent, and 4 percent, respectively.

Chile is the largest producer of copper in the world. Copper production is expected to grow to nearly 40 percent of world production in the medium term. The copper industry is by far the most important industrial energy consumer in Chile. In 2004, the total consumption was 15,700 GWh, which is 33 percent of the total electricity consumption in Chile.

In the 1990s, most of the 6.6 percent annual growth in industrial energy use was driven by non-energy-intensive industries, which grew at 9.1 percent annually. For total industrial energy consumption by fuel type, petroleum products accounted for 28 percent, electricity (35 percent), biomass (12 percent), coal and cokes (8 percent) and natural gas (12 percent). Natural gas has been replacing petroleum products, especially heavy fuel oil and coal in the industrial sector due to the introduction of Argentinean gas in the northern and central regions of Chile.

Transportation has recently been the fastest growing end-use sector, with an average increase of about 5.7 percent per year from 1984 to 2004

In the residential, commercial and public sectors, growth in energy consumption averaged about 2.7 percent, and in the transportation sector averaged about 4.9 percent per annum. The residential, commercial and public sectors accounted for almost 28 percent of energy consumption in 2004.

POLICY OVERVIEW

Energy policy in Chile has three axes Energy Security, Efficiency and Sustainability, which aims to promote dynamic development of the energy sector, overall economic growth and a better quality of life for its people. The ambitious Energy Security Action Plan comprising short and medium term measures has been devised by the government, and the government has set out to develop the energy sector, based on the following principles to achieve its goals:

- To promote a free competitive market in the energy sector. The role of government is to regulate the market in order to avoid market distortions, especially in those areas where natural monopolies arise;
- Improvement of energy supply conditions as well as the quality, efficiency and security of energy products and services with the aim of diversifying Chile's energy matrix (in terms of both fuel sources and suppliers); to achieve greater energy independence/autonomy and encourage the efficient use of energy.
- Reduction in the prices of energy products and services, within reason, in order to reflect technological and managerial advances, improve the economy's international competitiveness, maintain incentives for investment, and offer consumption opportunities to the poorest segments of the population;
- Protection of energy consumers by minimising abnormal fluctuations in the prices of key products, especially those caused by temporary distortions in markets;
- Focused and transparent support, through efficient and effective mechanisms, to sectors that do not have access to key energy resources, where providing such access has a high social priority or social return;
- Development of and compliance with regulations that protect the environment.

In other words, the main objective of Chile's energy policy is to achieve strong energy supply and economic growth, without compromising the welfare of energy consumers, key industries or the environment. The general guidelines for achieving this objective are as follows:

SHORT-TERM MEASURES

1. Quintero LNG Project – with a capacity of 10 million m^3/day (expandable to 20 million m^3/day). This plant will be able to provide the natural gas supply needed to meet restrictions on the import of Argentinean gas. Chile's state oil company ENAP, the Endesa Chile generator, the Metrogas natural gas distributor and GNL Chile will be the main partners – and signed an agreement with BG Group to develop this facility.

2. LNG Project in Northern Chile – the state copper company, CODELCO, is to lead a group of northern Chile's energy users in studying the possible construction of an LNG plant to supply the SING's needs.

3. International Tenders for Energy – under the Short Law II, distributors must issue public tenders for the energy required to supply their regulated clients. As indicated above, in order to guarantee supply availability in the medium term, this system establishes a payment mechanism based on stable long-term prices. The introduction of this incentive has triggered a major investment boom[14].

4. Operational Security Plans – under the Short Law II, the authorities can require Economic Load Dispatch Centers (CDECs) to adopt a more conservative operating plan with the aim, in the SIC, of optimizing use of the system's water resources.

5. Incentives for Electricity Saving – the Short Law II introduced a mechanism to encourage consumers to limit electricity use. Under this mechanism, generators will be able to offer rewards or incentives to regulated clients who save energy. The draft of the corresponding regulations has been drawn up and was presented to the electricity companies, the CDECs and the Panel of Experts for their observations, which have been received by the CNE.

[14] A recent survey by the Corporación de Bienes de Capital, a private organization that monitors investment, found that more than 60 generating projects, representing a total capacity of 11,800 MW and investment of some US$12 billion, are currently being considered.

6. Survey of Locations for Back-Up Turbines – new power plants will not come on line until 2010 and, in this context, a dry spell in 2008-2009, with its impact on hydroelectric output, could mean that the SIC would require backup diesel turbines to increase its installed capacity[15].

7. Strengthening the National Energy Efficiency Program (PPEE) – the National Energy Efficiency Programme is a public-private initiative that seeks to create, publicize and consolidate a National Energy Efficiency System covering housing, transport, manufacturing, industry, mining, commerce and the public sector[16].

8. Addressing the Logistical and Commercial Situation of the SING – restrictions on natural gas imports may force some SING generators to use diesel, which has to be shipped to the port of Mejillones and then transported by road to the plants, passing through different towns. This creates logistical challenges and difficulties, calling for measures to ensure that the fuel is made available and transported rapidly and efficiently and to reduce the environmental impact and the risks to the population[17].

MEDIUM-TERM MEASURES

1. Development of New and Renewables – Chile has undertaken a programme to promote and implement all the measures needed to ensure that 15 percent of new generating capacity installed through to 2010 is derived from New and Renewables sources.

2. Government Policy for the Development of Biofuels – a government working party was established to study a proposal for a public policy on liquid biofuels (ethanol and biodiesel), formed by the CNE, the Ministry of Agriculture, the Ministry of Transport, CONAMA and the Superintendency of Electricity and Fuels.[18]

Chile has a high level of energy import dependence because of the limited domestic energy resources and Chile currently imports almost two-thirds of its primary energy consumption; in 2005, 98 percent of the oil, 75 percent of the natural gas and 91 percent of coal consumed were imported, as a result Chile is extremely vulnerable to volatile international market prices and/or supply interruptions.

An example of a policy supporting these objectives is energy sector privatisation. Chile was the first economy in the world to restructure its power sector in the 1980s, almost a decade before the United Kingdom. The market reform strategy that Chile developed twenty years ago has served as a model for other economies in South America.

ELECTRICITY

The Chilean government passed a bill to change the General Law of Electrical Services of 1982, which was approved in March 2004 (Short Law I). The goal of the proposed changes is to improve economic incentives and encourage efficiency in the competitive segments of the electricity market, particularly in the transmission sector. Where market intervention by regulatory agencies is necessary, this intervention should increase sectoral 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. The main points included in the approved law are:

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[15] These turbines, which take only six months to install, have capacities that range from 30 to 120 MW and can be located in different parts of the country.

[16] A study carried out recently for the CNE examined the many different initiatives they have implemented and, on the basis of this information, estimated that an active energy efficiency policy means around a 1.5% annual reduction in total energy consumption.

[17] In October, the CNE completed a study to evaluate the response of storage and distribution facilities for both liquid and solid fuels in different supply and demand scenarios and to assess requirements.

[18] This group, which has been working since the end of May 2006, is looking at issues that include the relationship between the quality of biofuels and vehicle emissions (through a study to be carried out by CONAMA and the Transport Ministry) as well as the definition of the corresponding quality standards.

- Toll transmission system based on:
  - Transmission expansion oriented by planning study done every four years, with the participation of all shareholders
  - 100 percent remuneration of all existing transmission assets, at a 10 percent rate of return
  - Regulatory supervision
  - International and Public tenders for new lines, ensuring the payment for the bidded price for 20 years.
- Incorporation of low scale producers into the market;
- Expert council to solve conflicts among agents
- Tariffication in medium-sized systems;
- Basic procedure to calculate distribution tolls.

The House of Congress approved the law in March 2004 and the corresponding regulatory instruments and norms are underway. A key point in this law is the incorporation of small power generating units in the market, which will open the possibilities for NRE proliferation in the Chilean market. In fact, due to its longitudinal structure, several NRE resources are economically competitive in power generation, and clear rules for their commercialization are the only true barrier for their deployment.

Also in May 2005, the House of Congress included a new modification in the electricity law which would increase incentives for new investments in generation plants to warrant the supply in response to the grow demand (Short Law II). The main modifications are:

- Distributors must issue public tenders for the energy required to supply their regulated clients, at least three years ahead
- 5 percent of the energy tendered by distributors must be supplied using NRE sources, at average bidded prices.
- Mechanism to encourage consumers to limit electricity use. Under this mechanism, generators will be able to offer rewards or incentives to regulated clients who save energy.
- Defined the fortuity case or "greater force" in the operation of the system power; specifically indicating that the absence of security and quality caused by disability of power generators as regards the partial or total restrictions of natural gas will not be considered as fortuity case or "greater force".

NOTABLE ENERGY DEVELOPMENTS

INTERNATIONAL ENERGY INTEGRATION

Chile is engaged with other South American economies in a process to diversify its energy matrix and strengthen bilateral relations to ensure adequate energy supply. Historically, hydropower has been Chile's main source of electricity, making supply dependent on climatic conditions, while oil was used to supply industrial and residential consumption. In the mid-1990s, Chile started to diversify its energy mix by importing natural gas from Argentina for use in electricity generation and by industries and households. Seven pipelines, representing an investment of some US$1.6 billion were built connecting Chile to different gas basins in Argentina: gas-fired plants with a total capacity of 3,400 MW were also built at a cost of US$2 billion. Despite

that Bolivia can not supply natural gas to Chile because of a mandatory referendum that does not allow Bolivia to sell natural gas.

ARGENTINA

Although energy integration with Argentina has progressed more than with any other economy, a shortage of natural gas from Argentina has created problems for the electricity sector in Chile. As combined cycle units are an important source of energy for electricity production (nearly 29 percent in 2005), the impact of natural gas reduction has affected the Chilean policy for this fuel. On one hand, a bilateral agreement regarding these natural gas shortages is under development between the governments of Chile and Argentina. The aim of this agreement is to ensure crisis management and to allocate appropriate compensation schemes. However, on the other, Chile is planning to build two LNG ports to accommodate additional supply sources from other economies.

LNG TERMINAL FOR PACIFIC LNG GAS

In 2004, 2005 and 2006, Chile was confronted by an import restriction of natural gas supplies from Argentina that reached almost 45 percent of the total volume previously supplied.

Over the last two years, gas importers have invested in stand-by systems dual fuel (gas/diesel) mechanisms and plants to produce propane-air that allow them to maintain operation even if natural gas imports were reduced to zero.

As a result there is no risk to the system's security. All the different users of Argentine natural gas can switch to other fuels, although these are more expensive (gas supply restrictions increase generation costs to around US$190 /MWh versus US$33.1 /MWh.

Further supply cut-backs are to be expected because of the following reasons:

- High growth of domestic demand in Argentina (annual increase of 7 million m^3 /day) and a lack of new investment in exploration and production mean less gas is available for export and this will reduced even further if the capacity of pipelines connecting Argentina's basins to Buenos Aires is expanded.
- Argentina's proven and probable natural gas reserves have fallen by 17 percent and 4 percent respectively.
- As a result their proven reserve to production ratio has dropped to 8.9 years in 2005, down from 10.4 years in 2004.

To address the problem, the government is seeking to foster the diversification of Chile's energy supply, through the state company ENAP, it is promoting the construction of an LNG import terminal at Quintero Bay in central Chile which will start operation in late 2008, a second LNG terminal in the north of the economy is also planned to be built. In addition new opportunities are being offered for participation in exploration and production of natural gas in the Magallanes region and in the development of coal bed methane projects. Effort is being made to increase the efficiency of energy use through public-private collaboration. In this line, preliminary contacts with Indonesia, Algeria and other nations are under way in order to seek partners for the construction of the LNG ports.

HYDROCARBONS

ENAP is prospecting for natural gas in Lago Mercedes, a lake on Tierra del Fuego. After announcing the discovery of a continuous flow of gas from the Lago Mercedes II well, the company is making a new perforation in Lago Mercedes III to assess the extent of the reserves. At the same time, ENAP is continuing with its prospecting program in the block known as Dorado-Riquelme to the north of the city of Punta Arenas.

In addition, a number of overseas companies have expressed interest in signing Oil Prospecting and Production Contracts (CEOPs) with Chile which, for this purpose, is represented by the

Mining Ministry. At the end 2006, ENAP will put out a tender to incorporate private partners in its hydrocarbon exploration and production in the far south of Chile.

RURAL ELECTRIFICATION

Within the framework of the National Rural Electrification Program of Chile created in 1994 for the Comision Nacional de Energia (CNE), the government aims to reach a goal of 90 percent electrification of rural household's in the year 2006, as well as, to improve the electric generation systems for isolated rural communities. Furthermore, a project for the implementation and eventual operation of a Hybrid Electric Generation System, Wind-Diesel, in the Robinson Crusöe Island, of the Archipelago of Juan Fernández, in the Valparaíso Region is currently under way and in the next 3 years will electrify around 30,000 new householders in the economy.

In the four regions north of Santiago, the households connected by the Rural Electrification Program are widely spread out and since 2003, CNE in coordination with local Governments have implemented projects for 5,000 photovoltaic (PV) systems and are in the development of wind power projects, and small hydro power plants projects (refer to Renewable energy).

RENEWABLE ENERGY

A strong boost to renewable energy for electricity generation came with the modification of the law for the electricity sector, which removes barriers for the incorporation of small plants (up to or below 9 MW) to the generation mix through simplified commercial and operational regulations in the electricity market and the distribution systems. The streamlining of the law has been a key issue in the policy of the National Energy Commission (CNE) to allow competition for wind, biomass, PV and geothermal power sources, which are typically in the range of 100 kW to 10 MW.

In additional to this law that was approved by the congress in 2005, the Presidency established a goal in terms of renewable energy. The purpose is to develop and implement all the initiatives needed for 15 percent of new electricity generation capacity installed in the period of 2006 – 2010 to come from renewable sources. Consistent with this purpose, the Government has implemented activities/regulation to give the correct signals to the market to allow for new investment of renewables, including among others:

- Special funds for pre-feasibility studies for new private projects
- Studies of resources in the economy, considering wind, biomass, hydro, and geothermal.
- Guidelines for the environmental assessment of renewable projects
- Road shows for new investment
- Technical norms for renewable energy projects connected to the distribution grids.

The National Energy Commission in conjunction with Congress, has been during 2006 studying a new law for renewable energy projects, with the purpose to remove all commercial barriers that still exist in electricity regulation, and the objective is to send this new revision in early 2007 for the discussion and approval of the Congress. This initiative is a priority in the governmental energy policy and will be complementary to those activities mentioned previously.

ENVIRONMENT

Chile ratified the Kyoto Protocol in July 2002. According to the procedures established by the Meeting of the Parties of the Kyoto Protocol, the Designated National Authority for CDM in Chile has been working on project approval in Chile. CNE is part of the National Authority, particularly for the review of energy projects.

With the purpose to promote the use of the Kyoto Mechanisms in renewable energy and energy efficiency, in 2006, CNE developed, printed and distributed the document "Guía del mecanismo de desarrollo limpio para proyectos del sector energía", as a way to give to local and foreign investors a clear guideline of the required information for CDM projects in Chile and at the international level. These guidelines will help to reduce the transaction costs for small scale projects in Chile.

In another area, related with energy and the environment, in 2006 the Government approved the initiative to define an emissions standard for thermal power generation. According to the environmental Law, a Technical Committee was created to work on this issue, and the objective is to have a final proposal by the end of 2007.

In the context of the Security Energy Policy, the CNE and the National Environmental Agency (CONAMA) are working to identify the baseline in areas where it is possible to install emergency electricity generation capacity, with the purpose to reduce the timeframe for environmental assessment, in the case that this capacity needs to be installed by the private sector. The outcomes of this work will be publicised at the end of 2007.

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CHINA

INTRODUCTION

China is the fourth largest economy in the world, next to Russia, Canada and the US. It is located in North East Asia, and bordered by the East China Sea, Korea Bay, and South China Sea, and lies between North Korea and Viet Nam. Its population of 1.3 billion is roughly one fifth of the world's population. Its diverse landscape consists mainly of mountains, deserts, and river basins and covers around 9.6 million square kilometres.

Currently, China is the world's second largest energy consumer (next to the US) and the second largest energy producer (after the US). However, its per capita primary energy consumption (at 0.99 toe) is by far lower than in many developed economies and the world's average.

China has sustained high rates of economic growth, around 10 percent, for more than 20 years. However, in the late 1990s, growth slowed slightly reaching about 8 percent per year. Energy consumption continued to grow rapidly through most of the 1990s, but has levelled off since 1997. Since 2001, along with strong GDP growth, industrialization, urbanization and motorization, energy consumption has grown rapidly. In 2004, the energy consumption growth rate amounted to 18.3 percent. However, GDP per capita in 2004 was still quite low, at US$5,907 (2000 US$ at PPP).

China is rich in energy resources, particularly coal. In 2004, China was the largest producer and consumer of coal in the world, as well as the sixth largest producer and second largest consumer of oil. However, after a long history of being a net oil exporter, China became a net oil importer in 1993. According to recent estimates, China has recoverable coal reserves of some 114.5 billion tonnes, proven oil reserves of 2,200 MCM and proven natural gas reserves of 2,350 BCM. In addition, China is endowed with 676 GW of hydro potential, more than any other economy in the world. For power generation and industrial development purposes, coal and oil resources have been utilised more extensively than natural gas and hydro.

Table 9 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	9,600,000	Oil (MCM) – Proven	2,200
Population (million)	1,296.16	Gas (BCM) – Proven	2,350
GDP, Billion US$ (2000 US$ at PPP)	7656.18	Coal (Bt) – Recoverable	114.5
GDP per capita (2000 US$ at PPP)	5907	Hydro (GW) - Potential)**	676

Sources: Energy Data and Modelling Center, IEEJ. *Proved reserves, end of 2006, *BP Statistical Review*.

**China Energy Annual Review 1997.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

China's primary energy supply has expanded sharply since 2001, driven mainly by the rapid growth, especially by the energy consumption of heavy industry. In 2004, the total primary energy supply (TPES) reached 1,288.24 Mtoe. Of this total, coal accounted for 69 percent, oil for 24 percent, and natural gas for 3 percent, while hydropower, nuclear power and other sources accounted for the remaining 4 percent.

China has since given much political and financial support for the development of its abundant indigenous coal reserves to ensure the security of energy supply. However, since as early as the 1990s, Chinese authorities have been encouraging the switching of fuels (for example from coal to cleaner fuels), introduced energy efficiency initiatives (to reduce pollution and emissions from energy use) and optimise existing energy structure. The use for coal reached its peak in 1996, and then experienced a significant decline between 1997 and 2000. It did however recover in 2001, followed by strong growths during next four years. In 2004, coal production reached 996.2 Mtoe and climbed to 1,102.4 Mtoe[19] in 2005, reaching a new historic high.

The supply of petroleum products in 2004 grew by about 17 percent compared with the preceding year while domestic oil output also increased slightly to 175.9 million tons, while China imported approximately 172.9 Mtoe of oil. Import dependence on oil reached around 47 percent of total oil consumption in 2004. Primary natural gas supply totalled 33.3 Mtoe in 2004 while its share in total primary energy supply remained at 2.6 percent. Although the proportion of natural gas in total primary energy supply is still quite small, primary natural gas supply has increased very rapidly at a rate of 13.4 percent over the last four years along with the construction of natural gas pipelines and increases in gas reserves. The demand for gas is expected to more than double by 2010. This will involve an increase in domestic production, and imports, by pipeline and in the form of liquefied natural gas (LNG).

Table 10 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	1,198,120	Industry Sector	568,295	Total	2,203,293
Net Imports & Other	99,990	Transport Sector	91,165	Thermal	1,795,588
Total PES	1,288,243	Other Sectors	225,295	Hydro	353,544
Coal	900,765	Total FEC	884,756	Nuclear	50,469
Oil	305,377	Coal	415,816	Others	3,692
Gas	33,296	Oil	258,602		
Others	48,804	Gas	23,650		
		Electricity & Others	186,687		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

China's electric power industry experienced a serious oversupply problem in the late 1990s, due largely to demand reduction from the closure of inefficient state-owned industrial units, which were major consumers of electricity. However, a shortage of electricity supply appeared as a result of the rapid economic expansion after 2001. Since this time, the installed generation capacity has increased steadily at an annual average rate of 9.3 percent over the period 2002 to 2004, to reach 442.4GW[20] at the end of 2004 with a corresponding growth in power generation to 2,203 TWh. By fuel type, 75 percent of the total installed capacity was from thermal plants, 23 percent hydro, 2 percent nuclear, and 0.2 percent other[21]. The corresponding shares of power generation were 82 percent for thermal power, 16 percent for hydropower, 2 percent for nuclear power and 0.2 percent for other.

[19] China Statistical Yearbook, 2006

[20] China Electric Power Yearbook, 2005

[21] China Electric Power Yearbook, 2005

FINAL ENERGY CONSUMPTION

Final energy consumption in China reached 884.8 Mtoe in 2004, or 16 percent higher than the previous year. Industry was the largest user accounting for 64 percent of total final energy consumption. This was followed by the transportation sector accounting for 10 percent of energy use and other sectors – including residential and commercial – 26 percent. In terms of energy sources, coal (47 percent) remained the most important fuel in 2004, followed by oil (29 percent), electricity, heat and other fuel (21 percent), and natural gas (3 percent).

Coal consumption in 2004 reached 900.8 Mtoe, driven by the recent increase in economic activity. China's electricity sector is the biggest coal consumer, and in 2004, around 52 percent of coal consumption came from this sector, followed by metallurgical industry (14 percent), building materials sector (17 percent), chemical sector (6 percent) and others (11 percent) [22].

Electricity demand increased by 16 percent from the previous year and reached 2,203 TWh in 2004. The high demand growth resulted mainly from the increase in consumption in commercial, industrial and transport sectors at 20 percent, 17 percent and 13 percent respectively. The highest consumption for electricity was from the industrial sector at 75 percent, followed by residential sector (11 percent), agriculture (4 percent), commercial sector (3 percent), transport sector (2 percent) and others (5 percent).

China consumed 305.4 million tons of oil in 2004, the second-biggest oil consumer behind the US. The industry sector was the largest oil consuming sector, accounting for 47 percent of total final oil consumption. The transport sector, the second largest oil consumer and the fastest-growing oil consuming sub-sector, accounted for 27 percent of total oil consumption, an increase of 22 percent over the previous year.

The market for gas is mainly in Southeast China, and accounts for a third of total natural gas consumption of 33.3 Mtoe. However, the market is moving to North China and East China along with the completion of the Shaanxi-Beijing gas pipeline and West to East gas pipeline. At present, the chemical industry is the largest gas user, accounting for about 33 percent of the total, followed by industrial feedstock (22 percent), city gas (25 percent) and power generation (10 percent). City gas use has increased the fastest in recent years as a result of the construction of the city gas pipeline network.

POLICY OVERVIEW

In recent years, energy consumption grew rapidly with the robust economic development and acceleration of the industrialization process. Energy has become an important strategic issue concerning China's economic growth, social stability and national security. Since 2005 China set up the National Energy Leading Group and the Country Oil Reserve Centre to strengthen the leadership on forward-looking, comprehensive and strategic policy-making issues, and to perfect energy organization. In March 2006, The Outline of the 11th Five-Year Plan (2006-2010) for National Economic and Social Development was approved by the Fourth Session of the Tenth National People's Congress China (see notable energy developments for further details).

Energy supply capabilities have been gradually increased, such that in 2005 primary energy output accounted for 1.44 billion toe, 87 times the figure in the initial stage of the founding of the new China and 3.3 times the figure in the initial stages of the implementation of reforms and opening-up policy. In 2005 coal output came to 1.1 billion toe, the output of crude oil was 181 million tonnes, the production of natural gas reached 46 Mtoe, the installed capacity of electricity surpassed 500 GW, and the development and use of renewable energy has kept on increasing.

[22] China Industrial Maps – Energy, 2004-2005

The energy consumption structure has been optimized. The proportion of high-quality clean energy consumption continues to increase. The proportion of oil and natural gas consumption – considered clean fuels in China – rose from 19 percent in 1990 to 24 percent in 2005 and that of hydropower and nuclear power rose from 5 percent to 7 percent. Fast progress has been made in energy-related technologies. Oil exploitation and development technologies, hydropower construction technologies, and overall mechanized coal exploitation technologies have reached the levels seen in many of the world's advanced economies. Progress has also been made in economizing the use of energy resources and protecting the environment. The economy has intensified control of pollution avoidance in the energy sector.

Reforms of the energy sector have been pushed steadily. The power industry has accomplished the detachment of enterprises from government control and the separation of generation plants from transmission grids. Coal production and sales are basically based on market demand. Positive achievements have been made in the management of energy demand and energy-related legislation has been noticeably intensified. A series of new rules and regulations, such as the "Law on Electricity", the "Law on Saving Energy Resources", and the "Law on Renewable Energy" have been stipulated by the government.

Along with the rapid development of the economy and society, inconsistencies and problems accrued over many years have become more conspicuous. Major indicators are as follows: restrictions on energy resources have become noticeable; conflict between supply and demand is becoming more noticeable; energy-related technologies remain unsophisticated; energy efficiency is still markedly low; the energy structure remains heavily reliant on coal; energy production/consumption exerts considerable strain on the environment; the petroleum reserve system has not been perfected; production safety remains a key issue; reforms of the energy sector have not been properly put in place; and energy-related laws and regulations need improvement.

In general, the following initiatives have been established as the central tenants of energy policy: placing priority on energy conservation; to be based on energy supply; primary reliance on coal; the diversification of energy sources; optimization of the demand and supply structure; and the development of a stable, economic, clean and safe energy procurement structure.

COAL

To promote the steady, clean, safe and sustainable development of the coal industry, the State Council promulgated the Guidelines on Promoting the Healthy Development of the Coal Industry were established in June 2006. According to these guidelines, a series of policies and measures were released by governmental related ministries. These mainly concern the enhancement of operational management within the coal industry, adjustment and control, the improvement of safety in the production process and the criteria through which the order of coal resource exploitation will be undertaken (see notable energy developments for further details).

OIL

Responding to surging international oil prices, the NDRC issued a series of related policies to reduce the negative impact of oil price hikes on enterprises and society as a whole. They included raising the prices of refined oil products twice, the establishment of a subsidy system for disadvantaged sections of the community and public services sector, a price linkage mechanism for related industries, and a fiscal adjustment for oil enterprises. The goal of pricing reform is to establish a system reflecting the real situation of the market, caring for the interests of all groups and keeping social stability.

The fiscal adjustment mechanism for oil enterprises mainly refers to the system in which the state collects special proceeds from oil enterprises that have made excess profits – windfall tax. The funds will be used to subsidize disadvantaged communities, the public services sector and oil refining enterprises that incur losses because of the subsidized pricing system. The recipients of the subsidies mainly include farmers, fishermen and fishing firms, state-owned forestry enterprises and urban public transportation firms.

For the transportation industry affected by oil price hikes, the government decided to establish a mechanism linking transportation fees and refined oil prices in such areas as civil aviation, railways, taxis and highway passenger transport. On the basis that these enterprises themselves bear some of the cost of the rise in oil prices, the government adjusts the transportation fees based on market factors.

ELECTRIC POWER

With economic growth pushing electricity demand beyond generation capacity, the nation has experienced power shortages since 2002. Stimulated by the severe strain on the power supply, there was being a strong impetus to construct more power stations in various regions. China's electric power has kept developing at a double-digit growth rate over the past four years, which was higher than the growth pace of the economy's GDP during the same period. As a result, many small oil-fired generators have been built. The move comes as part of China's drive to remove power units that consume a lot of energy and produce severe pollution.

China's total power installed capacity has reached 531 million kilowatts in 2005, and more than 70 GW of newly installed capacity is expected to be put into production in 2006. About 250 GW of power station projects are under construction in China. Power supply and demand will be balanced nationwide in 2007, although short-term power shortages will still exist in a few regions.

It is a good opportunity to close small coal-fired and oil-fired units that use excessive energy and produce heavy pollution. The government will accelerate the efforts to close small coal-fired units with a combined capacity of 15 GW in the coming five years. According to China's power development project in the period 2006-2010, China will redouble efforts to develop clean energy projects such as hydropower, nuclear power and replace small coal-fired or oil-fired power generation units with large, coal-fired units.

ENERGY CONSERVATION AND EFFICIENCY IMPROVEMENT

The State Council passed in principle a resolution on the issue of energy saving, entitled "State Council Resolution on Stepping up the Work of Energy Saving", which highlights the importance of energy saving for China, an economy with the world's largest population and with a serious environmental pollution. China will improve energy conservation by increasing the proportion of the service sector in the economy.

In response to the rapid growth of energy consumption and environmental problems, China has initiated a number of special programs and action-plans to improve the energy efficiency. In the Medium and Long-term Plan of Energy Conservation, ten key projects for energy conservation are the main contents of the plan that was put forward in 2005. They are:

- Coal-fired boiler renovation
- Regional co-generation
- Residual heat and pressure utilization
- Petroleum conservation and substitution
- Motor system energy conservation
- Energy sector optimization
- Building energy conservation
- Green lighting
- Energy conservation in governmental agencies
- Creation of energy conservation monitoring and technical service systems

In order to further improve energy efficiency, NDRC and other governmental agencies created a GDP/Energy Consumption Level Reporting and Releasing System. This system has been

enacted since 2006. NDRC and related governmental agencies will release the energy consumption levels per unit GDP outputs and other major energy indicators for all provinces annually. Energy consumption indicator will be taken as a compulsory threshold when the authorities approve, certify or record new investment projects (see notable energy developments for further details).

DEVELOPMENT AND UTILIZATION OF RENEWABLE ENERGY

In 2005, China has established more than 60 windmills, with a capacity of 1.26 million kilowatts. In the coming years, China is moving ahead rapidly with its construction of renewable energy projects across the country, with hydro and wind-power capacity to reach 180 million kilowatts and 5 million kilowatts respectively by 2010.

The Renewable Energy Law of China, which came into effect in January, 2006. Subsequently, the NDRC of China released two new renewable energy regulations under the Renewable Energy Law: the Provisional Measures for Renewable Energy Electricity Generation Price and Cost Distribution Administration and the Administration Rules relating to Renewable Energy Electricity Generation. These regulations collectively:

- set up the pricing and cost distribution regimes for the Chinese renewable energy sector and are effective from 1 January 2006
- provide for a renewable energy project approval regime at the national and provincial levels
- set out each distributor's responsibilities about connecting renewable energy sourced electricity to the distribution network, and
- address each generator's responsibilities in relation to investing in renewable energy projects and meeting the national renewable energy generation target (see notable energy developments for further details).

ENVIRONMENTAL PROTECTION

While becoming the second-biggest energy consumer and energy producer in the world, China has also become the largest sulphur dioxide and second-largest CO_2 emitting economy in the world. In 2005, the total sulphur dioxide emission in China reached 25.5 million tonnes, of this 21.7 million tonnes came from industrial discharge and 3.8 million tonnes from domestic discharge. The amount is 27 percent over that of the 2000 level. China's coal consumption increased more than 800 million tons in the period 2001-2005, and as 80 percent of the coal is used for direct combustion, and coal-fired power plants – which account for roughly half of the total coal consumed in China – large amounts of sulphur dioxide, nitrogen dioxide and soot are produced.

To fulfil the sustainable development objectives of the economy, through adequate resource utilization and environmental protection, the government is undertaking efforts to reduce the emission of pollutants such as sulphur dioxide and nitrogen oxide, through improved pollution controls on power plants as well as policies designed to increase the share of natural gas in the country's fuel mix.

The State readjusted the energy structure in this area by promoting the use of clean fuel and low-sulphur coal, and prohibiting residents in big and medium cities from using coal for household stoves. By the end of 2005, 142 desulphurization projects had either been completed or were under construction within the economy, for major thermal power plants with a total installed capacity of approximately 50 million kilowatts or more.

Formulating price and tax policies favourable to environmental protection, a mechanism to share fees for renewable energy resources has been established. The tax rebate policy for exported products, which includes iron and steel, electrolytic aluminium and iron alloy, have been either annulled or reduced. Taxation policy has been formulated in favour of auto-industry upgrading and auto-pollution alleviation. Tax reductions or exemptions are extended to enterprises engaged in

reclaiming renewable resources, making comprehensive use of resources and producing equipment for environmental protection.

NOTABLE ENERGY DEVELOPMENTS

ENERGY DEVELOPMENT PLANNING

In March 2006, The Outline of the 11th Five-Year Plan (2006-2010) for National Economic and Social Development was approved by the Fourth Session of the Tenth National People's Congress China. In the outline, the national economy is expected to grow at an annual average rate of 7.5 percent during the period of the Five-Year Plan. By 2010, China's per capita GDP will be US$2400.

The Outline outlines two lines of strategic thinking, namely, the Scientific Concept of Development and building a socialist harmonious society. The government has set the target of decreasing energy consumption by 20 percent through to 2010 from the 2005 level; and reduce emissions of major pollutants by 10 percent through to 2010.

The major energy work tasks in the 11th Five-Year Programme period are the following six areas.

- Energy saving should be taken as the fundamental way for resolving the economy's energy-related problems and must be considered above all other aspects.
- To meet domestic demand the development of energy resources in a diversified manner. Coal production should be developed in an orderly manner, positive efforts should be made to develop the power industry, the development of petroleum and natural gas resources should be expedited, and great efforts should be made to develop new energy resources and renewable energy resources.
- Ensure safety and protect environment. To achieve the two aims of shutting down small-scale coal and gas mines and open various channels to increase the input – namely investment and managerial expertise – to ensure the safety of coal mines. Intensify supervision and management to reduce the number of serious accidents and develop a recycle-based economy that harmonises economic development while protecting the environment.
- Develop external cooperation and create a reciprocal win-win situation. Actively take part in the cooperative development of the world's petroleum and natural gas resources and safeguard our economy's energy security in the course of opening the economy to the outside world.
- Speed up the construction of strategic petroleum reserves and enhance operational coordination. Prioritize construction of strategic petroleum reserve locations, as well as the synchronization between the supply and demand of coal, power, oil, and transportation services.
- Intensify sector reforms and the creation of a just legal system. Pay attention to reforming energy price systems and speeding up the improvement and requirement of rules and regulations, such as the "Law on Energy Resources" and the "Law on Saving Energy Resources".

NEW COAL POLICY

The Guidelines on Promoting the Healthy Development of the Coal Industry were established in June 2006. This instruction document outlines the overall situation, the comprehensive nature, the systematic characteristic and the programmatic quality, is in the coal industry history the new

milestone, fully has manifested the country highly takes to the coal industry, to coal worker's deep concern. China's coal industry efforts to create larger mining conglomerates with the expectation such conglomerates would be more efficient, safer and easier to regulate. Several giant coal mine conglomerates are to be created over the next three to five years to better compete on the international market and improve mine safety. Large enterprises - each with annual production of more than 100 million tons – will be encouraged to take over smaller mines through mergers and acquisitions. It is hoped these conglomerates will use resources more efficiently and allow for better regulation and standardization.

The construction of coal mines has shown an increasing trend rising by an average of more than 40 percent from 2003 to 2005. The verified production capacity of coal mines with production permits exceeding the total demand for 2006 and was starting to show signs of overcapacity. However, in actuality the present production mix shows a shortage of high quality coal and excess supply of poor quality coal. Seven government departments, including NDRC and the State Administration of Quality Supervision and Inspection and Quarantine, have issued a joint document, Directory Proposals on Speeding up Structural Adjustment of the Coal Industry and Coping with Overcapacity. This makes it mandatory for coal mines to carry out production only according to their designated quotas and obliges them to strengthen supervision and administration over the production process. No department is permitted to issue production plans and targets that exceed the approved production capacity. Coal production permits of those found violating the order can be cancelled.

ENERGY EFFICIENCY AND CONSERVATION

In 2006, NDRC issued a detailed action plan called Proposal on Implementing Ten Key Projects for Energy. The target is saving 240 million tonnes of coal equivalent (tce) through the implementation of this plan during the 11th five-year programme, accounting for 40 percent of the economy's goal which is a 20 percent reduction in the energy consumption per unit of GDP in 2010 compared with the 2005 level.

The Top-1000 Enterprise Energy Conservation Action Plan was also formally launched in 2006. The 1008 top energy consumption enterprises in China are involved. The requirements for 1008 enterprises (including energy audits and an energy conservation plan) have been identified, and incentives will be applied to these enterprises in order to improving the energy efficiency. Based on the plan, the Energy Conservation target is saving 100 million tce by 2010. The goal is ambitious.

RENEWABLE ENERGY

The two new renewable energy regulations under the Renewable Energy Law of China stipulate two forms of renewable energy pricing: a government-set price and a government-guided price. The biomass power generation price is set by the government based on the provincial or local on-grid price of desulphurized coal, plus a government subsidy of 0.25 Yuan (US $0.03) per kilowatt-hour. For all renewable power projects approved after 2010, the subsidy provided per kilowatt-hour generated will decrease at an annual rate of 2 percent.

For biomass projects, if the licensees are determined through a competitive bidding process, the winning bid-price will be implemented provided it does not exceed the local price of grid-connected electricity. The on-grid price of wind power, too, will be set by the State Council authorities based on the winning bid-price. The price of solar, marine, and geothermal electricity generation projects, meanwhile, will be determined on an "economic and reasonable" basis. The cost difference between on-grid renewable power and power from on-grid desulphurized coal will be shared in the selling price at the provincial and national levels.

ENERGY LAW

China has set up a taskforce to draft Energy Law. Problems accumulated during the past decades have begun to emerge in the energy sector due to increasing demand for energy to power the economy's fast growing GDP. The complicated and changing international environment poses new challenges to China's energy and economic security. Up to now, China has had four specific energy laws, covering the coal industry, electric power, energy conservation and renewable energy, as well as local rules and regulations related to energy. China does not have a basic law on energy that reflects the government's energy strategy and policy orientation and regulates in general the structure of the various energy products and energy-related activities.

China is in urgent need of formulating such a basic, comprehensive law on energy to ensure national economic security, energy exploitation/international energy cooperation, streamline the energy reserve system, and emergency response mechanism. Such a law will help shape China into an economy that is energy efficient and environmentally friendly through optimizing its energy structure, improving energy efficiency and promoting clean production, and forming an economic growth mode characterized by low input, low energy consumption, low pollution and high efficiency.

The State Council approved the establishment of an inter-ministerial drafting team in January 2006 in order to strengthen the leadership and mobilize all government departments to co-draft the law. The minister in charge of NDRC and the director of the Office of National Energy Leading Group, serve as the team leaders with a total of 15 state ministries/institutions as members. The government plans the draft of Energy Law to be submitted to the legislature in 2008. From May to December 2006, a survey on proposals and suggestions to the Energy Law is being conducted through the internet and newspapers across the country by the State Energy Office and the NDRC.

WHITE PAPER ON ENVIRONMENTAL PROTECTION

The 45-page white paper, the second of its kind since 1996, is titled "Environmental Protection in China (1996-2005)" and released by the Information Office of the State Council in 2006. The 17,000-word white paper describes China's achievements in environmental protection legislation, prevention and control of industrial pollution, pollution control in key regions, environmental impact assessments, international cooperation in environmental protection and other related aspects.

The white paper points out that since the late 1970s, China's economy has developed rapidly and continuously. During this process, many environmental problems that have afflicted developed economies at different times during their 100-year-long industrialization process have also occurred in China. The divergence between environment and development goals is becoming ever more prominent. Relative shortage of resources, a fragile ecological environment and insufficient environmental capacity are becoming critical problems that could hinder China's development.

China has attached great importance to environmental protection and promotes it as one of the basic national policies, with sustainable development also being an important strategy. Although the amount of resources consumed has increased greatly and the amount of pollutants discharged has also shown a similar trend, the tendency toward aggravated environmental pollution and ecological destruction is slowing down. Consequently, the environmental quality of some cities and regions has improved, the amount of pollutants emitted as a result of industrial activities has declined, and people's awareness of the importance of environmental protection has been enhanced.

FIRST OIL RESERVE

The Chinese government has decided to establish a strategic oil stockpile, which was included in the Tenth-Five Year Energy Plan in order to ensure the nation's energy supply security (especially oil). China started to build national oil reserve bases in 2004. The sites of the first four bases are Zhenhai, Daishan in Zhejiang Province, Huangdao in eastern China's Shandong Province, and Dalian in north-eastern Liaoning Province.

China's first strategic oil reserve was completed in August 2006 and went into operation in October 2006. The completion of the base is a breakthrough for China which until now has had no national strategic oil reserves.

The oil reserve base in Zhenhai, close to China's largest refinery, Sinopec Zhenhai Refining and Chemical Company, is located at the head of the YongHuNing oil pipeline which runs from Ningbo to Shanghai and Nanjing, and has 52 storage tanks. 16 of them were erected in September 2005 and the remaining 36 were completed in October 2006. The base cost a total of 3.7 billion Yuan (462.5 million U.S. dollars) and has a storage capacity of 5.20 million m^3 of oil.

FIRST LNG TERMINAL

China's first liquefied natural gas terminal, the first phase of Guangdong LNG Project, started operation in June 2006. The project will import about 3.7 million tonnes of LNG annually from Australia's Northwest Shelf gas development project over the next 25 years and supply the gas to users in the Pearl River Delta region and Hong Kong, including five gas-fired power plants.

The Guangdong LNG Project was started in September 2003 and is scheduled to be completed in two phases. The construction of 7.4 billion Yuan first-phase project, with a nameplate capacity of 3.7 million tons a year, will mainly supply city gas to five cities including Shenzhen, Dongguan, Guangzhou, Foshan, Hong Kong and five gas-fired power plants. Guangdong Dapeng LNG Company Limited, a joint venture set up by 11 domestic and foreign enterprises including CNOOC and BP, is the operator of the terminal and the main trunk pipeline of the Guangdong LNG project.

In addition to the Guangdong project, China is also building an LNG terminal in Fujian province. This project is expected to come on stream in 2007 and will have a capacity of 7.6 million tones per year.

ULTRA HIGH VOLTAGE GRID

In August 2006, the cornerstone was laid for China's first ultra-high-voltage grid demonstration project. The project is the beginning of a new chapter in grid construction that focuses on the integration of ultra-high-voltage grids with grids of a different size at different levels around the economy.

Over two-thirds of China's water resources are distributed in western China's Sichuan and Yunnan provinces and the Tibet Autonomous Region, and over two-thirds of the coal resources are found in North China's Shanxi and Shaanxi provinces and the Inner Mongolian Autonomous Region. East and southern China have the lowest reserves of energy and other natural resources. But as these areas have the most rapid economic growth, they have the highest demand for energy. There is as much as 2,000 km between the energy bases in the west and the power load centers in the east. The ultra-high voltage grid, a power transmission network with 1,000 kVAC and 800 kVDC, can expand across great distances, has a large capacity, occupies limited space and uses only a small amount of power to transmit. However, there have no successful cases so far in the world. Japan and Russia have both built 1,000 kVAC power grids, but only for short-distance transmission. China finally gave permission for the experimental project to encourage the exploration of a way to supply the energy-thirsty eastern and central China by transmitting power from the energy-rich western and northern regions.

This demonstration project will span 653.8 km and cross both the Yellow and Hanjiang Rivers, transmitting power produced in Shanxi Province, China's largest coal base to Nanyang city of Central China's Henan Province and then to Jingmen city of Central China's Hubei Province, and is expected to be completed in 2008. With a planned investment of 5.7 billion Yuan ($US713 million), the grid is designed to have a rated voltage of 1,000 kVs, a maximum operational voltage of 1,100 kVs and a transmission capacity of 5 million kW.

THIRD LARGEST HYDROPOWER PROJECT

Construction of the Xiangjiaba Hydropower Station, China's third-largest, began in December 2006. Situated on the lower reaches of the Jinsha River in south western China, on the border of Sichuan and Yunnan provinces, the station will have an installed capacity of 6,000 MW and an average annual output of 30 billion kWh.

The station will be one of four in the lower reaches of the Jinsha River, which will together have the capacity to generate twice as much electricity as the Three Gorges project, turning the area into a centre for electricity transmission from western to eastern China. Construction of the four power stations is part of China's West-to-East Electricity Transmission Project, which aims to transfer power from the southwest, which is rich in hydropower resources, to the energy-hungry east. Construction of Xiluodu Hydropower Station, which will be the nation's second-largest hydropower station, began at the end 2005. This station will have a total generating capacity of around 12,600 MW. The entire project is expected to be completed by 2015.

NUCLEAR POWER DEVELOPMENT PLAN

The medium and long term nuclear power development plan (2005-2020) of China was deliberated and passed in principle by the State Council meeting in March 2006. According to the plan, nuclear power is a strategic energy source and should be actively developed to meet the economy's growing demand for energy sources. The plan stresses to rely on self-design and innovation while making use of international advanced technology and experience, insist on 'safety and quality first' to form an integrated capability for building advanced nuclear power plants in groups, set up the construction, operation and management of nuclear assets, while conforming to international safety requirements, and establish complete system for the nuclear power industry, through regulations and standards.

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HONG KONG, CHINA

INTRODUCTION

Hong Kong, China - one of the special administrative regions of the People's Republic of China - is a world-class financial, trading and business centre of some 6.8 million people situated at the south-eastern tip of China. As there are no natural resources, all of the energy consumed in Hong Kong, China is imported. The energy sector consists of investor-owned electricity and gas utility services.

In 2004, the GDP per capita of Hong Kong, China was US$26,698 (2000 US$ at PPP), one of the highest GDP per capita in APEC region. GDP of Hong Kong, China expanded by a robust 7.3 percent in real terms in 2005, down from the 2004 rate of 8.1 percent. The economic growth is mainly led by trade, marking the third consecutive year that the export of goods and services attained double-digit growth. As a whole, the services sector remained the dominant driving force of overall economic growth and it is responsible for 90 percent of GDP in 2005. Along with improving labour demand growth, the average unemployment rate reached 5.3 percent in the fourth quarter of 2005, a low record for the past four years.

Hong Kong, China's economy has been constantly driven by its vibrant financial services sector and will continue to shift towards higher value-added services and a knowledge-based economy. To stay competitive and attain sustainable growth, Hong Kong, China needs to restructure and re-position itself to face the challenges posed by globalisation and closer integration with Mainland China. "The Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA)" is a manifestation of the advantages of the "One Country, Two Systems". Under the trade in goods liberalization of CEPA, all products of Hong Kong origin enjoy tariff-free access to the Mainland China upon applications by local manufacturers and upon the CEPA rules of origin being agreed and met. On trade in services, Hong Kong service suppliers enjoy preferential treatment in 27 service areas in the Mainland China. In addition, the Pan-Pearl River Delta (PRD) Regional Co-operation Framework Agreement has brought more business opportunities for Hong Kong, China. The government's strategy is to go up the value chain by; speeding up structural transformation to a high-value, knowledge-based, and skill-intensive economy; pursuing reforms in education and population policy to achieve the talent pool required; as well as leveraging on the immense business opportunities available in Mainland China. Financial, logistics, tourism, professional, and producer services are the five high value added sectors in which Hong Kong, China possesses a competitive advantage over Mainland China.

Table 11 Key data and economic profile (2004)

Key data		Energy reserves	
Area (sq. km)	1,103	Oil (MCM)	-
Population (million)	6.8	Gas (BCM)	-
GDP Billion US$ (2000 US$ at PPP)	181.63	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	26,698		

Source: Energy Data and Modelling Centre, IEEJ.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Hong Kong, China has no domestic energy reserves or petroleum refineries and therefore imports all of its primary energy needs. It however generates some electricity. Total primary energy supply in Hong Kong, China was 16 Mtoe in 2004, increasing 4 percent from 2003. Oil maintained the highest share in the total primary energy supply at 47 percent, followed by coal (36 percent) and gas (13 percent). Electricity imports from China accounted for the remaining 4 percent.

As of the end of 2006, the total installed electricity generating capacity in Hong Kong, China was 12,644 MW, including the imported power from Guangdong, China. All locally generated power is thermal fired. Electricity is supplied by CLP Power Hong Kong Limited (CLP Power) and The Hongkong Electric Company Limited (HEC). CLP Power supplies electricity from its Black Point (2,500 MW), Castle Peak (4,108 MW) and Penny's Bay (300 MW) power stations. Natural gas and coal are currently the respective main fuel used for power generation at the Black Point and Castle Peak power stations. This natural gas is imported from the Yacheng 13-1 gas field off Hainan Island in southern China via a 780-kilometre high-pressure submarine pipeline. CLP Power is contracted to purchase about 70 percent of the power generated at the two 984 MW pressurised water reactors at the Guangdong Nuclear Power Station at Daya Bay to help meet the long term demand for electricity in its supply area. It also has the right to use 50 percent of the 1,200 MW capacity of Phase 1 of the Guangzhou Pumped Storage Power Station at Conghua. The eighth 312.5 MW gas combined-cycle generator at Black Point was commissioned in May 2006. Electricity for HEC is supplied from the Lamma Power Station and its total installed capacity was 3,756 MW. In May 2000, the government approved HEC's new power station at the Lamma Extension the first gas combined-cycle generator and the unit was commercially operated in October 2006 and its installed capacity was 335 MW.

Towngas and liquefied petroleum gas (LPG) are the two main types of fuel gas used throughout Hong Kong, China. Towngas is distributed by the Hong Kong and China Gas Company Limited. It is manufactured at plants in Tai Po and Ma Tau Kok, using both naphtha and natural gas (starting from October 2006) as the feedstock. LPG, on the other hand, is supplied by oil companies and imported into Hong Kong, China by sea and stored at the five terminals on Tsing Yi Island.

FINAL ENERGY CONSUMPTION

Table 12 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)*	
Indigenous Production	95	Industry Sector	851	Total*	37,131
Net Imports & Other	24,991	Transport Sector	5,800	Thermal	37,131
Total PES	16,224	Other Sectors	3,693	Hydro	-
Coal	5,845	Total FEC	10,344	Nuclear	-
Oil	7,713	Coal	0	Others	-
Gas	2,048	Oil	6,322		
Others	617	Gas	648		
		Electricity & Others	3,373		

Source: Energy Data and Modelling Centre, IEEJ. (See http://www.ieej.or.jp/egeda/database/database-top.html)

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

In 2004, the total final energy consumption in Hong Kong, China reached 10,344 ktoe, or 1.8 percent less than the previous year. The transport sector accounted for the largest share at 56 percent, followed by the residential/commercial sector (36 percent) and the industrial sector (8 percent). With the dominance of transport, the most important end use fuel was petroleum, accounting for 61 percent of energy use. Electricity and others made up 33 percent of end-use consumption, while gas accounted for only 6 percent.

As mentioned earlier, gas is supplied for domestic, commercial and industrial uses in two main forms. In addition, LPG is used as a fuel for LPG taxi and light buses, and natural gas is used for electricity generation.

POLICY OVERVIEW

The government of the Hong Kong Special Administrative Region (SAR) pursues two key energy policy objectives. The first is to ensure that the energy needs of the community are met safely, efficiently, and at reasonable prices. The second is 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 government intervenes only when necessary to safeguard the interests of consumers, ensure public safety, and protect the environment. The government 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. In consultation with the power companies, the government also promotes energy efficiency and energy saving measures. Additionally, the government has entered into an Information and Consultation Agreement with the Hong Kong and China Gas Company Ltd to make the town gas tariff adjustment mechanism more transparent.

To help monitor the energy situation, Hong Kong, China has developed an energy end-use database. The database provides 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 publicly available on the Internet.[23]

The Electricity Ordinance and the Gas Safety Ordinance regulate 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. To regulate the import, supply and installation of domestic gas appliances for use in Hong Kong, China, the Gas Safety (Installation and Use) Regulation and the Gas Safety (Miscellaneous) Regulation were amended in 2002.

The Government is also currently conducting an electricity market review to map out the regulatory arrangements for the electricity market after the current Scheme of Control Agreements with the two power companies expire in 2008. Emission caps have been imposed onto three power plants through their renewed licences. The government has asked the power companies to accelerate the timing of emissions reductions to fully achieve the emission reduction targets in 2010.

In the latest 2006-07 Policy Address, the government will continue to support environmental protection and promote sustainable development through taking vigorous measures to make sustained improvement in air quality. From January 2006, the Government introduced Euro IV emission standards for newly registered vehicles. The Government will also provide tax incentives to encourage the use of environment friendly cars. A 30% reduction in the first registration tax will be given to people purchasing vehicles with low emissions and high fuel efficiency, subject to a

[23] The website is available at http://www.emsd.gov.hk

ceiling of $HK50,000 per vehicle. In addition, the government will encourage 74,000 owners of old diesel commercial vehicles to replace these vehicles by offering a one-off grant, estimated at around HK$3.2 billion in total.

The government has taken the lead in reducing energy consumption in government buildings. From January 2006, all government office buildings has been set a target to reduce energy consumption by 1.5 percent annually, and the government has also taken the lead in using ultra-low sulphur diesel in all government projects. In addition, the government issued guidelines to all government drivers, requiring them to switch off engines while waiting. In July 2006, the government launched an "Action Blue Sky" campaign to mobilize community participation in improving air quality. As part of the "Action Blue Sky" campaign, corporations, private companies and schools were invited to endorse an Energy Conservation Charter through which they pledged to maintain a suitable indoor room temperature of 25.5˚C in summer. A "Dress Down in Summer" campaign was also launched to reduce the need for air-conditioning.

NOTABLE ENERGY DEVELOPMENTS

ENERGY EFFICIENCY PROMOTION

Hong Kong, China's government promotes energy conservation through the Hong Kong Energy Efficiency Registration Scheme for Buildings and the voluntary Energy Efficiency Labelling Schemes (EELS) for appliances and petrol passenger cars. Under the scheme for buildings, 718 venues have been registered as of January 2007. Likewise, more than 2,960 models have been registered under the voluntary EELS by the government as of the end of December 2006.

ENERGY END-USE DATABASE

Hong Kong, China's government has continuously maintained and updated the energy end-use database. The database provides a useful insight into the energy consumption patterns of the different sectors, sub-sectors and the end uses in Hong Kong, China. A basic data set (Year 2004 basic data) from the database was published in September 2006 and is made available for public access at the Electrical & Mechanical Services Department (EMSD).

ALTERNATIVE FUEL VEHICLES

Since 2002, a voluntary incentive scheme has been launched by the government to encourage owners of existing diesel public and private light buses to replace their vehicle with LPG or electricity models. As of August 2006, over 2,500 LPG light buses were in operation, representing more than 40 percent of all public/private light buses in Hong Kong, China. Through taking the leading role in the use of green vehicles, the government has introduced petrol-electric hybrid vehicles into its vehicle fleet from 2005. In addition, the government is continuously identifying possible ways to encourage vehicle owners to use cleaner alternative fuels.

RENEWABLE AND CLEAN ENERGY

The first commercial scale wind turbine of 800 kW set up by one of the two power companies in Hong Kong, China was commissioned in November 2005. The wind turbine is expected to produce 850 MWh of electricity a year.

According to the "First Sustainable Development Strategy for Hong Kong" published in May 2005, a target of having 1 to 2 percent of local power needs met by renewable energy by 2012 has been set. This target is subject to regular review in the light of advances in technological solutions and emerging sustainability considerations.

WIDER USE OF WATER-COOLED AIR CONDITIONING SYSTEMS (WACS)

In 2000, a pilot scheme for the use of fresh water cooling towers in air conditioning systems was launched, with 6 designated areas in the beginning to 79 designated areas in December 2006, covering about 70% of the non-domestic floor area of the economy. If compared with using air cooled systems, the estimated energy savings and greenhouse gas reduction of the completed installations are in the order of 35M kWh per year and 24,800 tonnes per year respectively.

LIFE CYCLE ENERGY ANALYSIS FOR COMMERCIAL BUILDING DEVELOPMENT

In Hong Kong, China, commercial buildings are responsible for 34 percent of the city's total energy end-use. Enhancing the sustainability of building development is of paramount importance to the sustainability of Hong Kong, China. To achieve this goal, the government has developed a software tool for assessing the environmental impact, energy use and costs associated with new building developments. An enhanced version of the software tool is being distributed free of charge to the local industry in September 2006.

ENERGY SAVING PROGRAMMES IN THE PUBLIC AND PRIVATE SECTORS

To demonstrate its commitment to protect the environment, the government set targets in March 2003 to cut down the annual electricity consumption of government departments. Since then, the government has provided technical support and expert advice to these departments by publishing energy saving tips and guidelines, organising experience sharing workshops, advising on good housekeeping practices, implementing energy saving retrofits etc. With these efforts in place, these government departments were able to achieve a saving of about 3.6 percent in electricity consumption in the first two years since the targets were announced.

In Hong Kong, China, it is estimated that air conditioning systems consume about one-third of total electricity consumption of the whole territory. In order to reduce electricity consumption, the government initiated a policy in October 2004 to maintain the air-conditioned room temperature of government premises at 25.5 °C during the summer months. In June 2005, the government further promoted the 25.5 °C initiative to the public as one of the themes of World Environment Day 2005.

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INDONESIA

INTRODUCTION

Indonesia is an archipelago located in the southern most region of Southeast Asia. The economy is comprised of 17,508 large and small islands near the equator, with a total area of 9.8 million square kilometres (including the Exclusive Economic Zone), about 81 per cent of which or about 7.9 million square kilometres are marine and the land mass is about 2 million square kilometres.

There are two main seasons in Indonesia, the dry and wet season (and occasional transition periods). The dry season (June to September) is influenced by the Australian continental air masses, while the rainy season (December to March) is influenced by the Asian Continental and Pacific Ocean air masses passing over oceans, which carry lots of moisture and cause rain to fall in Indonesia. Temperature varies across the economy and is influenced mostly by altitude. The average temperature ranged is from 28.2 ^{0}C to 34.6 ^{0}C in the day time and from 12.8 ^{0}C to 30 ^{0}C during the night.

The population in 2004 was about 218 million, the majority of whom reside in Java and Bali, and in the four other main islands namely Kalimantan, Sulawesi, Sumatra and West Papua.

In 2004, real gross domestic product (GDP) was US$746.3 billion and per capita GDP was about US$3,430 (both in 2000 US$ at PPP). Since 1991, manufacturing was the major contributor, to the Indonesian economy. In 2004 this sector accounted for 25 percent of total real GDP, while agriculture, livestock, forestry and fishery contributed 17 percent. Trade, hospitality and restaurants contributed around 16 percent. Mining and quarrying contributed about 11 percent, transport and communication 6 percent, financial ownership and business services 7 percent, services 10 percent and construction 6 percent. Electricity, gas and water supply contributed the remaining 2 percent. In 2004, Indonesia's economy grew at an average of 5.1 percent, an improvement from the 4.1 percent growth in 2003 and 3.7 percent in 2002.

Mining activities, especially tin, bauxite, copper and oil and gas exploration and production have expanded since 1970. Fossil energy resources, such as oil, natural gas and coal, played important roles in the economy both as industrial raw materials and foreign exchange earners. Oil and gas contributed US$17.7 billion or 25 percent of total export earnings and about 21 percent of the government budget in 2004.

In 2004, Indonesia's oil and natural gas reserves decreased slightly compared with the previous year to around 641.1 MCM and 2,560 BCM respectively, while that of coal remained at 5,370 million tonnes.

Table 13 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	1,937,179	Oil (MCM)	641.1
Population (million)	217.59	Gas (BCM)	2,770
GDP Billion US$ (2000 US$ at PPP)	746.34	Coal (Mt)	4,968
GDP per capita (2000 US$ at PPP)	3,430		

Source: Energy Data and Modelling Centre, IEEJ.

* Proved reserves at the end of 2004 from the BP Statistical Review.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2004, total primary energy supply was 128,856 ktoe. Of this total, 45 percent was oil, 33 percent gas, 16 percent coal, and 5 percent for other energy such as geothermal, hydro and new and renewable energy resources. Indonesia is net energy exporter and exported primary energy totalling 72 MTOE in 2004.

Most of Indonesia's proven oil reserves are located onshore in the Duri and Minas fields in central Sumatra. Other significant producing fields are located in offshore north-western Java, East Kalimantan and the Natuna Sea. During the last decade, crude oil production in Indonesia ranged between 1.3 and 1.4 million B/D. But as fields have been extensively developed and reserves have been depleted, crude oil production has started to decline in recent years. Thus, in 2004, Indonesia was only able to produce crude oil at an average rate of 966,466 B/D, or 401 million barrels (of which 179 million barrels was exported) in 2004. Aside from oil, Indonesia also produced about 131,000 B/D of natural gas liquids and condensate in 2004.

Besides relying on its domestic oil production, Indonesia also imports crude oil and refined products to support domestic oil requirements. Because of increased demand and depleting reserves, Indonesia became a "net oil importer" in 2002, with net oil imports accounted for 3 million barrels in 2002. Net oil imports increased to 30 million barrel in 2004. Of this amount Indonesia imported 148 million kl of crude oil for domestic refining and 23 million kl of petroleum products. Indonesia is trying to reduce oil import dependency and BP Migas the Indonesian downstream oil and gas regulatory body has a target of increasing oil production to 1.3 million barrel by 2009.[24]

In 2004, Indonesia produced 3,030 BCF of, which is a decrease compared with production of 3,155 BCF in 2003. About 46 percent of Indonesia's natural gas production was converted to LNG for export. Of the exported LNG, around 69 percent went to Japan, 19 percent to Korea and 12 percent to Chinese Taipei. In addition, Indonesia also exported 129 BCF in 2004 or 4 percent of total natural gas production to Singapore and Malaysia in 2004. The remainder, about half of total production was used to supply domestic demand. In the domestic market, about 47 percent was utilized by the industry and electricity sectors, while 39 percent was used for gas injection and fuel at oil and gas fields. The rest of the domestic supply is utilized either as city gas (9 percent), or in refineries (3 percent). An additional 2 percent was converted to LPG.

More than half of Indonesia's total recoverable coal reserves are lignite (about 57 percent), 27 percent is sub-bituminous, 14 percent bituminous and less than 0.5 percent is anthracite. Based on a recent assessment of Indonesia's coal reserves, 10 or more coal basins were identified which contain 336 tcf of Coal Bed Methane (CBM). The majority of coal reserves in Indonesia are located in the islands of Sumatra, and Kalimantan, while some reserves are also found in West Java and Sulawesi. Indonesian coal generally has a heating value ranging between 5,000 - 7,000 kcal/kg, with low ash and sulphur levels (sulphur levels are typically less than 1 percent). In 2004, Indonesia produced about 132 million tonnes of steam coal, an increased of 16 percent compared with production of 114 million ton of 2003. About 70 percent of production was exported, about 70 percent to Japan, South Korea and Chinese Taipei. Indonesia plans to double coal production, eyeing economies in East Asia and India as potential markets.

[24] In order to meet the national target production of 1.3 million barrel per day by 2009, the Ministry of Energy and Mineral Resources introduced additional incentives on April 2005. The incentive allows the investor to recover 120 percent cost recovery for fields with an estimated rate of return less than 15 percent. However, in the case that during the production period the rate of return exceeds 30 percent the incentive will be removed.

Indonesia has 27,765 MW of installed generating capacity in 2004, from which 120,161 GWh of electricity was generated. Most of the electricity generated was from thermal (89 percent), while the rest was supplied by hydro (6.4 percent) and geothermal/others (4.6 percent).

Table 14 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	201,596	Industry Sector	31,444	Total	120,161
Net Imports & Other	-72,740	Transport Sector	22,623	Thermal	103,812
Total PES	128,856	Other Sectors	25,057	Hydro	9,674
Coal	20,983	Total FEC	79,124	Nuclear	-
Oil	58,570	Coal	7,186	Others	6,675
Gas	42,748	Oil	48,138		
Others	6,555	Gas	14,682		
		Electricity & Others	9,117		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

FINAL ENERGY CONSUMPTION

Indonesia's final energy consumption increased to 79,124 ktoe in 2004 from 65,741_ktoe in 2003. Increased energy consumption in the energy sector was mainly because of new investment in the industry sector and completion and operation of new coal-fired power plants. The increase was mainly because of greater consumption in industry (63 percent), and moderate consumption in the transport sector (7 percent) compared with that of 2003. The industrial sector's final energy consumption accounted for 39 percent of final energy consumption in 2004, an increase of 63 percent compared with 2003. Likewise energy consumption in the transport sector accounted for 29 percent of final energy consumption in 2004, 7 percent higher than 2003. The remaining 32 percent was accounted for by the commercial/residential and other sectors.

The most important end use energy source was oil, accounting for 60 percent of consumption, followed by gas (18 percent), electricity (11 percent) and coal (9 percent). Despite many efforts to reduce oil consumption, Indonesia oil consumption in 2004 increased by 22 percent to reach 48,138 ktoe from 39,434 ktoe in 2003.

POLICY OVERVIEW

Indonesian energy policy is collaboratively formulated by inter-ministerial bodies; the BAKOREN (Badan Koordinasi Energy Nasional) the National Energy Coordinating Board. BAKOREN is a cabinet level inter-ministerial body, created in 1980 to formulate government policies on the development and utilization of national energy resources and to coordinate the implementation of the policy. Membership consists of the Minister's of Energy and Mineral Resources, Public Works, Industry, Agriculture, Forestry, Environment, Defence, Research and Technology and the Head of the Nuclear Agency and the Director of Pertamina.

In the executive level, the Ministry of Energy and Mineral Resources has overall responsibility for the development of mining, oil, natural gas, electricity and new and renewable energy. The supervision and regulation of the Indonesian energy sector falls under the three Directorate General's of the Ministry.

The Directorate General of Oil and Gas (MIGAS) covers regulation and supervision of the upstream and downstream oil and gas industry. MIGAS is also responsible for offering oil and gas

acreage to oil and gas companies. Under the Oil and Gas Law, promulgated in 2001, MIGAS is supported by two independent bodies; BP Migas and BPH Migas. BP MIGAS (Badan Pelaksana Minyak dan Gas Bumi) is the upstream implementing body, responsible for managing oil and gas contractors. On the other hand, BPH Migas (Badan Pengatur Hilir Minyak dan Gas Bumi), is responsible for controlling downstream activities, such as regulating and determining the supply and distribution of oil based fuel, regulating the transmission and distribution of natural gas, allocating fuel to meet national oil fuel reserves, the use of oil and gas transportation and storage facilities, setting tariffs for gas pipeline use, and the price setting of natural gas for household and small consumers.

Directorate General Geology and Mineral Resources (DJGSM) renamed to Directorate General Mineral, Coal and Geothermal in 2005 handles the promotion and supervision of the mining industry, including coal, minerals and geothermal. Also established in 2005 the National Geology Agency is responsible for geological related research and services. Furthermore the Directorate General Electricity and Energy Utilization (DJEEU) is responsible for policy planning and supervision of electricity industry and new and renewable energy development.

The Indonesian energy policy was launched in 1990 and amended in 1991, 1998 and 2004. In addition a Presidential Regulation regarding national Energy policy was issued in January 2006. National Energy Policy is also supported by the Blue Print Energy National, Policy on Coal, Policy on Geothermal, Policy on Renewable Energy and Conservation.

The main objective of the National Energy Policy is to secure reliable energy supply to the economy in order to maintain economic growth and welfare. Indonesia's Energy Policy consists of three major policies objectives, namely: 1) diversification of energy resources, 2) intensification of searching for new reserves, and 3) energy conservation.

DIVERSIFICATION OF ENERGY SOURCES

The main objective of the diversification policy is to reduce the share of oil in the economy's energy mix. To meet this objective, Indonesia is promoting the consumption of energy sources other than oil, including coal, geothermal, natural gas and new and renewable energy. The economy is also seriously considering the addition of nuclear in the energy mix.

The share of coal in the energy mix is to be increased from 14 percent in 2002 to 20 percent by 2020 and 32 percent in 2025. To support the target, the Minister of Energy and Mineral Resources issued the National Coal Policy in June 2004. The policy is focused on intensification of exploration to increase reserves and production for both export and domestic uses by providing a better business environment. To increase national coal consumption Indonesia has invited the private sector to build coal-fired power plants near the mine mouth.

To increase the share of renewable energy Indonesia has issued several policies. In 2002, the Ministry of Energy and Minerals issued decree No. 1122 K/30/MEM/2002 which provides guidance for remote small power producers of less than 1 MW to be connected to the national grid. The state electricity company PLN is obliged to buy power from small power producers which generate power from wind, solar, mini/micro-hydro, agricultural and industrial wastes, municipal solid waste, dendro-thermal and geothermal. However, the sale of electricity should be concluded with conditions acceptable to both parties.

In October 2003 the geothermal law was enacted, to promote a more favourable business climate. Under this law the monopoly of Pertamina was abolished. The geothermal business is now conducted under a competitive transparent open tender and is open to all business entities. With the new business environment, expected installed capacity of electricity generation from geothermal is projected to increase to 6,000 MW by 2020 and 9,500 MW by 2025 from 800 MW in 2005.

In early 2004, Indonesia introduced a new Policy on Renewable Energy Development and Energy Conservation. Under this policy, the Indonesian Utilities Company is required to generate 5 percent of electricity produced from renewable energy, with the aim of utilising 78,500 BOE of renewable energy by 2010. .In order to meet this target, Indonesia plans to increase power

generation from solar photo voltaic, wind, geothermal and other new and renewable sources. In the National Energy Blue Print issued in July 2005, Indonesia plans to have 70 MW of Photo Voltaic capacity installed by 2025, a significant increase from 5 MW in 2005. Furthermore, installed wind power generation is planned to increase from 0.5 MW in 2005 to 250 MW in 2025.

For the transport sector, Indonesia plans to utilise both bio-diesel and gasohol and is expected to produce 720 million litres of bio diesel by 2010 to supply about 2 percent of total demand. Production capacity is expected to increase further to 4.7 million kl or 5 percent of projected demand in 2025. On the other hand, gasohol production is also expected to provide an alternative transportation fuel accounting for at least 2 percent of the gasoline demand in 2010 and 5 percent of demand by 2025. In addition Indonesia is also considered the development of bio-oil to partly substitute fuel oil. The target is to produce 900 million litres of bio-oil per year by 2025.

Indonesia is also seriously considering the introduction of nuclear power in the energy mix. Under the Blue Print of National Energy for the period 2005 to 2025, the first nuclear power plant is expected to start operation in 2016. By 2025 Indonesia plans to have 4 or at least 3,600 MW of installed capacity from nuclear power plant.

As a result of all these programs, it is expected that Indonesia's energy mix will become less oil intensive, such that in 2025 oil will account for less than 20 percent, natural gas 30 percent, coal 33 percent, biofuels about 5 percent, geothermal 5 percent, new energy and renewable energy such as biomass, nuclear, small scale hydro, solar and wind 5 percent, and coal liquefaction about 2 percent.

INTENSIFICATION OF THE SEARCH FOR NEW ENERGY RESERVES

This policy encourages the exploration of energy resources such as oil, coal and new and renewable energy. In 2003 and 2004 the Ministry of Energy and Mineral Resources initiated measures to improve the investment climate in the oil and gas sector by simplifying procedures for exploration and production contracts and increasing the profit share for involved companies. Previously, oil and gas companies could only receive working areas through official tenders. By simplifying procedures, companies can now apply for working areas without waiting for a formal bidding session. Upon receipt of application, the government invites other bidders to participate. If there are no other bidders within a prescribed time, the sole bidder will be awarded the block. The new fiscal system will allow an increase in the production share for the companies from 15 percent to 25 percent for oil, and from 30 percent to between 35 percent and 40 percent for gas.

In addition to intensify the search for domestic energy resources, the National Energy Policy 2004 also encourages the expansion of Indonesia's presence in overseas oil and gas resources by permitting Indonesian oil companies to participate in upstream oil and gas projects overseas. By 2005, Pertamina, Indonesia's national oil company secured oil exploration concessions in Iraq and Libya and joint operations in Viet Nam and Malaysia.

ENERGY CONSERVATION

Institutionally, Indonesia's energy conservation program started in 1991, through the promulgation of Presidential Decree No. 43 on energy conservation. The decree led to the National Master Plan for Energy Conservation in 1995. The plan included programmes for training, efficiency award, energy management, and industrial energy audits. It also outlined fiscal incentive such as tax reduction and soft loans for energy conservation projects. In 2000, Indonesia announced a target to reduce energy intensity by 1 percent per year, this target is a continuous effort that aims each year to reduce energy intensity by the one percent compared with the previous year.

With the exception of Brunei Darussalam, Indonesia along with all other ASEAN members has adopted the voluntary building energy codes that were initiated in 1992. Full adoption of these codes could result in estimated energy savings of about 20 percent over the long-term.

In 2000, Indonesia disseminated mandatory standards for compact fluorescent lamps (CFLs). Refrigerators will be subject to mandatory standard from 2005, with a maximum allowable

consumption of 250 kWh per year. Standards for other electrical appliances such as air conditioner, flat irons, televisions and freezers have been in effect since 1992.

To boost the energy conservation program, Indonesia also introduced the Demand Side Management Program (DSM) in 1992. The program focuses on the introduction of more efficient lighting tariffs based on, time of use and improvements in motor efficiencies.

SUPPORTING POLICIES

In order to meet the policy objectives, Indonesia has also issued seven supporting policies, namely:

- Accelerating energy infrastructure development
- Promoting rational and market based pricing
- Providing direct and targeted subsidies to low income populations. It is considered a government obligation to provide energy access to the poor
- Protecting the environment.[25]
- Enhancing private participation
- Enhancing community development
- Encouraging research and development in energy sector

In addition Indonesia has also issued policies by sector such as, the oil and gas policy, electricity policy, coal policy, geothermal policy, and the new and renewable and conservation policy. The detailed programme and targets are set out in the Blue Print National Energy Management 2005 to 2025 issued in July 2005.

OIL AND GAS

The policies governing the oil and gas sectors are stipulated in the Oil and Gas Law, Law No. 22/2001. Under the law oil and gas mining rights are held by government. According to Article 3 of Oil and Gas Law, exploration and exploitation of oil and gas (upstream activities) should be competitive, and that processing, transportation, storage and trading should be conducted through a mechanism that allows fair and transparent competition among businesses. The Oil and Gas law 2001 mandated the application of a market price for petroleum product pricing in the domestic market. However, in 2004 the Indonesian Constitutional Court rejected the provision and returned the power to set up tariffs over to the government.

The law mandated the government to transform the nation oil and gas companies Pertamina and PGN from monopolies into limited liability companies. Pertamina's transformation started in 2002, when the company was legally transformed into a limited liability company, and the process was completed in 2005, when all privileges/special governmental entitlements given to the company were removed entirely. However, Pertamina still operates all seven of the economy's refineries with a capacity 1.03 million B/D.

PGN a government owned gas transmission and transportation company was divested in 2003, when 39 percent of the shares were offered to the public through an initial public offering (IPO). In 2005, the privileges/special governmental entitlements given to PGN were also removed, thus the company now has to compete with other companies to secure natural gas infrastructural projects.

[25] Indonesia stopped producing leaded gasoline from July 2006. The phase out of leaded gasoline is expected to help improve air quality in Indonesia.

ELECTRICITY POLICY AND MARKET

As the Indonesian Court annulled the Electricity Law No. 20/2002 in 2004, the Indonesian power market is thus regulated by Regulation No. 15 /1985. Under this regulation the government is responsible for providing electricity to the Indonesian market through the creation of a state owned enterprise Perusahan Listrik Negara (State Electricity Company) known as PLN. PLN is operated as a vertically integrated monopoly; however, whenever the company is unable to provide electricity to the market, regulation authorizes PLN to establish cooperation with other entities and cooperate with the private sector. In any event that PLN can not provide the necessary services; consumers are allowed to develop their own electricity generation for own use or captive power. Excess production may also be sold to PLN.26

The islands of Java and Bali are served by an interconnected power system, while on the outer islands isolated systems have developed around major load centres, and electricity is delivered through mini-grids.

The initial step in restructuring the electricity market in Indonesia began in 1994 through the conversion to corporate status of PLN from a state owned enterprise with a social purpose to Limited Liability Company. Restructuring efforts continued in 1995 through the unbundling of PLN's Java-Bali generation, distribution and transmission assets. Generation assets were unbundled into two generation companies, called Pembangkit Jawa-Bali (PJB) and Indonesia Power. The distribution unit was separated into four-distribution units (East, West, Central Java and Jakarta). Each distribution unit operates as semi-autonomous; where they receive funds allocated to cover their operational expenses in order to meet the performance targets as set out in their contract with PLN's headquarter. Java-Bali transmission is transferred to the Java-Bali Electricity Transmission unit and load dispatch centre as a subsidiary of the generation company. The market structure has become a single buyer market, where the PLN transmission company buys power from PLN generators and IPPs. Outside Java and Bali restructuring took place in form of decentralization of PLN's assets. The government plans more robust competition to allow transition from a single buyer market to a fully competitive multi-buyer/multi-seller market (MBMS)[27].

Pricing is an important aspect in the Indonesian power market. Electricity prices are set by the government, by considering the cost of generation and a suitable rate of return for the company. The government also supplies subsidies to the state electricity companies as in several places the current pricing scheme does not allow the power companies to recover production costs.

COAL

The coal business is regulated by Law No 11/1967 regarding general mining and Government Regulation No. 25/2000 regarding the roles of national and provincial governments. The Ministry of Energy and Mineral Resources is responsible for administering the coal mining sector. A company wishing to mine coal must first submit an application to the Ministry of Energy and Mineral resources. The contractor is restricted from mining other minerals, and is fully responsible for all risks in all activities. It must complete a general survey and to relinquish 25 percent of the initial contract area within the first year of the general survey, 50 percent within 3 years and 75-80 percent of the contract area on or before the end of the exploration period. In addition, the contractor should spend at least US$2.50/ha on the coal-field by the end of the general survey period, to commence exploration upon completion of the general survey and spend at least US$15.00/ha on exploration. Following the enactment of an autonomy law, a new Coal Contract

[26] In 2006, national power capacity was 45,707 MW of which 25,218 MW was owned by PLN, 15,215 MW by non-PLN (captive power) and 5,554 MW owned by the private sector. Among PLN's generating capacity 19,516 MW is located in Java and 5,702 MW is located on the other islands.

27 Under the previous market structure the target for achieving a MBMS market system was 2010; however, as a result of the court ruling that abolished this system, the new target is still under negotiation.

of Worth (CCOW) is being drafted to empower regional governments and introduce a new royalty scheme. CCOW terms require that domestic companies must eventually have the majority ownership of mining projects. During the first 10 years of production, foreign shareholders must transfer shares according to a fixed timetable so that Indonesian companies eventually hold 51 percent of the mining project.

Upon production, companies will have the option to either export or sell the coal in the domestic market. Coal production is subject to a 13.5 percent royalty and since 2005 a 5 percent export tax has been imposed on coal exports.

GEOTHERMAL

Under law No. 27/2003, geothermal resources belong to the government and the government through the Ministry, Provincial Government and Regency exercises its right to determine policy, regulation, and licensing. Geothermal exploration and exploitation are conducted on a licensing basis, where the government opens competitive bidding for prospective geothermal working areas where any business entities – public, private or cooperative – are eligible to submit a bid. Successful bidders are awarded a maximum working area of 200,000 hectares, and have the right to conduct exploration for three years (with possible extension of two more years). Upon completion of exploration, the company is mandated to complete a feasibility study within two years, and during the exploitation stage, the company is granted 30 years exploitation right (which is extendable). Working areas are subject to tax, land rent, and royalties determined by the government. The utilisation of geothermal energy for electricity is subject to electricity regulation and policy.

NOTABLE ENERGY DEVELOPMENTS

NEW PIPELINE RIGHTS AWARDED

In 2006, downstream regulatory body BPH MIGAS announced the winner for the East Java to West Java gas and East Kalimantan to Central Java natural gas pipelines. Pertamina and local firm PT Rekayasa Industri won the rights to build and operate the East Java to West Java pipeline for a period of 25 years and reportedly will spend US$350 million on construction. Pertamina will build the 250 km Gresik to Semarang segment, while Rekayasa will build the 230 km Semarang to Cirebon segment. Gas flows from East Java are slated to start in 2009 and Pertamina and Rekayasa plan to charge pipeline tariffs of US$36.25 per million BTU.

Meanwhile, the Bakrie Group won the tender for the US$1.2 billion pipeline from East Kalimantan to Central Java. The 1,120 km pipeline will stretch from Balikpapan, East Kalimantan to Semarang, Central Java and have a capacity of 1,000 trillion cfpd. BPH MIGAS chose the Bakrie Group after the company offered a transmission fee of US$0.814 per MTU. However, currently most of the natural gas produced in Kalimantan is utilized for the Bontang LNG plant and there are concerns that the natural gas producers in this region do not have sufficient reserves to fully meet their commitments to supply the Bontang LNG plant as well as the domestic market. Thus, industry watchers predict that the Bakrie Group will need to negotiate with gas producers to ensure sufficient gas supplies for the pipeline.

PERTAMINA AND EXXONMOBIL SIGN CEPU JOA

In March 2006, Pertamina and ExxonMobil signed a Joint Operating Agreement (JOA) for the Cepu block located in East and Central Java, ending more than four years of negotiations. Under the agreement, the two companies agreed to form a joint operating committee, with ExxonMobil subsidiary Mobil Cepu Limited serving as the sole operator. In September 2005, Pertamina and ExxonMobil signed an agreement with upstream regulator BP Migas converting ExxonMobil's Technical Assistance Contract (TAC) with Pertamina into a joint Production Sharing Contract

(PSC), and extending the PSC for 30 years to the year 2035. ExxonMobil and Pertamina each hold a 45 percent interest in the Cepu block, with the remaining 10 percent being held by the governments of East Java, Central Java, Blora Regency, and Bojonegoro Regency. The Cepu block is estimated to contain reserves of 1.7 trillion cubic feet of gas and 600 million barrels of oil.

TENDER REGULATION REVISIONS

In June 2006, the Minister of Energy and Mineral Resources issued Ministry Regulation 40/2006 on the Procedures for Oil and Gas Blocks Allocation and Offering.[28] It aims to provide increased transparency and clarity regarding tender procedures, including the selection criteria for the winners of tender bids. The regulation also includes provisions aimed at securing exploration commitments from the winners of tender bids. Tender participants now must provide at least a 20 percent bank guarantee of the proposed value of the signature bonus when bidding for an oil and gas block under the regular tender process or US$500,000 for a direct offer bid. A winning bidder must also provide an additional bank guarantee equal to the value of the budget for three years of seismic surveys.

NEW BIDDING ROUND

In 2006, Indonesia offered a total of 68 blocks for oil and gas exploration to investors in two rounds. In the first round, 27 blocks were offered in May 2006. For the second round, 41 blocks were offered at the end of 2006. In addition, in 2006 the government also announced the winner of first round tendered in 2005. Five cooperative contracts were signed with investors including, Petronas Carigali Lampung, Husky Oil East Bawean, Ltd., Marathon International, ExxonMobil Exploration and ConocoPhilips.

LPG CONVERSION PROGRAM

In 2006, the government announced a programme to convert kerosene use in households to LPG with the primary aim of reducing the consumption of subsidized kerosene. The program will be prioritized in the Jakarta area and Java as these areas have the available infrastructure to supply LPG. According to government estimates the conversion could save as much as US$2.41 billion from the subsidies paid to kerosene. However, the effectiveness of the program is questionable, as LPG conversion will create demand for LPG of about 6.5 million metric tonnes. Whereas, total domestic production, will only able to supply one million tonnes. In addition, conversion will require households to convert their stoves and purchase gas tubing, which is not cheap.

GAS DEAL

In 2006, several gas producers signed gas supply agreements. Pertamina signed four gas supply agreements with West Java and South Sumatra buyers. The agreements, which ranged from five to 10 years in duration, have a combined volume of 66.9 trillion BTU, with a reported value of US$181.6 million. In addition, EPIC Sengkang signed a Memorandum of Understanding (MOU) with the state owned mining company PT Aneka Tambang (Antam) and Lapindo Brantas signed a MOU with Indogas Kriya Dwiguna.

PERTAMINA STARTS BIOFUEL DISTRIBUTION

Pertamina began selling the economy's first biodiesel fuel in May 2006. Bio-Solar is also known as B-5 biofuel and contains 95 percent diesel fuel and five percent Fatty Acid Methyl Ester (FAME) is available at selected fuel stations in Jakarta. Bio-solar, which is derived from the processed extract of crude palm oil (CPO) or the seeds of the Jatropha Curcas plant. Currently Pertamina sources its biodiesel supply from the Gresik, East Java plant of local chemical producer Eterindo Wahanatama; however, Pertamina is also developing its own biodiesel plant at the Balongan refinery, West Java. The company set the Bio-solar price at the same price as regular subsidized diesel or IDR 4,300 (US$47 cents) per liter.

[28] The new regulation effectively replaced the previous Ministerial Decree 1480/2004.

CRASH POWER PROJECTS ANNOUNCEMENT

The government ordered the state owned electricity company PLN to expedite fuel diversification in the electricity sector by construction of a 10,000 MW coal-fired power plant. The crash program consists of construction of a total of 24 coal-fired power projects, 10 power plants in Java and 14 outside Java. PLN is aiming to have all these power plants in operation by the end of the year 2009. A Chinese investor will reportedly build one 8,000 MW coal-fired power plant without any guarantee from the government of Indonesia.

INVESTMENT IN BIOFUELS

The Indonesian biofuel program has received positive response from investors. Several investors, both domestic and foreign have shown an interest to investing in Indonesia's biofuels market. Among the investor are:

- PT Bakrie Sumatera Plantations Tbk and PT Rekayasa Industri which formed a joint venture to build a biodiesel plant which has a nameplate capacity of 60,000 to 100,000 tonnes of biodiesel per year. Total investment expected at US$25 million dollars. Bakrie has a 30,000 hectare palm plantation which is going to be expanded to 50,000 hectares.
- A Korean investor has been expressed interest in building a bioethanol plant in Lampung Province. Total investment is around US$1 billion, which will be implemented over 50 years. This investment is to build two plants with a capacity of 300 kiloliters per day or 1 million kiloliters per year. These two plants will need at least 6.5 tonnes of sweet potatoes per day as a raw material.
- Nippon Oil Corporation has agreed to build a biodiesel plan with investment of as much as US$40 million in Jambi Province. It is expected that the plant will produce 20,000 tonnes of biodiesel per month. The Jambi local government has agreed to give this Japanese company a special permit for issuing, legal certainty, land acquisition, and access to raw materials.
- PT Eterindo Wahanatama with its associate: PT Anugerahinti Gemanusa (AG) is producing around 100,000 kiloliter of biodiesel per year.
- PT Rajawali Nusantara is expected to start producing biodiesel from 2007.
- BPPT and PT Hutan Lestari have signed a contract with Campa Biodiesel Gmbh to supply raw materials crude palm oil (CPO) to Germany.
- Australian Investor with the local government owned company (BUMN) from Riau Province have agreed to build a biodiesel and gasohol plant.
- PT AGB Energi of Korea plans to invest US$300 million in raising castor oil plants (jatropha) on a 300,000 hectares plot of land in North Maluku province. In the initial stage of the project, some100,000 hectares (ha) of land will be cultivated over five years with an investment of US$100 million. In the sixth year, the Korean company will monitor the development of the situation and conditions and consider investment of a further US$200 million for 200,000 ha. It is expected that the 100,000 ha of castor oil crops will produce 170,000 tonnes of castor oil per year for both the domestic and export markets. During the initial stage of the project 20,000 ha will be managed by PT AGB Energi, and 80,000 ha will be cultivated by local farmers. In the second and third stages, each 100,000 ha plot will be cultivated by local farmers. There is scope for projects of this type to be expanded to other rural communities within Indonesia.
- In February 2006, the Indonesian coal mining firm Berau Coal signed a MOU with Japan's Sojitz Corporation (formerly Nissho Iwai) to develop a biodiesel fuel plant in Berau regency, East Kalimantan. The project will blend oil extracted from the seeds of the Jatropha Curcas plant with alcohol to produce biodiesel fuel. The Ministry of Energy and Mineral Resource's research Institute (Lemigas) and the Agency for Assessment and Application of Technology (BPPT) are supporting the project, which is scheduled to be completed in 2009.

The government of Indonesia has allocated US$1.4 billion in the 2007 state budget for the support and development of the biofuels industry. About ten percent of the budget will be disbursed to subsidize the interest payments on loans taken out for biofuel-related ventures, and the rest will used for infrastructure development, such as the development of irrigation systems and road access in remote areas allocated for biofuel plantations and the procurement of seedlings. In addition the biofuel program will likely attract the support of financial institutions. It has been reported that several banks have shown an interest in financing some of these biofuel projects. It has also been reported that the national bank will set-aside about US$1.8 billion in loans for the biofuel industry.

INFRASTRUCTURE SUMMIT

The development of infrastructure will be promoted as one of the pillars for next 5 year's as part of Indonesia's development strategy

The second Infrastructure summit was held in November 2006. At the summit, 25 infrastructure projects are under preparation for implementation, namely 12 toll road projects, three gas pipeline projects, seven electricity generation projects and three water supply projects; with an estimated investment value of more than US$7 billion. In addition, two sub-sector transportation projects are being assessed for implementation.

PERTAMINA AND SK CORP SIGNS BASE OIL JOINT VENTURE

In April 2006, Pertamina and South Korea's SK Corp signed a joint venture agreement to build a Group-III base oil plant at Pertamina's refinery in Dumai, Central Sumatra. (Group-III base oils have a high viscosity index and are commonly used as basic lubricant materials.) The plant is slated to have a capacity of 7,250 barrels per day and will reportedly have a construction cost of US$175 million, of which SK Corp will pay US$113.75 million entitling the company to a 65 percent stake in the venture. Construction is due to begin in late 2006, with completion of the project by mid-2008. The two companies will work together to market the products with SK handling international sales and Pertamina concentrating on domestic sales of the product.

LNG INVESTMENT IN TIMOR SEA

Inpex Holdings Inc. a Japanese oil company successfully identified a gas deposit in the Timor Sea. The company plans to invest US$4.2 billion to develop the gas field. The expected production plan will be submitted to the government for approval in 2008, while the gas production mostly in form of LNG is projected to begin in 2015.

UPGRADED BROWN COAL PROJECT

Kobe Steel will develop a pilot project to process Upgraded Brown Coal (UBC) in South Kalimantan. Low-rank coal has a high moisture content and low heat value, resulting in a lower energy value. Indonesia has an estimated 57 billion tonnes of coal, over 50 percent of which is low quality lignite (brown coal). The proposed plant will process low-quality coal from PT Arutmin Indonesia's Satui mine, South Kalimantan, turning it into cleaner, higher quality coal briquettes suitable for use in power plants. The initial plant capacity will be 600 tons per day with construction expected to start by the end of 2006. The project will cost US$70 million and production is projected to begin in 2008.

COAL BRIQUETTE JOINT VENTURE

In June 2006, Australia's Amerod Resources Limited and Indonesia's Bayan Resources signed a joint venture agreement to build a coal briquette plant in East Kalimantan. Amerod owns 51 percent of the joint venture while Bayan holds the remainder.

Bayan and White Energy Technology Limited said they intend to exploit a patented briquetting process using coal from Bayan's Tabang Mine in East Kalimantan. The two companies hope to use the process to convert relatively low quality coal into a higher quality and more environmentally

friendly coal briquettes. The plant will have an initial capacity of 1 million tons of coal briquettes per year with a possible upgrade up to 3 million tons capacity per year if demand exists. The joint venture also includes a 5-year off-take agreement by Bayan is for US$100 million of coal briquettes. Both companies are now completing a feasibility study of the project.

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JAPAN

INTRODUCTION

Japan is a small island nation in Eastern Asia. It consists of several thousand islands, the largest of which are Honshu, Hokkaido, Kyushu and Shikoku. It spans across a land area of approximately 377,800 square kilometres and most of its land area is mountainous and thickly forested.

Japan is the world's second largest economy after the US. Japan's real gross domestic product (GDP) in 2004 was about US$ 3,456 billion (2000 US$ at PPP). With a population of 128 million people, per capita income was US$ 27,051.

Up to the early 1990s, Japan enjoyed a long period of rapid socio-economic development. In 1992, however, Japan's economy entered a decade of stagnation. GDP grew 1.2 percent annually between 1992 and 2002, while during the previous decade; GDP grew by 3.9 percent per year. In 2003, the Japanese economy showed signs of recovery, with the annual GDP growth rate at 1.7 percent (2002-2003). In 2004, the economic activity remained resilient, with GDP growing at an annual rate of 2.7 percent. The recovery was driven by exports, mainly to China, and strengthened domestic capital investment.

Japan possesses a modest amount of indigenous energy resources and imports almost all of its crude oil, coal and natural gas requirements to sustain economic activity. In 2004, proven energy reserves included around 9 MCM of oil, 40 BCM of natural gas and 359 Mt of coal.

Table 15 Key data and economic profile (2004)

Key data		Energy reserves	
Area (sq. km)	377,800	Oil (MCM) – Proven	9
Population (million)	127.76	Gas (BCM)	40
GDP Billion US$ (2000 US$ at PPP)	3,456.10	Coal (Mt) – Proven	359
GDP per capita (2000 US$ at PPP)	27,051		

Source: Energy Data and Modelling Center, IEEJ.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Japan's total primary energy supply (TPES) was 519 Mtoe in 2004, an increase of 3.7 percent from the previous year. By fuel, oil represented the largest share at 47 percent, coal was second at 22 percent, followed by natural gas (13 percent) and others represented the remainder. In 2004, net import of energy sources, accounted for 83 percent of the total primary energy. With limited indigenous energy sources, Japan imported almost 99 percent of oil, 99 percent of coal and 96 percent of gas.

In 2004, Japan was the world's third largest oil consumer after the US and China[29], and almost all of the oil was imported. The bulk of these imports (89 percent in 2004) came from economies in the Middle East such as the United Arab Emirates (UAE), Saudi Arabia, Iran, Qatar and

[29] In 2003, China overtook Japan to become the second largest consumer of oil in the world.

Kuwait.[30] In 2004, the primary oil supply was 243 Mtoe, down by 3 percent from the previous year.[31]

Japan is endowed with only limited coal reserves at 359 million tonnes. The small amount of coal production was heavily subsidised until January 2002 when Japan's last coal mine in Kushiro eastern Hokkaido was closed. Japan is the world's largest coal importer of steam coal for power generation, pulp and paper and cement production and coking coal for steel production. Japan's main steam coal suppliers are Australia, China, Indonesia, Russia, the US, South Africa and Canada. Coking coal is imported from Australia, Indonesia, Canada, China, Russia, the US and South Africa. In 2004 primary coal supply increased by 10 percent from the previous year, reflecting the power companies' efforts to take advantage of coal's price competitiveness compared with oil and natural gas.

Natural gas resources are also scarce in Japan. Domestic reserves stand at 40 BCM, located in Niigata, Chiba and Fukushima prefectures. Domestic demand is met almost entirely by imports of LNG[32], which come mostly from Indonesia (28 percent of imports in 2004), Malaysia (22 percent) and Australia. Natural gas is mainly used for electricity generation, followed by reticulated city gas and industrial fuels. In 2004, primary natural gas supply was 69 Mtoe, or down 3.0 percent from the previous year.

Japan has 272 GW of installed generating capacity and generated about 1,128 TWh of electricity in 2004. The generation amount by energy type is broken-down as: thermal (coal, natural gas and oil) at 62 percent, nuclear (25 percent), hydro (9 percent) and geothermal, solar and wind taking up the remainder.

Table 16 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	97,040	Industry Sector	157,890	Total	1,127,644
Net Imports & Other	429,336	Transport Sector	87,058	Thermal	697,448
Total PES	518,726	Other Sectors	111,869	Hydro	103,153
Coal	113,135	Total FEC	356,817	Nuclear	285,866
Oil	243,205	Coal	38,872	Others	41,177
Gas	69,289	Oil	204,480		
Others	93,097	Gas	23,436		
		Electricity & Others	90,029		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/apec/database/selecttable.html)

After the first oil crisis in 1973, Japan invested heavily in nuclear power generation to reduce its reliance on oil. Despite Japan's desire to increase on the share of nuclear, the Japanese nuclear power industry has faced several challenges in recent years. In 2002, Tokyo Electric Power Company (TEPCO) was found to have falsified their safety reports in the later half of the 1980s and during the 1990s. This led to the closure for inspection of all 17 nuclear units belonging to TEPCO for several months.[33] In early August 2004, an accident occurred in one of the Kansai

[30] Japan's Middle East oil import dependency has been rising steadily from 68 percent in 1985 to 89 percent in 2004. It is due mainly to the decline in oil imports from Asian economies such as Indonesia and Malaysia.

[31] In 2003, Japan's electric power companies increased oil consumption for power generation to make up for the loss from nuclear power production. However in 2004, nuclear power plants resumed operation, thereby electric power companies reduced oil consumption.

[32] In 2004, LNG imports to Japan comprised 57 percent of total world LNG trade.

[33] To make up for nuclear capacity shortages, TEPCO had to increase its generation from crude oil, diesel, coal, and LNG.

Electric Power Company's nuclear reactors caused by a fracture on one of the secondary piping systems at Mihama Unit 3[34]. As a result of these incidents, public opposition against nuclear power generation has increased.

FINAL ENERGY CONSUMPTION

In 2004, Japan's total final energy consumption was 357 Mtoe, or 0.5 percent higher than the previous year. The industrial sector consumed 44 percent of the total, followed by the other sectors mainly residential/commercial at 31 percent and the transportation sector at 23 percent. By energy source, petroleum products accounted for 57 percent of total final energy consumption, followed by electricity and others (25 percent), coal (11 percent) and city gas (7 percent).

Energy consumption for the industrial sector showed an increase of 1.1 percent in 2004, compared to a decline of 5.8 percent in 2001, increase of 1.9 percent in 2002 and 1.3 percent in 2003. The upturn of industrial energy consumption in recent years reflects the increase in production for energy intensive industries such as iron and steel, pulp and paper and petrochemicals.

The energy consumption of the residential/commercial sector in 2004 showed a slight decline of 0.6 percent. The decline in energy consumption of this sector reflects energy efficiency improvement in appliances, slow growth in the number of households and floor space for commercial buildings.

Energy consumption of the transport sector increased 0.8 percent in 2004 from the previous year. The modest increase in 2004 is due mainly to a decline in the distance travelled and fuel-efficiency improvements in the road sub-sector.

POLICY OVERVIEW

The Ministry of Economy, Trade and Industry (METI) is responsible for formulating Japan's energy policy. Within METI, the Agency for Natural Resources and Energy (ANRE) is responsible for the rational development of mineral resources, securing stable supply of energy, promoting efficient energy use, and regulating electricity and other energy industries. The Nuclear and Industrial Safety Agency (NISA) is responsible for the safety of energy facilities and industrial activities while the Ministry of Foreign Affairs formulates international policies.

The fundamental goal of the Japanese energy policy is to achieve a stable energy supply while meeting the demands for environmental conservation and efficiency improvement.

Japan is faced with the following energy challenges. First is securing a stable energy supply at reasonable prices, despite the 82 percent reliance on imports for its total energy supply. The second is meeting the Kyoto Protocol commitment for reducing greenhouse gas (GHG) emissions to 6 percent below the 1990 level between the time period 2008 and 2012. The third is on improving Japan's industries' (including the energy sector's) economic efficiency and thereby increasing their domestic and international competitiveness.

OIL

Japan aims to decrease oil dependency, due in part to the past experiences of the oil crises. However, oil still accounts for around 50 percent of Japan's total primary energy supply and oil is expected to take the dominant share of Japan's future energy supply. Securing a stable supply of oil will continue to be one of Japan's major energy policy issues.

[34] Five workers were killed by the release of steam into the plant.

Japan's oil supply structure is vulnerable to supply disruption incidents since Japan imports almost all of its crude oil. Middle East dependency in 2003 was high at 85 percent. In preparation for any supply disruption incident, Japan has been pursuing emergency measures by: 1) holding emergency oil stockpiling, and 2) conducting independent development of resources and promoting cooperation with oil producing economies for emergency situations.

The Japan National Oil Corporation (JNOC) carried out the national stockpile business until 2003. JNOC provided financial and technical assistance to the Japanese oil industries for their oil and natural gas exploration and development both domestically and abroad. In 2004, the functions of the national stockpile business were transferred to Japan Oil, Gas and Metals National Corporation (JOGMEC), which was established in February 2004. Following the Specially Designated Public Corporation Rationalisation Plan, JOGMEC was established through merging JNOC and the Metal Mining Agency of Japan.

The oil industries have been making every effort to rationalise their activities with huge cost reductions, like downsizing and tie-ups with distributors. The reorganisation of the structure and consolidation of the groups are still ongoing. Making a strong oil industry through the promotion of rationalisation and efficiency is also important for the energy security in Japan.

NATURAL GAS

Demand for natural gas has been increasing rapidly over the last two decades. Between 1980 and 2002, natural gas demand grew at an annual growth rate of 5.3 percent – the fastest growth rate in all primary energy sources. The robust growth in natural gas demand is expected to continue due in part to environmental reasons and the ease of use.

Japan has undergone natural gas market reform since 1995 in an attempt to lower the cost of gas supply and increase the economy's industrial competitiveness in the global market. To date, Japan has taken three steps to liberalise the gas market

- The Gas Utilities Industry Law was amended in 1995. The Law allowed industrial customers with contracted amounts of more than 2 million m^3 per year to directly negotiate prices with suppliers.
- The Gas Utilities Industry Law was further amended in 1999. The scope of deregulation for large volume supply was extended by lowering the annual contract volume to 1 million m^3 per year and over. Regulations for third-party access for the supply of large-volumes of natural gas were also established.
- In June 2004, the Diet passed the amended Law on the Gas Utilities Industry. The amendment in 2004 stipulated that customers with the contracted amount of 0.5 million m^3 could freely choose suppliers. The Law has set a timetable for those customers with contracted amount of 0.1 million m^3 to be allowed to choose their suppliers by 2007.

Natural gas is supplied almost entirely by imports in the form of LNG from Indonesia, Malaysia, Brunei Darussalam and Australia. Since Japan has placed priority on the stable and secure supply of LNG, Japanese LNG buyers have been in general paying a higher price than buyers in Europe or the US under long-term "take or pay" contracts with rigid terms on volume and price.

Now Japanese gas and electric utilities are faced with mounting pressure to reduce cost because of the deregulation of gas and electricity markets. Japanese gas and electric utilities have been making efforts to secure LNG supply at flexible terms that enable them to quickly respond to the changes in the market situation and to supply gas at lower prices. For example, the agreement reached by Tokyo Electric Power Company (TEPCO) and Tokyo Gas for their purchase on LNG from Malaysia's MLNG Tiga project includes outstanding features: (1) some of the LNG will be

shipped on FOB, rather than Ex-Ship, and (2) agreement increased both the upward quantity tolerance and downward quantity tolerance.[35]

COAL

In 2003, coal accounted for 20 percent of the total primary energy supply. Coal will continue to play an important role in Japan's energy sector mainly for power generation, iron and steel, cement and paper and pulp. Coal mines in Japan have become increasingly deeper and remoter and the cost of domestic mining is approximately three times that of imported coal. The government used to subsidise the domestic coal mining industry, however, through structural adjustments and reduction of subsidies coal production gradually has gradually decreased. The domestic production of commercial coal ended at the end of fiscal year (FY) 2001.

Japan is the biggest coal importer in the world with imports reaching over 20 percent of the total global imported coal. From the standpoint of Japan, it is essential therefore, to promote the development of overseas coal for energy security in Asia, and address growing domestic coal demand. To secure a stable supply of overseas coal, Japan is implementing a five-year plan to transfer coal-mining technologies overseas to economies that still have abundant coal resources. Some of the concrete measures to support overseas coal development include, subsidies for investigations prior to mine exploration and development and loans for mine exploration, technology cooperation with coal producing economies and for environmental concerns, development of technology to improve heat efficiency such as technologies of pressurised fluidised-bed combustion, coal gasification combined cycle electricity generation and coal gas production for fuel cells, support the introduction of high efficiency coal boilers and development and diffusion of Clean Coal Technologies (CCT).

ELECTRICITY

Electricity is an important source of energy that took the second largest position in total final energy consumption in 2003. Increased use of electrical appliances at home, through the widespread use of personal computers and related information technology in offices, and a shift in industry structure to more services based sectors has combined to create an upward pressure on electricity demand.

Despite Japan's heavy reliance on electricity, its electricity price is among the highest of the developed economies. To lower the electricity price and increase industrial competitiveness, Japan has undergone a programme to reform the electricity sector.

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

Subsequent amendment in 1999, allowed 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 enter into contracts with power suppliers, including IPPs.

In June 2004, the Japanese Diet passed an amendment to the Electricity Utilities Industry Law. The amendment includes a plan to permit more eligible customers that can choose their electricity supplier. According to the law, customers with 500kW of consumption can directly negotiate with suppliers. This is followed by a plan to open the electricity market in 2005 for those customers

[35] In addition, in December 2006, TEPCO and Tokyo Gas reached an agreement to use those LNG tankers that are owned by their respective subsidiary companies. This agreement was reached in the attempt to reduce costs in LNG transportation and flexibly to meet their LNG transportation requirements.

with 50kW. Discussion has started to consider the total opening of the retail market and for the introduction of full competition in 2007.

NUCLEAR ENERGY

Nuclear energy is perceived to address two key energy issues: supply stability and the environment (no CO_2 emissions). It has now become a major source for electric power generation and will most likely play a big role in the future. To achieve the goals of supply stability and environmental sustainability, Japan is expected to install an additional 10 to 13 nuclear power stations by 2010 (according to the Long-term Energy Supply-Demand Outlook (July 2005)). The New Energy Strategy, released in May 2006, plans to increase the share of nuclear to total electricity generation from the current 29 percent to between 30 and 40 percent by 2030.

It is deemed necessary that significant and sufficient dissemination of information about the safety and necessity of nuclear power is provided in order to facilitate both national and regional support for the construction of additional nuclear power stations. The government has undertaken several promotion measures for the siting of the future nuclear power stations.

The government has also undertaken measures to increase human resources for nuclear engineering. According to the nuclear promotion programme, released in 2006, the Japanese government will allocate 280 million yen for the fiscal cycle 2007 for the nuclear study programme in Japanese universities.

To ensure the efficient use of nuclear resources, it is essential to work out countermeasures to establish (assist with) the nuclear fuel cycle. In May 2000, the "Specified Radioactive Waste Disposal Act" was approved to ensure the planned and most importantly the reliable disposal of high-level radioactive waste. In October 2000, authorisation was granted by METI to establish the Nuclear Waste Management Organisation of Japan (NUMO). NUMO is responsible for the identification of the disposal site, construction, operation and maintenance of the repository, closure of the facility and post-closure institutional control. The Low-level Radioactive Waste Disposal Center of Japan Nuclear Fuel Limited (JNFL) has been in operation at Rokkasho-mura in Aomori Prefecture since 1992.

ENERGY CONSERVATION

In order to achieve the target set forth at the Kyoto conference on climate change (COP 3), Japan formulated its energy efficiency measures in 1998. In 2000, the Advisory Committee for Natural Resources and Energy started the total review of energy policy and the Energy Efficiency and Conservation subcommittee has re-evaluated the energy efficiency measures set in 1998 and has added measures for the industrial, residential/commercial and transportation sectors.

The current energy efficiency measures include, measures for factories based on the Law Concerning the Rational Use of Energy, a follow-up of the Keidanren environmental voluntary action plan in the industry sector, strengthening efficiency improvement of equipment and improvement of energy efficiency performance of houses in the residential/commercial sector, strengthening fuel efficiency improvements in cars and acceleration of the popularisation of clean-energy motor vehicles in the transportation sector.

Given the substantial increase in green house gas emissions from energy consumption, the Ministry of Economy, Trade and Industry has amended the Energy Conservation Law to strengthen energy efficiency measures. The amendment of the Energy Conservation Law became effective in April 2006.

The amendment newly includes transportation sector to enforce (1) owners of freight trucks, rail, air and cargoes and (2) companies operating passenger travel for road, rail, ship and air, to report to METI their annual plan for efficiency improvement, and annual energy consumption regarding transportation. Further to increase the scope of industrial factories responsible for the measures under the Law, the amendment will lower the threshold for annual energy consumption

by a factory. The amendment forces those who build new residential and commercial buildings with more than 2,000m² to report the energy conservation measures to the local governments.

NOTABLE ENERGY DEVELOPMENTS

NEW NATIONAL ENERGY STRATEGY

In light of the changes in global energy markets, and the tight balance between energy demand and supply globally, the Agency for Natural Resources and Energy (ANRE) under Ministry of Economy, Trade and Industry, released Japan's New Energy Strategy in May, 2006. The ultimate goals for the Japanese government in establishing the New Energy Strategy are to (1) enhance energy supply security and (2) achieve sustainable development through a wide-range of measures in both the demand and supply sides.

The Japan's New Energy Strategy has instituted the following three key areas:

- Rational use of energy through energy efficiency improvement, expanding the use of new and renewable energy sources, and increasing the use of nuclear for electricity generation;
- Promotion of international cooperation for the exploration/development of energy resources and protection of the environment by strengthening political and economic relations with those economies producing oil and gas, and those neighbouring economies in Asia.
- Enhancement of emergency response measures by improving stock draw-down systems.

For the enhancement of energy security, the New Energy Strategy has set five long-term targets. Those targets are established as guidelines for both the public and private sectors to work in close cooperation.

Energy intensity

- Since the first oil crisis in 1973, Japan's energy intensity (energy use per GDP) has improved by 37 percent. The New Energy Strategy calls for another 30 percent improvement of energy intensity by 2030.

Oil dependence

- Currently, Japan's ratio of oil consumption to total primary energy consumption accounted for around 50 percent, which is a significant reduction from the 1973 level at around 75 percent. The New Energy Strategy further requires Japan to reduce the ratio of oil to total primary energy consumption to reach 40 percent in 2030.

Oil dependence for the transport sector

- For the enhancement of energy security, it is of critical importance for Japan to reduce the heavy dependence on oil products in the transport sector and the New Energy Strategy aims to reduce oil dependence in the transport sector from 98 percent in 2000 to 80 percent in 2030.

Expansion of nuclear

- Japan lacks indigenous energy resources, and nuclear energy plays an important role for the enhancement of energy security. From 1973, the share of nuclear in the total electricity generation increased from 3 percent to 29 percent in 2004. The New Energy Strategy calls for further increase in the share of nuclear to the total electricity generation, reaching between 30 and 40 percent in 2030.

Increase in overseas natural resources development

- The ratio of oil import, from those overseas projects that Japan has stakes, to Japan's total oil imports increased from 8 percent in 1973 to 15 percent in 2004. Despite the increasing competition for securing upstream stakes in overseas projects, the New Energy Strategy requires Japan to increase the ratio of oil import from those Japanese overseas projects to 40 percent in 2030.

The New Energy Strategy addresses a need for government support in creating conditions through which Japan can achieve energy security and sustainable development goals. In particular, the Strategy stresses that it is essential for the Japanese government to nurture internationally competitive companies for oil and gas resources development and companies for nuclear energy promotion through offering financial support. It also identifies the importance of the Japanese government to financially assist those companies that introduce new technologies for energy efficiency, clean coal and nuclear energy in projects implemented in neighbouring Asian economies.

The New Energy Strategy also identifies the importance of public education on energy issues. The New Energy Strategy promulgates its plan for promoting energy education, through holding public hearings, and the dissemination of information through the media.

COOPERATION ON ENERGY RESROUCES DEVELOPMENT AND NUCLEAR ENERGY WITH KAZAKHSTAN

Japan and Kazakhstan reached an agreement for cooperation on energy resources development in June 2006 when Former Prime Minister Mr. Koizumi visited Kazakhstan. The agreement includes (1) the development of Kazakhstan's oil, natural gas and uranium resources with financial support from JOGMEC, Japan Bank for International Cooperation (JBIC) and Nippon Export Import Insurance (NEXI), and (2) the development of nuclear power generation in Kazakhstan with the technological and financial support of Japan.

Kazakhstan is rich in natural resources, in particular uranium – reserves are the second highest in the world after Australia However, the uranium imports from Kazakhstan accounted for only 1 percent of total uranium imports to Japan in 2004. With the implementation of the project for uranium resource development in Kazakhstan, Japan expects to ensure a stable supply of uranium in the future.

IMPLEMENTATION OF JAPAN'S VOLUNTARY EMISSIONS TRADING SCHEME

Under the Ministry of Environment, Japan started voluntary emissions trading scheme (JVETS) – with the first operational period being implemented from April 2006 to March 2007. The JVETS is held in order for Japanese companies to accumulate knowledge and experience for emissions trading with gaining support from the Japanese government.

There are two ways to participate in the JVETS. 32 companies are allowed to join this scheme with emissions reduction targets being imposed and one-third of the total cost for the project implementation being subsidized by the government. These 32 companies are entitled to trade certified emission reductions (CER). 8 companies are authorized to join this scheme as a trader for certified emission reductions (CER), however, for these 8 companies; neither emission reduction targets are imposed nor are subsidies provided.

PROMOTION OF BIOFUELS

In March 2006, the Ministry of Agriculture and Fishery released its revised strategy for the promotion of biofuels in Japan entitled "Nippon Biomass General Strategy". In light of the global shift towards promoting the use of biofuels and the pressing need to reduce CO_2 emissions to meet the Kyoto target, the revised strategy has focused on two areas: the electricity generation and transport sectors. In electricity generation, the strategy aims to increase the use of biofuels from 680,000 kl in 2004 to 3.08 million kl in 2010, and in the transportation sector it aims to expand the use of biofuels from 0 percent in 2004 to 500,000 kl in 2010.

To meet the target, the strategy report identifies the importance for converting 10 percent of forests into the production of biofuels. Also the strategy report stresses cooperation with Asian economies, and identifies Japan's potential for technology transfer for those biofuel refineries and production plants.

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KOREA

INTRODUCTION

Korea is located in Northeast Asia between China and Japan. It has an area of about 99,601 square kilometres and a population of around 48.1 million. Approximately 21 percent of the population lives in Seoul, Korea's largest city and the capital.

In the last few decades, Korea has been one of Asia's fastest growing and most dynamic economies. GDP has increased at an unprecedented growth rate of 6.9 percent per year over the period 1980 to 2004, reaching US$912.8 billion (2000 US$ at PPP) in 2004. Per capita income in 2004 reached US$18,983, more than four times higher than the 1980 level. Korea's major industries include the semi-conductor, shipbuilding, automobile, petrochemicals, digital electronics, steel, machinery, parts and materials industries.

Korea has very few indigenous energy resources. It is completely without oil resources, and at the end of 2004, there were only 308 Mt of recoverable coal reserves and 250 BCM of natural gas at a recently discovered small field. To sustain its high level of economic growth, Korea imports large quantities of energy products. In 2005, Korea was the fourth-largest importer of oil and the second-largest importer of both coal and liquefied natural gas in the world.

Table 17 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	99,538	Oil (MCM)	-
Population (million)	48.08	Gas (BCM) - Recoverable	250
GDP Billion US$ (2000 US$ at PPP)	912.76	Coal (Mt) - Recoverable	308
GDP per capita (2000 US$ at PPP)	18,983		

Source: Energy Data and Modelling Center, IEEJ.

Korea Ministry of Commerce, Industry and Energy and Korea Energy Economics Institute (2004), *Yearbook of Energy Statistics*.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Korea's total primary energy supply increased 5.6 fold from 38 Mtoe in 1980 to 214 Mtoe in 2004. In particular, energy supply from 1990 to 2000 increased by an annual average growth rate of 7.7 percent, far exceeding the economic growth rate of 6.2 percent for the same period. Likewise, per capita primary energy supply grew from 1.0 toe in 1980 to 4.5 toe in 2004. This is a level similar to that of Japan and most European economies.

In 2004, Korea's total primary energy supply was 214 Mtoe, 3.7 percent increase from the previous year. By energy source, oil represented the largest share at 47 percent, coal at 24 percent, and gas at 12 percent. The remaining 17 percent of primary energy came from nuclear, hydro and other fuels. Korea imported around 86 percent of its total energy needs in 2004, including all of its oil and gas requirements and 95 percent of its coal supply.

The total primary oil supply in 2004 was 101 Mtoe, a 0.2 percent increase over the previous year. The share of oil in total primary energy supply has declined from 64 percent in 1980 to 51 percent, as fuel switching from oil to liquefied natural gas (LNG) and other energy sources has

taken place. In 2004, the amount of imported crude oil increased from 805 million barrels in 2003 to 826 million barrels due to the growth of industrial energy use and petroleum product export. The economy imported about 80 percent of its crude oil from the Middle East. Korea was the world's seventh-largest consumer of oil (sharing 2.7 percent of world oil consumption) in 2005.

Coal use in 2004 totalled 51 Mtoe, 8.2 percent higher than the previous year, reflecting the continuous growth of steam coal demand for power generation. Korea has modest reserves of low-quality, high-ash anthracite coal that is not sufficient to meet domestic demand. Almost all of Korea's coal supply is therefore met by imports. Korea is the world's second-largest importer of both steam and coking coal after Japan. Coal imports come from China, Australia, Indonesia, Canada, Russia, and the US.

Since the introduction of LNG in 1986, natural gas use in Korea has grown rapidly, reaching 25 Mtoe in 2004, with its share in the primary energy supply mix increasing to 10 percent. The bulk of Korea's LNG imports come from Qatar, Indonesia, Oman, Malaysia, and Brunei Darussalam. Korea has begun to produce natural gas domestically since November 2004, with the recent discovery of a small quantity of natural gas – about 250 BCM of recoverable reserves – in the Donghae-1 offshore field southeast of the economy.

Korea's electricity generation in 2004 was 367 TWh, 6.3 percent more than in 2003. Nuclear accounted for 36 percent of total electricity generation, followed by coal (37 percent), natural gas (16 percent), oil (5 percent), and hydro (1 percent). The total installed electricity generating capacity in 2004 was 60.0 GW, of which there are currently 20 nuclear power plants with a total installed capacity of about 17.7 GW.

Table 18 Energy supply & consumption for 2004

Primary Energy Supply (Ktoe)		Final Energy Consumption (Ktoe)		Power Generation (GWh)	
Indigenous Production	38,799,	Industry Sector	38,499	Total	366,614
Net Imports & Other	184,113	Transport Sector	34,243	Thermal	231,512
Total PES	214,022	Other Sectors	71,496	Hydro	4,330
Coal	50,954	Total FEC	144,239	Nuclear	130,715
Oil	101,425	Coal	8,055	Others	57
Gas	25,288	Oil	86,791		
Others	36,356	Gas	14,514		
		Electricity & Others	34,879		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html).

FINAL ENERGY CONSUMPTION

Korea's total final energy consumption in 2004 was 144 Mtoe, a 1.7 percent increase over the previous year. Industry accounted for the largest share at 51 percent, followed by residential and commercial sector (28 percent) and transport (21 percent). In general, industry demand growth has weakened since the late 1990s, while the rate of demand growth in the transport and commercial sectors has increased.

By energy source, petroleum products were the most important, accounting for 60 percent of total demand, followed by electricity (24 percent), coal (6 percent) and natural gas (10 percent). Because of strong policy measures to promote the utilisation of natural gas, consumption has increased significantly, particularly in the residential and commercial sectors, from 4 percent in 1990 to 31 percent of the sector's energy consumption in 2004.

POLICY OVERVIEW

Supporting high levels of economic growth despite inadequate indigenous energy resources has been the key driver of Korea's energy policy platform. The Ministry of Commerce, Industry and Energy (MOCIE) is responsible for developing and implementing energy policies and programmes, administrating the energy industry, supporting research and development of new energy technologies and formulating international cooperation on energy-related matters.

In the past, the primary goal of Korea's energy policy has been focused on ensuring stable energy supply to sustain economic growth. The new and changing situation has however has induced the government to seek a new direction in energy policy that could support sustainable development in full consideration of the 3E's (Energy, Economy, and Environment). To this end, in December 2002, the Korean government announced "The 2nd National Basic Plan for Energy Policy." The Plan sets "Sustainable Development" as Korea's new goal for energy policy.

Korea has been shifting energy market operations from a government-controlled system to a market-oriented system, with due consideration of recent world trends in efficiency improvement and privatisation. In addition, since the world energy market has rapidly become integrated, Korea is now pursuing an active international role in regional energy cooperation with an open energy system. Korea is also set to provide more financial resources in the development of new energy technologies.

In summary, the following four dimensions comprise Korea's energy policy:

- Goal - sustainable development;
- Energy industry - from government-controlled system to market-oriented system;
- International relations - open to outside markets and regional cooperation; and
- Activity - support technological innovation.

OIL

Due to Korea's complete dependence on oil imports, the government has been trying to secure supplies in the short and long-term. To ease short-term supply disruptions and meet the International Energy Agency's (IEA) obligations, the Korean government plans to increase strategic oil stocks from 74.3 million barrels (54 days of net imports) in December 2004 to 141 million barrels (72 days of net imports) by 2008. By combining the oil inventories of both public and private oil companies this would equate to about 109 days of net imports and would substantially exceed the IEA's obligation of 90 days.

In the longer term, the Korea National Oil Corporation (KNOC) has been actively exploring and developing oil and gas locally and abroad to improve energy security. To encourage private companies to invest in development projects overseas, the Korean government has expanded its policy of supplying long-term low-interest loans through the Special Account of Energy and Resources. As of the end of 2004, Korea had equity stakes in 56 overseas exploration and production projects in 24 economies including Indonesia, Vietnam, and Peru.

Korea has also been trying to diversify its crude oil supply sources. The number of source economies has increased from only 9 in 1980 to 29 in 2004, but oil import dependency from the Middle East remains high at 78 percent in 2004. Korea is also actively strengthening its bilateral relations with oil-producing economies as well as multilateral cooperation through the IEA, APEC, ASEAN+3, IEF and ECT, in order to enhance its crisis management capabilities. In particular, the government plans to play a leading role in energy resource development and trade in Northeast Asia by creating a collaborative framework on energy cooperation.

NATURAL GAS

To reduce the economy's dependence on imported oil, Korea introduced natural gas-based city gas to the residential sector in the 1980s. Since then, gas use has grown rapidly, replacing coal and oil in the residential sector, to reach a 10 percent share of primary energy supply in 2003. Korea Gas Corporation (KOGAS) has a monopoly over Korea's natural gas industry including the import, storage, transport and wholesale businesses. Thirty three city gas companies operate in the gas retail business in each region of the economy.

According to *"The 7th Plan of Long Term Natural Gas Demand and Supply,"* which was finalised by MOCIE in December 2004, it is projected that natural gas demand would grow by 3.9 percent per year from 2003 to 2017. To ensure a stable supply base for gas, KOGAS plans to expand LNG storage capacity to 8.6 MCM (64 units) in 2017 from 4.2 MCM (33 units) in 2004.

In February 2005, Korea reached a final agreement on a long-term contract for LNG with Yemen's YLNG Company, Malaysia's MLNG TIGA, and Russia's Sakhalin Energy Investment Co. (SEIC). Under the contract, Korea will purchase 5 million tons per year from 2008 through 2028. Korea is able to buy LNG for about 30-40 percent cheaper than before and have an option to buy an additional 700,000 tons annually. The economy will also import two-thirds of the contracted 5 million tons in the winter season, to facilitate coordination of supply and demand.

ELECTRICITY

Due to economic growth and higher quality of life nationwide, electricity consumption has risen substantially over the past few decades, marking a 9.5 percent average annual growth through the 1990s. The installed capacity in 2004 reached 60 GW from 21 GW in 1990, a more than three-fold increase. According to *"The 2nd Basic Plan of Electricity Demand and Supply (2004-2017),"* which was finalised by MOCIE in December 2004, it is projected that electricity demand would grow by 2.5 percent per annum from 2003 to 2017 and a total of 38.2 GW in additional capacity will be required by 2017. Taking decommissioning into account, this translates to 88 GW of total generation capacity for that year.

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 the development of nuclear, coal and natural gas electricity generation units was promoted. Gas-fired power plants were introduced in 1986 and in 2004, accounted for more electricity production than oil-fuelled plants, with a share of capacity of 16 percent and 5 percent, respectively.[36] While the gas-fired share of generating capacity is expected to stabilise at around the current level, the oil-fired share is expected to decline to under 4 percent during the next 15 years.

Korea has been building nuclear power plants since the 1970s, which now account for around 37 percent of electricity production. The share of nuclear capacity is projected to increase from 28 percent in 2003 to 30 percent in 2017, surpassing the largest share traditionally held by coal-fired power plants. Including the two currently under construction, eight additional nuclear power plants (currently there are 20 plants) will be built by 2017.

ENERGY MARKET RESTRUCTURING

Since the late 1990s, Korea has been pursuing the restructuring of its energy sector with the introduction of the principle of free competition in such industries as electricity and natural gas that have been traditionally considered natural monopolies. In a move to introduce competition to the electricity industry, the government announced "*The Basic Plan for Restructuring the Electricity Industry*" in January 1999, which includes unbundling and privatisation of Korea's state-owned electricity monopoly, Korea Electric Power Corporation (KEPCO).

[36] Korean Yearbook of Energy Statistics 2005

Part of the plan has been implemented, including the establishment of the Korea Power Exchange and the Korea Power Commission in April 2001. The power generation part of KEPCO was split into six companies (five thermal generation companies and Korea Hydro and Nuclear Power Co., Ltd.). The five thermal generation companies that split from KEPCO will be privatised in stages. Korea South-East Power Co., Ltd was found in April, 2001, as the first company which was separated from KEPCO through a plan of structural reorganization.

Along with electricity market restructuring, the Korean government developed "*The Basic Plan for Restructuring the Gas Industry*" in November 1999. The plan outlines a scheme to introduce competition to the import and wholesale gas businesses. The government plans to enact the relevant law on restructuring based on agreement by a tripartite committee which consisted of labour unions, the management-side and the government.

With regard to introducing competition into KOGAS's import/wholesale sectors, the final decision will be made on whether to split the sectors from KOGAS or to introduce new companies, following discussion among the invested parties. Given the strong public interest in this sector, the existing public utility system is expected to be maintained. As for the retail sector, which is currently operated under a monopoly system within each region, competition will be introduced in stages, in conjunction with the progress made in the wholesale sector.

ENERGY CONSERVATION AND EFFICIENCY PROMOTION

To establish a low energy-consuming economy, the Korean government has promoted energy conservation and enhanced efficiency for the end use sector. In the industrial sector, the Korean government has enforced stringent administrative regulations on energy management in combination with provision for free consulting services to small enterprises. In addition, the government has been developing voluntary agreements on energy saving with large energy-consuming enterprises that consume more than 2 Ktoe. The number of such agreements increased from only 15 in 1998 to 1,110 in 2004.

In the transport sector, tax and fee incentives are provided for the purchase of small cars with an engine size less than 800 CC to increase the usage of low energy-consuming vehicles. The government enforced a regulation that automobile industries should improve the energy efficiency of vehicles by 20 percent from the 1999 level by 2009. In the public sector, all agencies were mandated to reduce energy consumption by 3 percent in 2006, from the 2003 level. In addition, newly constructed public buildings are obliged to adopt High Efficiency Energy-Using Appliances as certified by MOCIE.

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 targeting some household appliances, lighting and automobiles which began in 1992; 2) the Certification of High Efficiency Energy-Using Appliances Programme implemented in December 1996; and 3) the Energy-Saving Office Equipment and Home Electronics Programme which began in April 1999. One key objective of these programmes is to grant incentives to manufacturers to improve the energy efficiency of their products. Another key objective is to induce consumers to purchase more energy efficient products among those available on the market.

In July 2005, the Korean government launched a program called 'Standby Korea 2010', which intended to lower the standby power of all the electronic devices used in Korea from 3.66 watt of the current level to 1 watt by 2010. Standby power accounts for 11 percent of the nation's total residential power usage and, in fact, the estimated annual cost for electricity lost to standby power is approximately 500 billion Korean Won (about US$495 million). Therefore, this program could result in substantial energy savings.

District heating and cogeneration for industrial parks, factories and large buildings were also encouraged. As of the end of 2004, 10.3 percent of total households, or 1.3 million households, were being supplied by district heating. Furthermore, a rational energy pricing structure has been

developed and implemented to facilitate the efficient use of energy. Aided by these policies, the GDP elasticity of energy consumption has declined from an average of 0.89 in the 1990s to 0.59 in 2004.

In January 2006, the Korean government implemented the Average Fuel Economy (AFE) program for passenger cars to meet the challenge of low fuel economy in the face of the recent high oil prices. The standard AFE is set at 12.4 km/ℓ for vehicles less than 1,500 cc and 9.6 km/ℓ for vehicles over 1,500 cc. Auto makers and sellers of vehicles which put more than 1,000 cars on the market annually are obliged to meet the regulation. If they fail to comply with the regulation, MOCIE will issue an order to improve their fuel economy. When they still cannot achieve the targeted level, MOCIE will make it public.

NEW AND RENEWABLE ENERGY

The Korean government plans to increase the share of new and renewable energy to 5 percent of total primary energy consumption by 2011. As of 2004, the share stood at approximately 2.3 percent, comparably lower than that of other advanced economies. The government formulated the Second Master Plan for Developing and Disseminating New and Renewable Energy Technologies in December 2003, and selected three major areas with viable market potential and plans to concentrate support in these areas: hydrogen fuel cell, photovoltaic, and wind power.

To disseminate new and renewable energy, the government also plans to strengthen its support for this energy source. As of the end of 2003, the number of cities regarded as Green Villages where 50 houses are designated to purchase a considerable share of their energy needs from new and renewable energy sources has increased to five. Since May 2002, MOCIE has implemented the price support program to compensate the difference between the cost of power generation and the selling price of new and renewable energy. In addition, the government made it mandatory for the installation of new and renewable energy facilities in March 2004, for all new public buildings that exceed a certain size.

After a drift of 19 years, the site for storing low-and-intermediate-level radioactive waste was finally decided in Gyeonju City, with 89.5 percent approval of the residential vote. Gyeonju City will receive a financial support package of 300 billion Korean Won (about US$297 million) for regional development and yearly storage fees, which is estimated at 8.5 billion Korean Won (about US$8.4 million) a year. In addition, Korea Hydro & Nuclear Power Company (KHNP) headquarters, which is in charge of the facility, will be relocated to the area from Seoul. The government plans to complete the construction of the repository by 2008.

NOTABLE ENERGY DEVELOPMENTS

ESTABLISHING AND ANNOUCING THE FUNDAMENTAL LAW ON ENERGY

The government established and announced the Fundamental Law on Energy in March 2006. The Fundamental Law on Energy presents the following fundamental principles; continuous enforcement of demand-side management of energy and stringent transportation tax, integrated consideration for all kinds of fields in relation to energy and the continuous encouragement for achieving the equality of energy use. Furthermore, it was devised to attain security of energy supply, to promote vigorous production and use of clean energy, and to switch to a low-energy-intensive economy.

This law requires the National Plan for Energy to be revised every five years for the next 20 years and the Regional Plan for Energy to be revised at least every five years for a period no less than five years. Additionally, the government organizes and runs the National Committee of Energy that regulates and assesses governmental plans for significant energy policies.

The National Committee of Energy consists of total of 25 members including the ministers of the following departments; Ministry of Commerce, Industry and Energy, Ministry of Foreign Affairs and Trade, Ministry of Finance and Economy, Ministry of Science and Technology, Ministry of Construction and Transportation, Ministry of Environment etc, and 5 nominated experts from NGOs and non-governmental experts from industries, universities and institutes. This committee includes 4 sub groups, namely energy policy, technology infrastructure, resource development, and conflict management. Because of the participation of NGOs and external experts, the government ensures speciality, transparency and impartiality in the policy-making process. It is expected that significant energy policies will be thoroughly discussed by the committee.

The National Plan for Energy includes:

- prospects for energy supply and demand at the domestic and international levels
- measures for ensuring secure control , introduction, supply and management of energy
- measures for assuring supply and use of clean energy including new and renewable energy
- measures for achieving the rational use of energy and reducing greenhouse gas emissions
- measures for assuring the safe management of energy flows
- measures for encouraging the development and dissemination of energy technologies
- measures for promoting the development of human resources relevant to the energy sector
- measures for internationally harmonizing and cooperating energy policies and environmental policies in connection with energy
- measures for the further development and utilisation of domestic energy resources

ANNOUCING LEGISLATION OF THE MANDATORY ENERGY AUDIT PROGRAM

The government established the legal foundation so that it can implement mandatory energy management audit according to the Law on Rational Use of Energy in December 2005. Therefore, the government announced the legislation of regulations and rules as sub-laws in March 2006; hence, the process of establishing the details of criteria and procedures is currently under investigation.

1) The criterion for identifying energy-intensive businesses is

An energy-intensive business, which is subject to Energy Audit, shall consume more than 2,000 toe of energy per year[37]. In 2004, the number of companies, subject to mandatory energy audits, was estimated at 2,045.

2) Energy Audit Interval

- A business with total annual energy consumption of < 0.1 million toe: every 5 years
- A business with total annual energy consumption of ≥ 0.1 million toe: every 3 years (option : conducting partial energy audit)

3) Energy Audit Incentive

The government supports an Energy Audit fee for small and medium-sized businesses where the total amount of energy use per year is less than 5,000 toe.

4) Appointing Energy Auditing Organization

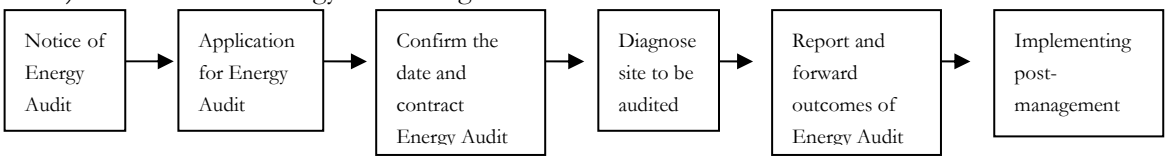
[37] Energy includes fuel, heat and electricity.

The minister of MOCIE appoints expert companies that operate a certain type of equipment in the Energy Audit process. Based on the operating engineers and equipment therein, the type of energy audit and the range of energy audit work are defined accordingly.

5) Management and Monitoring of Energy Auditing Organization

The government appointed the Korea Energy Management Corporation (KEMCO) to exclusively conduct and oversee the overall management of the Mandatory Energy Audit Program for the last 10 years.

6) Procedure of Energy Audit Program



7) Concluding Remarks

As energy-intensive businesses are periodically conducted by the Energy Audit Program, it is expected that factors concerning energy loss will be uncovered and ameliorated in advance; additionally the government will continuously promote the rational use of energy through the revision and expansion of energy conserving measures.

ENERGY-EFFICIENT LIGHTS FOR WELFARE FACILITIES

As part of a campaign to promote on-going energy conservation, MOCIE is installing energy-efficient light bulbs and fixtures at welfare facilities free of charge. The project began in 2004 and will continue until 2008 to provide energy efficient lights to a total of 2,055 welfare facilities including nursing homes and child care centres. Once completed, the campaign is expected to save 3.3 million kWh of energy, which is equivalent to the annual electricity consumption of 100,000 households or 3.87 billion won.

EXPANDING RENEWABLE ENERGY PROJECTS TO THE NEEDY

MOCIE will make new and renewable energy sources more available to lower-income groups. As part of the project, solar panels and other equipment will be installed at welfare facilities. The Minister also announced MOCIE's plan to increase the renewable energy budget for welfare facilities in 2006 to 9.3 billion won, a 127% increase over the previous year, and added he would continue to expand the renewable energy project in the future.

Since 2001, MOCIE has provided 18.3 billion won to new and renewable energy projects to equip 182 welfare facilities.

NO-DRIVING DAY STARTS IN PUBLIC OFFICES

From June 12, all cars visiting public offices including government and educational facilities are required to observe a no-driving day once a week designated by the last digit of the vehicles license number plate under a new plan.

MOCIE announced that, in accordance with the results of the 4th National Energy Advisory Committee (Chaired by President in May 2006) that all public offices should take an initiative and set an example of energy conservation to cope with recently sustained high oil prices, with the government deciding after discussion with the National Affairs Arbitration Office to implement the "No-driving Day" from June 2006 targeting public offices.

The "No-driving Day" means that all cars with license numbers that end with 1 or 6 will prohibited to park at government facilities on Mondays, while those that end with 2 or 7 will be prohibited on Tuesdays. 640 public institutions will be subject to the new measure, which also applies to their staff.

However, an "optional No-driving Day system" which has been implemented by the Seoul Metropolitan Government will be mutually acknowledged and vehicles with the "optional No-Driving Day system" stickers on them will be restrained from entry to public institutions based on the sticker.

Together with this system, in the case that there are any vehicles of officers and staff of respective public institutions which are unable to comply with the system, it is possible to obtain a sticker from the department in charge of the system to exempt the vehicle from the above conditions. Accordingly, vehicles that attend/work at/need to go to public institutions which have registered a fixed day of the week (optional day system) are also acknowledged similarly to that of those registered to local government organizations and are allowed to enter public institutions on days other than the days registered under the optional day system.

However, as in the case of the existing "10th-day No driving system", vehicles, such as those for people with special-needs, vehicles with an engine size less than 800cc, emergency vehicles, special automobiles, vans (for more than 11 passengers), cars for convoy and hybrid cars will be excluded from the system.

The government estimates that there will be additional savings of approximately 160 billion won a year in the case of implementation of the "No-driving day once a week" campaign as opposed to the "10th-day No driving system".

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MALAYSIA

INTRODUCTION

Malaysia is located in Southeast Asia. Its 330,242 square kilometres of territory consist of Peninsular Malaysia and the Sabah and Sarawak States on the island of Borneo. The total population of Malaysia was 24.89 millions in 2004.

The Gross Domestic Product (GDP) grew steadily over the 14 year period (1990-2004) at an average of 6.3 percent per year. Between 2003 and 2004 GDP grew at 7.1 percent, to reach US$246.31 billion (2000 US$ at 2000 purchasing power parity (PPP)) in 2004. GDP per capita likewise experienced an improvement reaching US$9,894 (2000 US$ at PPP) in 2004 compared to US$9,408 (2000 US$ at PPP) in 2003.

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 December 2004, the proven reserves including 4.83 billion barrels of oil, 87.02 tscf of gas and 1,483 million tons of coal. Malaysia is a net energy exporter. Crude oil, LNG and petroleum products contributed 15 percent of the economy's export earnings from January to September 2006.[38]

Table 19 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	330,242	Oil (Bbl) - Proven	4.83
Population (million)	24.89	Gas (Tscf) - Proven	87.02
GDP Billion US$ (2000 US$ at PPP)	246.31	Coal (Mt) -Recoverable	1,483.06
GDP per capita (2000 US$ at PPP)	9,894		

Source: Energy Data and Modelling Centre, IEEJ. *National Energy Balance Malaysia, 2004

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary supply in 2004 was 60,293 ktoe. Gas accounted for 40 percent of total primary supply, while oil, coal and others accounted for 47 percent, 12 percent and 1 percent respectively. Most of the coal utilized in Malaysia was imported.

Malaysia produced 774.3 thousands barrels per day of crude oil in 2004.[39] Most of Malaysia's oil fields are located offshore near Peninsular Malaysia. In view of the declining domestic reserves, PETRONAS, the state oil and gas company, is investing in exploration and production projects outside of Malaysia. As of 1 January 2006, Malaysia's total international reserves reached 5.94 billion barrel of oil equivalent (boe), representing nearly a quarter of PETRONAS' total reserves.

Gas production in Malaysia reached about 6,420 million scf per day in 2004.[39] Forty one percent of this gas was exported, usually in the form of liquefied natural gas (LNG), to Japan, Korea and Chinese Taipei, while a small percentage of the gas is exported to Singapore by pipeline. Gas is used domestically for electricity generation and as a feedstock in the petrochemicals industry.

[38] Key Statistics November 2006, Department of Statistics, Malaysia

[39] National Energy Balance Malaysia 2004, Ministry of Energy, Water and Communications, Malaysia

In 2004, total electricity generation was 79,194 GWh. Thermal generation, mostly from natural gas and coal accounted for 93 percent of production and hydropower for the remaining 7 percent.

Table 20 Energy supply & consumption (2004)

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	89,520	Industry Sector	14,375	Total	79,194
Net Imports & Other	(29,207)	Transport Sector	15,365	Thermal	73,371
Total PES	60,293	Other Sectors	6,799	Hydro	5,823
Coal	7,451	Total FEC	36,539	Nuclear	-
Oil	28,418	Coal	1,239	Others	-
Gas	23,924	Oil	22,785		
Others	501	Gas	5,877		
		Electricity & Others	6,638		

Source: Energy Data and Modelling Centre, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

FINAL ENERGY CONSUMPTION

In 2004, total final energy consumption in Malaysia was about 36,539 Mtoe. The transport sector consumed 42 percent of this total, followed closely by the industrial sector at 39 percent and other sectors (agriculture, residential/commercial and non-energy) at 19 percent. By fuel source, petroleum products contributed the largest share with 62 percent of consumption followed by electricity (18 percent), gas (16 percent) and coal and coke (3 percent).

POLICY OVERVIEW

MALAYSIA ENERGY POLICIES

Malaysia's National Energy Policy was formulated in order to achieve the following objectives;

i. Ensuring the provision of adequate, secure and cost-effective energy supplies by developing indigenous energy resources, both non-renewable and renewable, using least-cost options, and diversifying supply sources both within and outside the economy;

ii. Promoting the efficient utilisation of energy and the elimination of wasteful and non-productive patterns of energy consumption; and

iii. Ensuring factors pertaining to environmental protection are taken into consideration in the production and utilization of energy by minimizing the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment.

To support the policy, the National Depletion Policy was formulated with the intention to prolong/preserve the economy's energy resources particularly oil and gas resources. Under this policy total production of crude oil is limited to about 650,000 barrels per day while that of natural gas for Peninsular Malaysia is limited to 56.6 MCM per day (2,000 million standard cubic feet per day). Meanwhile, the Four-Fuel Policy was expanded to incorporate renewables (RE) as the fifth fuel after oil, gas, coal and hydro.

Under the current Malaysian Plan (Ninth Malaysia Plan – 2006 to 2010) the government has set a target of 350 MW of grid-connected RE electricity generation by 2010.

NOTABLE ENERGY DEVELOPMENTS

Oil and gas make up 87 percent of the primary energy supply for the key sectors of the Malaysian's economy. However, since these fossil fuels have resources a limitation, Malaysia has given importance to the implementation of energy efficiency measures and development of RE resources while continues the exploration for oil and gas reserves in ultra-deep water and deep water areas. The Government is encouraging the use of renewable energy such as solar power, hydro, geothermal and agricultural biomass to ensure the sustainability of energy resources.

RENEWABLE ENERGY (RE) INITIATIVES

To fast track the implementation of the Five-Fuel Policy, the Government has launched the Small Renewable Energy Power Program (SREP) in May 2001. Under this program, the utilization of all types of RE sources including biomass, biogas, municipal solid waste, solar, mini hydro and wind are allowed. Besides the launching of SREP, there were a few more initiatives taken by the government to promote RE including the implementation of Biomass-based Grid Connected Power Project and the Malaysian Building Integrated Photovoltaic Project.

With a view of sustainable energy development, RE is considered to be one of the best options to for the economy to achieve its goal. Subsequently, the development of RE was emphasized under the Outline Perspective Plan (OPP3) as well as the 8th Malaysia Plan (2001-2005) and the 9th Malaysia Plan (2006-2010).

Under the 8th Malaysia Plan, the government has made a commitment towards the development of RE in the country. This was done with the introduction of the Five Fuel Policy where RE will constitute the fifth fuel in the national energy mix. Under this policy Malaysia's energy mix will be focused primarily on oil, gas, coal, hydro and RE sources. The commitment was further emphasised under the 9th Malaysia Plan (2006-2010), where the government has announced plans to further intensify the utilisation and development of RE. Under the Plan it was targeted that 350MW of installed capacity from RE to be connected to the national grid by 2010.

Small Renewable Energy Power Program (SREP)

Small Renewable Energy Power Program (SREP) was established to fast track the development of RE in Malaysia. SREP projects are power generating projects that are capable of converting RE resources into electricity. A Renewable Energy Purchase Agreement (REPPA) allows each independent power producer to negotiate directly with the utility company on all aspects including the selling price on a 'willing-seller, willing-buyer' and 'take and pay' basis. RE electricity producers receive a 21-year license, and are allowed to export to the grid up to a maximum of 10MW. Under this program, the utilisations of all types of renewable energy including biomass, biogas, municipal solid waste, solar, mini hydro and wind are permitted. A SREP developer can apply to sell electricity to the utility company through the distribution Grid System.

Since its introduction in May 2001, SREP has shown very slow progress. As at June 2006, 23 projects with a generating capacity of 252 MW had been approved. However, of those 23 projects only two projects – of 12MW installed capacity – have been successfully completed and connected to the national grid. Among the barriers to the higher take-up rate are the high entry barriers in the energy market faced by RE projects, the viability of power purchase price and the REPPA terms and perceived poor economics of RE projects compared to that of fossil fuels. To tackle this issue, thus providing more inducement for RE developers, on September 2006 the government has announced the raising of the selling price for RE for biomass under the SREP program from 17 sen per kWh to 19 sen per KWh.[40]

[40] Ministry of Energy, Water and Communications, Malaysia (2006), YB Minister Speech at the National Renewable Energy Forum 21 September 2006.

Malaysian Building Integrated Photovoltaic Project (MBIPV)

The Malaysian Building Integrated Photovoltaic (MBIPV) Project that was launched in July 2005 and has the objective of reducing the long-term cost of Building Integrated Photovoltaic (BIPV) technology within the Malaysian market, which will subsequently lead to sustainable and widespread BIPV technology applications that will subsequently reduce GHG emissions from the electricity supply industry. This five-year project is co-financed by Government of Malaysia, UNDP/GEF and private institutions with funding reaching a total of US$25 million. It is estimated that the project will facilitate an increase in the number of BIPV applications by about 300 percent with the overall costs decreasing 30 percent by the year 2010.

This project will among others create the much needed market penetration for BIPV technology through the development of BIPV showcases, demonstrations projects and the execution of the National Suria 1000 Programme. The National Suria 1000 Programme[41] was launched in November 2006, the programme is carried out in order to encourage public participation and to create local demand. This programme will also review existing building standards and create new installation guidelines for BIPV technology.

Fiscal Incentives for Renewable Energy

The previous tax incentives for companies generating energy from renewable resources were enhanced in the 2006 Budget. The level of tax exemption under pioneer status was increase from 70 percent to 100 percent for 10 years, and the rate of Investment Tax Allowance from 60 percent to 100 percent for the first five years. The tax incentives application period has also been extended to 2010. Whilst the Import Duty and Sales Tax on equipment utilized for these activities has also been extended to 2010.

ENERGY EFFICIENCY (EE) INITIATIVES

In terms of energy efficiency, the government has continue to show its commitment towards reducing energy intensity in the economy, this commitment has been spelt out in the current Malaysian Plan (2006-2010), that emphasises the efficient utilization of energy and resources, and on ensuring the minimisation of waste.

There have been a few initiatives undertaken to pursue the utilisation/promotion of EE while maintaining these objectives. Such initiatives include, the implementation of the Malaysian Industrial Energy Efficiency Improvement Programme (MIEEIP), energy auditing programme, the energy service companies support programme and a technology demonstration programme. The government also has taken the lead in promoting EE in buildings within the economy by constructing the Low Energy Office (LEO) Building and the Zero Energy Office (ZEO) Building.

Malaysian Industrial Energy Efficiency Improvement Program (MIEEIP)

The four-year MIEEIP project is co-funded by the government of Malaysia, UNDP/GEF and the private sector in Malaysia with a total cost of US$20,790,200. The project's main goal is to remove the barriers to the efficient use of energy in the industrial energy sector. The MIEEIP project is focused on selected energy-intensive industrial sectors. The eight industrial sectors selected are wood/timber, food, glass, cement, rubber, pulp and paper, iron and steel and the ceramic industries. In 2005 it was extended to other three energy intensive industries namely the oleo-chemical, plastic and textiles industries.

Currently the MIEEIP has successfully undertaken 48 energy audits in eight energy-intensive manufacturing sectors. Apart from conducting energy audits, the project has facilitated the establishment of a RM8 million Energy Efficiency Project Lending Scheme (EEPLS). The EELPS will be distributed out as soft-loans to energy services companies (ESCOs) and industries to implement EE projects. In addition, nine EE demonstration projects will be developed under this project. Currently, two EE demonstration projects have been successfully implemented.

[41] Suria 1000 Programme is targeted to install a minimum of 1,000kWp by 2010

Energy Efficiency in Buildings

The energy demand in the commercial and residential sector has grown at a fast rate of 5.3 percent between 2000 and 2004, to reach 13 percent of total final energy demand in 2004.[39] Even though the share of the commercial and residential sectors is small, the high growth rates have prompted the government to take some initiatives in order to reduce the energy intensity of the economy by increasing the overall energy efficiency of buildings:

1) Low Energy Office Building (LEO Building)

The Low Energy Office (LEO) Building, which houses the Ministry of Energy, Water and Communications (MEWC) in the Federal Government Administrative Centre, Putrajaya, is the first large government office building to be specifically designed with an integrated energy efficient design and fitted with cost-effective/reductive features. The LEO building is used as a showcase building for EE and a demonstration building due to its low environmental impact.

The targeted Energy Index (EI) of the LEO Building is 100kWh/m² per year compared to the EI in conventional office buildings, which is 200-300kWh/m² per year. This means that the energy savings for the LEO Building are 50 percent or an equivalent annual energy cost savings/reduction of up to RM600,000. The additional construction cost of the LEO building is less than 10 percent compared with conventional building types and the pay back period this investment is less than 10 years[42].

2) Zero Energy Office Building (ZEO Building)

The ZEO Building will be a showcase building for BIPV technology and will be one of the demonstration projects for BIPV under the MBIPV Project implemented by Pusat Tenaga Malaysia. The ZEO Building design incorporates both RE and EE features.[43] The Building is targeted to achieve EI of 50 kWh/m² which is half that of the EI of the MEWC's LEO Building and well below the 135 kWh/²m specified in the *Guidelines for Energy Efficiency in Buildings, 1989*[44].

A solar PV system will be installed on the roof of the building, and the electricity load of the building will be fully supplied by this system during the day. The building will utilize electricity from the grid to operate the chillers at night where the electricity tariff is cheaper and the excess electricity produced by the PV system during the day will be sold to the grid; thus the term 'Zero Energy Building'.

Apart from producing electricity using the PV system, the building will be fitted with many EE features, including high performance glazing which allow the use of natural light in the building but avoid unnecessary heat radiation from entering the building, concrete floor slabs with thermal storage and radiant cooling to store the cooling from night time to daytime, fresh air and dehumidification and usage of energy efficient office equipment.

Fiscal Incentives for Energy Efficiency

Fiscal incentives for energy efficiency (EE) initiatives were provided for in the 2003 National Budget. The incentives will be extended up to the year 2010. In addition, an Investment Tax Allowance of 60% on capital expenditure for improving energy conservation is to be provided to the building owners.

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[42] Ministry of Energy, Water and Communications, MEWC Low Energy Office (LEO) Building Putrajaya, Malaysia. Website, http://www.mecm-leo.gov.my

[43] The building will house Pusat Tenaga Malaysia (PTM) and will be completed by early of 2007.

[44] Pusat Tenaga Malaysia, Energy Smart Quarter 1 Issue 0017, Paul E. Kristensen, 'Special Focus: The New PTM ZEO Building is on the Drawing Board', 2005

CLEAN DEVELOPMENT MECHANISM (CDM)

Malaysia signed the Kyoto Protocol in March 1999 and ratified to the protocol in September 2002. Even though Malaysia – an Annex II economy – is not subjected to any emission reduction commitments of greenhouse gases (GHG), the economy could benefit by participating in CDM projects. Among the benefits, the Protocol is seen as an instrument through which the economy could achieve sustainable energy development by utilising alternative financing schemes for RE projects, while also contributing to the overall improvement of the environment through the reduction of GHGs emissions.

Malaysia has a high potential for CDM projects, preliminary studies haves shown that by 2010 the economy could produce up to 17.8 million CERs per year from various fields/areas/sectors such as biogas palm oil mill effluent (POME) and animal manure, landfill gas, reduction of gas flaring from oil production and biomass combined heat and power (CHP) projects.[45]

As at August 2006 the total number of projects that had received Host Country Approval was 54 projects, where biomass empty fruit bunch (EFB) and biodiesel for the transportation sector accounts for 36 percent and 28 percent of total CERs respectively.[45] Of the 54 projects, 11 projects are now registered with the CDM Executive Board, with an estimated potential annual reduction of 1.62 million tonnes of CO_2-eq.[46]

ALTERNATIVE FUEL

Currently, the economy has two programmes to develop alternative fuels for the transport sector, which are a natural gas vehicles (NGV) programme and the biofuel utilisation plan.

Natural Gas Vehicles (NGV) Programme

The Natural Gas Vehicle (NGV) programme in Malaysia was introduced in 1986 and championed by PETRONAS, the state-owned oil company. The programme is a part of efforts to utilize the economy's abundant natural gas resources and to diversify the use of natural gas away from current utilization in the electricity generation and industry sectors.

Presently, there are 51 NGV refuelling stations located in Kuala Lumpur, Johore, Penang and Seremban.[47] To expand the operation of NGVs the target is to increase the number of refuelling stations to 94 units by 2009. It is also targeted that the number of NGVs will be increased from 14,700 in 2005 to 57,000 vehicles in 2009 [48]. Presently, there are attempts to expand the utilization of natural gas to include utilization in buses, for example the target is to have 51 NGV buses operating in Putrajaya by the end of 2006.[49]

To facilitate the widespread utilization of NGVs, the government has introduced many incentives over the years to support the NGV industry. These incentives including exemption on duty on the sale of CNG, exemption on the import duty and sales tax on NGV conversion kits, reduction of road taxes and accelerated capital allowance for the purchase of mono-fuel natural gas buses and the construction of NGV outlets.

Furthermore, in order to encourage trucks and buses to utilize natural gas, import duty and sales tax exemption is provided for the conversion kits and the chassis's and engines of natural gas trucks and buses. In addition, a grant of RM50,000 per bus will be provided for the acquisition of each new natural gas buses purchased until the end of 2008.

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[45] Pusat Tenaga Malaysia, 2006

[46] UNFCCC, 2006

[47] 2006 Budget Speech

[48] International Association for Natural Gas Vehicles (IANGV), 'Malaysia-Country Report', 4 May 2005 Website: http://www.ngvglobal.com/index.php?option=com_content&task=view&lang=en&id=117&Itemid=2

[49] Utusan Malaysia Online, 22 June 2006, ' Bas Putrajaya Guna Gas Ganti Diesel'

Bio-fuel Utilisation

Malaysia has launched a new type of bio-fuel, named Envo Diesel, and announced the National Biofuel Policy in March 2006. The objective of the policy is to encourage the production and usage of palm oil biofuel as an environmentally friendly alternative energy source and also to stabilize the price of palm oil at a higher level through the increased usage of palm oil. The National Biofuel Policy consists of three important strategies that are, the production and utilization of biofuel for transportation, production of biofuel for export, especially to the European market and the commercialization of biofuel technologies as a local technology.

As of July 2006, 43 applications for biodiesel plants had been approved out of a total of 98 applications received. Presently, 10 biodiesel plants are being constructed where three of them are to be developed in collaboration with the Malaysian Palm Oil Board (MPOB), a government-run company. With the operation of more biodiesel plants Malaysia's domestic biodiesel production is expected to increase to 500,000 tonnes in 2007. The utilization of Envo Diesel, containing 5 percent palm oil and 95 percent diesel, and is estimated to reduce diesel imports by 500,000 tonnes a year.

To encourage the production and utilisation of biodiesel in the economy, the Government has provides a number of incentives: 1) Pioneer Status, 2) Investment Tax Allowance, and if eligible developers can also received 1) Incentives for strategic or Technology projects; 2) Incentives for commercialization of research and development findings of the public sector in resource based industries. Apart from these incentives, to further develop the biodiesel industry in Malaysia, a RM500 million Biodiesel Fund will be established by the Bank Pembangunan of Malaysia.[50]

OIL AND GAS SECTOR[51]

As at January 2006, the total domestic reserves for Malaysia were 19.91 billion barrels of oil equivalent (boe); 5.25 boe of crude oil and 14.66 boe of natural gas. At the current production rate, the reserve life for Malaysia for crude oil and gas is 20 years and 34 years respectively. This is higher than the previous year's estimate due to a respectable Reserve Replacement Ratio (RRR) of 1.8 times.

Two new fields - South Angsi (oil) offshore Peninsular Malaysia and Shallow Classic (gas) offshore Sarawak – has started production bringing the number of producing fields in Malaysia to 77.

A number of new exploration wells (53) were drilled resulting in the discovery of 645.3 million boe of oil and gas reserves, of which nearly 60% is from deepwater discoveries. Nine new Production-Sharing Contracts (PSCs) were signed where six of the PSCs were for deepwater blocks. Including the new PSCs, the total number of PSCs in operations reached 60, the highest number historically; deepwater and ultra deepwater prospects account for about 30 percent of total PSCs. The current deepwater areas under development are the Kikeh, Gumusut-Kakap and Malikai fields that are expected to begin operation in 2007, 2010 and 2012 respectively.

To increase the national reserve, the economy through its national oil company-PETRONAS, is involved oil and gas exploration and production internationally. As at January 2006, Petronas's total international reserves amounted to 5.94 billion boe, where 41 percent of these were in Africa, 32 percent in Central Asia and the Middle East and 27 percent in South East Asia.

Natural Gas

The power sector in Malaysia remains the largest single domestic gas consumer, consuming 66.8 percent of gas sales through the Peninsular Gas Utilisation (PGU) system. The industrial, petrochemical and other users accounted for 27.5 percent, while 5.7 percent was exported to Singapore through a gas pipeline.

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[50] 2007 Budget Speech

[51] Petronas Group Results for the Financial Year Ended 31 March 2006, PETRONAS

Due to increasing domestic natural gas demand, additional supply was obtained from the offshore Terengganu gas field and through imports from Vietnam, Indonesia, and the Malaysia-Thailand Joint Development Area (JDA); gas imports have increased 188 percent from the previous year to reached 426 mmcsfd in 2006 - representing 17.8 percent of total gas supplies through the PGU system.

LNG

During 2005, PETRONAS – the national oil company – has sold a total of 23.6 million tonnes of LNG, an increase of 5.4 percent over the previous year. This is sustained by the higher volume produced and sold by the PETRONAS LNG complex in Bintulu and the Group's Egyptian LNG (ELNG) Plant. The LNG produced in Bintulu was exported to Japan (62%), South Korea (22%) and Chinese Taipei (15%). The market share in Japan and Chinese Taipei has increased to 23 percent and 42 percent respectively, while market share in South Korea remains at 21 percent.

At a combined annual capacity of 23 million tonnes, the PETRONAS LNG Complex in Bintulu, Sarawak remains the world's largest LNG production facility in a single location. The combined production capacity is expected to be increased to 24 million tonnes per annum once the de-bottlenecking for MLNG Dua Plant is completed in 2009.

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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 populated economies in Latin America, with the total population about 103.8 millions in 2004, growing at an average of 1.5 percent annually over the last 10 years. 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 19 million people within the city.

Mexico's economy rebounded in 2004 from years of slow economic performance, the real gross domestic product (GDP) reached US$945.5 billion (2000 US$ at PPP), an increase of 4.4 percent over 2003; in contrast, the Mexican economy shrank by 0.2 percent in 2001 and grew by only 0.8 and 1.4 percent in 2002 and 2003, respectively.

Mexico is a major non-OPEC oil producer. Together with other independent producers and OPEC, it has been a main contributor to the stabilisation of crude oil market prices. 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 January 2006, proven oil reserves were the fourteenth largest in the world, totalling 2,310 MCM (including gas liquids), gas reserves were 448 BCM and coal resources were 1,211 Mt.

Table 21 Key data and economic profile (2004)

Key data		Energy reserves	
Area (sq. km)	1,964,375	Oil (MCM) – Proven**	2,310
Population (million)	103.8	Gas (BCM) – Proven**	448
GDP Billion US$ (2000 US$ at PPP)	945.5	Coal (Mt) –Recoverable***	1,211
GDP per capita (2000 US$ at PPP)	9,109		

Sources: Energy Data and Modelling Center, IEEJ

* INEGI, Información geográfica. 2006

** As of January 2006. Statistical Yearbook 2006 PEMEX.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2004, Mexico's total primary energy supply (TPES) grew at 3.5 percent compared with 2003, reaching 165,491 ktoe. Oil and gas (with contributions of 58 percent and 26 percent respectively) dominate primary energy supply with a combined share of 84 percent. The remaining fuel sources are biomass (5.0 percent), coal (4.3 percent), hydro (1.3 percent), nuclear (1.4 percent), and geothermal/wind/others (3.5 percent). Included in biomass is firewood, which continues to be an important source of energy in rural households and contributes 5 percent to total primary energy supply.

Mexico had 13.7 (including gas liquids) billion barrels of proven oil reserves as of January 1, 2006, the 14th largest in the world. Mexico's proven reserves have declined in recent years; in 2006 reserves were 7.6 percent less than the previous year. The state oil company, Pemex, is the largest

oil company in Mexico and one of the largest oil and natural gas companies in the world. By law, Pemex is the sole producer of oil in Mexico from upstream exploration to final distribution. Total production of crude oil in 2004 reached around 195 Mtoe, 9.2 Mtoe or 5 percent more than the previous year. Domestic consumption accounted for 45 percent of the total volume produced, with 87.6 Mtoe; the remaining 55 percent or 107 Mtoe was exported. Of this amount, about 88 percent went to the US, followed by 11 percent to Europe. In 2004, Mexico was world's sixth-largest oil producer and the world's seventh-largest crude oil exporter. Pemex also controls the downstream oil sector. It has six major refineries with a total refining capacity of 1.68 million barrels per day. The total volume distributed to refineries in 2004 was 74.8 Mtoe, 7.4 percent more than 2003. Despite its status as one of the world's largest crude oil exporters, Mexico is a net importer of petroleum products. In 2004, Mexico imported 13.2 Mtoe of petroleum products, while exporting 4.1 Mtoe. Of these imports, gasoline represented about 50 percent. In order to increase output volume and improve the quality of petroleum products, the government has carried out a long-term upgrading plan for all six refineries. The plan is to increase the total refinery capacity by about 350 thousand barrels per day and improve the quality of gasoline by reducing the amounts of sulphur and lead. Pemex has recently completed the upgrading work in four of the refineries (Madero, Salamanca, Tula and Cadereyta). The modernization of the Minatitlan refinery in Veracruz State is expected to be finished in 2008, which will increase the capacity by about 185,000 B/D to reach a total capacity of 330,000 B/D.

Mexican natural gas proved reserves as of year beginning 2006 were 448 BCM. Most Mexican proved reserves are associated gas (e.g., contained within oil fields), while the rest arise from non-associated gas reserves. The Southern Region of the country contains the largest share of proven reserves, with 43 percent in 2006. Indigenous production of natural gas in Mexico in 2004 was 35.5 Mtoe, an increase of 4.5 percent compared with 2003. Total natural gas consumption in Mexico rose from 25.4 Mtoe in 1995 to 43.7 Mtoe in 2004, at an annual average growth rate of 6.2 percent. Over this period, consumption growth was driven by electricity generation with average growth rate of 15.5 percent per year. Mexico is currently a net importer of natural gas; it imported 9.3 Mtoe from the U.S. in 2004 through 15 natural gas interconnections with the southern United States. Mexico is expected to continue increasing imports from the US in the future.

Mexico has 1,211 million tons of recoverable coal reserves. The majority of these coal reserves are in the north-eastern part of the economy. Around 70 percent of recoverable reserves are anthracite and bituminous, while 30 percent are lignite and sub-bituminous. 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. Total coal supply in 2004 was 7.1 Mtoe and accounted for around 4.3 percent of total primary energy, a decrease of 13 percent from 2003. In 2004, indigenous coal production was 4.7 Mtoe. To supplement production, coal is imported from the US, Canada, and Colombia. Coal in Mexico is mostly used for electricity generation and steel sector. The contribution of coal-fired power plants to Mexico's electricity generation has declined from 14.3 percent in 2003 to 10.7 percent in 2004, mostly as they have been replaced by natural gas and hydro.

Electricity demand has grown rapidly over the past decade, with an average growth rate of 4.0 percent per year. Electricity consumption reached 170 TWh in 2004 and is expected to increase by an average of 5.2 percent per year over the next ten years. The Mexican electric grid is well developed; 96 percent of the population had access to electricity in 2004. Electricity generation capacity in Mexico in 2004 was 53,561 MW, 73 percent of which is owned by the two state-owned electric utilities Commission Federal de Electricidad (CFE, 71 percent) and Luz y Fuerza del Centro (LFC, 2 percent); 14 percent is owned by IPPs; 7 percent by self-supply; 3 percent by co-generators; and 1 percent by small own-users. The total power generation for 2004 was 224,077 GWh which is a 2.9 percent increase from 2003. Most of the power was generated by thermal generation (82 percent). Gas remains the dominant fuel used with 39 percent of the generation in 2004, followed by oil (31 percent), hydro (11 percent), coal (11 percent), nuclear (4 percent), new and renewable energy (3 percent). Gas is the fuel showing the fastest growth at an annual average rate of 16 percent between 1995 and 2004. Mexico has interconnections with the US in the north and Belize in the south. In 2004, Mexico imported 46.5 GWh of electricity while 1012 GWh was exported.

Table 22 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	253,873	Industry Sector	27,170	Total	224,077
Net Imports & Other	-86,145	Transport Sector	45,150	Thermal	183,050
Total PES	165,491	Other Sectors	33,272	Hydro	25,206
Coal	7,133	Total FEC	105,592	Nuclear	9,194
Oil	96,122	Coal	1,276	Others	6,627
Gas	43,713	Oil	68,293		
Others	18,523	Gas	14,134		
		Electricity & Others	21,889		

Source: Energy Data and Modelling Center, IEEJ.

For full details of the energy balance table see http://www.ieej.or.jp/cgi-bin2/J101outbcgi.sh

FINAL ENERGY CONSUMPTION

In 2004 the total final energy consumption in Mexico reached 105,592 ktoe, an increase of 5.0 percent relative to the previous year. Total energy consumption was divided between the industry, transport and other sectors. Industry consumed 26 percent of energy, the transport sector 43 percent, and other sectors (including residential, commercial and agriculture) 32 percent. By fuel source, petroleum products accounted for 65 percent of consumption, natural gas for 13 percent, coal 1.0 percent and electricity and others 21 percent (electricity accounted for 14 percent of consumption).

POLICY OVERVIEW

NATIONAL ENERGY POLICY FRAMEWORK

The Mexico's Energy Secretariat is responsible for Mexico's energy policy within the current legal framework. The main objectives of the National Energy Policy of Mexico are: increase the quality of life of the Mexican people; promote the rational use of resources in the context of sustainable development and intergenerational equity; promote investment in productive and feasible projects for Mexico; generate an elastic supply of hydrocarbons; increase productivity in the sector; and achieve a competitive pricing policy.

The Energy Sector Program 2001-2006, encapsulates the main policies, the strategic goals and measurable targets set for energy sector. The main driving principles of Mexico's energy policy are:

- Guaranteed energy supply with high quality standards and competitive prices;
- Enhance the competitiveness of domestic industry through the availability of the sufficient, timely and competitive supply of cost effective fuels; and contribute to a better environment by using cleaner fuels;
- Social commitment. Energy is a key driver not only for economic growth, but also for assuring higher living standards for the population;
- Modernization of the energy sector. Current infrastructure needs to incorporate new technology trends in order to be able to compete within world energy markets;
- Increasing participation of the private sector; and
- Commitment to sustainable development.

ENERGY SECTOR RESTRUCTURING

In Mexico, the State's ownership of natural resources including oil, and its control over the oil and electricity industries, are principles embedded in the Political Constitution. The Constitution defines "strategic" areas that are the exclusive responsibility of the government and include: the ownership and production of radioactive minerals, oil and all other hydrocarbons, basic petrochemical processes, electricity and nuclear electricity generation.

This legal framework has historically restricted the participation of private investors in the energy sector. However, in the interests of modernisation of national infrastructure and increased productivity, the government in its "Energy Sector Program 2001-2006" recognises the need to liberalise energy markets to augment investment capacity, foster competition and to enhance energy quality and supply.

The Energy Regulatory Commission (CRE) was created in 1994 as a consultative body reporting to the Ministry of Energy, with its role as an advisor limited to the electricity industry. The CRE Act (1995) transformed this role to that of an empowered, independent regulator with technical and operational autonomy and provided the CRE with a legislative mandate to regulate the activities of both public and private operators in the electricity and gas industries. The main functions of CRE are to grant permits, authorize prices and rates, approve terms and conditions for the provision of services, issue directives, resolve disputes, request information, and impose sanctions, among others.

OIL AND NATURAL GAS SECTOR

In 1995, the Oil Regulatory Law was reformed to open the possibility to investors to construct, own and operate natural gas transport, distribution and storage systems. As well, the modifications make it possible now for private entities to import export and commercialise natural gas to final consumers. At the end of 2005, the CRE had granted 21 distribution, 138 transportation and 5 storage permits. These permits represent investments of US$4.86 billion.

In the Liquefied Petroleum Gas (LPG) market, private participation had been allowed since the 1950's, but a new "LPG Regulation" published in June 1999 reorganised the industry into four areas and defined the participants allowed in each. Under the terms of this regulation, Pemex continues to be responsible for first hand sales (sale of the original product), transportation by pipeline, and the operation of production and supply plants. However, national and foreign private participation is allowed in transportation and storage sectors.

In the last five years, greater participation of the private sector in the development of infrastructure has been sought, in the areas permitted within the current legal framework. As of August 2005, Mexico's Energy Regulatory Commission has awarded three LNG storage permits with total capacity of 2.45 billion cubic feet per day (Bcf/d) and total investments of $1.87 billion.

ELECTRICITY SECTOR

Like Pemex in the oil and gas industry, for many years the state power companies CFE and LFC enjoyed an oligopoly in the electric power sector. CFE is the dominant player in the generation sector and also holds a monopoly on electricity transmission and distribution outside of Mexico City and some other municipalities; within those areas, LFC holds a monopoly on distribution activities in some of these municipalities and also within Mexico City.

Constitutional provisions set the legal framework for the electricity industry. Changes to the "Public Service Electric Energy Law" of 1992 opened the door to private investment in the electricity industry to Independent Power Producers (IPPs), co-generators, auto-producers, small-scale generation (less than 30 MW), and imports and exports. IPPs are power plants with an installed capacity larger than 30 MW, built and operated by private companies where electricity is sold exclusively to CFE through a Power Purchase Agreement.

As of August 2006, the CRE had granted 500 permits: for self-supply (397), co-generation (42), and IPPs (21), as well as 34 imports and 6 export permits. These permits represent investments of $15.02 billion in the construction and operation of an additional 22,644 MW of generating capacity. Of this capacity, 12,557 MW corresponds to IPPs; 5,777 MW to entities generating electricity for their own consumption; 2,231MW to exporters; 1,852 MW to cogeneration facilities and only 228 MW to importers. However, it should be noted that the permits are at different stages within the approval process and in reality only 451 permits (accounting for16,981 MW); representing 75 percent of the authorized capacity are operating. An additional 41 projects (4,557 MW) are under construction, representing 20 percent of the authorized capacity.

Total investment of the permits amounts to US$15 billion, of which US$2 billion (13 percent) corresponds to the 61 Pemex projects. The rest, or US$13 billion, is the amount of private capital currently committed to the electricity sector of Mexico. The available data indicates that the largest proportion of the investment is provided by the IPPs, which carry out larger-capacity projects on average. The IPPs accounts for 46 percent of investment with only 21 authorized permits, self-supply contributes 36 percent, exporters 9 percent, and co-generation also 9 percent.

But CFE still owns most of Mexico's installed electric generating capacity and generates more than 70 percent of total electricity in Mexico.

ENERGY AND ENVIRONMENT

Tax Incentives for Clean Energy

Mexico's current legal framework allows power generation projects that may use renewable energy sources under self-supply, small production, independent production and export schemes. While environmental costs are not expressly considered in Mexico's power market pricing, proposals to create tax incentives for renewable energy; and for clean energy services and research were provided with a number of tax incentives. Thus, from December 2004, investments in environmentally-friendly technologies could benefit from accelerated depreciation. Investors are allowed to deduct 100 percent of the investment after one year of operation, as defined in the General Law for Ecological Equilibrium and Environmental Protection. Currently, the equipment shall operate for at least five years, following the tax deduction declaration; otherwise, the taxpayer will be required to recapture the percentage of the deductions corresponding to those years in which the machinery was not operated and characterize the recaptured amount as taxable income.

Renewable Energy Utilization Law

In December 2005, the Low Chamber of the Mexican Congress approved the initiative for the Renewable Energy Utilization Law, which aims at establishing a Renewable Energy Utilization Programme and establishes a goal of 8 percent of the national power production to come from renewable energy by 2012 (not including big hydroelectric plants). With this Law, Mexico's regulatory framework will be strengthened through the recognition of the benefits derived from renewable energy in electricity generation and other applications. The Law also includes provisions to create a renewable energy fund to make renewable-based generation competitive versus other fossil-fuel based projects. The Law would combine a set of incentives and federal taxes to produce renewable energies (RE), and seeks to build up around 600 million pesos per year (approximately US$55 million, at 2005 value) to attain it. Incentives would comprise a set of policies and measures to promote using renewable energies.

Law for the Development and Promotion of Bioenergy

This Law promotes the production of ethanol and other biofuels, as a means to encourage participation by the economy's agriculture sector, diversify energy supply and achieve sustainable development. The Law was approved with modifications by the Senate on April, 2005; and is currently waiting for review and approval by the Lower Chamber.

NOTABLE ENERGY DEVELOPMENTS

OIL AND GAS SECTOR DEVELOPMENTS

Mexico's challenges in the oil and natural gas sectors are not only focused on discovering more reserves and increasing hydrocarbon production volumes, but are also focused on improving the efficiency of exploration and production processes.

The Cantarell oil field, located in the Gulf of Campeche, is one of the largest oil fields in the world. In 2005, the Cantarell Complex's total production was 2.032 million B/D, representing 59 percent of Mexico's total crude oil production. Pemex estimated that production levels in the Cantarell complex for 2006 will be approximately 1.905 million B/D; this volume is 6 percent lower than that of the production level in 2005. For 2007 and 2008, estimated production is 1,683 and 1,430 MMbpd, respectively.

Pemex has stated on several occasions that projects such as the Ku-Maloob-Zaap, A.J.Bermúdez, Offshore Light Crude, Jujo-Tecominoacán, and others will make up for the Cantarell production decrease. In this context and taking into account Pemex's investment portfolio, crude oil production in 2006 is expected to surpass 3.400 million B/D and is related to investments of almost Ps.107 billion (US$9.4 billion).

Pemex plans to increase crude oil production to 4 million B/D by 2007. The company estimated that for the next five years the capital expenditure needed for exploration and production will be US$45.3 billion, and for refinery upgrades over the next ten years is US$16.1 billion. Over the next 15 years Pemex is expected to utilize US$29.8 billion for the development of 13,500 wells at Chicontepec which have an estimated 18 billion barrels of hydrocarbon reserves.

In 2005, natural gas production was 4818 million cubic feet daily (Mcfd); which was an increase of 5 percent compared with 2004 and reached record levels, reversing the decreasing trend of gas production evident since 1998.

Mexico began operating a Strategic Gas Program (SGP) in the middle of 2001. The objective of the SGP is to increase proved natural gas reserves and natural gas production. The SGP considers exploration and production activities, where exploration is focused on high potential regions for their subsequent development and production, and includes activities aimed at optimizing the development of existing natural gas fields.

The SGP includes projects in three regions. In the northern region, the SGP has advanced substantially with the development of the Cocuite field and with exploratory discoveries such as Papán, Playuela, Vistoso Apertura, Arquimia, Lizamba and Madera, which are part of the Veracruz Basin project. In the southern region, there have been important discoveries such as an additional block at the San Manuel project, and the Shishito, Saramako and Viche fields in the Macuspana Basin. In terms of development, through new investments, Pemex seeks to overhaul production at the Narváez and Cafeto fields. In the southeast marine region, the program includes the Crudo Ligero Marino and Ixtal- Manik projects. The former comprises the Sinán, May, Yum, Kab, Citam and Bolontiku fields. The later includes the Ixtal and Manik fields.

In 2005, the SGP reached production of approximately 1,113 Mcfd of natural gas and is currently consists of 18 projects: 3 integral projects (exploration and production); 12 exploratory projects; and 3 development projects. Over the long term, the SGP has engaged in the following activities: drilling and completion of 842 exploratory wells and 165 development wells; 154 well work-overs; acquisition of 1,600 km and 6,559 km^2 of 2D and 3D seismic information; and the construction of development infrastructure. In 2008, the SGP is expected to expand natural gas production to around 2,000 Mcfd; and in 2015, peak production of 2,800 Mcfd. Total investment during the period 2006 – 2019 is estimated to be approximately US$27 billion.

Pemex is using the Multiple Services Contracts (MSC) system to work around constitutional limitations and allow private parties to participate in exploration activities for oil and natural gas. In

these contracts, Pemex pays a set fee for services provided and retains ownership of the energy resources produced. By the end of 2004, 22 wells have been drilled under the five contracts assigned to execute the works and services in the Burgos basin using the MSC scheme. This encapsulated a US$71 million investment, and gas output reached 94 Mcfd. The contract for the Pandura-Anáhuac block was assigned in November 2004 to the Mexican firm Industrial Perforadora de Campeche (IPC). In 2005, the Monclova and Pirineo contracts were assigned for US$456 and US$645 million, respectively.

LNG FACILITIES

During the next 10 years, Mexico's natural gas demand is expected to grow at a rate of 6.2 percent per year while production is projected to increase from 4.6 billion cubic feet per day (Bcf/d) in 2004 to 7.7 Bcf/d in 2014 at an annual average growth rate of 5.2 percent. Therefore, by 2014 imports will account for 2.795 Bcfd of domestic natural gas demand in 2014 or 27 percent.

In order to increase Mexico's supply of natural gas, the *Programa Sectorial de Energía 2000-2006* considers the installation of storage and re-gasification LNG terminals in the Gulf of Mexico and Pacific Coasts as an alternative to complement national production and to diversify supply sources at competitive prices. Under this policy, as of August 2005, Mexico's Energy Regulatory Commission has awarded five LNG storage permits: including the Altamira Terminal located on the Gulf of Mexico coast with a capacity of 0.70 Bcf/d, the project is scheduled to be online by the end of 2006; the *Comisión Federal de Electricidad* (CFE) will purchase all of the natural gas from this project, which will be sourced from Nigeria and Trinidad and Tobago.

Three other terminals located on the Pacific coast at Baja California near the boarder with the US are also being implemented. Two of them were integrated in the project of the company "Energia Costa Azul" in Baja California with total capacity of 1.0 Bcf/d. The project is scheduled to begin operation in 2008 and envisages the supply the electricity in the industrial and residential sectors, as well as exports to Arizona in the US. The natural gas will be sourced from Indonesia and, possibly, Russia. Currently, the facility is under construction. One other facility on the Coronado Islands with a capacity of 0.70 Bcf/d is also under consideration. The project sponsor is Chevron Texaco de México and it is estimated that the facility will start operations around 2008; however, its construction has not started yet.

POWER SECTOR DEVELOPMENTS AND RURAL ELECTRIFICATION

Mexico's Energy Secretariat has been formulating plans to meet increasing energy demand in parallel with economic development. The Prospective Development of the Electricity Sector 2005-2014 was made in 2006. In this document, electricity demand is expected to grow rapidly over the next decade with an annual average growth rate of 5.2 percent. From 2005 to 2014, Mexico will need to add approximately 23,200 MW of generation capacity. The investment needed for the electricity sector for the period 2005-2014 is estimated by Mexico's Energy Secretariat to amount to US$54 billion, US$22 billion of which will be required for additional generation capacity and US$32 billion for additional transmission and distribution infrastructure. Appropriating these funds will be a challenge for the federal budget and so finding alternatives for financing is a necessity. In the next decade, the private sector will account for about 49 percent of total investment in the power sector.

Mexico has already achieved electrification coverage of almost 95 percent. However, there remains an estimated 5.96 million people without electricity living predominantly in rural areas of the southern States (Oaxaca, Chiapas, Guerrero, Veracruz) where the average electrification coverage is only 88 percent. To decrease the electrification gap, allow more efficient use of available public resources and to promote the use of renewable energy in distributed rural applications, the government has requested assistance from the World Bank to prepare and implement a rural electrification Project. This project is coordinated by the Energy Secretariat with the joint participation of the Commission for the Development of Indigenous People and the World Bank. The objective of programme is to provide 50,000 rural households (450,000 people)

isolated from the national electric grid, in the states of Chiapas, Guerrero, Oaxaca and Veracruz with electricity within the next 5 years. The investment in the project is estimated at about US$2,600 million, and is made up of funds from state and municipal resources, as well as a loan and a donation through the World Bank/ Global Environmental Fund (GEF).

RENEWABLE ENERGIES (RE)

Among Latin American nations, Mexico is one of the most promising areas for renewable energy development. There are some international organizations such as the GEF, the United Nations Development Program (UNDP) and the World Bank among others that support large-scale electricity production from renewable energy, specially wind power and research and development.

Wind energy development: Mexico has wind resource energy potential estimated at 30,000 MW located in the region of the Isthmus of Tehuantepec, State of Oaxaca. The Mexican Wind Energy Association (AMDEE) currently estimates the development of at least 3,000 MW in the period2006-2014. Currently, Mexico has a total installed capacity of 3.2 MW in two small wind farms. In 2005 CFE began the construction of La Venta II, the first large-scale wind power plant in Mexico (83 MW) located in the state of Oaxaca. This plant will start operations in October 2006. There is an intention to develop five in-grid, large scale renewable energy projects through a US$70 million donation form the GEF. La Venta III will be the first one of these projects, developed under an IPP scheme, and will have a capacity of 100 MW with an estimated investment of $US120 million. There is other four other projects considered under the same scheme, each of 100 MW that will be tendered from 2007 to 2010. Additionally, CRE has granted eight permits to install a total wind capacity of 1,076 MW for self supply purposes: 716 MW in the state of Oaxaca and 360 MW in the state of Baja California.

Mini-hydropower development: The Mexican company Comexhidro has developed mini-hydro-power projects for energy use at existing agricultural dams. The minihidroelectric Chilatán, a 14 MW plant located in the State of Michoacán, began operations in 2005. The most important project of the enterprise, "El Gallo", in the State of Guerrero, will have a 30 MW capacity, and has been under construction since 2004.

Biomass generation-self supply: The CRE awarded a permit for 40 MW of additional capacity. In addition, two paper mills have a permit from CRE to co generate steam and electricity with biomass, one with bagasse (10MW) and the second incinerating black liquor (10 MW). Three more permits are in operation based on biogas from landfills (18.2 MW) and a fourth one using biogas from industrial processes (1 MW). One more project is under development, and has been authorized to generate power using biogas produced by anaerobic fermentation of cow manure (10.6 MW).

Thermosolar generation-public service: CFE plans to bid this year (2006) for the installation of a new hybrid power plant (combined cycle + thermo-solar) under the financed public work scheme. The plant will be located in Agua Prieta, Son, with 240 MW of thermal capacity, and 30 MW of thermo-solar capacity. The project will receive a grant of US$50 million from the GEF.

ENERGY EFFICIENCY

Mexico placed a lot of emphasis on supply side management until the early 1990s, and few or no public sector entities devoted much attention to coordinating energy savings and efficiency. This trend was recognised by the government, and in 1989 the National Commission for Energy Saving, the Comisión Nacional para el Ahorro de Energía (CONAE), was founded to implement energy saving and efficiency measures. CONAE is a decentralised administrative body of the Energy Ministry that serves as a technical consultant for public federal administration entities, such as state and municipal governments, for issues of energy efficiency and renewable energies.

In the year 1990, additionally the Fideicomiso para el Ahorro de Energía Electrica (FIDE), the Trust for Electric Energy Saving was founded with the goal to promote cogent electric energy use and energy saving. FIDE has been promoting the efficient use of electricity in the municipal,

commercial, and industrial sectors for the past decade. Among its activities, FIDE provides financing for energy audits and assessments, financial incentives for the buying of energy efficient equipment, financing of energy efficiency measures in energy intensive companies, capacity building through courses and workshops, information distribution, FIDE seals for energy efficient appliances, educational materials, and the sale of energy efficient lamps. To date, FIDE has supplied financial assistance to over 3,000 energy saving projects and in the past 15 years FIDE's domestic lighting programme has distributed over 9 million energy-efficient lamps. FIDE also has been instrumental in the replacement of over half a million inefficient refrigerators and 100,000 air conditioners, as well as an insulation project that has helped to achieve energy efficiency improvements in nearly 20,000 homes in just 3 years. The application of the present electric energy saving programmes culminated in an estimated 15.5 billion kWh in savings in 2004, equivalent to 10 percent of the total sales of electricity for that year. A significant portion of these savings are attributable to energy standards in existence since the 1990s: 12,491 GWh of savings in generation equivalent to around 2,220 MW in capacity have been avoided through the consumption of different types of energy sources, which is also equivalent to 3.45 million BOE An additional measure, the summer schedule (between 1996 and 2003), resulted in energy savings of 8,545 GWh, and a decrease of 919 MW in the maximum electricity demand, which promoted the investment of more than Ps9 billion over the same period.

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NEW ZEALAND

INTRODUCTION

New Zealand is a small island nation in the southern Pacific with a population of approximately 4.1 million in 2004. GDP has grown by an average of around 3.3 percent per annum (1990-2004), reaching about US$89.01 billion in 2004 (2000 $US at PPP).

New Zealand is currently self-sufficient in all energy forms apart from oil and has modest energy resources including 49.8 MCM of oil, 24.6 BCM of natural gas, and 8,600 Mt of coal. As of 2004, hydro, geothermal and wind resources currently meet around 64 percent of electricity demand.

Table 23 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	268,680	Oil (MCM)**	49.8
Population (million)	4.06	Gas (BCM)	24.6
GDP Billion US$ (2000 US$ at PPP)	89.01	Coal (Mt) - Recoverable	8,600
GDP per capita (2000 US$ at PPP)	21,917		

Source: Energy Data and Modelling Center, IEEJ.

* Ministry of Economic Development reserve estimates as at 31 December 2004 from the New Zealand Energy Data File, January 2006. If reserves from fields due to come into production soon are included, oil reserves amount to 184.7 MCM and gas reserves amount to 51.9 BCM.

** Oil reserves include oil, condensate, naphtha and LPG.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

New Zealand's total primary energy supply in 2004 was 18,306 ktoe. A variety of energy sources are used to meet these needs comprising of oil (35 percent), gas (21 percent), hydro (13 percent), coal (12 percent), geothermal (11 percent), and others (8 percent). Self-sufficiency in 2003 was 75 percent.

New Zealand was over 50 percent self-sufficient in oil in 1986. By 1995, with demand having increased faster than production, this figure declined to 36 percent. By 2004, self-sufficiency had continued to decline to 18 percent and remained 18 percent in the 2005 year ending September. This decrease is mainly due to declining production from the Tariki/Ahuroa, Waihapa/Ngaere, Maui including condensate and naphtha, Maui F Sands, Mangahewa, McKee and Kaimiro fields.

With the exclusion of international transportation, domestic transport is the main consumer of petroleum products, accounting for 85 percent of the total oil consumption in 2004. Consumption in the other sectors was shared between agriculture (5 percent), industrial (6 percent), commercial (3 percent) and residential (1 percent).

In terms of power generation, in 2004 New Zealand generated 41,554 GWh, which was up 4 percent over the previous year. Around 75 percent of generation was from hydro and renewable resources. Hydro at 65 percent was the most important source of generation. Thermal generation showed a modest decrease of 17 percent to 10,493 GWh compared with the previous year increasing; however, as natural gas was replaced by coal, electricity generation from coal showed a 25 percent increase compared with the previous year. 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 generated by natural gas, coal, wind, and landfill gas. The largest electricity consumer is industry (with an aluminium smelter, iron and steel works, pulp and paper mills/timber mills and large dairy factories/agriculture being the main consumers), which accounted for 40 percent of electricity consumption in 2004. The residential sector consumed around 34 percent with the commercial sector consuming the balance of 26 percent.

Table 24 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	13,640	Industry Sector	5,230	Total	41,554
Net Imports & Other	5,272	Transport Sector	5,817	Thermal	10,493
Total PES	18,306	Other Sectors	2,898	Hydro	26,932
Coal	1,887	Total FEC	13,946	Nuclear	0
Oil	7,034	Coal	912	Others	4,129
Gas	3,453	Oil*	6,934		
Others	5,933	Gas*	2,002		
		Electricity & Others	4,098		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

* This figure includes non-energy use

FINAL ENERGY CONSUMPTION

New Zealand's final energy consumption jumped by 5.1 percent in 2004 to 13,946 ktoe compared with the previous year. The industrial sector consumed 37 percent of energy used, the transportation sector 42 percent and other sectors 21 percent. In 2004 final energy consumption was dominated by oil, comprising 6,934 ktoe (50 percent), followed by gas 2,002 ktoe (14 percent), coal 912 ktoe (7 percent) and 4,098 ktoe (29 percent) for electricity and others (heat etc).

Domestic transportation is the largest end user of energy accounting for 42 percent of final consumption with the bulk of petroleum products used in New Zealand consumed by this sector (85 percent). The next largest energy consumer is the industrial sector on 37 percent followed by others, which comprises the residential/commercial, non-energy, and agricultural sectors' and consuming the remaining 21 percent.

POLICY OVERVIEW

New Zealand's energy sector has experienced a period of significant change and reform over the past 10-15 years, in particular, quite dramatic change in the structure of the electricity industry. Former government-owned/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 has been established.

Recently it has become apparent that New Zealand faces some challenge to ensure security of supply in gas and electricity sectors at the best price. These include the depletion of the Maui gas field, low storage capacity of hydro lakes and vulnerability to low rainfall/dry year in addition to growth in demand for electricity. To meet these and other related energy challenges, the Prime Minister announced plans to develop a formal, comprehensive New Zealand Energy Strategy (NZES) in November 2005. This strategy is being prepared under the auspices of the Ministry of

Economic Development (MED), a draft report was released for consultation in December 2006 and a final report is due in mid 2007.

OIL

Deregulation of the oil industry in the late 1980s removed price control, government involvement in the refinery, licensing of wholesalers and retailers and restriction on imports of refined products. In the financial year ending March 2006, there were 14 fields producing crude oil in New Zealand – all located onshore and offshore of the Taranaki region. With the inclusion of natural gas liquids the Maui oil field was the largest producer making up 68 percent of total production in the year ended 2005. This was followed by the Kapuni field on 9 percent and the McKee field on 7 percent, with the remaining 16 percent being produced at the remaining 11 fields. New Zealand has one oil refinery, at Marsden Point in Northland, which is jointly owned by the four major oil companies (BP, Shell, Mobil and Caltex) through the New Zealand Refining Company. There are six petrol retailers: BP, Caltex, Challenge! (now owned by Caltex), Gull (owns its import terminal at the port of Tauranga), Mobil and Shell.

New Zealand's primary self-sufficiency in oil depends on both indigenous oil production and petroleum product demand. Over the period from 1974 to 1986 self-sufficiency increased dramatically from under 5 percent to over 50 percent. However, by 1995 with demand having increased faster than production, this figure declined to 36 percent. As a result of maturation and associated production decline within the most prominent oil fields this decreasing trend has continued, with self-sufficiency reaching 18 percent in the year ending March 2006. To circumvent falling self-sufficiency and to promote New Zealand's exploration potential, in October 2005, seven petroleum blocks were announced by the government bringing the total number of blocks on offer to 19 – a record number in New Zealand at any one time. Further, to encourage domestic exploration for petroleum and particularly gas resources the New Zealand government has released a package of incentives through the Minerals Programme for Petroleum 2005. The major features of the programme include: 1) reduced royalties payment on new exploration discoveries made between 1 July 2004 and 31 December 2009; 2) the introduction of a definition of "discovery" for the purposes of royalty eligibility; 3) exclusion of the Titi Islands from exploration and mining for the reasons of cultural significance; and 4) simplification of the procedure to process for flaring and venting. As a result of these measures, in November and December 2005 two offshore petroleum mining permits were issued by Crown Minerals for the Tui and Maari oil fields.

The Ministry of Economic Development is also leading work with New Zealand's major oil companies to investigate how best to increase the economy's stockpiling of crude oil and oil products – chiefly gasoline and diesel. The project follows a review and recalculation of industry data on oil stock to meet International Energy Agency's obligation to maintain 90-days of stocks of oil products as a buffer against disruptions to global oil supplies. Subject to a successful tender round and finalization of government-to-government arrangements, New Zealand expects to achieve the IEA target by the end of 2006.

NATURAL GAS

The gas sector has a critical role to play in achieving the government's objective of sustainable and efficient energy future and higher economic growth rates. Gas is also a critical component of electricity production, contributing approximately 25 percent towards total electricity generation. However, New Zealand's proven gas reserves have steadily declined since the Maui field commenced production in 1976. Subsequent discoveries have failed to off-set this decline and significant new discoveries are needed to meet projected electricity demands.

The Government initiated a wide-ranging review of the gas sector in February 2001. A draft Government Policy Statement was released in November 2002 and after a period of consultation and comment, the final Statement "Development of New Zealand's Gas Industry" was released in March 2003. The package of changes contained in the Statement is designed to enhance efficiency and reliability in gas production and transportation, and improve fairness for gas customers.

Exploration for new gas reserves will be encouraged through the Minerals Programme for Petroleum that was announced in January 2005 (see oil section above).

ELECTRICITY

In May 2003 the Government announced the establishment of the Electricity Commission to govern the electricity industry due to concern that existing market arrangements did not ensure security of supply in dry years/years of low rainfall. The Commission is responsible for managing the electricity sector so that electricity demand can be met even in a 1 in 60 dry year[52]. The key tasks of the Commission include securing New Zealand's electricity supply with adequate reserve generation for dry years, establishing a transmission pricing methodology for investment in the natural grid and improving demand-side participation in the wholesale market.

On the retail market side electricity sold by generators and purchased by retailers and large industrial users is subject to the Electricity Governance Regulations and Rules 2003 that came into force on 1 March 2004. This replaced two multi-lateral industry contracts related to the operation of the New Zealand Electricity Market (NZEM) and the Metering and Reconciliation Information Agreement (MARIA).

To establish a new legal framework for the electricity and gas industries, the Bill on Electricity and Gas Industry was passed in October 2004. The Bill's main focus is on improving regulation to enhance consumer protection and ensure security of electricity supply. However, the Bill also allows for the establishment of a co-regulatory governance body for the gas industry and backstop powers for the establishment of an Energy Commission. Other changes include enabling electricity lines companies to own generation equivalent to the higher of 50MW or 20 percent of their network load, allowing Transpower to contract for generation to manage grid reliability and delaying the transfer of jurisdiction for the lines targeted price control regime from the Commerce Commission to the Electricity Commission until after 31 March 2009.

RENEWABLE ENERGY AND ENERGY EFFICIENCY

Renewable energy sources are already making a significant contribution to New Zealand's total energy, with hydroelectricity and geothermal being the main renewable energy sources in New Zealand. However, in recent years the introduction of wind power has gained momentum.

In order to establish sustainable development and values, the Sustainable Development Programme of Action (SDPOA) was released in January 2003. The SDPOA calls on government agencies to take a wider, more integrated approach to policy development with the three desired outcomes for the SDPOA being: 1) energy use in New Zealand becomes more efficient and less wasteful; 2) renewable sources of energy are developed and maximised; and 3) New Zealand consumers have a secure supply of electricity. A discussion document "Sustainable Energy – Creating a Sustainable Energy System" was released in October 2004 (by the Ministry of Economic Development) which identifies the energy challenges and opportunities facing New Zealand, explains Government's strategic direction in energy policy and outlines possible future directions for policy development.

In terms of energy efficiency, in 2001 the Government developed the National Energy Efficiency and Conservation Strategy (NEECS) through the joint cooperation of the Ministry for the Environment and Energy Efficiency and Conservation Authority (EECA). The two main targets of the NEECS were the a 20 percent improvement in energy efficiency by 2012; and increasing New Zealand's renewable energy supply to provide a further 8,300 GWh by 2012. However, given the close-fitting relationship of NEECS in the context of development of the NZES and climate change policy, the government is through the EECA working in close cooperation with other government departments and agencies to lead the preparation of a new

[52] The 1 in 60 year chance of low inflows of water to the southern hydro lake system.

NEECS framework. The framework sets the purpose, rationale, and expectations of the new strategy and will be developed in parallel with the NZES with both sharing common goals. In effect, the NEECS will be an integrated subset of the NZES.

NOTABLE ENERGY DEVELOPMENTS

NEW ZEALAND ENERGY STRATEGY

The terms of reference of the New Zealand Energy Strategy were released in July 2006 and a full draft was released in December for public consultation. , The principal challenge is to strike an appropriate balance between flexibility around the various options and the direction needed to provide a reasonable level of certainty that objectives will be met. To do this the strategy focuses on some key questions to identify the strategic directions and priorities in the face of uncertain future events and developments. The strategy considers issues across a range of future energy scenarios to establish long-term policy goals and guiding principles for decisions about the various energy options. Its six high-level objectives are:

1. Providing clear direction on the future of New Zealand's energy system.
2. Maintaining high levels of security of energy supply, and reliability at competitive prices.
3. Maximising how efficiently we use our energy to safeguard affordability, economic productivity and our environment.
4. Maximising the proportion of energy that comes from our abundant renewable energy resources.
5. Reducing our greenhouse gas emissions.
6. Promoting environmentally sustainable technologies.

NATIONAL ENERGY OUTLOOK TO 2030

The pre-publication edition of "New Zealand's Energy Outlook to 2030" was released in August 2006. Under the base case "business as usual", by 2030 New Zealand's energy demand is expected to be 30 percent higher than the base year 2005. The main point of divergence between this outlook compared with past versions is that eleven sensitivity cases are included that inform and show the potential range of "energy futures" possible in New Zealand as a result of changing business environments or international circumstances. While the sensitivity analysis is not an indication of current or future government policy, a broad indication of the key trade-offs between different policy options can be observed[53].

ELECTRICITY

There have been a number of Government initiatives enacted in 2006 in relation to regulation of the New Zealand electricity industry:

- A revised Government Policy Statement (GPS) on electricity has been released, stressing the importance of security of supply and emphasising that the role of the Electricity Commission in relation to Transpower, (the national transmission grid company), is to approve or decline its upgrading plans, not to actively direct hose plans. These GPS's provide statutory directions to the Electricity Commission.
- A statement on the Governments policy on electricity transmission and distribution has been issued under Section 26 of the Commerce Act, again emphasising the Governments

[53] Further information available at http://www.med.govt.nz/templates/StandardSummary____10186.aspx

view that security of electricity supply is a primary concern. These statements must be taken into account by the Commerce Commission (the other electricity regulator), but unlike Policy Statements issued to the Electricity Commission, take the form of information documents rather than directives.

- The Commerce Commission has announced its intention to declare control (that is to take on a directive role in pricing decisions) of Vector – New Zealand's largest electricity distributor. This announcement follows on from similar announcements applying to Transpower and to another large distributor, Unison.
- The government has also announced that it will include the section of the Commerce Act (the Commerce Commissions governing legislation) relating to the regulation of electricity transmission and distribution within a wider review aimed at reducing compliance costs and streamlining regulatory processes.

OIL EMERGENCY RESPONSE STRATEGY

The Ministry of Economic Development developed an oil emergency response strategy which details the policy and operational aspects of managing an emergency disruption of oil supplies. The overall objective of the strategy is to ensure that the effects of an oil supply disruption are minimised and to ensure that New Zealand is able to effectively meet its obligations as a member of the International Energy Agency (IEA). The result was a report that identified the demand restraint options that New Zealand could employ during an emergency disruption of oil supplies. The report also determined the implementation issues, costs, and benefits of each available demand restraint option.

As a result of this report a discussion paper was released by the Energy Minister in September 2006, which outlines the proposed approach that will be taken by the government in allocating roles and responsibilities in the event of an emergency disruption. In addition this paper delineates measures that could be taken in response, and provides some guidance on how these measures could be implemented. It should be noted that these measure would only be implemented in response to an emergency oil supply disruption and would depend on the scale of the disruption.

CLIMATE CHANGE DEVELOPMENTS

The carbon tax on greenhouse emissions from fossil fuels to be introduced from 1st April 2007 was abolished by the government in December 2005. At this time it was also announced that no other broad-based economic instrument would be introduced in New Zealand before the end of the first Kyoto Commitment Period in 2012. As a result of this policy change efforts that had been undertaken to streamline the Negotiated Greenhouse Agreements[54] (NGA's) and Projects to Reduce Emissions (PRE) programme are under review.

An initial set of draft policy options was completed in April 2006, through which alternative measures to the abolished carbon tax were outlined. These draft options, included consideration of emissions trading and new arrangements – possibly voluntary – to replace the above mentioned NGA'S. In late 2006 New Zealand released for public consultation a number of documents on various aspects of climate policy. These documents cover energy policy (the draft New Zealand Energy Strategy, discussion paper on transitional measures for the stationary energy sector, and the draft Energy Efficiency and Conservation Strategy), and land use policy (discussion paper on

[54] Negotiated Greenhouse Agreements (NGAs) are for sectors and industries that would face difficulty in adjusting to a full price on emissions in the first commitment period. These sectors and industries are identified as having their competitiveness at risk. Negotiated Greenhouse Agreements comprise a contractual commitment by the industry or sector to achieve international best practice in managing emissions, in return for exemption from an emissions charge.

sustainable land management and climate change) as well as options for greenhouse gas pricing and policy measures post 2012.

As a backstop while the policy review process is underway, and to show that New Zealand remains serious about meeting its obligations under the Kyoto Protocol, the Government has listed a liability of NZ$347 million for 2007/2008 financial year in its financial statements to account for the potential purchase of emissions credits during the first commitment period (in the event that any shortfall in New Zealand's Kyoto target is met through purchasing rather than policy measures).

In addition, in October 2006 the government announced a number of initiatives that will be undertaken to help New Zealand respond/adapt to climate change.

- An adaptation programme to prepare for the impacts of climate change, especially in coastal areas and the agricultural sector.
- Measures to improve the energy efficiency of buildings – a report in October 2006 showed that New Zealand is lagging behind other developed countries in improving household energy efficiency and that a mixture of market mechanisms, incentives and regulations supported by widespread information were needed for improvement.[55]
- Consultation on a minimum biofuels sales obligation – a New Zealand government discussion document on a proposed Biofuels Sales Obligation (BSO) was released in September 2006. The proposal would require oil companies to include a minimum percentage of biofuels in transportation fuels sold, beginning with 0.25 percent of sales in 2008, and rising to 2.25 percent by 2012.[56]
- A commitment to increase the uptake of solar water heating.
- Options to create links with the Asia Pacific Partnership for Clean Development and Climate.
- Launch of the Permanent Forest Sinks Initiative – as a result of a re-evaluation of climate change policies in 2005 this initiative was revisited and officially launched by the government in August 2006 as a means through which land owners could obtain economic benefit from marginal land through the capture and sequestration of carbon dioxide.

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[55] Taylor Baines and Associates (2006).

[56] The Minister of Energy envisages that biofuels can move New Zealand towards a more sustainable future and make a significant contribution to meeting New Zealand's climate change/Kyoto commitments. Public submissions on the BSO close on the 20th of October 2006.

PAPUA NEW GUINEA

INTRODUCTION

Papua New Guinea (PNG), 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 five million people, spread across its total area of 462,840 square kilometres.

The PNG economy is slowly recovering from the current global economic slowdown. Current per capita GDP (US$2,146) is 5.6 percent higher than previous year at US$2,033. In 2004, real GDP at 2000 US$ at PPP was estimated at US$12.39 billion, which increased by 10.7 percent compared to the previous year which was at US$11.19.

PNG's energy use per capita at 0.2 toe is far below the APEC average of 1.5 toe. Export of energy resources is a very important foreign exchange earner and contributes greatly to national revenue. In 2003, the energy industry accounted for approximately 14 percent of the economy's GDP and about 20 percent of total exports. It has also employed more than 1,000 Papua New Guineans in both upstream and downstream operations.

Table 25 - Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	462,840	Oil (MCM) - Proven	63.6
Population (million)	5.77	Gas (BCM)	430
GDP Billion US$ (2000 US$ at PPP)	12.39	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	2,146		

Source: Energy Data and Modelling Centre, IEEJ, WDI 2005 and BP 2005 Statistical Review of World Energy.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2004, PNG's net primary energy supply was 1,477 ktoe, a decrease of 4.9 percent compared with 2003. Light crude oil and petroleum products accounted for 88 percent, gas 7 percent while hydro and other fuels, the remaining 5 percent. Around 50 percent or 1,320 ktoe of indigenous energy production is exported to other economies. To sustain the economy's export goals, the national government allots about US$20 million of its annual budget for oil and gas exploration.

PNG's small oil field has been producing 100,000 bbl/day of light crude since 1992, mainly for export. However, with the commissioning of its first Napanapa Oil Refinery in 2004, crude is now refined locally. Sixty five percent of the refinery's output is consumed locally while the remaining 35 percent is exported overseas

PNG also has a natural gas field with estimated reserves of 430 BCM. Since 2001, small amounts of gas (144 ktoe) have been produced annually to supply the electricity requirements of the Porgera gold mine. PNG however plans to sell this gas to Australia and negotiations are underway to supply 212 petajoules per year as base load.

The project participants, Exxon Mobil, Oil Search, MRDC and Japan Papua New Guinea Petroleum, have started the project front end engineering design in 2004 and are anticipating a decision and closure of finance related issues by late 2006.

To deliver gas to Australia, the PNG Gas Project owners signed a Letter of Intent (LOI) with APC (a consortium led by AGL and Petronas). Under the LOI, APC will be responsible for designing, owning and operating the pipeline that brings the gas to Australia. Total investment for the project is estimated at US$2 billion.[57]

Table 26 - Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	2,111	Industry Sector	637	Total	3,364
Net Imports & Other	-629	Transport Sector	377	Thermal	2,496
Total PES	1,477	Other Sectors	110	Hydro	868
Coal	-	Total FEC	1,124	Nuclear	-
Oil	1,294	Coal	-	Others	-
Gas	107	Oil	835		
Others	77	Gas	-		
		Electricity & Others	289		

Source: Energy Data and Modelling Center, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/egeda/database/database-top.html

As of 2003, PNG's total installed power generating capacity stood at 487.3 MW. In the same year, PNG had generated 3,364 GWh of electricity (a 6 percent increase from 2003). The sources of generation were hydro at 32 percent, geothermal at 1 percent and thermal (gas and fuel oil) at 67 percent (an increase of 10 percent to meet demand as the share of hydro has remained steady over the last 3 years). There is little economic potential for the expansion of large hydro, due to the lack of substantive demand near supply sources. However, there is a greater potential for developing smaller hydro schemes. Most thermal and hydro power stations are owned and operated by PNG Power Limited (formerly the PNG Electricity Commission).

FINAL ENERGY CONSUMPTION

In 2004, the total final energy consumption in PNG was 1,124 ktoe (an increase of 2.6 percent from 2003). The industrial sector, accounted for 57 percent (an increase of 6 percent over 2003) and was the largest end user, followed by transport (34 percent), and other sectors including agriculture and residential/commercial (10 percent). Petroleum products accounted for 74 percent of total consumption (a. decrease of 0.5 percent over 2003), electricity and others accounted for 26 percent and natural gas accounted for less than 1 percent.

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 as well as for the generation of electricity. PNG Power Limited is continuously extending rural distribution network throughout the economy especially within the outskirts of urban areas.

POLICY OVERVIEW

In PNG, the national government has jurisdiction over energy matters including overall energy policy matters. Exploration and development of petroleum resources are authorized and

[57] The Government has set aside US$133 million in its 2006 National Budget (as government equity) for the development of the gas pipeline to Australia.

administered by the Department of Petroleum and Energy. The Petroleum Act of 1972 and the Oil and Gas Act of 1998 mandated the Department of Petroleum and Energy authority over the licensing and development of petroleum resources.

The provincial governments work with the PNG Power Limited, 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 small hydro and other renewable energy resources.

The PNG National Energy Policy and Rural Electrification Policy have been reviewed by the PNG Government Task Force on Policy and the documents are undergoing refinement for distribution to the government agencies for comments. Upon accommodating all the comments, these documents will be submitted to the government for endorsement before the first half of 2006.

In the Electricity Industry Act of 2000, Sections 21 and 23 spell out the functions and powers of the PNG Power Limited. According to this Act, PNG Power Limited's function is to plan and coordinate the supply of electricity throughout the country especially in urban areas.

The Act also authorized the Independent Consumers and Competition Commission (ICCC) as the technical regulator of the electricity sector to determine the standards, inspection and controlling of applications on all matters relating to the operations of the supply of electricity.

The Independent Consumer and Competition Commission was established in 2002 to oversee and regulate price and service standard issues relating to utilities such as PNG Power Limited and selected corporatized Government statutory entities and therefore, is responsible for setting prices or tariffs for electricity and petroleum products.

However, due to a lack of technical capacity to perform a technical regulatory role in the electricity sector, ICCC has outsourced this role to PNG Power Limited on a contractual basis for an initial period of 2 years ending 2005, which was extended for another 3 year period ending 2008.

NOTABLE ENERGY DEVELOPMENTS

RENEWABLE ENERGY DEVELOPMENT

In 2005, a 30 MW geothermal power plant was commissioned by Lihir Gold Limited in addition to the first 6 MW geothermal power plant that was constructed in April 2003. Lihir Gold Limited is the first in PNG to use geothermal energy for electricity generation and the expansion of additional capacity of 30MW is in line with the government's goal of promoting green energy and reducing dependency on fuel oil for electricity generation.

PNG Sustainable Energy Limited has secured US$673 million to enhance electricity under the electrification programme in the country.

OIL AND NATURAL GAS EXPLORATION AND DEVELOPMENT

Transeuro Energy Corporation from Canada has established an office in PNG and has been granted prospecting licenses over four identified prospecting areas to explore gas and oil as of November 2005.

InterOil Products Limited (IPL) has acquired the retail and distribution assets from British Petroleum (BP) and an agreement was made between IPL and Shell PNG Limited for IPL to purchase Shell PNG Limited retail and distribution assets in PNG upon Government's approval.

The Highland Gas Project's Front End Engineering Design stage which started in 2004 is expected to be completed at the end of 2005. The project is also hoped to enter into the Project

Sanction Decision stage by early 2006 and gain a closure of finance also in the same year. PNG hopes to have its first gas production in 2009.

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PERU

INTRODUCTION

Peru is located on the Pacific Ocean coast of South America. It shares borders with Chile to the south, Ecuador and Colombia to the north, and Brazil and Bolivia to the east. Its 27.56 million people are spread over an area of 1,285,216 square kilometres, 73 percent of which live in urban areas. Geographically, about 53 percent of the population live in the coastal region, 37 percent in the mountainous region and 10 percent in the Amazonian region. Peru has three main regions and climates: the western desert coastal plains, the cold central Andean mountains, and the tropical eastern Amazon jungle. The huge metal deposits in the Andean mountains make Peru a major metal exporter and the world's second largest silver and third copper exporter (after Mexico and Chile). It is also among the top five exporting economies for gold, zinc, tin and lead.

Peru's GDP in 2004 was US$140.63 billion while GDP per capita was US$5,102 (both in 2000 US$ at PPP). In the same year, the real gross domestic product (GDP) grew at 4.8 percent, up from 3.8 percent in 2003. Overall real GDP growth is projected to remain favourable in 2005, at around 7.5 percent, with mineral exports, construction, and the long-expected Camisea energy project driving Peru's economy.

Peru is currently a net importer of energy. Of the total energy imported, more than 90 percent is crude oil used as refinery feedstock; domestic crude is not of adequate quality for such feedstocks. The remainder of Peru's energy imports consist of coal. Its energy proven reserves in 2004 included 174.46 MCM of oil, 325.45 BCM of gas and 64.63 Mt of coal.

Table 27 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	1,285,216*	Oil (MCM) – Proven*	174.46
Population (million)	27.56	Gas (BCM) – Proven*	325.45
GDP Billion US$ (2000 US$ at PPP)	140.63	Coal (Mt) - Proven*	64.63
GDP per capita (2000 US$ at PPP)	5,102		

Source: Energy Data and Modelling Center, IEEJ.

* 2004 data from Ministry of Energy and Mines, Peru.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Peru's total primary energy supply (TPES) in 2004 was 10,951 ktoe, nearly the same as in 2000, which was 10,653 ktoe. Oil still comprised the biggest share of TPES (69 percent). The share of natural gas in 2004 reached 8 percent. The giant leap is due to the coming on stream of the Camisea natural gas field in August 2004, supplying gas to the Ventanilla power plant. Furthermore, coal's share in 2004 increased by 19 percent from 773 ktoe in 2003 to 923 ktoe in 2004.

Peru imported about 3,795 ktoe or 35 percent of its energy requirements (mostly oil from Colombia, Ecuador, Venezuela and Nigeria) in 2004, close to previous years imports of 3,218 ktoe.

With a wealth of new important oil discoveries, production of crude oil increased by 3 percent from 2003 to 2004. In 2004, Peru increased the production slightly, to about 4,827 ktoe while consuming 6,565 ktoe.

Current production areas are located in the northern jungle along the Ecuador border, north eastern and central Peru and offshore. The total number of wells drilled by oil companies decreased significantly from around 30 wells in 2000 and 2001 to only 10 in 2002 but in 2004 the number of wells drilled increased to 34. The current administration has taken several measures to attract more investors; however, the economy's political situation remains unstable.

The Norperuano pipeline, with a capacity of 200,000 B/D runs from the Amazon to the Pacific Ocean and 30 percent of its total capacity is being utilized to meet domestic oil demand. In 2001, Ecuador utilised the line to export oil. Oil is currently shipped using river barges and transferred to Peru's existing pipelines. However, there are plans to build a connecting pipeline to the Norperuano pipeline.

Peru's annual gas production increased from 444 ktoe in 2003 to 828 ktoe in 2004 due to the start-up of the Camisea gas field. The share of natural gas in TPES was about 8 percent in 2004.

In August 2004, with start-up of production from the Camisea natural gas field the Ventanilla Power plant using natural gas was also started. Peru has the potential to produce much more gas than it does currently as domestic gas demand and gas export markets grow. Upstream operations recently began at the Camisea field, one of the largest in South America, which was first discovered in Peru's southern jungle in the early 1980s. The field is expected to produce 10 MCM/d of gas and 0.004 MCM/d of condensate once fully operational. The revenue from royalties and taxes over the next 30 years is expected to reach US$5-6 billion. . The two reservoirs in this area are estimated to contain 325 BCM of gas and over 114.7 BCM of condensate. The power generation and industrial sectors are expected to be major gas consumers.

Table 28 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	7,132	Industry Sector	2,990	Total	22,517
Net Imports & Other	3,795	Transport Sector	3,772	Thermal	6,246
Total PES	10,951	Other Sectors	2,242	Hydro	17,777
Coal	923	Total FEC	9,004	Nuclear	0
Oil	7,535	Coal	530	Others	493
Gas	828	Oil	6,565		
Others	1,666	Gas	55		
		Electricity & Others	1,854		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

The installed electricity generation capacity in Peru increased from 5,970 MW in December 2002, to 6,016 MW in December 2004; 76 percent of the population had access to electricity in 2004. Hydropower with a 51 percent and thermal with a 49 percent share almost equally account for all of the electric generating capacity. However in 2004, hydropower produced 72 percent of the electricity and thermal plants produced the remaining 28 percent. Thermal power is generated from residual fuel oil, diesel, natural gas and coal.

Peru has a north central interconnected system (SICN) and southern (SIS) grids to form the National Interconnected Electrical System (SEIN). In 2004, of the 24,267 GWh of electricity generated in the economy, 93 percent was delivered through the SEIN and the remaining 7 percent was delivered through several smaller isolated systems (SSAA).

Of all electricity traded in 2004, 53 percent was traded in the regulated market and 47 percent through free trade. With the privatisation of Peru's transmission electricity sector in June 2002, the government awarded Red de Energía del Perú (REP), a consortium comprising of the Colombian companies Empresa de Energía de Bogotá (EBB), Isaperu, and ISA subsidiary Transelca, a 30-year concession to own and operate Peru's two main transmission companies, Empresa de Transmision

Centro Norte (Etecen) and Empresa de Transmision del Sur (Etesur). EBB is the largest shareholder of REP, with a 40 percent stake. Isaperu and Transelca each hold 30 percent. In order to regulate the operation of the market, the Peruvian government created Osinerg (Organismo Supervisor de la Inversion en Energía), which is currently Peru's energy regulator.

FINAL ENERGY CONSUMPTION

Between 1980 and 2004, final energy consumption in Peru increased by 44 percent while energy production fell by 36 percent. In 2004, final energy consumption in Peru amounted to 9,004 ktoe, of which, the transport sector consumed 42 percent, industry sector 33 percent and other sectors 25 percent. Petroleum products dominated end use consumption, accounting for 73 percent of demand in 2004, an increase of 6.4 percent from the share in 2003. The share of electricity from final energy consumption was 21 percent. Coal accounted for 6 percent while gas was less than 1 percent.

POLICY OVERVIEW

In 2002 Peru amended the constitution and began to decentralise the structure of the government. The amendment mandated the creation of three levels of government (National, regional and local), with political and economic autonomy. Regional elections were held in November 2002 and the new administration took office in January 2003. The decentralisation of government structure will be followed by a decentralised neutral fiscal system.

In order to improve tax neutrality and increase the tax base in 2002, Peru also reformed the tax policy and tax administration measures. Reform includes the removal of some VAT exemptions, an increase in kerosene tax by 80 percent to partially reduce the differential with the tax on diesel, intensifying the control of tax collection and improve the administration.

Peru's economy is becoming more market-oriented. Virtually all trade, investment and foreign exchange controls were eliminated in 1990. The mining, electricity, hydrocarbons and telecommunication industries have all been partially privatised. In particular, the state oil company, Petroperu, was partially privatised in 1993. In the same year, State Company of Perupetro was created by law to be responsible for promoting the investment of hydrocarbon exploration and exploitation activities. 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 Electricity Concessions Law, passed in 1992, allows private firms to invest in power generation, transmission and distribution. The state utility ElectroLima and the bulk of state utility ElectroPerú were privatised soon after the law was implemented. Another law, passed in 1997, promotes competition in the electricity sector by prohibiting control of more than 15 percent of electricity generation, transmission or distribution by any one firm. The government can block acquisitions to ensure that private companies do not gain excessive market power. The private sector, including foreign companies, today controls about 65 percent of generating capacity and 72 percent of the distribution system. The government retains ownership of key hydroelectric plants.

Currently there exists a free electricity market, but the government has proposed changes to correct or eliminate barriers that they think do not allow the efficient running of the market such as:

- transmission system is not developed enough.
- it is necessary to create a spot market.
- introduction of an independent operator for the electricity system.

In July 2006 the Government approved the Law intends to perfect the rules established in the Law of Electrical Concessions with the purpose of:

a) To assure that there is sufficient efficient generation that reduces the exposure of the Peruvian electrical system to the volatility of prices and the risks of rationing brought on by a lack of energy; assuring the final consumer a more competitive electrical tariff;

b) Reduce the administrative intervention for the determination of the prices of generation by means of market solutions;

c) Take the measures necessary to create effective competition in the generation market; and,

d) Introduce of mechanisms of compensation between the SEIN and the Isolated Systems so that the prices in the bar incorporate the benefits of the natural gas and reduce their exposure to the volatility of the fuel market. It is of public interest and the responsibility of the State to ensure the opportune and efficient supply of electricity for the Public Service of Electricity.

In this context the introduction of biddings and incentives for the optimal supply of electrical energy, the establishment of a spot market, modification of the functions under the Comite de Operacion Economica del Sistema (COES) with the purpose of forming an independent operator for the electricity system, adjustment of the legal framework of the formation of transmission prices.

The government is promoting the utilisation of natural gas use and replacement of oil in the energy mix with the target of reducing oil import dependency. Increasing energy imports, combined with depleting domestic resources, have raised concerns over energy supply security. The new fuel mix that will include natural gas as an integral element is being undertaken in accordance with the plan called the "Plan Nacional de Transformación de la Matriz Energética".

In recent years for economic, social or environmental reasons, there has been increasing activity and interest in the production and consumption of biofuels worldwide. In the coastal and forest regions of Peru, suitable areas exist, in terms of quality of the soil and climatic conditions, for the development of crops that provide the volumes of adequate raw material to produce both anhydrous ethanol and biodiesel, the two principal biofuels. Pursuant to the policy of the promotion of biofuels production in Peru, legislation concerning the introduction of biofuels has been passed: *Ley 28054 de Promoción del Mercado de Biocombustibles* and the relevant regulations *Decreto Supremo Nº 013-200.* The goal of this policy and legislation is:

- • To promote investment in the production and commercialization of biofuels,
- • To disseminate the environmental, social, and economic advantages of biofuel use that can be attained through the protection of public health, the environment and the creation of new jobs
- • To contribute to the National Strategy in the fight against drugs by means of the cultivation of alternative crops in the coca zones of the country.

In September 2000, the Law of Promotion of Efficient Use of Energy was promulgated. Through this Law the Government declared of national interest the promotion of Efficient Use of Energy (UEE) with the objective to assure the provision energy, to protect the consumer, to foment the competitiveness of the national economy and to reduce negative environmental impacts through the use and consumption of the electricity. Through this Law the Ministry of Energy and Mines is the body designated to undertake authority for the execution of this policy by the following attributes:

a) To promote the creation of a culture oriented to the rational use of the electricity resources to allow the sustainable development of the economy and trying to achieve a balance between conservation of the environment and economic development;

b) To promote greater transparency of energy markets, by means of a permanent diagnosis of problems surrounding electricity efficiency and the formulation and the execution of programmes disclosing; the compatible processes, technologies and informative systems ;

c) To design, support, coordinate and execute programmes and projects of international cooperation for the development of the UEE;

d) The elaboration and execution of plans and referential programmes of power efficiency; and to promote the setting up the companies of special services (EMSES), as well as the technical attendance to public and private institutions, and the agreement with enterprise organizations of consumers and producers;

e) To coordinate with other sectors and public and private organizations to promote the development of policies for the efficient use of the energy; and promote the efficient consumption of electricity in isolated and remote regions.

In terms of privatization in July 2006, the new government assumed the post and in their policy guideline the privatizations finished. It explained that the Garcia's administration will look for to impel a concession scheme and to promote depending on the case an alliance of private and governmental capital. They will apply a franchise mechanism with direct private investment or through a strategic alliance between the public and private sectors.

With the target of improving efficiency in the electricity sector the government, through legislation covering the promotion of cogeneration passed D.S. N° 037-2006-EM. This policy gives priority in the dispatch system to cogeneration power plants; meanwhile these power plants produce heat and electricity simultaneously.

Peru is a member of the Andean Community, set up in March 1996 by leaders of Bolivia, Colombia, Ecuador, Peru, and Venezuela (In 2006 Venezuela withdrew and Chile was incorporated as an Associated Country at the Andean Community). Currently, the Community is working towards integrating the energy sectors, particularly the electricity and natural gas markets, through physical networks and harmonised regulatory frameworks. In November 1997, Peru joined the Asia Pacific Economic Cooperation (APEC) forum. Peru has also been participating in the Free Trade Area of the Americas negotiations. The robust growth is expected as Peru accelerates its free trade agreements; thereby increasing trade flows and mining production (the key driver to economic growth). Accession to the free market agreement TLC with the US would allow Peruvian exports access to this important market.

NOTABLE ENERGY DEVELOPMENTS

PRIVATISATION PROGRAMME

The government that took office in July 2001 stepped up privatization activities in the energy sector that had slowed under the two previous governments. While opposition claims that privatization contributes to unemployment and high-energy tariffs, the government believes that it increases investment and lowers prices. Active promotion of private investment helped bring about the July 2001 sale of the Electroandes Power Company to PSEG Global of the US. The Talara oil refinery and the Mantaro hydroelectric plant are also being considered for privatization. However, violent demonstrations and riots in June 2002 in the cities of Arequipa and Tacna, which followed the government's announcement of the sale of the Egasa and Egesur electric utilities to Belgium's Tractebel, have delayed privatization plans. In February 2004, ENERSUR was awarded the use contract of Yuncan offering US$205 million. This payment will be made as follows:

- Contract rights, US$57.6 million.
- Use rights, US$124.5 million over 17 years that will be used to pay the Japan Bank for International Cooperation.
- Social contribution, US$23 million over 17 years for the development of the Pasco Department

The Yuncan project consists of the construction of a Hydroelectric Power Plant with 130 MW installed capacity, including the installation of 3 generators of 44.5 MW each, to produce 901 GWh

per year and also the construction of 50 km of transmission lines of 220 KV (Yuncan-Carhuamayo) is also required for interconnection to the National Grid.

The private company with the largest presence in Peru is Spain's Endesa, which manages 1.5 GW of installed capacity. As of December 2003, Endesa held 60 percent of generators Etevensa (340 MW) and Empresa Eléctrica de Piura (Eepsa) (148 MW), as well as a controlling interest of 63.3 percent in Edegel (970 MW), through its subsidiary Enersis. Endesa, in conjunction with Enersis, also holds a 60 percent interest in electricity distributor Edelnor, the largest of Peru's 21 distributors. Some other international companies include Belgium's Tractebel, which holds a 78.95 percent stake in Enersur (362 MW); Duke Energy International, which owns 100 percent of Egenor (529 MW); and PSEG Global, which owns 100 percent of Empresa de Electricidad de los Andes (ElectroAndes). Electroandes's main assets are four hydroelectric plants: Yaupi (108 MW); Malpaso (54 MW); Pachachaca (12 MW); and Oroya (9 MW). PSEG Global, along with Sempra Energy, jointly own 84.05 percent of Luz del Sur, (previously Edelsur), the second-largest electricity distributor.

In July 2006 the new government in their policy guidelines promised to see the privatization process finished, the Premier said "In the Presidency of the Council of Ministers (PCM) we have had deactivation in the direction in charge of privatization", during his presentation before the Peruvian Congress of the Republic. The administration will look to push a concession scheme and to promote alliances between private and governmental capital – depending on the case in point. When "the privatization process is finished", the franchise mechanism will be applied, with direct private investment or with a strategic alliance between the public and private sectors to assure that the economy is in control of its natural resources and is not taken advantage of by private interests.

ADVANCES IN THE CAMISEA GAS PROJECT

Camisea gas was discovered by Shell in 1986, however, its development only started in 2000 with the establishment of the Special Committee for the Camisea Project (CECAM). CECAM had divided the Camisea development into two projects, upstream and downstream. A consortium led by Argentina's Pluspetrol SA and consisting of Hunt Oil, SK Group and Tecpetrol, was awarded the 40-year contract to develop the upstream project. A 33-year contract for the downstream project consisting of transportation of the gas from Camisea to Lima, transportation of liquid gas (condensate) to coast and distribution of gas in Lima and Callao was awarded to Tranportadora de Gas del Peru (TGP). TGP, a consortium made-up of Techhint, Pluspetrol, Hunt Oil, Sonatrach, SK Corporation and Tractebel will build two pipelines, one for natural gas (714 kilometres) and another for condensate (540 kilometres). The pipelines are expected to deliver 250 million scfd of natural gas expandable to 729 million scfd by 2015 and 70,000 B/D of condensate, with the first delivery beginning in August 2004.

In 2002 an additional downstream project, a 30-year concession for the construction and operation of a gas distribution network in Lima and adjacent port Callao was awarded to Tractebel. The distribution network spans 60 kilometres to deliver gas to industries and power generators around Lima but in the same year TGP transferred the contract to Gas Natural de Lima y Callao SRL Company (Calidda) and operation was started in August 2004.

Pluspetrol believes that Camisea could yield as much gas as fields in neighbouring Bolivia, where recent exploration and development activities have uncovered reserves of 3.68 BCM of natural gas and 95 MCM of condensate. Techint SA, also from Argentina, operates a transportation concession to deliver gas from Camisea to the city of Lima, and Belgium's Tractebel SA heads the consortium that will handle distribution in Lima that was transferred to Calidda.

Additional reserves could make Peru a regional gas exporter, with potential customers in Mexico, and the western US. With this aim in August 2006 the Consortium Peru LNG – Hunt start the construction the Liquefied Natural Gas (LNG) Export Project (Project), which includes plant and marine facilities designed to liquefy natural gas and provide LNG for transportation and export, and its interaction with environmental components within the area of influence of the project. In addition it is expected that Peru will be interconnected through the "energy ring" with

natural gas pipelines in surrounding economies such as, Brazil, Uruguay, Paraguay, Argentina, Chile and Bolivia

The government, in cooperation with the private sector, is carrying out an aggressive plan to expand gas utilisation in Peru that could lead to a gas grid linking all communities with more than 5,000 inhabitants and help reduce the dependence on oil imports nationwide. In the transportation sector the rail company Empresa Ferrocarril Central Andino started to use compressed natural gas (CNG) in their units. Also envisioned is a greater use of compressed natural gas (CNG) along the lines of Argentina's programme that has yielded a fleet of 800,000 CNG vehicles.

In November 2006 Edegel start up the first combine cycle power plant using Natural Gas in Peru at the Ventanilla Power Plant increasing the initial capacity from 300 MW to 492 MW.

Work has also started on the construction of a gas pipeline that would distribute gas from the Camisea project to the major Peruvian cities of Lima and Callao; as at October 2006 almost 3310 householders have been connected with this system, with plans to increase this to 29,000 connections by 2007.

PERU LNG PORT

The huge reserves of natural gas discovered in Camisea, besides the reserves discovered at less than 20 kilometres in the Pagoreni Field, together make an estimated 11 TCF of proven and probable reserves, and has drawn the interest of two other enterprises into the consortium in charge of the Camisea Project. Hunt Oil and SK (Korean Enterprise) have established the PERU LNG Consortium in order to export liquefied natural gas, PERU LNG is a Peruvian registered company created in 2003 for the purpose of developing a natural gas liquefaction and related facilities, and a natural gas pipeline to utilize Peru's abundant natural gas reserves for export to the west coast of North America. PERU LNG is majority owned and directed by the Hunt Oil Company of Dallas, Texas, one of the world's leading independent oil and natural gas companies. Other participating owners are SK Corporation of South Korea, the energy and chemical affiliate of SK Group, and Repsol YPF of Spain, listed within the world's top ten oil companies.

The Project will be situated on a 521 hectare coastal site at Pampa Melchorita, located between 167 to 170 kilometres south of Lima on the west side of the Panamericana Sur Highway in the district of San Vicente de Cañete, province of Cañete. This project is expected to start up in 2009. The initial investment to build a plant to liquefy natural gas will be within 1,600 and 2,000 million dollars. Peruvian gas market demand will always be guaranteed. Repsol YPF entered into the LNG Company and reached an agreement to buy all the production from the Cañete LNG plant, Repsol YPF also bought a 20 percent stake in the LNG project such that they can participate in the exploration and production of the Camisea field.

POWER GRID

Peru has been in the process of integrating its power grid with Colombia and Ecuador. Those three economies signed an agreement in September 2001 and April 2002. The integration will possibly be expanded to the Andean Community common electricity market, which will increase the efficiency of the market. The first inter-country electricity sales began in 2005, when Peru started exporting electricity to Ecuador. A US$15 million 56 kilometre transmission line has being built and in the future a continuous AC substation that allows the transmission line to transport 150 MW of electricity in both directions is going to be built. Eventually, the capacity of the lines will be increased to 250 MW. The facilities will enable Peru to sell excess hydropower during the rainy season to Ecuador. Also in November 2006 Ecuador bought 95 MW because of the crisis in electricity supply.

By law the government did a change in the elaboration the transmission plan that consist in development of the Guaranteed System of Transmission, it is made according to the Transmission Plan, which will be updated and published every two years. The Ministry approves the Plan of Transmission, with the previous opinion of OSINERG (regulatory body). For the favourable

opinion, the OSINERG will have to verify that the study of the COES (System operator) has fulfilled the policies and criteria established by the Ministry. The Plan of Transmission has a binding nature for the investment decisions that are adopted during their use.

ENCOURAGING NEW EXPLORATION

The participation of exploration and exploration contractors in exploration activities have been encouraged recently. The government has introduced a more attractive fiscal term in May 2003 to address this problem. This new fiscal term offers two options; the first being, royalties based on production levels that range from 5 to 20 percent and the second with a royalty based on a fixed component (5 percent) and a variable component (up to 20 percent) that are dependent on the profit margin. The new scheme also reduces payable royalties by up to 30 percent from the previous scheme. In addition, the government also offers other incentives such as the right to market hydrocarbons freely, allow free capital flow both within and outside the economy, a more flexible work programme and international arbitration on resolving disputes in 2004 with these actions, 29 exploration contracts were still in force in 2005 and 61 exploration contracts were still in force in 2006.

Peru will become in export oil Country in 2010 because the American Company Barrett Resources take a decision to development oilfield in 67 lot discovered in 1998, the target is produce 100,000 b/d in 2010 in this oilfield.

RURAL ELECTRIFICATION

Within the framework of the National Rural Electrification Program of Peru, which is coordinated by Energy and Mines Ministry, the government aims to reach a goal of 91 percent electrification coverage of rural household's in the year 2012, as well as, to improve the electric generation systems for isolated rural communities.

The government declares of national necessity and public utility the isolated electrification of countryside, localities and of border of the country, with the intention of contributing to the sustainable socioeconomic development, improving the quality of life of the population, to fight poverty and to deter the migration of people from rural regions to cities the government will assume a subsidiary roll, through the execution of the Rural Electrical Systems. Decentralization in the execution of the Rural Electrical System will be undertaken by the national, regional and local governments, the concessionary of electrical distribution and rural electrification, public or private companies, or other private investors. The participation of the regional and local governments will be carried out in direct consultation or coordination with the Ministry of Energy and Mines. In the case of the work executed by private investors or other companies, will be of application the scheme smaller percentage of subsidy, in agreement to the arranged thing in the present Law.

The resources for the rural electrification constitute:

- The national government will transfer funds annually for this programme;
- Some external financing is also included;
- The regulatory body OSINERG imposes penalties of up to 100 percent in the case that the companies do not develop electrical activities in a specific timeframe ;
- The Sector of Energy and Mines holds a 25 percent share of the electrical companies when they are privatised;
- The electrical sector, including the generating, transmitting and distributing companies, must pay a 4 percent rent tax to the government annually.

The Ministry of Energy and Mines will further develop the National Plan of Rural Electrification (PNER), for the long term, with a horizon of ten years, the same one that will consolidate the arranged plans of regional and local development, the programmes of expansion of the concessionary companies of electrical distribution and rural electrification, private initiatives and

the programs or projects to be developed by the national government. The projects that correspond with the PNER are subject to a technical and economic evaluation in order to guarantee they achieve social gains and administrative, operative and financial sustainability over the long-term. For this, the Ministry of Energy and Mines will coordinate with the regional and local governments and other organizations, offering the technical expertise that corresponds with the legal characteristics for decentralization. Also, the short-term plan will also be developed and will include the projects to be developed within corresponding budgetary limits, on the part of the national, regional and local governments and the private sector. The short-term plan will include projects that are part of programmes or resulting projects from donor agreements or external financing for the electrification of rural regions, isolated localities without access to the national grid and regions on the border of the country, which will be governed and executed under their own rules and regulations.

RENEWABLE ENERGY

A strong boost to renewable energy technologies is predicted with the signing of an agreement to undertake the Electrification Rural master plan with JICA using renewable energy technologies such as mini-hydro, wind, biomass, PV and geothermal sources.

By law the government intends to promote the use of the renewable energies for electrification, with the purpose of contributing to the economic development of rural regions, isolated and communities on the border of the country, as well as improving the quality of life of the rural population and protection of the environment. The Ministry of Energy and Mines is the department of the government in charge of promoting, directing and to executing projects within the scope of the regional and interregional rural electrification scheme that use renewable energy technologies.

In order to fulfil these aims the government will maintain limited coordination with the regional and local authorities into the research – with the coordination national universities and the specialized technical institutions – of renewable power plants that complement the national objectives, and then in coordination with the regional governments , will implement the corresponding mechanisms and actions for the development of renewable power projects destined to improve rural electrification.

The relevant national authority will detail a Plan of Renewable Energies, the same one that will be in agreement with the Regional Plans of Renewable Energies. This Plan will include projects to be developed using renewable resources that improve the quality of life of the population located in rural regions, or isolated at the border of the economy. To achieve this aim the Executive Director of Projects will establish the respective criteria and the order of priority.

In this context the National government and the Tacna Regional Government are working together to promote geothermal power development in south part of Peru.

ENVIRONMENT

Peru ratified the Kyoto Protocol in July 2002. It is expected that the National Commission for the Environment (CONAMA) will have measures in place to use the Clean Development Mechanism (CDM). The first approved CDM project in Peru, the Ponchos Hydro Project, started producing energy in March 2004. This 15.4 MW power plant is located some 20 km from the border of Ecuador. The project obtained support from the Carbon Prototype Fund of the World Bank. It is expected to reduce emissions by approximately 1.26 million tonnes of CO_2 during its lifetime.

Peru had to need to meet the fuel standards recommended by the World Bank for South American Countries before 2005 for diesel fuel but was delayed, it was decided that the sulphur content in diesel fuel in Peru should be reduced from the current 5,000 to 10,000 ppm (0.5 – 1 percent) to 50 ppm (0.005 percent) by January 2010. For imported diesel the sulphur limit is currently 2,500 ppm. To reduce the sulphur content to 50 ppm will require substantial investment

in the refineries of Peru. The Ministry of Energy and Mines has indicated that the two largest refineries will have to invest around $US300 million in each refinery to fulfil the sulphur requirements from 2010. The investments will also increase the production capacity to some degree. Operating costs could be reduced as a result of this upgrade, but at this stage how much savings could be achieved is unknown. Through this investment all diesel sold in Peru will have a sulphur content less than 50 ppm. This is a challenging task, given the refineries' relatively short time to carry out the necessary investments. Thus, it is evident that they will not be able to deliver the required low sulphur diesel by 2010.

Another important issue is the local pollution in some places such as La Oroya City one of the most polluted cities in the world, the pollution is as a result of mining activities and the utilisation of very old smelting plants

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THE PHILIPPINES

INTRODUCTION

The Philippines is located along the western rim of the Pacific Ocean and covers an area of 300,000 square kilometres of land, which is carved out into an archipelago of 7,107 islands and islets. The total population in 2004 was 81.62 million and more than a half of the population lives in Luzon, the largest among the three major island groups in the Philippines.

Between the period 2000 to 2004 the Gross Domestic Product (GDP) grew by 3.9 percent, to reach US$356.14 billion (2000 US$ at PPP) in 2004. GDP per capita likewise experienced an improvement reaching US$4,364 (1995 US$ at PPP) in 2004 compared with US$4,188 (1995 US$ at PPP) in 2003.

The Philippines' indigenous energy reserves are relatively small with only about 24 million cubic metres (MCM) of crude oil, 107 billion cubic metres (BCM) of natural gas and 399 million metric tonnes of coal, mainly lignite. However, the Philippines have an extensive geothermal resource that could make the economy the world's largest producer and user of geothermal energy for power generation. Other renewable energy resources (solar, wind, biomass and ocean) are theoretically estimated to have a power generation potential of more than 250,000 MW.

Table 29 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	300,000	Oil (MCM) - Proven	24
Population (million)	81.62	Gas (BCM) - Proven	107
GDP Billion US$ (2000 US$ at PPP)	356.14	Coal (Mt) - Recoverable	399
GDP per capita (2000 US$ at PPP)	4,364		

Source: Energy Data and Modelling Centre, IEEJ. *Philippine Department of Energy, 2003 (DOE)

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2004, the total primary energy supply (TPES), excluding traditional biomass fuels, amounted to 32,697 Mtoe. The economy imports 19,128 (or 59 percent) of the total energy supply; the remainder was supplied through domestic production of indigenous resources, at 13,420 Mtoe. The main energy sources were oil (49 percent), others (29 percent), coal (15 percent), and gas (6 percent). Gas production decreased from 2,628 ktoe in 2003 to 2,059 ktoe in 2004. Oil production on the other hand increased considerably from 14 ktoe in 2003 to 466 ktoe in 2004. As for coal, most of the economy's total coal requirements are supplied through imports. However the coal production improved to 1,310 Ktoe in 2004 from 910 Ktoe in 2003.

In 2004, total electricity generation reached 55,957 GWh. Thermal generation, mostly from fuel oil and coal accounted for 66 percent of electricity production, followed by hydropower (15 percent) and others (18 percent).

FINAL ENERGY CONSUMPTION

In 2004, total final energy consumption in the Philippines was 17,867 Mtoe. The transport sector consumed 49 percent of this total, while the industrial sector and other sectors (agriculture,

residential/commercial and non-energy) each accounted for 25 percent and 26 percent respectively. By energy source, petroleum products contributed the largest share with 73 percent of consumption followed by electricity (21 percent), and coal and coke (6 percent).

The updated Philippine Energy Plan, 2005 indicates that between 2005 and 2014, the economy's final energy demand will grow at 4.7 percent per year with petroleum used mainly in the transport sector taking the bulk of the final energy demand with an average share of 39 percent. This will be followed closely by biomass with a 38 percent share. Electricity, coal and natural gas will post an average share of 15 percent, 3 percent, and 2 percent, respectively.[58]

Table 30 Energy supply & consumption for 2004

Primary Energy Supply Ktoe		Final Energy Consumption Ktoe		Power Generation GWh	
Indigenous Production	13,420	Industry Sector	4,532	Total	55,957
Net Imports & Other	19,128	Transport Sector	8,668	Thermal	37,082
Total PES	32,697	Other Sectors	4,667	Hydro	8,593
Coal	4,991	Total FEC	17,867	Nuclear	-
Oil	16,065	Coal	1,055	Others	10,282
Gas	2,059	Oil	13,021		
Others	9,581	Gas	0		
		Electricity & Others	3,791		

Source: Energy Data and Modelling Centre, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/egeda/database/database-top.html

ENERGY POLICY OVERVIEW

The development of the energy sector in the Philippines is based on the economy's two-tiered energy agenda; energy independence and market reform. The Philippines Energy Plan was further updated in 2006, and the major issues covered by the update include;

ENERGY SECTOR FRAMEWORK[59]

Energy Independence and savings

The economy will continue to increase the utilisation of indigenous fossil fuel reserves and also aggressively develop its Renewable Energy (RE) resources such as biomass, solar, wind and ocean resources. Furthermore, the use of alternative fuels will be increased and energy efficiency and enhancement programmes will be strengthened and enhanced. In order to achieve energy independence and savings the Philippines will also form strategic alliances with other economies and create/promote joint development on upstream exploration with neighbouring economies.

The economy is targeted to achieve a 60 percent self-sufficiency level by 2010. In order to achieve this target, in the next ten years the economy is aiming to increase oil and gas reserves by 20 percent, reduce coal imports by 20 percent and increase RE-based capacity by 100 percent. In addition, the retiring and operation of oil-based power plants will be converted to natural gas-based power plants is targeted to be completed by 2010. Furthermore, in 2010 all of the buses in Metro Manila are targeted to use CNG, and for other vehicles a five percent Coco-Methyl Ether (CME)

[58] Philippine Energy Plan 2004-2013

[59] The Philippines Energy Plan 2006, Department of Energy Philippines.

blend with diesel fuel and a 10 percent ethanol blend with gasoline. It is also targeted through the National Energy Efficiency and Conservation Program that the average annual energy savings in 10 years will reach 25.7 MTOE.

Apart from these, other measures include; 1) to continuously implement the transmission system upgrade and expansion program, 2) implement the wholesale electricity spot market (WESM) in Luzon and Visayas by 2006, 3) targeted 100 percent of barangay[60] electrification by 2008, and 4) opening of 14 'First Wave' National Power Corporation-Small Power Utilities Group (NPC-SPUG) areas to power sector participants.

Power sector/market reforms

In an effort to reform the power sector, the government will continue to create a transparent privatization process and investment climate that is attractive to investors. It is targeted that by 2007 the privatization level will reach 70 percent of the installed capacity through privatization of TransCo, and privatization of National Power Corporation's (NPC's) generating assets in Luzon and Visayas.

In addition, to counter the impact of increases in the price of electricity some measures will be enhanced including; 1) energy conservation and demand side management, 2) NPC internal efficiency measures, 3) economic dispatch, 4) time-off-use pricing, and 4) implementation of WESM and working towards open access to provide economics price signals, power of choice, market-based competition and retail competition.

As for the development of the Electric Power Industry reform Act (EPIRA), there are many initiatives that are pursued, among others; 1) preparatory works for the commercial operation of WESM, 2) privatization of NPC generation assets, 3) privatization of the TransCo concession, 3) preparatory work for the implementation of retail competition and open access, 4) administration of universal charge for missionary, 5) electrifications and environmental charge, and 6) loan relief of EC loans.

The Philippines also plans to increase its rural electrification rate; the economy targets to have 100 percent barangay electrification by 2008 and will continue to energize small villages to achieve the target 90 percent household electrification level by 2017.[61]

Other Energy Programs

Deregulation of the downstream oil industry (RA 8479) of 1998 was introduced with the objectives of; 1) to create an environment that will promote competition in downstream oil industry, 2) to create level playing field, 3) to promote consumer welfare through more choices and better products and more reasonable prices in oil and oil-derived products.

As of 30 September 2005 the number of industry players engaged in the different downstream activities increased from 361 in 2004 to a total of 488 in 2005 and total investment of new players reached a total of Php 28.3 billion September 2005 compared to Php 25.0 billion in 2004.

[60] The barangay is the smallest local government unit

[61] As at December 2005, the rural electrification of Philippines are about 94 percent while 2,564 barangays are unelectrified.

NOTABLE ENERGY DEVELOPMENTS

In pursuing its energy policy objectives, the Philippine government has actively pursued the review of existing policies and carried out various reforms not only in the power and downstream oil and gas sectors but also in renewable energy.

MOVING TOWARDS ENERGY INDEPENDENCY[62]

It is targeted that the energy independence be achieved by reaching an energy self- sufficiency of 60 percent by 2010 and beyond. Measures to achieve the goal include;

Accelerating the Exploration, Development and Utilization of Indigenous Energy Resources

The targeted increases in indigenous oil and natural gas reserves are expected to be completed through competitive service contracting schemes. As of 2005, the petroleum reserves of the economy are 65.8 Mtoe, of which 80 percent is oil reserves while the balance is natural gas reserves.

Oil production from the Nido and Matinloc fields reached 0.14 million barrels in 2004, and the economy targets to increase oil production to 21.3 million barrels in 2012. As for natural gas in 2004, production[63] reached 87,556.6 million cubic feet of natural gas, and the economy plans to increase production to 185,023 million cubic feet of natural gas in 2012.

The DOE initiated another Philippine Energy Contracting Round (PECR) in middle of 2005 for petroleum, geothermal and coal. This resulted in the offering of four petroleum blocks and seven coal areas.[64]

In 2005, 11 petroleum service contracts (PSCs) were signed amounting to US$155 million of initial financial commitments. As for coal, in December 2005 the economy has 35 coal operating contacts (COCs) with development, production and explorations[65] commitments. Of these 35 COCs, 14 were awarded from 2004 to 2005 concession rounds.

Intensifying Renewable Energy Resource Development

The government targets to increase renewable energy-based capacity to 9,143 MW in 2013.[66]

Geothermal

In 2005 the generating capacity of geothermal resources contributed about 18 percent of Philippine's electricity supply mix, and ranks the economy as the second largest user of geothermal energy in the world after the U.S. The total installed capacity of geothermal power generation is 1,931 MW, and an additional 1,200 MW of capacity is targeted by 2013. During the PECR 2005, 11 geothermal blocks were offered. Presently, most of the geothermal plants are developed by state-owned PNOC-Energy Development Corporation (PNOC-EDC).

To augment the development of the geothermal power generation in the Philippines, the government has set up a few plans that are; 1) to continuously offer prospective sites through PECR, 2) to optimize existing geothermal fields, and 3) to establish guidelines for small-scale and non-power applications of geothermal energy.

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[62] The Philippines Energy Plan 2006, Department of Energy Philippines.

[63] From Malampaya and San Antonio Fields.

[64] About 12,000 km² for each block for petroleum and 1,000 hectares for each area for coal.

[65] The investment for exploration of coal is amounting to US$1.3 million.

[66] Renewable Energy Policy Framework (2003)

The economy aims to develop many more geothermal electricity generations plants, including; a 40-MW geothermal plant in Sorsogon Albay province, 100 MW Cabalian geothermal plant in Leyte, three other additional geothermal power plants in Leyte with a total installed capacity of 540 MW, nine facilities in Luzon with a total installed capacity of 400 MW, of which two new geothermal plants with a total installed capacity of 80 MW are going to began operation in 2006 at Dauan Negros Oriental.

Hydropower

In 2004, hydropower resources accounted for about 16 percent of the economy's total electricity generation mix. The current installed capacity of overall hydropower resources is 3,219 MW, and an additional 3,999 MW of capacity is targeted to be installed by 2014. This increase is targeted to be achieved though the development of all possible and financially viable small and mini-hydro power plants.

To encourage the development of more hydropower resources, the government are carrying out the following plans; 1) development/identification of micro-hydropower sites and; 2) establishment of a one-stop shop for a hydropower resources market service centre.

Solar

The Philippines has a nationwide potential for solar PV application; however, due to the prohibitively high initial cost, the take-up rate is quite low. Presently, only 1.4 MW of installed capacity is connected to the grid. Nevertheless, the increasing demand for clean and renewable energy makes the use solar energy the most viable alternative to fossil fuel for the electrification of isolated communities, specifically in the installation of off-grid power systems.

Currently, there is cooperation carried out for this purpose, for example; the Philippine's and Spanish governments, through BP, agreed to a $48 million contract to develop solar power in 150 villages and; BP, Australia and the Philippines governments have also agreed to supply solar power to 52 municipalities located in remote rural villages.

Furthermore, about 15,000 houses in the remote areas of Regions I to VII[67], including the Cordillera Autonomous Region (CAR) and Mindanao Region, is expected to be installed with solar power cells by 2007 through the PNOC Solar Homes Systems Distribution Project.[68] The solar system package consists of a solar panel, battery, wiring, lights and other fixtures, inclusive of maintenance visits within the first year of installation. The solar panels can run up to 20 years and can generate enough electricity to run small electrical appliances.

Wind

The potential for wind energy in the Philippines is estimated by the United States Department of Energy wind mapping to be 70,000 MW, seven times the economy's current electricity demand. The areas identified as having the greatest potential are; 1) the north and northeast of the economy, in the regions of Batanes and Babuyan Islands north of Luzon and, 2) the interior of Luzon, Mindoro, Samar, Leyte, Panay, Negros, Cebu, Palawan where the land elevation is higher. Other areas also possess a good-to-excellent degree of potential for wind energy, such as areas that face east towards the coast from Luzon to Samar.

Currently, the installed capacity for wind energy is 25 MW. A 25 MW capacity wind farm was installed at Bangui Bay in June 2005; the wind farm is the first wind farm to be operated in the Philippines and is considered to be the largest in Southeast Asia. The wind farm was developed by Northwind Development Cooperation to deliver electricity to the Ilocos Norte Electric Cooperative via TransCo Laoag. This wind farm project was also the first project in the Philippines to have an Emissions Reduction Purchase Agreement (ERPA) under the Clean Development

[67] The Philippines is divided into 17 regions in total.

[68] As December 2005, 8,944 units of the solar home systems have been installed.

Mechanism. The government target for wind energy capacity an additional 417 MW in the next 10 years.

INCREASING THE USE OF ALTERNATIVE FUELS

The Philippines government continues to promote the utilization of alternative fuels and technologies such as biofuels, compressed natural gas and autogas.[69] Biofuels in the Philippines includes coco-biodiesel or coco-methyl ester (CME) produced from coconuts, ethanol fuel and jatropha curcas[70].

The government mandated the use of biodiesel for all government departments in February 2004. As a result, in December 2005, there were 1,100 government vehicles of 59 government agencies operating on a 1.0 percent CME blend. The government will take measures to increase the blend to 5.0 percent by 2014 for all diesel vehicles throughout the economy. In addition, to increase the availability of CME in the local market, the accreditation of two manufacturing companies was approved in June 2004. The DOE has also initiated discussions with various stakeholders on the potential of jatropha curcas as a feedstock for biodiesel.

As for ethanol, the target is to achieve a 5 percent ethanol blend with gasoline fuel by 2007 and gradually increase it this to a 10 percent ethanol blend by 2010. However, the launching of E10 in August 2005 and development of the first 10 percent ethanol blended gasoline by Seaoil has significantly surpassed the 5 percent mandated blend by the government. Presently, E10 is available at all Seaoil service stations throughout the economy and four Flying V outlets in Metro Manila.

To encourage wider utilization of biofuels, particularly CME and ethanol, DOE will strengthen its advocacy work to move forward the legislative agenda on CME and ethanol at the Lower House. The proposed legislation among others will pursue the mandatory use of the biofuels and encourage industry investment through incentives.

IMPLEMENTING POWER SECTOR REFORM[71]

The power sector reforms under the EPIRA are designed to instigate competition and achieve sound electricity prices.

Transparent Privatization Process

It is targeted that by 2007, 70 percent of the generating assets of the NPC in Luzon and Visayas will have been privatized. As of 2005 five power plants had been privatized, which are all mini-hydro facilities with a combined capacity of 8.5 MW. However, the sold assets only account for 0.08 percent of NPC's total generating capacity in the Luzon and Visayas regions.

Presently, the Power Sector Assets and Liabilities Management (PSALM) Corporation is finalizing the process of transaction and bidding documents for the tender offer of TransCo.[72]

Creating an Investment Climate Attractive to Investors

The Rural Electrification Program which was introduced in April 2003[73] is an integration of all the electrification efforts of both the government and the private sector to electrify the as yet not

[69] Particularly for the transport sector

[70] A type of plant whose seed can be used to produce biodiesel

[71] The Philippines Energy Plan 2006, Department of Energy Philippines.

[72] Which will be the government's biggest privatization effort in the power sector

[73] Consistent with the ten-point agenda of the administration particularly the provision of water and electricity in all barangays

electrified sites. The DOE has targeted to provide 100 percent household electrification by 2008 with the secondary objective to achieve 90 percent electrification by 2007.

The recent progress of the rural electrification has been remarkable; within 2001 to October 2005 almost 5,479 barangays were electrified. As a result, only 2,945 of a total of 41,945 barangays throughout the economy remain not electrified. The unelectrified barangays will be connected to distribution utility networks while others have been allocated to various Expanded Rural Electrification Programs.

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RUSSIA

INTRODUCTION

Russia is the largest economy in the world in terms of land area (about 17 million square kilometres). It is located in East Europe and Northern Asia, bordering the Arctic Ocean, between Central Europe and the North Pacific Ocean. Broad plains with low hills west of Urals, vast coniferous forests in Siberia and tundra along the Arctic seaboard, uplands and mountains on the southern regions characterise its terrain. It has a vast natural resource base which includes major deposits of coal, natural gas, oil and other minerals. Despite the land area advantage, it is unfavourably located in relation to the major sea lanes of the world. Likewise, it lacks the proper climate for agriculture, which is either too cold or too dry. The overall population density is low – less then 9 persons per square kilometre, with its northern and eastern regions very sparsely populated. Since 1990 the permanent population declined from 148.4 million to 142.8 million as of 1 January 2006. Urban population accounts for 73 percent of the economy's total population.

After a decade of economic contraction, of about 40 percent compared to the 1990 GDP level, the Russian economy began to grow again at the beginning of 1999, boosted by the stimulating effect of the 1998 rouble devaluation and higher oil prices. Russia's economy is continuing to develop strongly and achieved the 6th year of positive economic recovery in 2006, reaching an average growth rate of 6.9 percent. GDP in 2004 was estimated at US$1,306 billion (at 2000 $US PPP) and inflation was 11.7 percent. The unemployment rate in 2005 was about 7.6 percent.

Russia has the world's largest proven gas reserves, 6 percent of the world's proven oil reserves and 15.9 percent of the world's coal reserves. However, the formidable obstacles of climate, terrain, and distance have hindered exploitation of these natural resources. The economic potential of hydropower is estimated at 852 TWh per year, while only 20 percent of this has been developed. Economic reserves of uranium ore comprise about 14 percent of the world total.

Russia is the second largest primary energy producer (behind the US), the third largest energy consumer (behind the US and China), the world's largest exporter of energy with more then 40 percent of total energy produced being exported, the largest exporter of natural gas, and the second largest oil exporter (behind Saudi Arabia).

The energy sector is very important to Russia's economic development. In 2004, it accounted for 30 percent of GDP and approximately 60 percent of the economy's exports, which includes oil, petroleum products and natural gas, and more than 50 percent of economy's domestic tax collections.

Table 31 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	17,075,200	Oil (MCM) - Proven	11,850
Population (million)	143.9	Gas (BCM) - Proven	47,800
GDP Billion $ (2000 US$ at PPP)	1305.9	Coal (Mt) - Proven	157,010
GDP per capita (2000 US$ at PPP)	9,078		

Source: Energy Data and Modelling Center, IEEJ. * The BP Statistical Review of World Energy, 2006.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Russia's total primary energy supply in 2004 was 641.5 Mtoe, amounting to 4.5 toe per capita, a level similar to that of Japan and Korea. This total is broken down into 54 percent natural gas, 20 percent crude oil and petroleum products, 16 percent coal and 9 percent others including nuclear and hydro. Western and Eastern Europe (including the Commonwealth of Independent States) accounted for more then 92 percent of Russia's total energy exports by destination. Currently, Russia is developing new energy export routes aimed at markets in APEC economies such as the US and Canada in the North America, and China, Japan, and South Korea in the Northeast Asia.

In terms of oil, in2004 Russia produced 458.8 million tonnes of crude oil and gas condensate (NGL), in West Siberia, the main oil producing province, accounting for approximately 70 percent of total crude oil and NGL production. Domestic refineries processed 195 million tonnes of crude oil or 2.9 percent more then the previous year. The net exports of crude oil and petroleum products totalled 327.5 million tonnes or 55 percent of crude oil production and 53 percent of petroleum product production. New prospective oil provinces are located in the Timano-Pechora and East Siberia onshore regions and offshore in the North Arctic and Far East seas, as well as in the North Caspian shelf.

In 2004, natural gas production reached 633.5 BCM. Net exports accounted for 193 BCM or 30 percent of production. About all of the natural gas exports were destined for West and Central Europe, including Turkey, with small amounts piped to the Transkaukasian states - Armenia, Azerbaijan and Georgia. Non developed resources are located in remote regions and a lack of infrastructure prevents the start-up of upstream operations.

Russia produced, 280 million tonnes of coal in 2004, and hard coal amounted to 75 percent of production, with lignite accounting for the balance. Coal exports amounted to 78.8 million tonnes, or 28 percent of production. The main coal production areas are located in the Asiatic part of Russia - the Kuznetsk and Kansk-Achinsk basins. Prospective coal deposits have been found in more remote areas of Eastern Siberia, South Yakutia and the Far East.

Table 32 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	1 158,510	Industry Sector	112,432	Total	859,656
Net Imports & Other	-511,124	Transport Sector	82,735	Thermal	546,210
Total PES	641,449	Other Sectors	191,318	Hydro	174,868
Coal	104,139	Total FEC	386,485	Nuclear	135,622
Oil	130,831	Coal	42,836	Others	3,956
Gas	346,716	Oil	75,894		
Others	59,762	Gas	123,736		
		Electricity & Others	188,230		

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

Russia produced 931 TWh of electricity in 2004, of which 65 percent was produced from fossil fuels (gas, coal and fuel oil), 19 percent from hydro and 16 percent from nuclear energy. The largest hydropower stations – in addition to significant untapped hydro energy potential – are located in the Asiatic part of Russia; however, the capital costs of new hydro are prohibitively high. In 2004 Russia operated 31 nuclear reactors with an installed capacity of about 22.7 GW. Most of these reactors are located in the European part of Russia.

FINAL ENERGY CONSUMPTION

In 2004, total final energy consumption in Russia was 425 Mtoe, an increase of 1.6 percent compared with the previous year, and Russia has the highest final energy intensity among APEC economies. By sector, industry accounted for 35.5 percent share, transport for 19.5 percent and other sectors for 45.0 percent. By energy source the shares, coal accounted for 11.4 percent, petroleum products 17.9 percent, natural gas 26.5 percent and electricity, heat and others 44.3 percent. The most important energy use is for space heating, comprising about 40 percent of total final energy consumption due to the extremely cold climate. The traditional energy intensive industrial structure with its aging capital stock has not changed greatly, due to the lack of 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 measures to improve energy efficiency for existing industries. Russia has an untapped technical potential for energy savings at 35 to 45 percent of total energy consumption, according to various experts' estimations.

POLICY OVERVIEW

ENERGY STRATEGY UP TO YEAR 2020

One of the milestones in Russia's energy sector development is the adoption of the Energy Strategy of Russia to 2020, which was approved by the Federal government in August 2003. The document identifies the economy's long-term energy policy and mechanisms for the realisation of this policy. The main priority of the Energy Strategy of Russia is to improve energy efficiency. Among others instruments there are: market approach to energy pricing, tax and customs policy. Russia will perform also institutional and organisational reforms in the fuel and energy sector by improving its legislative and regulatory policies.

The main pricing policies include:

- Gradual expansion of the application of market pricing for fuel and energy in the domestic energy markets
- Provision for the financial stability and improving the investment attractiveness of fuel and energy enterprises

Another key factor in Russia's energy policy is its participation, as the largest supplier of energy resources, in improving international energy security. To achieve these objectives, Russia has adopted the following strategic initiatives:

- modernisation and construction of energy infrastructure, including the development of the main trunk oil and gas pipeline systems to enhance energy export capacity
- development of a closed nuclear fuel cycle and enhancement of nuclear power generation
- development of new oil and gas bearing provinces, and
- increasing energy exports to the Asia-Pacific regional international market.

ENERGY INDUSTRIES DEVELOPMENT PLANS

In October 2006, the government approved the Federal Programme for development of the nuclear industry up until the year 2015. the programme includes reorganisation of industry and the state owned facilities, and more than US$50 billion in government investments for research and development, as well as facilitating involvement of Russian companies in international nuclear markets. Under this programme it is expected that 10 GW of nuclear electricity generation capacity will be commissioned by the year 2015, and the construction of another 10 reactors will be started.

The general scheme for the construction of new power plants and transmission lines is expected to be approved by the government before March 2007. The following preference for

energy sources will be made: nuclear, coal and hydro power plants, and totals more than 70 GW by the year 2015. At the same time gas-powered utilities will undergo refurbishment and upgraded to combine cycle gas turbines in order to improve overall efficiency.

INTERNATIONAL ENERGY POLICY

The Russian government is also actively promoting domestic oil companies to seek opportunities in the world energy markets, supporting changes in pricing policy and integration of Russia's export facilities with import economies energy infrastructure, as well as providing incentives for oil companies to refine more crude domestically.

The plan of action on global energy security was adopted at the G8 summit in St Petersburg in July 2006. It reaffirms the G8's commitment to implement and build upon the agreements related to energy reached at previous G8 summits. The objective of the plan is to enhance global energy security through: increasing transparency, predictability and stability of global energy markets; improving the investment climate in the energy sector; enhancing energy efficiency and energy saving; diversifying energy mix; ensuring physical security of critical energy infrastructure; reducing energy poverty; and addressing climate change and sustainable development. Prior to the G8 leader's meeting, Russia hosted a meeting of the G8 energy ministers in Moscow. The meeting produces a statement that calls for increasing the reliability of world energy supplies and improving transparency in world oil markets.

MARKET LIBERALISATION

Oil and coal markets in Russia have been deregulated since the 1990s. Oil industry consists of 9 large companies that produce about 90 percent of crude oil in Russia, and some 300 small-scale enterprises producing the remaining 10 percent, while operators of three Production Sharing Agreements make less then 0.5 percent. There is no state control on petroleum products prices except under the Federal Antimonopoly Supervision Agency. Refining sector is controlled by 8 vertically integrated oil companies leaving 20 percent share of this market to 8 large and some 40 small independent refineries.

The coal sector has been restructured since 1996, when the state coal monopoly was privatised. Quantitative export restrictions have been removed and no export quotas exist. Coal is the single largest commodity transported by Russia's railway network, accounting for over 27 percent of the economy's rail freight. The geographical size of Russia's vast economy requires the haulage of coal over long distances; therefore, it is extremely important to set up freight rates that are competitive to allow coal to maintain its share in the energy mix. Rail tariffs were relatively cheap in the past; however there has been a significant increase in rail freight rates due to the restructuring in the railway industry. Although domestic price controls have been removed, many coal producers fight to compete with low natural gas prices. Foreign ownership in the Russian coal sector is practically nonexistent.

Market liberalisation is a strategic direction for the power industry development. One of the main issues is a gradual move from state-regulated energy pricing to free market regulation. Thermal electricity generation and distribution networks are expected to be privatised, while the hydro, nuclear and backbone transmission grids will remain under the state's control.

Trunk pipeline systems for crude oil (except for the Caspian Transportation Consortium), petroleum products, and natural gas are to remain under the government's control.

ENVIRONMENTAL POLICY

Russia's President signed the bill ratifying the economy's accession to the Kyoto Protocol in November 2004, effectively enforcing the Protocol on Russia. This decision reconfirmed Russia's strong commitment to addressing climate change and to working with the international community in dealing with this global problem. After Russia's ratification and approval of the treaty, the Kyoto Protocol went into affect in February 2005.

One of major concerns for world energy development is nuclear safety. Some economies have no large-scale plans for development of nuclear energy, and accordingly, do not require new energy fuel – recycled products of spent nuclear fuel (SNF) processing. The Russian Federation, however, uses another approach based on the so-called "Fast Breeder Reactor" and closed nuclear fuel cycle technologies.

Russia adopted the concept of "the closed fuel cycle" with SNF processing and obligatory return of fission nuclear materials to the fuel cycle. That concept improved the technological side, global environment and safety. The adoption of the closed fuel cycle was announced in an initiative by Russia's President at the "Millennium Summit" in the United Nations, in September 2000. To provide the legal framework in managing nuclear wastes, amendments to the Environment Protection Law and Nuclear Energy Utilisation Law were made in June 2001. The amendments allow treatment of other economy's SNF and permanent storage of nuclear waste in Russia.

NOTABLE ENERGY DEVELOPMENTS

RUSSIA AND KAZAKHSTAN SET UP AN INTERNATIONAL NUCLEAR CENTER

The Russian President's Global Nuclear Infrastructure Initiative was announced in early 2006, as a means of calming international tensions over Iran's nuclear problem. This is in line with the International Atomic Energy Agency's (IAEA) 2003 proposal for Multilateral Approaches to the Nuclear Fuel Cycle (MNA) and with the US Global Nuclear Energy Partnership (GNEP). Russia will host four types of international nuclear fuel cycle service centres as joint ventures with other economies, which would be secure under IAEA control. Firstly, a uranium enrichment centre will be constructed – one of four or five worldwide. Secondly would be a centre for reprocessing and storage of used nuclear fuel. The third centre would deal with the training and certification of personnel, especially for emerging nuclear states. In this context there is a need for harmonized international standards, uniform safeguards and joint international centres of which the fourth centre would be dedicated to R&D and the integration of new scientific achievements.

In October 2006 Russia and Kazakhstan set up three nuclear related joint ventures in which each side will have a 50 percent stake. One company will extract Kazakh uranium ore that a second company will enrich at the Angarsk International Uranium Enrichment Centre. The third joint venture will have its headquarters in the former Kazakh capital of Almaty, where the development of new small and medium-sized nuclear reactors for both domestic and export purposes will be undertaken.

The first joint venture, the International Uranium Enrichment Centre to enrich uranium was established by Russia and Kazakhstan in October 2006 in Angarsk city, about 5,000 km east of Moscow. Any state needing nuclear fuel would be able to enter into a commercial contract with this Centre. Following the normal practice for international trade in nuclear fuel, the natural uranium to be enriched would be obtained on the international market or from sources in the contracting state, and would then be enriched in Russia and sent back to the contracting state for use in its nuclear reactors. Speaking in Vienna in September 2006, the Russian President declared that access to these services would be "non-discriminatory." The Angarsk Centre will be operated in close cooperation with the International Atomic Energy Agency (IAEA) and Russia will voluntarily place the plant under IAEA safeguards.

ELECTRICITY AND GAS PRICES DEREGULATION

During the transition period, the government kept control over the tariff-setting policy for natural monopolies services. The Federal Tariff Service is authorised to set maximum allowable regional natural gas, electricity and centralized heat tariffs. In September 2006 correlation for the per energy unit producer's price for oil, fuel oil, steam coal and natural gas was retained as 1 to 0.9 to 0.2 to 0.1 respectively.

The free electricity trade market was launched in November 2003 within the framework of the Federal Wholesale Electricity Market (FOREM). A new model for wholesale electricity trading was introduced in September 2006, as the regulated sector of the wholesale market was replaced by a system of regulated contracts to be concluded between the buyers and sellers of electric power. The day-ahead market replaces the free trade sector that was previously operating. The only difference between the two is that in the day-ahead market participants' bids cover all power produced and consumed (except that covered by regulated contracts), while in the [previous] free trade sector suppliers bid for less then 15 percent of production, and buyers for less then 30 percent of consumption. These contracts are considered to be regulated as electricity prices under these contracts are administered by the Federal Tariff Service (FTS). From 2007 the volume of electric power (capacity) traded on the wholesale market at regulated prices will substantially reduce, with the pace of reduction being set annually by the Federal government. Buyers and sellers may reduce contracted volumes by up to 15 percent if they are able to reach agreement. As a result in five to eight years a fully competitive wholesale market is projected to be operating in Russia – as specified in Russia's legislation for the electric power industry.

The un-contracted electricity volumes will be traded at free unregulated prices. The new market model implies two ways of electricity trading at "free prices" – free bilateral contracts and a day-ahead market. Under free bilateral contracts, market participants have the right to choose contracting parties, prices and supply volumes. The day-ahead market is based on competitive selection of bids submitted by suppliers and buyers a day before the electricity is actually supplied. If there are deviations from the day-ahead forecast, participants are obliged to sell excess amounts or buy additional amount from the balancing market.

Currently there is 377 players on the two-sectional markets (Europe and Siberia), and free trade volume for day-ahead contracts in September 2006 exceeded 8 percent for the European section and reached 6.5 percent for the Siberia section for the electricity produced. The new wholesale market will also include capacity trading, an ancillary services market, financial transmission rights (FTRs) market (market, where rights for the use of carrying capacity of electric grids are traded) and derivatives market (to create a risk management system in the electric power industry).

The Federal government remains the key shareholder in the economy's gas monopoly, Gazprom, while independent companies have a 15 percent share in Russian gas production and meet some 25 percent of domestic gas consumption. The access to Gazprom's gas transportation system by independent producers as well as the wholesale gas price system is regulated by a special Federal Government Decree. In August 2006 tariff regulation regarding new pipelines came into force, which paves the way for enhance access by independent companies to Gazprom's natural gas pipeline system.

Starting from April 2007 power plants will be granted the right to make five year contracts for gas deliveries, with extension to other industries before January 2008. The regulated natural gas prices for industry will rise by 15 percent in 2007, by 25 percent in 2008, and then four times by 13 percent every six month over the next two years. Thus in 2011 the regulated prices for the industrial sector will reach the European price level under the net-back pricing mechanism. Regulated prices for the residential sector will be eliminated by 2015, as the pace of increase will be lower than that for industry – 15 percent in 2007, 14 percent in 2008, and 13 percent in 2009.

The first free trades for next month deliveries of natural gas were started in November 2006. It is expected that free trading of natural gas will account for 2 percent of total trade in 2007, gradually increasing thereafter.

OIL EXPORT CAPACITY EXPANSION IN THE ATLANTIC DIRECTION

At the beginning of 2006 for the first time in Russia's history crude oil export facilities exceeded export capacity by 6 percent, as a result of enhancement of existing trunk pipeline's and completion of the Baltic pipeline system's third phase in April 2006. The Baltic pipeline system was the largest Russian energy export infrastructure development in 15 years; the construction has allowed Russia to stop oil transit to the Baltic Sea through the Baltic States and lower transit risks.

The project cost US$2.2 billion and allows the transport of 76 million tonnes of crude oil per year to the export terminal next to the town of Vyborg on the Russian Finnish border with a loading capacity of four aframax tankers.

EAST OIL PIPELINE PROJECT DEVELOPMENT

Construction of main trunk oil pipeline from Eastern Siberia to the Pacific coast (ESPO) was launched in April 2006. The first phase with 30 million tonnes per year capacity will stretch from Taishet in the Irkutsk region to Skovorodino on the Baikal-Amur railway, just 60 kilometres from the Russian Chinese border. The route was corrected so as to be compatible with environmental legislation to bypass Lake Baikal (which is one of the World Nature Heritage, supervised by UNESCO). At the end of December 2006 some 24 percent of the total pipelines length had been prepared and 19 percent was already constructed. The first phase is to be finalised at the end of 2008, together with the branch to China. Construction of an oil export terminal in Nakhodka is also considered during the first phase. Export oil deliveries of Siberian crude oil to the Asian-Pacific market will be temporarily supported by more than 2000 kilometres of railway operations.

The second phase is to extend the route to the Pacific coast by pipeline, rather then by rail. It is expected that when this pipeline is completed and attached to that of phase one the supply capacity of the system will be 80 million tonnes per year.

RUSSIAN-CHINESE ENERGY COOPERATION

During a May visit by Russia's President to China several important documents for energy cooperation were signed. Gazprom, Rosneft and Unified Electricity Systems of Russia (UESR) are the only Russian companies entitled to export natural gas, crude oil and electricity to China. Gazprom and CNPC signed a MOU on pricing formulae principles and intentions to start natural gas deliveries to China between 2011 and 2015 by two routes – one is through the Altai mountain range of northwest China, and the other is to northeast Chinese province Heilongjiang.

Rosneft and CNPC signed a feasibility study to build a branch of the East Siberia – Pacific Ocean oil pipeline to China, and established the protocols governing the Rosneft-Vostok joint venture company. Rosneft is planning to deliver crude oil to China next year sourced from its share of the Sakhalin-1 project by tanker and from West Siberia either by railway, or through the already constructed Kazakhstan-China pipeline.

UESR and the Chinese State Power Grid Company signed a MOU to conduct a feasibility study on up to 60 TWh electricity export from Russia to China from 2007.

RUSSIAN-UKRAINIAN GAS DISPUTE

2006 started with a strong dispute between Russia's Gazprom and Ukraine's state gas company Ukrnaftogaz. Russia's approach to a transition to market mechanisms in natural gas pricing and gas transportation services was initially welcomed by it counterpart in May 2005. However, there wasn't any progress on the negotiations until the deadline was reached in December 2005, which resulted in the temporarily cutting off of gas supply to the Ukraine, which eventually affected European consumers as the Ukraine continued to take gas from the pipelines. The situation was further exacerbated by extremely strong cold weather conditions in January and February 2006 in Eurasia, from Spain to the north of Siberia.

The dispute brought new impetus to the Russia-European Union energy dialogue, highlighting the different approaches to energy security issues and the need for more cooperation between energy exporters and energy importers.

GAZPROM

As at 31 December 2005, consulting firm DeGolyer and MacNaughton performed an evaluation of Gazprom Group's 24 major fields with gas, condensate and oil (excluding the data on Gazpromneft) reserves accounting for 95, 90 and 90 per cent, respectively. Based on the assessment results, Gazprom Group's proved and probable reserves stand at 20.7 tcm of natural gas, 692.7 million tonnes of oil and 299.5 million tonnes of condensate. Gazprom's capitalisation as at October 2006 reached US$252.4 billion. In this year's FT-500 Gazprom (with a market value in December of 2004 of US$196 billion) was rated forth after ExxonMobil (US$372 billion, December 2005), BP (US$233 billion, December 2005) and Royal Dutch Shell (US$211 billion, December 2005).

In December 2006 Gazprom takes control over Sakhalin-2 project with 50 percent plus one share. Earlier this year Gazprom repeal their proposal for the participation of IOC's in the development of the giant Shtokman offshore natural gas field, claiming an absence of good offers and reduced risks of the project due to the results of recent exploration activity.

ROSNEFT

Rosneft capitalisation through the July's 2006 IPO was enlarged by US$12 billion to US$92 billion, which was the largest offering of shares of any oil company in the world. In the IPO, Rosneft raised US$10.7 billion for 14.9 percent of its shares on exchanges in Moscow and London. Four months later capitalisations exceed US$100 billion.

Rosneft and Sinopec signed an agreement to develop a refining and retailing business in China, similar to the previous one signed with CNPC. Rosneft and a number of Chinese companies will cooperate in oil exploration and production in Russia.

In November 2006 Gazprom and Rosneft, signed an agreement on strategic cooperation. Pursuant to the accords achieved, Rosneft and Gazprom will cooperatively develop the hydrocarbon exploration, production, transportation and processing sectors; natural and associated gas marketing; electric and thermal power generation and marketing; oil and gas field and power equipment production; development of production capacities and industrial facilities; information, ecological, social and staffing support. Rosneft and Gazprom will coordinate activities and exchange geological information on joint projects. In the case of joint project participation in exploration and development, the parties will have an equal stake in joint projects (Gazprom and Rosneft will own 50 per cent each).

Both parties have expressed an interest in liquefied synthetic fuel production based on GTL technologies. Gazprom and Rosneft are planning to cooperate in projects for development of gas processing and gas chemical production capacities in Eastern Siberia and the Far East. The agreement on this strategic partnership was signed for the period up to 2015 taking into consideration an opportunity for further extension for the next five-years.

Rosneft and BP signed a deal to cooperate in the Arctic region through joint studies and further development and exploration and production of oil and gas.

TATNEFT OIL COMPANY

Tatneft became the first Russian oil company to show a decline in resources (by 2.8 percent) after audition by Miller and Lents. However, the company's additional unconventional oil reserves, like bitumen, accounted for more than 15 billion barrels. Synthetic crude production based on Canada's technology started in 2006 and is projected to reach 7 million tonnes in 2007. Advanced technologies to enhance oil recovery contribute to 45 percent of total oil extracted by this company.

The company decided to build a new refinery in 2009 to process 7 million tonnes of heavy and very sour crude and export high-quality petroleum products. This move will also improve the quality of the Russian export crude oil benchmarks Urals and REBCO.

SAKHALIN ISLAND'S OIL AND GAS FIELDS DEVELOPMENT

ExxonMobil under the Sakhalin 1 production sharing agreement started natural gas deliveries to Khabarovsky Kray, and begins pumping its first crude oil for export at the De-Kastri terminal. This marks the start of regular Russian oil deliveries to the Pacific rim, where all three of the world's largest oil importers are situated – the US, China and Japan. Assuming Sakhalin's proximity to Japan, this economy is likely to be a primary customer.

In October 2006 Sakhalin Energy, Sakhalin-2 PSA operator, temporarily suspended gas pipeline construction, facing charges over the violation of environmental conservation legislation, while the expected cost of the project jumped from previous US$12 billion to US$20 billion and has still not been confirmed by the Russian government. In December 2006 Shell, Mitsui and Mitsubishi agreed to sell 50 percent of each stake in the Sakhalin-2 project to Gazprom. Gazprom will have a majority control in the project with 50 percent plus one share. An UBS assessed 7.5 billion US$ deal for 11.5 billion US$ project (at official cost) as a fair price.

CNPC is participating in exploration activity in the Sakhalin-3 project, as the Cantan-3 floating drilling rig spend summer drilling on the Veninsky block.

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SINGAPORE

INTRODUCTION

Singapore is situated in Southeast Asia at the intersection of the Straits of Malacca and the South China Sea. Singapore has a total land area of 699.0 square kilometres and a population of 4.24 million (2004 figure). Despite its small size and population, Singapore is one of the more highly industrialised and urbanised economies in the Southeast Asian region.

A highly developed and successful free market economy, Singapore's gross domestic product (GDP) in 2004,experienced high growth of 8.41 percent reached US$106.26 billion and per capita GDP was US$25,059 (both in 2000 US$ at PPP). The economy depends heavily on exports, and major industries include electronics, chemicals, financial services, oil drilling equipment, petroleum refining, rubber processing and rubber products, processed food and beverages, ship repair, offshore platform construction, life sciences/bioengineering, etc. Because of its strategic location on the Straits of Malacca, Singapore serves as important shipping centre and is host to one of the largest petroleum refining industries in South East Asia. Singapore, however, relies entirely on imports to meet its energy requirements.

Table 33 Key data and economic profile (2004)

Key data		Energy reserves	
Area (sq. km)*	699.0	Oil (MCM)	-
Population (million)	4.24	Gas (BCM)	-
GDP Billion US$ (2000 US$ at PPP)	106.26	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	25,095		

Source: Energy Data and Modelling Center, IEEJ. * Singapore Department of Statistics.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Singapore is a net energy importer. Its domestic energy supply depends on imported oil and gas. In 2004 Singapore's total primary energy supply was 22,730 ktoe. Oil accounted for 79 percent of the domestic supply, natural gas at 21 percent, while coal took a small portion of primary energy supply. More than half of the oil imports or around 57 per cent of supply was re-exported as refinery products, while the rest was retained for domestic consumption. Natural gas supply increased by 18 per cent from 3,955 ktoe to 4,664 ktoe in 2003, mainly as a result of the increasing utilisation of natural gas for electricity generation.

The amount of electricity generation in 2004 was 35,331 GWh in Singapore. By plant types, the installed generation capacity consists of 53 percent steam plants, 30 percent combined cycle plants, 11 percent cogeneration plants, 5 percent gas turbines and 1 percent incineration plants. At the end of 2004, gas contributed to 80 percent of Singapore's electricity production.

FINAL ENERGY CONSUMPTION

In rough terms, the industrial and transport sectors each account for about two-fifths of final energy consumption, while the residential and commercial sectors account for somewhat less than

one-fifth. About three-quarters of final consumption are in the form of oil, mostly for transport and industry, while about a quarter is in the form of electricity.

Singapore's final energy consumption increased from 10,951 ktoe in 2003 to 13,218 ktoe in 2004, showing very high growth of 21 percent. The growth achieved is a reflection of the recovery from the adverse impact of the SARS epidemic.

Table 34 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)*		Final Energy Consumption (ktoe)*		Power Generation (GWh)*	
Indigenous Production	-	Industry Sector	6,861	Total	35,331
Net Imports & Other	43,236	Transport Sector	4,480	Thermal	33,897
Total PES	22,730	Other Sectors	1,877	Hydro	-
Coal	6	Total FEC	11,501	Nuclear	-
Oil	18,062	Coal	104	Others	1,434
Gas	4,664	Oil	10,261		
Others	-	Gas	0		
		Electricity & Others	2,853		

Source: * Energy Data and Modelling Centre, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

POLICY OVERVIEW

PRICES AND EFFICIENCY

There are no energy subsidies in Singapore. Energy prices are allowed to reflect the current market price to ensure that energy is being used efficiently. Electricity tariffs are reviewed to be cost effective. Natural gas and oil prices are set by the individual companies and reflect international market prices of fuel. By allowing price signals to pass through and prevail, consumers will respond to higher prices by learning to use energy more efficiency.

On the supply side, the competition among fuels has accelerated the entry of more efficient and competitive technology in electricity generation. Gas-fired power plants provide a cleaner and more efficient alternative to the traditionally used oil-fired plants. From 2003-2005, the gross efficiency of the system has increased by about five per cent. In order to avoid being replaced, some oil-fired power plants have tried utilising ways to improve efficiency by using other alternative fuels. For example, Power Seraya uses orimulsion, a bitumen based fuel, to keep its existing steam plants competitive.

In the energy end-use sector, a programme to improve the energy efficiency in the transport, manufacturing, consumer and building sectors has been implemented. For the transport sector, a package of incentives for Compressed Natural Gas (CNG) vehicles has been implemented. For instance, tax and Additional Registration Fee (ARF) rebates are given to all new Euro 4 diesel engines and CNG vehicles. For households, the Energy Efficiency Labelling scheme has been introduced to guide consumers' choices when purchasing energy-efficient appliances. The "Energy Smart Building" label will also be recognised for buildings that are designed and constructed to better manage and control their energy performance.

NEW LNG IMPORT

Natural gas is a major fuel used for electricity generation in Singapore. Today, almost 80 per cent of total electricity production is generated from gas-fired combined cycle power plants.

Natural gas was introduced for electricity generation in 1992 when Singapore started importing gas from Malaysia via pipeline. Additional gas is being imported from Natuna and Sumatra, Indonesia which commenced operation in 2001 and 2003 respectively. Starting from the middle of 2006, Singapore imports more natural gas from Malaysia. It is expected that the demand for gas will grow beyond currently contracted quantities and Singapore needs to diversify its energy resources in order to ensure that it is not over-reliant on a single source for its energy needs. As the result, Liquefied Natural Gas (LNG) imports are considered an option for additional gas to meet the rising demand in the future.

According to a feasibility study of LNG import to Singapore, three million ton per year (mtpa) of LNG receiving terminal will be developed to start operations around 2012. Energy Market Authority (EMA), the gas and electricity industry regulator, has now started to proceed with the bidding to build and operate the terminal through a Request for Proposal (RFP) process. EMA targets to call the RFP by end of 2007.

ENERGY MARKET REFORMS

Singapore first restructured the energy sector a decade ago, with the corporatisation of the electricity and gas industries as vertically integrated companies started in 1995. In 2000, the natural electricity transmission monopoly, Power Grid, was separated to keep the infrastructure open to "free access". By 2001, the electricity market reforms were completed. In 2003, the National Electricity Market of Singapore (NEMS) was launched. In addition, liberalisation of the retail market is being implemented in three phases, and began in July 2001. The last phase of full retail market liberalisation is now being under studied to ensure that consumers will be able to enjoy innovative and customised services at competitive prices[74].

ENVIRONMENT AND CLIMATE CHANGE STRATEGY

Climate change is recognised as one of the major environmental challenges confronting the global community today. Greenhouse gas (GHG) emissions are responsible for an unprecedented increase in global temperatures. In Singapore, the primary GHG is carbon dioxide contributed by the energy sector; through the burning of fossil fuels e.g. in power stations, industries and vehicles. Singapore singed the UN Framework on Convention Climate Change in 1997 and ratified the Kyoto Protocol in April 2006, however, at this stage is not required to reduce emissions during the first commitment period.

The actions taken domestically to address climate change in Singapore range from the measures adopted to improve energy efficiency and increasing use of cleaner energy. To this end, in 2002 a voluntary Energy Labelling Scheme for air-conditioners and refrigerators was launched. To further enhance the promotion of energy efficiency, mandatory labelling will be decreed for all air-conditioners and refrigerators from mid-2007. In addition, the Energy Smart Buildings Scheme will also be mandated to promote energy efficiency in buildings.

To promote the use of green vehicles such as compressed natural gas (CNG) or any other hybrid vehicles, Singapore has doubled the Green Vehicle Rebate and extended it until 2007. As of February 2006, there were more than double the number of green vehicles compared with the previous year; that is, there were 208 green vehicles on the road.

In contributing to the global effort, Singapore will develop a holistic climate change strategy that actively engages the public and private sectors to have a better understanding of the causes of climate change and the affects to human society. Four key prongs of action will be examined, which include adaptation to climate change, mitigation of the carbon emissions, raising awareness of climate change and competency building to entail promoting climate-related research and development as well as helping Singapore's companies to gain from the economic opportunities form climate change action i.e. the CDM under the Kyoto Protocol.

[74] Planned to be completed in 2003; however, due to …

NOTABLE ENERGY DEVELOPMENTS

FURTHER DEREGULATION OF THE ELECTRICITY INDUSTRY

The electricity in Singapore had been traditionally vertical integrated and government-owned before corporatisation in 1995, when the industry was restructured to introduce competition. Under Singapore power Ltd., two generation companies, a transmission and distribution company and supply company were formed to facilitate competition in electricity generation and supply. A wholesale electricity market, the Singapore Electricity Pool (SEP), started operating in 1998 in favour of promoting trading competitiveness. Generation companies have to compete with their electricity prices selling to the Pool and supply companies will purchase electricity at competitive prices to be sold to consumers.

In the process of restructuring Singapore's electricity industry, generation and retailing have had to be separated from the transmission and distribution businesses at the ownership level. This was achieved by the divestment of two generation companies, PowerSenoko and PowerSeraya to Temasek Holding in 2001. A new company, the Energy Market Company Pte Ltd (EMC) was also formed as a part of the electricity industry restructuring to operate the electricity Pool. In 2003, to further enhance competition and market efficiency, a new electricity wholesale market started operation to replace the existing electricity Pool. As for the retail market, from July 2001 liberalisation was started and is being in three phases, starting. To date, about 10,000 consumers are able to buy electricity from competitive electricity retailers. The last phase of liberalisation to introduce full retail contestability involves 1.3 million small non-domestic and household consumers, is currently under investigation.

ENERGY DIVERSIFICATION AND EFFICIENCY

In Singapore, more than 60 percent of electricity is generated from natural gas which has been imported from Malaysia and Indonesia since 1992 and 2001 respectively. Starting from middle 2006, a new gas contract with Malaysia will be initiated. As gas demand is expected to exceed supply in the future, imported gas in the form of Liquefied Natural Gas (LNG) is being considered. The feasibility study to import LNG has been carried out by Energy Market Authority (EMA) to evaluate the business, financial and technical aspects and recommend the most efficient and cost effective method for its implementation.

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CHINESE TAIPEI

INTRODUCTION

Chinese Taipei, consisting of the islands of Taiwan, Penghu, Kinmen, Matsu, and several islets is strategically located in the middle of a chain of islands stretching from Japan in the north to the Philippines in the south, and only 160 kilometres off the south-eastern coast of China, is a natural gateway to East Asia. It has an area of about 36,188 square kilometres. Only one quarters of the land is arable and the subtropical climate permits multi-cropping of rice and the growing of fruit and vegetables all year round.

As one of the most densely populated areas in the world, the population of Chinese Taipei was about 22.6 million in 2005 and grew at a rate of 0.4 percent between 2004 and 2005, slower in comparison with the 0.6 percent annual growth rate between 1994 and 2004. The rate of urbanisation growth has been seen to slow down as well. Between 1990 and 2005, the urbanisation of Chinese Taipei has grown at 0.2 percent, reaching at 66.9 percent urbanisation in 2005.

Driven by rapid economic development in the past decade, the economic structure of Chinese Taipei has substantial changed. In the structure of domestic production, the service sector was 69 percent, industrial was 29 percent and the agriculture sector was 2 percent in 2004. Chinese Taipei enjoyed a long period of robust economic expansion from 1994 through 2004, averaging 18.5 percent per year during the same period. Thus, the GDP of Chinese Taipei reached US$374.83 billion in 2004. In addition, the unemployment rate fell from 4.99 percent in 2003 to 4.13 percent in 2005.

Chinese Taipei has very limited domestic energy resources and relies on imports for most of its energy requirements. Oil reserves are 0.38 MCM and gas reserves are around 7.1 BCM. In 2004, electricity generation capacity totalled 41,947 MW.

Table 35 Key data and economic profile (2004)

Key data		Energy reserves**	
Area (sq. km) *	36,188	Oil (MCM) – Proven	0.38
Population (million)	22.62	Gas (BCM)	7.1
GDP Billion US$ (2000 US$ at PPP)	323.47	Coal (Mt) - Recoverable	-
GDP per capita (2000 US$ at PPP)	14,303		

Source: Energy Data and Modelling Centre, IEEJ

* Directorate General of Budget, Accounting and Statistics, Executive Yuan, Taiwan

** US Energy Information Administration

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Chinese Taipei's total primary energy supply (TPES) was 104.3 Mtoe in 2004, up 12 percent from the previous year. By fuel, oil represented the largest share at 44 percent; coal was second (35 percent), followed by natural gas (9 percent), and others (1 percent). With the exclusion of nuclear fuel Chinese Taipei has limited indigenous energy sources and had to import around 98 percent of its required energy needs.

In 2004, Chinese Taipei's small oil field produced 44.6 thousand KL of crude oil, compared to total crude supply of 58.1 million KL. Seventy seven percent of crude oil imports came from the Middle East, though West African countries also are important suppliers. Oil reserves in 2004 stood at 0.38 million cubic metres (MCM), down from 0.44 MCM in 2003. Chinese Taipei imported 68.4 million KL of crude oil and petroleum products and around 22 percent of the petroleum products were export to other economies as the refining capacity of the economy exceeds the domestic demand for petroleum products. To ensure against a supply disruption, Chinese Taipei's refiners are required by the Petroleum Administration Law to maintain stocks of no less than 60 days of sales volumes.

The total refining capacity of Chinese Taipei has reached 1.22 million barrels per day (B/D), of which 63 percent is operated by Chinese Petroleum Corporation (CPC) and the rest is operated by Formosa Petrochemical Corporation (FPCC). CPC – Taiwan's state-owned oil company – is the dominant player in all sectors of the economy's petroleum industry, including exploration, refining, storage, transportation, and marketing. FPCC is a subsidiary of the private Taiwanese petrochemical firm Formosa Plastics Group. In August 2006, FPCC completed an upgrade of the refinery facility at Mailia, increasing their refining capacity from 450,000 B/D to 520,000 B/D. Although current refining capacity in Chinese Taipei exceeds domestic consumption of petroleum products, both CPC and FPCC are considering constructing new additional refineries or expanding their existing plants.

Natural gas resources are also limited in Chinese Taipei. Domestic reserves stand at 7.1 BCM, located offshore on the western side of the island. Domestic demand is met almost entirely by imports of LNG, which mostly come from Indonesia and Malaysia. CPC is responsible for Chinese Taipei's natural gas exploration, production and imports. Chinese Taipei had net imports of 9.0 billion cubic meters (BCM) of liquefied natural gas (LNG) in 2004, compared with 0.78 BCM of indigenous natural gas production. In 2004, primary natural gas supply was 45.6 Mtoe, or a 37 percent increase from the previous year. CPC operates Chinese Taipei's only LNG receiving terminal at Yungan, Kaohsiung, with a handling capacity of 7.87 million tons per year. In order to supply 1.68 million tons of natural gas to the Taiwan Power Company's (Taipower) Datan Power Station by the end of 2007, CPC is now constructing an LNG receiving terminal in Taichung. A long-term agreement has been signed with Qatar's RasGas for LNG supply in order to diversify LNG supply sources. In addition, Japan's NYK-Mitsui join venture was chosen to undertake a 25-year contract to ship the LNG from Qatar to Chinese Taipei in August 2006.

Coal is used for power generation as well as for the steel, cement and petrochemical industries. Since 2001 coal has been totally imported from foreign countries, mainly from Mainland China (41 percent), Indonesia (32 percent), Australia (21 percent), and others. In 2004, primary coal supply was 60.63 million tons or 11 percent higher than the previous year. In order to secure a stable supply of coal, joint ventures to undertake exploration and development overseas are being pursued.

Chinese Taipei has 41.9 GW of installed generating capacity and generated about 205.87 TWh of electricity in 2004. By fuel type, the generation is broken-down as thermal (coal, natural gas and oil) at 76 percent, nuclear at 18 percent, and hydro at 3 percent and geothermal, solar and wind making up the remainder. Taipower, the state-owned electric power utility, currently dominates Chinese Taipei's electric power sector, and Independent Power Producers (IPPs) consisted of only 17 percent of the total capacity. The IPPs are required to sign power purchase agreements with Taipower, which distributes power to consumers. To expand foreign participation, the government decided in January 2002 that foreign investors are permitted to own up to 100 percent of an IPP. In addition, two 1,350 MW advanced light water reactors in the Fourth Nuclear Power Project, are under construction and are scheduled to be in commercial operation by 2006 and 2007, respectively. In Accordance with the "Nuclear-Free Homeland" Policy, Chinese Taipei has no plans to build any additional nuclear plants in the future.

In order to effectively promote renewable energy and respond to the requirements of the private sector for institutionalised incentive measures, Chinese Taipei has proposed a "Renewable

Energy Development Bill". With the Bill, it is hoped that electricity from renewable resources will be able to make up over 12 percent of the total electricity generation capacity.

Table 36 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	13,087	Industry Sector	37,062	Total	205,688
Net Imports & Other	96,061	Transport Sector	13,789	Thermal	157,032
Total PES	104,316	Other Sectors	13,208	Hydro	6,528
Coal	36,453	Total FEC	64,059	Nuclear	37,939
Oil	45,642	Coal	6,913	Others	4,190
Gas	9,869	Oil	39,004		
Others	12,352	Gas	1,891		
		Electricity & Others	16,251		

Source: Energy Data and Modelling Center, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

FINAL ENERGY CONSUMPTION

In 2004, Chinese Taipei's final energy consumption was 64 Mtoe, or 3 percent higher than the previous year. The industrial sector consumed 58 percent of the total, followed by transportation (22 percent) and the other sectors mainly residential/commercial (21 percent). By energy source, petroleum products accounted for 61 percent of total final energy consumption, followed by electricity (25 percent), coal (11 percent) and city gas (3 percent).

The industrial sector has been the primary energy consumer, but its share in total consumption has been declining, as a result of adjustments to the industrial structure and motorisation of the economy increasing transportation consumption. Energy consumption for the industrial sector showed an increase of 3.3 percent in 2004, compared with a decline of 2 percent in 2003. Due to the rise in national income and improvements in the transportation system, the energy consumption of the transportation sector has increased significantly, reaching 13.8 Mtoe in 2004 from 12.9 Mtoe in 2003, at 6.8 percent increase. The consumption of the commercial and residential sectors showed a decrease of 2.2 percent.

By energy source, petroleum products were the most important accounting for 61 percent of total energy consumption. Electricity and others accounted for 25 percent, coal for 11 percent and gas for 3 percent of end use. With improvement in living standards, technological progress and diffusion of electrical appliances, electricity consumption has steadily increased in the past decade at 6.0 percent per year.

POLICY OVERVIEW

The Bureau of Energy is responsible for formulating and implementing Chinese Taipei's energy policy. Also, it is charged with carrying out the Energy Management Law and the Electricity Law. It regulates natural gas utilities, petroleum and LPG filling stations, and the importation, exportation, production and sale of petroleum products. It maintains an energy database, evaluates energy demand and supply, and promotes energy conservation. Further, it implements research and development programmes and promotes international energy cooperation.

The fundamental goal of the Chinese Taipei Energy Policy is to promote energy security, supported by secure import of oil, natural gas and coal as well as the development of domestic energy resources, nuclear, fossil fuels and new and renewable energy. In December 2005, the

Bureau of Energy released an Energy Policy White Paper addressing the current worldwide trends, the short-term and long-term energy security challenges as well as the corresponding measures to be taken. The future energy policy will focus on: (a) stabilising energy supply to increase the use of independent energy sources; (b) increasing energy efficiency and reinforcing the management of energy efficiency; (c) further promoting liberalization of the energy market; (d) coordinating the development of energy, environment and the economy; (e) reinforcing research; (f) promoting education campaigns and expanding public participation.

OIL

As Chinese Taipei is almost completely dependent on oil imports, the government has been trying to secure supplies. To stabilise the oil supply, private oil stockpiling could replace 60 days of supply, which is defined as the average domestic sales and private consumption over the past twelve months. The LPG stockpile should replace no less than 25 days of supply. Using the Petroleum Fund to finance the storage of oil, the government is responsible for stockpiling 30 days of oil demand, which is defined as the average domestic sales and consumption of the previous year.

NUCLEAR ENERGY

In 2001, Chinese Taipei's government announced the "Nuclear-Free Homeland" policy, a policy which is aimed primarily to help end the threat of nuclear weapons, and to review the various uses of nuclear power for peaceful civilian purposes, eliminate nuclear waste pollution and develop renewable energy. In order to realise the no nuclear homeland, the government currently will not support the construction of any new additional nuclear power plants in the future.

NEW AND RENEWABLE ENERGY

The government plans to increase the share of new and renewable energy to 10 percent of total installed electricity generation capacity by 2010. In order to promote the use of new and renewable energy, the government has selected some major areas with viable market potentials: solar, wind power, geothermal energy, small hydro and bio-gas power generation. To advance the development of new and renewable energy technologies and to establish a legal basis for promoting them, the government has drafted the "Renewable Energy Development Bill" and submitted to the Legislative Yuan.

NOTABLE ENERGY DEVELOPMENTS

GREENHOUSE GAS EMISSIONS REDUCTION

In Response to global climate change, Chinese Taipei has developed an Action Scheme to promote greenhouse gas emissions reduction in the energy sector. The scheme focuses on a number of areas and strategies to respond to global climate change, through future energy policy and energy structure by focusing on how to promote green energy and energy efficiency, and strategies to reduce energy demand within the industrial, transportation, residential and commercial sectors. In this regard, around 191 measures have been formulated.

In relation to CO_2 emissions abatement, the major measures contain the promotion of the use of renewable energy, the expansion of the use of low-carbon clean energy, the promotion of energy conservation and energy efficiency improvement, the establishment of a CO_2 management system and emission reduction capacity building in the energy sector. Also, the industrial sector is encouraged to reduce CO_2 emissions through voluntary agreements.

The Bureau of Energy has organised the "Energy Conservation Technology Service Mission" to serve the industrial, business and government sectors providing comprehensive energy

conservation inspection services. Over 600 companies and government buildings have been served. The Bureau also conducted various energy conservation measures, such as promoted energy auditing guidance to large energy consumers, set up energy conservation targets and improvement plans, implemented efficiency management programs on electrical equipment, vehicles and fishing craft engines, expanded the certification of products on the voluntary energy saving labelling scheme, promoted the education of energy conservation. Through these efforts, CO_2 emissions were reduced at least 500 thousand metric tons in 2005.

In terms of renewable energy, Chinese Taipei will continuously encourage and support the development and use of renewable energy technologies. The selection of the first demonstration project of a "solar city" has been completed. Also, 350 thousand households have been installed with solar water heaters and this rate of diffusion ranks as the 10th in the world. In addition, the operation of wind generators has contributed to the reduction of at least 350 thousand metric tons of CO_2 emissions.

IMPLEMENTATION OF BASIC DEMAND PAYMENT MECHANISM OF NATURAL GAS

The new natural gas pricing system took effective from January 2006. To reflect the fixed cost on the demand side and the actual supply cost the consumers have to pay is a basic monthly charge of 60 NT dollars in addition to the actual amount of gas consumed per month under the new pricing system. The implementation of the new natural gas pricing system is expected to improve the rationalisation of gas price, expand the utilisation of clean energy and increase public awareness of energy efficiency.

ELECTRICITY MARKET REFORM

The electricity market of Chinese Taipei started opening up to Independent Power Producers (IPP) in 1995 through three stages, in order to stabilise the power supply and increase the reserve margin to the target of 16 percent. Recently, due mainly to environmental reasons, some of TaiPower's new power plants were not able to meet the construction schedule. As a result, by 2011, the reserve margin is estimated to decrease to 11.5 percent from currently over 16 percent. To prevent the power outage and supply limits, the Ministry of Economic Affairs (MOEA) released the "*Forth Stage of Opening Electricity Market to IPPs*" to encourage IPPs doing investment on new generation capacity of 1,980 MW on June 2006. According to the plan, the target reserve margin is to remain 16 percent. Through consideration of power safety, environmental protection and economic issues, it is allowable to install coal-fired based load units, gas-fired medium load units, and oil- or gas-fired peak load units during the forth stage. The new generated units are expected to start operation during 2011 and 2013. In addition, the construction of new generation units in the northern area will take the highest priority in order to balance the electricity demand and supply and reduce the transmission loss among the regions. Furthermore, the thermal efficiency of coal-fired power units is required to improve to over 40 power and gas-fired power units to over 53 percent.

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THAILAND

INTRODUCTION

Thailand is located in Southeast Asia and shares its borders with Malaysia to the south and Myanmar, Lao PDR and Cambodia to the north and east. It has an area of 513,115 square kilometres and a population of about 64 million at the end of 2004. In 2004 the Gross Domestic Product (GDP) was US$ 471.54 billion (at 2000 US$ at PPP) with GDP per capita of US$ 7,403.

Thailand is highly dependent on energy imports, particularly oil. In 2004, net energy imports accounted for 60 percent of energy supply in the economy; down significantly from 96 percent in 1980.

Table 37 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	513,115	Oil (MBBL)	238
Population (million)	63.69	Condensate (MBBL)	289
GDP Billion US$ (2000 US$ at PPP)	471.54	Gas (TCF)	12.51
GDP per capita (2000 US$ at PPP)	7,403	Lignite (Mt) - Recoverable	2,121

Source: Energy Data and Modelling Centre, IEEJ. * Proved reserves, Department of Mineral Fuels, Ministry of Energy.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2004, Thailand's total primary energy supply was 82,475 ktoe, of which oil accounted for 58 percent, natural gas 27 percent, coal 13 percent and others 2 percent. About 60 per cent of total primary energy supply was met by imports.

Most of Thailand's proven coal reserves are lignite, coal of low calorific value; therefore, imported coal is needed for both electricity generation and the industry sector. In 2004, coal supply was 10,495 ktoe, an 8 percent increased from the previous year, mainly resulting from increasing use in the industry sector. In terms of oil, total supply was 47,683 ktoe in 2004, a 5.3 percent increased from 41,027 ktoe in 2003 due to the extra requirements of fuel oil and diesel to generate electricity in order to substitute natural gas which was not able to be delivered to some areas due to full capacity of the existing pipelines. New capacity expansion of gas pipeline network is scheduled to be completed in 2006.

Thailand is more self-sufficient with respect to natural gas. Around 75 per cent of natural gas supply was met by domestic production while 25 per cent supplied by imports from Myanmar. In 2004, natural gas consumption was 2,341 ktoe, a slightly increase of 2 percent from the previous year due to constraints in the capacity of the existing pipeline network. Natural gas is mainly used for power generation which accounted for almost 80 percent of consumption.

From statistics of the Department of Mineral Fuels, Ministry of Energy, at the end of 2004, Thailand had proven reserves of petroleum both onshore and offshore as follows: 238 million barrels of crude oil, 289 million barrels of condensate, and 12.51 trillion cubic feet of natural gas. For lignite, total reserves include the remaining resources from areas currently in production as well as the proven and probable reserves from undeveloped areas, was 2,121 million tons.

In 2004, the total electricity generation reached 125,726 GWh, a 7.5 percent increase from 2004. The generating capacity consisted of domestic electricity production as well as power purchased from Lao PDR and Malaysia. Natural gas accounts for 71 percent of the fuel used for power generation and the balance is derived from fuel oil, coal, diesel, hydro, and other renewable fuel sources.

Table 38 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	32,358	Industry Sector	16,918	Total	125,726
Net Imports & Other	49,292	Transport Sector	22,811	Thermal	106,171
Total PES	82,475	Other Sectors	14,014	Hydro	6,040
Coal	10,495	Total FEC	53,743	Nuclear	-
Oil	47,683	Coal	5,935	Others	13,515
Gas	22,484	Oil	35,614		
Others	1,814	Gas	2,341		
		Electricity & Others	9,854		

Source: Energy Data and Modelling Centre, IEEJ.

For full detail of the energy balance table see http://www.ieej.or.jp/egeda/database/database-top.html

FINAL ENERGY CONSUMPTION

Thailand's total final energy consumption for 2004 was 53,743 ktoe, an increase of 7.0 percent over the previous year, resulting mainly from the increase in oil and coal consumption by the electricity sector and the increase in demand for oil in the transportation sector due to the price ceiling imposed on retail prices from May 2003 through to August 2004.

The transportation sector was the largest energy consuming sector and accounted for 42 percent of total final energy consumption at 22,811 ktoe. This was 8.0 percent more than consumption in the previous year. The industry sector consumed 16,918 ktoe in 2004, an increase of 8.0 percent over 2003.

Natural gas consumption increased by 1.1 percent compared with the previous year, of which the increase in the electricity and industry sectors were 2.9 percent and 15 percent respectively when compared with the previous year. In 2004, natural gas consumption in electricity sector accounted for 78 percent, following by gas separation plants (14 percent) and the industrial sector (8 percent).

As a result of economic expansion, domestic electricity demand increased by 7.1 percent from the previous year. The demand growth resulted mainly as a result of increased consumption in both the industrial and commercial sectors at 4.9 and 13 percent respectively. The industrial sector consumed the highest share at 44 percent of electricity produced in 2004.

POLICY OVERVIEW

Aiming to reduce the heavy dependency on energy imports, Thailand has implemented various "proactive" energy policies to sustain energy security. Key policy measures include diversification of fuel options and supplies, speeding-up of exploration and development of new energy resources, energy efficiency improvement, and development of new and renewable energy.

DIVERSIFICATION OF FUEL OPTIONS AND SUPPLIES

In the electricity sector, an additional of 20,000 MW is projected to be required during the next ten years in order to meet future demand. One aspect of the efforts to secure electricity supply has been through bilateral MOUs on the purchase of hydro electricity from neighbouring economies which have been signed with Lao PDR, Myanmar and China. In addition, multilateral cooperation on projects to promote power interconnection systems and power trade among the six Greater Mekong Sub-region (GMS) economies is under progress. As for domestic electricity supply, natural gas is the major fuel used, accounting for 71 per cent of total generation by fuel type. Supply sources are both from domestic fields and imports from Myanmar; however, Liquefied Natural Gas (LNG) will be needed in the long run. The Ministry of Energy in collaboration with PTT and PTTEP are currently searching for an appropriate LNG field to jointly develop; there are prospective fields in Australia, Indonesia, Iran, Malaysia, Oman and Vietnam being considered.

SPEED-UP OF EXPLORATION AND DEVELOPMENT OF NEW ENERGY RESOURCES

The new awarding of concessions for domestic petroleum exploration and production onshore and offshore has been boosted to accelerate domestic production. However, Thailand also needs to seek for oil and natural gas reserves abroad to increase energy security by encouraging Thai companies to invest or partake in joint ventures in energy project overseas. So far, Thailand has acquired a growing number of concessions in Myanmar, Oman, Algeria and Vietnam. Such investment is, on one hand, in accordance with the government's proactive energy policy to re-position Thailand's role from an "energy buyer" to an "energy trader." And on the other hand, this helps increase energy reserves and, as a consequence, will enhance national energy security.

ENERGY EFFICIENCY IMPROVEMENT

With regard to energy efficiency improvement, the focuses are on the transportation and industrial sectors. If combined together, these two sectors account for over 70 per cent of total national energy demand. In the transportation sector, the focus is on the improvement of mass transportation infrastructure. The Thai government has planned to invest over the next five years to modernise the rail system and to expand the mass transport networks in Bangkok and suburbs in order to reduce the use of private vehicles, and hence reduce oil consumption. For the industrial sector, the set target is to reduce oil consumption by 20 per cent by 2008, natural gas will thus be used to replace oil in large industries and industrial estates by five per cent of oil demand. In addition, energy efficiency improvement is being intensified in small and medium-sized enterprises (SMEs), with tax incentives put in place. Government support is also given to the energy service business to boost energy efficiency improvement nationwide.

However, energy efficiency improvement will have to also be emphasised in other sectors. For example, in the residential sector, various energy-saving programmes have been launched aiming to make energy saving a habit of the Thai people. As for government building, the target is to reduce the energy consumption both oil and electricity by ten per cent in 2006 from the level of consumption in 2003.

DEVELOPMENT OF NEW AND RENEWABLE ENERGY

The increasing demand for energy and the oil price spikes pose a challenge for Thailand to intensify energy security measures and to reduce the impacts of the oil price crisis. One important measure is to maximise the use of domestic energy resources. For electricity generation, the applications of solar, wind, hydro and biomass resources continue to gain support from the government and private sectors.

In the transportation sector, the use of natural gas for vehicles (NGV) is now a major alternative fuel in Thailand. The government has a target of replacing ten per cent of oil consumption through the use of NGV by December 2008. For this to be realised, related

infrastructure such as natural gas pipelines and service stations will need to be increased, in addition to the development of automotive engines that can run on natural gas.

With regard to bio-energy promotion, Thailand has already devised roadmaps for the development of gasohol and bio-diesel. To this end, government support is provided, for example, through soft loans, investment promotion and the promotion of joint ventures by oil traders. The target is to replace gasoline by gasohol; the plan is to remove 95 octane gasoline from the market in 2007 and 91 octane gasoline in 2012. For bio-diesel, the target is to replace ten per cent of diesel consumption by bio-diesel in the year 2012. The Ministry of Energy and the Ministry of Agriculture are now working closely to speed up the expansion of oil palm plantations and other potential oil plants; jatropha, to be used as feedstocks.

ENERGY AND ENVIRONMENT

Although Thailand is an Annex II economy under the Kyoto Protocol, the economy may be affected by global climate change, the government, therefore, ratified the Kyoto Protocol in August 2002. Thailand has diversified the types of fuel supplied, emphasizing cleaner energy, like natural gas, and more renewable energy sources with a view to reducing the economy's level of carbon intensity. In addition, improvement of energy efficiency and promotion of bio-fuels is to be intensified, such as ethanol and bio-diesel, to reduce fossil fuel consumption. Furthermore, environment impact assessments are required for major energy projects and more public participation in the development of energy infrastructure projects is being encouraged. The government has also promoted and supported other non-conventional, alternative energy production. For example, owners of pig farms and food processing factories are encouraged to install biogas systems to better manage their waste streams and to make use of the biogas in electricity generation. With the instalment of such systems, these enterprises can save on electricity costs and garner some income from the sale the by-products of the waste treatment process (such as organic fertilizer), which further helps to reduce environmental loads.

In the case of electricity generated from renewable sources – solar, wind, biomass/biogas and micro hydro – are also encouraged to replace electricity generated from more carbon intensive fossil fuels.

NOTABLE ENERGY DEVELOPMENTS

ENERGY INFRASTRUCTURE DEVELOPMENT

As for electricity, according to the Thailand Power Development Plan 2004-2015, in the next ten years Thailand will need an additional 20 Gigawatts (GW) of electricity. Under the plan, 700 MW x 4 combined cycle power plants will be constructed by Electricity Generating Authority of Thailand (EGAT) and the other 700 MW by licensed IPP; Gulf Power Generation Co., Ltd. There will also be an additional 18 power plants scheduled to be constructed during the period 2011-2015 with a total generating capacity of 12.6 GW. As for the transmission system, in order to cope with the increasing demand, it is planned that:

- To upgrade the 115-kV transmission line linking the central and southern regions to become a 230-kV system by 2007.
- To improve the 230-kV transmission line to enable electricity flow from the central to north-eastern region by 2007.
- To construct a 500-kV transmission line to import 930 MW of electricity from Nam Theun-2 hydropower project in Lao PDR which is scheduled to be completed in 2009.

- To construct a 500-kV north-northeast transmission line by 2011 in order to sustain reliability over the long-term as new supply sources for the region are sought.

Regarding the electricity supply from neighbouring economies, currently the interconnections linking Thailand and Lao PDR, and Thailand and Malaysia are in operation. However, to further enhance the reliability and efficiency of the electricity system, the construction of interconnection lines between Thailand and Cambodia are scheduled to complete during 2006-2007. Moreover, a feasibility study into the construction of an interconnection from southern China to Thailand via Lao PDR is now under investigation.

With regard to the natural gas infrastructure development, as it is projected that natural gas demand will grow at a rate of five percent per year up to 2015, and in order to cater for this increasing demand the 3rd offshore natural gas pipeline is being constructed. When it is finished, the total pipeline capacity will reach five billion cubic feet per day compared with three billion cubic feet per day as at 2006.

GASOHOL AND BIODIESEL PROMOTION

The development of bio-fuel in Thailand has advanced for some time and is now being intensified with a view to reducing oil imports. Gasohol or the so-called E-10 has been available to consumers in the Bangkok metropolitan areas since 2005 and the outcome has been very satisfactory, with the demand for gasohol increasing ten-fold from January to October 2005. As of October 2005 the consumption was 2.7 million litres per day. It is expected that gasohol 95 utilisation will increase consumption to four million litres per day by the year 2007. The establishment of gasohol stations has also been sped up in 2005, increasing from 730 stations to 2,857 stations. Currently, as of September 2006, the numbers of gasohol stations has increased to 3,444 stations nationwide, with 695 stations in the Bangkok area. On the production side, at present there are six private plants approved to produce ethanol with a total capacity of 1.09 million litres per day, however, only three plants are in operation with a capacity of 400,000 litres per day.

For bio-diesel, the target is to produce 8.5 million litres by 2012. A demonstration project of bio-diesel production from wasted cooking oil in the north of Thailand was launched in June 2005 with the trail blending ratio of bio-diesel of two per cent or known as "B2". The blending ratio is targeted to increase to five per cent and ten per cent by 2007 and 2012 respectively. The outcome has been very successful which can be the prototype of bio-diesel production at the community level in other major cities.

NGV PROMOTION

As a part of the development and utilisation of alternative fuels in the transportation sector, NGV is seen as the best way of utilising Thailand's domestic natural gas resources because it replaces 100 percent of imported oil. The target has been set to replace ten per cent of oil by 2008. The establishment of NGV stations will be sped up from the current 55 stations to 180 stations in 2008. Thailand envisages that 260,000 NGV cars are expected to be run throughout the nation by the end of 2008. Cheap loans for vehicle owners who want to switch to NGV-powered engines are provided by PTT incorporated with a private bank. Loans with instalment payments for as long as 36 months will offer zero interest if the vehicle owners apply before March 2007. It is expected that 25,000 car owners will apply for the loans.

ELECTRICITY SUPPLY REFORM

In December 2003, the cabinet made a significant change to the Thai national electricity company by approving the energy reform model known as Enhanced Single Buyer (ESB). This model allowed Electricity Generating Authority of Thailand (EGAT) to be the sole electricity buyer, transmitter and wholesaler as well as maintained its status as the national grid operator. However, the decision to privatise EGAT was in response to public concern over the stability of

the economy's electricity supply; one contentious issue was how assets would be managed after EGAT went public, such as dams which are also used for agricultural purposes. If profit is the priority, dams should be mainly used for power production. Another issue is ownership of the power grids. And a critical concern was the lack of supervisory body. As a result, in March 2006, the Supreme Administrative Court nullified the privatisation on grounds that the process violated the Constitution. The Court revoked the two royal decrees supporting EGAT's privatisation. One served as EGAT's charter and the other ordered the dissolution of the status of EGAT as a state enterprise. As a result of this verdict, EGAT remains a state enterprise and all the plans for its stock market listing have been cancelled.

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UNITED STATES

INTRODUCTION

The United States (US) is the world's largest and most influential economy, with a GDP of US$10.6 trillion (in 2000 US$ at PPP) in 2004. The US is located in North America between Canada and Mexico. It has a population of 294 million people (2004), and spans 9.6 million square kilometres.

The US enjoyed a long economic expansion from 1991 through 2000. Growth was particularly robust from 1995 to 2000, averaging 3.8 percent per annum. A brief recession slowed growth to 0.8 percent in 2001, recovering to 1.6 percent in 2002, 2.7 percent in 2003 and 4.2 percent in 2004. The unemployment rate rose from 5.8 percent in 2002 to 6.0 percent in 2003 before decreasing to 5.5 percent in 2004 as economic growth recovered.

The US is the largest producer, consumer, and importer of energy in the world. It is also rich in energy resources. At the end of 2004, there were 3,480 MCM of proven oil reserves, 5,293 BCM of natural gas reserves and 246.6 billion tonnes of coal reserves. There was 933.4 GW of electricity generating capacity in 2004 of which 77 percent was thermal, 11 percent was nuclear, 10 percent was hydro and renewable energy (biomass, geothermal, solar and wind etc) made up the remaining 2 percent. Due to a large, wealthy population and broad industrial base, the economy consumed 5.4 toe per capita in 2004, nearly four times the APEC average and far in excess of production.

Table 39 Key data and economic profile (2004)

Key data		Energy reserves	
Area (sq. km)	9,631,418	Oil (MCM) – Proven**	3,480
Population (million)	293.66	Gas (BCM) – Proven**	5,450
GDP Billion US$ (2000 US$ at PPP)	10,573	Coal (Mt) –Recoverable***	246.6
GDP per capita (2000 US$ at PPP)	36,004		

Source: Energy Data and Modelling Centre, IEEJ. * CIA World Fact book.
** Oil and Gas Journal, 2005 *** Data are at end of 2005, BP Energy Statistical Review, 2005

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2004, total primary energy supply in the US was about 2,3267 Mtoe. By fuel type, 41 percent of supply came from crude oil and petroleum products, 23 percent from coal, 22 percent from natural gas and 14 percent from nuclear, hydro, geothermal and other fuels. The US imported about 31 percent of its energy requirements in 2004.

In 2004, the US used approximately 866 Mtoe of petroleum for final energy consumption. Petroleum product supply grew 1.5 percent per annum during the 1990s, but domestic crude oil production levels declined by 2.2 percent per year as oil exploration and production companies turned their attention to cheaper, less mature basins in Africa, Asia and the Middle East. While 42 percent of crude oil and products demand was met by

net imports in 1990, the net import share had climbed to 56 percent by 2003. About 43 percent of imported oil in 2004 comes from OPEC economies. Neighbouring Canada and Mexico are the largest non-OPEC suppliers. Growth in the transportation and industrial sectors has been driving demand for petroleum products. Four-fifths of the economy's oil reserves are located in Texas, Alaska, Louisiana and California, which are the four largest states in terms of current oil production.

The US contains about 3.0 percent of the world's natural gas reserves. Primary natural gas supply totalled 515 Mtoe in 2004, exceeding domestic production by 22 percent. Most of the production shortfall was met by imports from Canada through an extensive network of pipelines. Gas use by industry and power generators has grown because natural gas is a clean fuel that favours environmental approval. Growth was assisted by a period of falling wellhead gas prices following their deregulation in the 1980s and by an expanding pipeline network that made gas more widely available. From 1990 to 2003, the annual growth rate of natural gas consumption was about 14 percent, although consumption fell about 5 percent in 2003 due to high gas prices.

At the close of 2003, the US natural gas transportation network included more than 226 gas pipeline systems, more than 306,000 miles of pipeline, and more than 178 Bcf/d of gas transportation capacity. During 2003, total U.S. gas pipeline system mileage increased by about 1 percent while the overall system capacity increased by slightly more than 5 percent. There are currently approximately 400 underground gas storage sites located in the US, operated by 127 companies. On balance, interest is growing in LNG as a source of natural gas for US electric power generation and also as a source that would provide supply flexibility. EIA expects that LNG imports to the US will increase sharply beginning in 2007, growing to 2.2 Tcf in 2010 and 4.8 Tcf in 2025. During 2003, the US received about 506 Bcf of LNG, mainly from Trinidad and Tobago, Algeria, and Qatar.

Table 40 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation GWh)	
Indigenous Production	1,642,282	Industry Sector	300,211	Total	4,147,705
Net Imports & Other	714,255	Transport Sector	632,351	Thermal	3,032,877
Total PES	2,326,754	Other Sectors	661,273	Hydro	271,118
Coal	545,194	Total FEC	1,593,835	Nuclear	813,339
Oil	947,469	Coal	34,264	Others	30,371
Gas	514,928	Oil	866,393		
Others	319,162	Gas	335,043		
		Electricity & Others	358,135		

Source: Energy Data and Modelling Centre, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)

Primary energy supply of coal in the US totalled 545 Mtoe in 2004. US coal reserves are concentrated in Appalachia and key western states. Appalachian coal, which accounted for 35 percent of production in 2003, is mainly high-sulphur coal from underground mines. Western coal, which accounted for most other production, is mainly low-sulphur coal from surface mines. Western coal production, which first surpassed that of Appalachian coal in 1998, was given a major boost by the Clean Air Act Amendments of 1990, which have required the reduction of sulphur emissions from coal combustion since 1995.

The US is the fifth largest coal exporter in the world behind Australia, South Africa, Indonesia and China. Since 1998, US coal exports have fallen sharply due to lower world coal prices, increased competition among coal-producing economies, and substitution of natural gas for coal in power production. In 2002, US coal exports fell to their lowest level of 40 million metric short tons since 1961, as a strong dollar made coal from elsewhere cheaper and high spot prices for domestic coal made it attractive for producers to sell at home. In 2004, the coal export increased to 48 million metric short tons, of which nearly half went to Canada. In coming years, the US coal industry is expected to continue to face strong competition from other coal-exporting countries, with limited or negative growth in import demand in Europe and the Americas.

The US produced 4.15 million GWh of electricity in 2004 with 73 percent coming from thermal plants, 20 percent from nuclear power, 7 percent from hydropower, and 1 percent from other sources.

In August 2003, a huge electric power blackout hit large parts of the north eastern United States, the Midwest, and southern Canada late in the afternoon. Power was knocked out for at least several hours in major cities like New York, Detroit, Cleveland, and Toronto. Three months later (November 2003), the U.S.-Canada Power System Outage Task Force released an investigative report which concluded that the blackout was "largely preventable" and cited several failures by regional utility companies and regulators.

The US generates more nuclear power than any other economy in the world but has not had any new nuclear power plants built since 1977. The Three Mile Island accident in 1979 raised concerns about nuclear power plant safety while ad-hoc regulatory responses to these concerns made some new plants very expensive; both factors deterred further expansion. But the average utilisation rate of the 103 commercial nuclear plants has risen steadily to over 90 percent in 2002. In 2003, the utilisation rate dropped to 87.9 percent and came back to 90.5 percent in 2004. Moreover, many nuclear plants have applied to the Nuclear Regulatory Commission (NRC) for 20-year extensions of their operating licenses, to 60 years. As of October 2004, the NRC had approved license extensions for 26 nuclear units and had applications for another 20 extensions under review, while more than 20 other units had informed the agency of their intent to seek extensions by 2012.

FINAL ENERGY CONSUMPTION

In 2004, end use energy consumption in the US totalled 1,594 Mtoe. Broken down by sector, transport consumed 40 percent, industry accounted 19 percent, and the rest 41 percent. By fuel, petroleum accounted for 54 percent of consumption, natural gas 21 percent, coal 2 percent, and electricity and other fuels 22 percent.

POLICY OVERVIEW

The present National Energy Policy (NEP) was released in May 2001 by the Bush Administration, who took office in January 2001. A primary goal of the Policy is to add supply from diverse domestic sources, which include not only oil, gas and coal but also nuclear and renewable energy. This is high-lighted by the recent imbalance between supply and demand as well as increased dependence on foreign sources of energy. NEP calls for new, environmentally friendly technologies to increase energy supplies and encourage cleaner, more efficient energy use, which includes clean coal, advanced nuclear and hydrogen technologies. It also seeks to modernize energy infrastructure which is deteriorating and strained to capacity. In August 2005, the Energy Policy Act of 2005

(EPAct) was signed into law as a comprehensive energy legislation after 4 years of debate on several issues including drilling for oil in the Arctic National Wildlife Refuge.

TECHNOLOGIES AND POLICIES FOR ADVANCED ENERGY FUTURE

The US is the world's largest economy, and remains the world's largest single source of anthropogenic greenhouse gas emissions. To add energy supply from diverse sources, while addressing the climate change issue, the Bush Administration has proposed several initiatives:

Clean Coal Technology

In 2003, the FutureGen project was initiated to build a 275- megawatt demonstration power plant designed to separate carbon and hydrogen streams from coal so that all the carbon can be sequestered without entering the atmosphere. It is a $1 billion, 10-year project and is being led by the FutureGen Alliance, non-profit industrial consortium representing the coal and power industries.

Hydrogen Technology

In 2003, the Hydrogen Fuel Initiative was launched to accelerate the transition to a hydrogen economy in both furthering the technology of hydrogen fuel cells and a construction of fuelling infrastructure with a provision of $1.2 billion. Through the Hydrogen Fuel Initiative, automotive and energy industries are working to realise the commercialization of fuel cell vehicles by 2020.

Nuclear Power Technology

New nuclear energy systems hold the promise of retaining nuclear power as a major option after generation from current plants is retired. The Generation IV technology roadmap, which was issued in 2002, identified the six most promising next generation nuclear technologies which are safer, more affordable, and more proliferation-resistant. Very High Temperature Reactor (VHTR) system, known as the Next Generation Nuclear Plant (NGNP) is one of these technologies, which is cost-effective and offers the potential to produce commercial quantities of hydrogen.

The EPAct contains critical provisions that encourage the building of new nuclear plants in the US.

Fusion Energy Technology

In January 2003, the Bush Administration committed the US to participate in the ITER (International Thermonuclear Experimental Reactor) project, the largest and most technologically sophisticated research project in the world to harness the promise of fusion energy.

Renewable Energy and Hybrid and Fuel-Cell Vehicles:

The Bush Administration has called for tax incentives totalling $4.1 billion through 2009 to spur the use of clean, renewable energy, and energy-efficient technologies, such as hybrid and fuel-cell vehicles, residential solar heating systems, renewable energy produced from landfill gas, wind, or biomass, and efficient combined heat and power systems. The EPAct requires that by 2012, at least 7.5 billion gallons per year of renewable fuel (such as ethanol and biodiesel) be blended into the nation's fuel supply. It also authorizes the establishment of incentives to ensure that annual production of one billion gallons of cellulosic biofuels is achieved by 2015.

ENERGY CONSERVATION

Fuel Efficiency Standards and Transportation Technology

Corporate Average Fuel Efficiency (CAFÉ) standards, have been in place since 1978, and have helped to bring about a huge improvement in the efficiency of the vehicle fleet. However, CAFÉ standards have been static at 27.5 miles per gallon (mpg) for cars since 1985 and 20.7 mpg for light trucks since 1996. Due to increased sales of sport utility vehicles and minivans, which fall within the light truck category, average fleet efficiencies have even declined slightly in recent years, reaching a 20-year low of 24.4 mpg in 2001. In 2001, a statutory prohibition on examination of fuel efficiency standards by the Department of Transportation (DOT) was lifted. In 2003, DOT issued a rule raising the fuel CAFÉ standards for light trucks to 21.0 mpg in 2005, 21.6 mpg in 2006 and 22.2 mpg in 2007. In March 2006, a new rule was issued to further increase these standards to 24 mpg in 2011.

In addition to fuel economy standards, several other policies are proposed or in place to raise the efficiency and limit the environmental impacts of transport. The Department of Energy (DOE) has invested heavily over the last decade, with major US automakers, in the Partnership for the Next Generation of Vehicles and then the Freedom CAR initiative, to support research and development of gasoline hybrids and fuel cell vehicles that could ultimately triple the efficiency of vehicles on the road.

Building and Appliance Standards

DOE has energy efficiency standards in place for all major types of energy-using appliances, including air conditioners, clothes washers and dryers, space and water heaters, kitchen ranges and ovens, refrigerators and freezers, and lighting. In 2001, new minimum efficiency standards were issued for central air conditioners and heat pumps, water heaters, clothes washers, and some types of commercial heating and cooling equipment. The NEP called for appliance standards to be strengthened for products already covered and extended to additional products where technologically feasible and economically justified.

The highly successful Energy Star labelling programme clearly signals high efficiency in office buildings and appliances to consumers. The NEP recommended that the program be expanded from office buildings to include schools, stores, homes, and health care facilities. It also recommended that Energy Star labels be extended to additional products, appliances, and services. Further, the NEP recommended doubling expenditure on weatherisation of houses for low-income households, as well as support for educational programs related to energy development and use.

MODERNIZING ELECTRIC POWER INFRASTRUCTURE

America's electric infrastructure of power lines, substations, transformer banks, and switchyards is aging and suffering from underinvestment. Over the past several decades power plants have become cleaner and more fuel efficient as have electricity-using appliances and equipment. However, during that same time period, the vast majority of the equipment that delivers electricity from power plants to consumers has not been upgraded. Forecasts show that future investment in electric transmission and distribution are not expected to keep pace with the growth in demand.

The Office of Electric Transmission and Distribution is dedicated to the modernization of America's electric grid. The President's 2004 state-of the union address contained a call to action for modernizing the grid. The EPAct contains measures that: repeal out-dated rules that discourage investment in new infrastructure; offer tax incentives for new

transmission construction; and encourage the development of new technologies to improve the efficiency and reliability of the power grid.

STRATEGIC PETROLEUM RESERVE

The U.S. imports more than half of its oil requirements and the economies heavy dependence on oil imports are expected to continue. A vital policy instrument in this context is the Strategic Petroleum Reserve (SPR), established in 1975. With the capacity to hold 727 million barrels, the SPR is the largest emergency oil stockpile in the world. The emergency drawdown of the SPR has been implemented two times in the past, one in 1991 at the time of Iraqi invasion of Kuwait and the other one in 2005 after Hurricane Katrina. The EPAct directs the Secretary of Energy to expand its current capacity to one billion barrels to ensure the US is able to respond to significant disruptions in oil supplies. The site selection process for a new storage location is under way.

NOTABLE ENERGY DEVELOPMENTS

INTERNATIONAL COOPERATION

- • Global Nuclear Energy Partnership (GNEP)

In Feb, 2006, the Department of Energy announced the creation of GNEP. GNEP aims to increase access to clean, non GHG emitting nuclear energy throughout the world; increase the amount of energy generated by nuclear fuel while decreasing the amount of material that must be disposed of in waste repositories and; reduce the risk of proliferation by providing fuel cycle services to developing countries so they do not need to develop uranium enrichment or spent fuel reprocessing capabilities.

- • Asia Pacific Partnership on Clean Development and Climate (APP)

APP is a voluntary public – private partnership among six Asia Pacific nations – namely, the US, Australia, China, India, Japan and Korea. Ministers from the six Partner countries held an inaugural meeting in January 2006 in Sydney, Australia. The aim of APP is to accelerate the development and deployment of clean energy technologies, focusing on expanding investment and trade in cleaner energy technologies, goods and services in key market sectors. The Partners have approved eight public/private sector task forces covering: cleaner use of fossil energy, renewable energy and distributed generation, power generation and transmission, steel, aluminium, cement, coal mining and efficiency improvement in buildings and appliances

- • Generation IV International Forum (GIF)

GIF, which was established in 2001, is a US led multilateral partnership fostering international cooperation in research and development for the next generation of nuclear energy systems. The Generation IV technology roadmap was completed with the participation of experts from GIF economies. Membership consists of Argentina, Brazil, Canada, France, Japan, Korea, South Africa, Switzerland, the United Kingdom, and Euratom. China and Russia are expected to join GIF by November 2006.

THE FIRST ANNIVERARY OF THE ENERGY POLICY ACT OF 2005

The Energy Policy Act of 2005 provides a long-term strategy to confront energy challenges in a balanced, comprehensive and environmentally sensitive way. This strategy focuses on diversifying energy supply, increasing energy efficiency and on energy conservation in homes and businesses, improving vehicle fuel efficiency, and modernizing key energy infrastructure. Key implementation actions to date include:

1. Diversifying Energy Supply

Promoting Alternative and Renewable sources of Energy

- Developing new bio-refineries: DOE announced a $50 million funding opportunity for a demonstration project. Currently the Department has received more than 50 letters of intent to participate.
- Using loan guarantees to encourage private investment in new energy technologies: DOE established a Loan Guarantee Program Office and issued program guidelines that will govern the first round of loan guarantee applications. This program will provide backing for up to $2 billion of loans to finance new energy projects.
- Producing energy from wind, solar, biomass and hydroelectric sources: 27 new ethanol plants have broken ground since the enactment of the EPAct. The 2007 Fiscal Budget proposed the Solar America Initiative (SAI). DOE announced a funding opportunity for $170 million over 3 years for public/private partnerships to advance solar energy technologies.
- Encouraging safe and secure expansion of nuclear energy
- Encouraging the construction of advanced nuclear power facilities: Companies that take risks and enter the market first, after a 30- year hiatus, should not be penalized by hold-ups that are not their fault. The final rule was announced that establish the process for the utility companies to qualify for a portion of the $2 billion in federal risk insurance.
- Establishing the Global Nuclear Energy Partnership (GNEP): DOE announced a funding opportunity for sites interested in hosting GNEP facilities, including an advanced burner reactor and a consolidated fuel treatment facility.
- Funding research to support advanced reactor technologies: DOE has submitted a report that recommended greater industry participation and an accelerated schedule for the Next Generation Nuclear Plant (NGNP) project.
- Increasing Domestic Production of Conventional Fuels
- Creating adequate Liquefied Natural Gas (LNG) infrastructure: Streamlining the regulatory review process is under way to expedite the siting of new LNG import terminals. Since the EPAct was passed, the Federal Energy Regulatory Commission (FERC) has approved three new LNG import facilities and expansions at two operating or previously authorized import facilities. In 2006, LNG forums were held for public education and information several times.
- Expanding the availability of power from clean coal technologies: The Clean Coal Power Initiative (CCPI) is underway. The goal is to dramatically reduce emissions of pollutants such as sulphur dioxide, nitrogen oxide and mercury, and improve the coal to product (electricity) efficiency for all types of coal by 2020. The FutureGen Alliance recently announced a short list of candidates competing to host the

prototype plant. The US has been joined in this demonstration project by India and Korea.

- Enhancing oil and natural gas production through carbon dioxide injection: The EPAct calls for a competitive grant to support CO_2 EOR/sequestration projects. DOE reports released in 2006 indicate that an additional 89 billion barrels of oil could be recovered through CO_2 EOR in the United States.
- Accelerating the development of oil shale, oil sands and other unconventional fuels: The task force which coordinates and accelerates the commercial development of these fuels has been established, and is expected to make its initial analysis and recommendations on methods to accelerate these energy sources shortly.
- Advancing methane hydrate research: The interagency (DOE/the Department of Commerce, Defence, and the Interior/The National Science Foundation) Roadmap for Methane hydrate Research and Development was released in July 2006. A 5 year research plan will be developed based on this roadmap.

2. Investing in Science and Technology

- Moving toward a hydrogen economy: In 2006, a Hydrogen Technical Advisory Committee was created to coordinate and oversee the Hydrogen Fuel Initiative and a report on recommendations for promoting the availability of solar and wind technologies for the production of hydrogen were completed.
- Leading the way on biofuels research: DOE recently announced that it will spend $250 million to fund the creation and operation of two new Bioenergy Research Centers to accelerate basic research on the development of cellulosic ethanol and other biofuels.

3. Increasing Energy Efficiency in Homes and Businesses

- Improving the energy efficiency of consumer products: A number of efficiency standards prescribed by the EPAct were issued in 2005. In 2006, a report was submitted to Congress, announcing a schedule for all upcoming appliance efficiency standards for 23 different products.
- Tax incentives for encouraging smart energy practices: To increase energy efficiency and encourage conservation, the EPAct establishes new tax incentives for consumers who buy and use EnergyStar products, and businesses and manufacturers who use energy efficient building products and practices.
- Promoting energy efficiency and savings at federal agencies: The EPAct calls on federal agencies to lead by example and improve their energy efficiency. The Energy Savings Performance Contract program allows private contractors to help federal agencies improve the energy efficiency of their facilities.
- Reducing industrial energy consumption: In 2005, a campaign was announced to save energy from the most energy consuming plants in the economy by providing for voluntary energy savings assessments. As of July 2006, 124 energy savings assessments had been completed.

4. Improving the Energy Efficiency of Cars and Trucks

- Establishing a renewable fuel standard: The current pace for ethanol plant development and construction has been sustained and accelerated by an escalating requirement for biofuel production (7.5 billion gallons per year by 2012)

- Providing consumer tax credits for energy-efficient vehicles: The tax credits (up to $3,400 per vehicle) to encourage consumers to purchase energy-efficient vehicles, including hybrid, fuel cell and alternative fuel motor vehicles are available for eligible cars purchased on or after January 1, 2006. The credits extend over the next 6-10 years.

5. Modernizing Electric Power Infrastructure

- Reporting on electric energy transmission congestion and the designation of National Interest Electric Transmission Corridors: DOE published the National Electric Transmission Congestion Study in August 2006. The report identifies three groups of congestion areas that merit further federal attention.
- Designating energy corridors: The EPAct directs the Departments of Energy, the Interior, Agriculture and Defence to designate multipurpose energy corridors (for oil, natural gas and hydrogen pipelines and electricity transmission and distribution facilities) on federal lands by August 2007 for the western states, and by August 2009 for the rest of the economy.

With the aim of modernizing the nation's electrical energy infrastructure through the introduction of advanced technologies: an industry workshop was held in February 2006 to obtain input from stakeholders and to develop a plan of action. DOE completed a 5-year research and development plan and has begun to restructure its research priorities to support the plan.

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VIET NAM

INTRODUCTION

Vietnam is located in South East Asia and shares boarders with Cambodia, Laos and China. It has an area of 331,111 square kilometres and a population of about 82.16 million (2004). With the start of reform policies for an open market-oriented economy in 1986, the economy of Vietnam has developed considerably. GDP grew at an annual average rate of 7.5 percent from 1991 to 2004. In 2004, GDP reached US$194.29 billion, however, Vietnam's income per capita is still low at US$2,365 in 2004 (both GDP and income in 2000 US$ at 2000 PPP). The government has setup a target of achieving GDP in 2010 that is more than 2.1 times greater than that of the year 2000. The GDP growth rate shall reach 7.5 – 8 percent per year, with the goal to achieve annual growth of over 8 percent; export turnover shall increase annually at 16 percent; the nation's total annual investment capital shall reach around 40 percent of GDP and controlling population growth under 1.14 percent in the period up to 2010.

Energy is a key component in Vietnam's economy which contributed greatly to the economy's recent industrialisation and export earnings. Vietnam is endowed with diverse fossil energy resources such as oil, gas and coal, as well as renewable energy (such as hydro, biomass, solar and geothermal). In 2005, total energy reserves stood at about 615 million tonnes of oil, 600 BCM of gas, 3880 million tonnes of coal and 20,000 MW of hydropower potential. Natural gas and crude oil are found mainly in the southern region (offshore), while coal reserves (mostly anthracite) are located in the northern region. Since 1990, Vietnam has been a net energy exporter, exporting mainly crude oil and coal.

Table 41 Key data and economic profile (2004)

Key data		Energy reserves*	
Area (sq. km)	331,111	Oil (Mt) - proven	615
Population (million)	82.16	Gas (BCM) - proven	600
GDP Billion US$ (2000 US$ at PPP)	209.23	Coal (Mt)	3,880
GDP per capita (2000 US$ at PPP)	2,547		

Source: Energy Data and Modelling Center, IEEJ. See http://www.ieej.or.jp/edmc/edmc_db/index-e.html

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2004, total primary energy supply (TPES) in Vietnam was 24.35 Mtoe. This indicates a total increase of 64 percent from the year 2000, or a 13.2 percent annual growth rate. By fuel type, 47 percent of supply came from petroleum products, 27 percent from coal, 19 percent from natural gas, and 6 percent from others resources.

In 2005, Vietnam has 615 million tonnes of proven oil reserves, but that total is likely to increase as exploration continues. Crude oil production has grown rapidly from only 2.75 Mtoe in 1990 to 21.1 Mtoe in 2004. Vietnam has eight operating oil fields: Bach Ho, Rong, Dai Hung, Rang Dong, Ruby, Emerald, Su Tu Den and Bunga Kekwa. Most oil exploration and production activities occur offshore in the Cuu Long and Nam Con Son Basins. Having no refinery capacity of its own, Vietnam exports all of its crude oil production and imports petroleum products – crude oil being a key export product of Vietnam. In the last 10 years, the economy's oil exploitation and

exports grew an annual growth rate of 11.8 percent. In 1995, oil production totalled 7.65 million tonnes and this figure increased to 20.3 million tons in 2004. The export value of crude oil has also increased year on year, from $3.47 billion in 2000 to $5.6 billion in 2004 and an estimated $7.4 billion in 2005. Imported oil products grew from 5.1 Mtoe in 1995 to 11.5 Mtoe in 2004 at an annual growth rate of 10.5 percent; the import value of oil products was $3.57 billion in 2004. Oil product demand has increased from 7.78 Mtoe in 2000 to 11.55 Mtoe in 2004; the average growth rate was about 10.4 percent per year. Oil has been the predominant energy source in Vietnam for a number of years, accounting for 47 percent of the economy's TPES in 2004; however, the share of oil in TPES has decreased significantly from 1995 when it was 52 percent of the total.

Vietnam's gas reserves are more promising than known oil reserves with large confirmed amounts of gas in Vietnam's offshore basins. In 2005, proven gas reserves were estimated at about 600BCM; this figure is likely to change because some of the main oil and gas discoveries are still at an early stage of appraisal. The resources are distributed around the whole economy, although the majority are expected to lie within offshore basins. Besides several big-reserve fields that have been discovered such as the Cuu Long and Nam Con Son basins in the South East offshore; Malay-Tho Chu basin in the South West offshore, and the Song Hong Basin in the North region. Cuu Long basin is one of the developed natural gas production areas and is mostly produced as associated gas from crude oil production. A 160 km pipeline from the Bach Ho field has been operating since 1995; associated gas has been gathered and transported onshore to fuel power plants. The gathering, transportation and processing systems for the associated gas from the Bach Ho and Rang Dong oil fields have a capacity of 2 BCM per year and are capable of supplying 1.7 bcm of dry gas, 350 thousand tons of LPG and 130 thousand tons of condensate for domestic use. The gas development complex at Lan Tay field of Block 06.1 in the Nam Con Son basin has an output of 2.7 BCM per year and a gas pipeline of 400 km long with a maximum capacity of 7.5 BCM per year both of which were completed in November, 2002. Thus, from 2003, the total gas supply of Vietnam has been 2.7 bcm per year, which is capable of supplying enough gas to the Phu My power generation complex that has a generating capacity of 4000 MW. The natural gas demand of Vietnam has jumped from 0.2 Mtoe in 1995 to 4.6 Mtoe in 2004, at an annual average growth rate of 43 percent; the biggest increase in gas use has come from power generation. The share of natural gas in TPES has increased from 2.0 percent in 1995 to 19 percent in 2004.

Vietnam has 2 main coal fields: anthracite coal is found mainly in Quang Ninh Province in northern Vietnam with reserves of about 3.8 billion tonnes, at a level of 300m (below sea level), and over 10 billion tonnes at a level of 1000m. Brown coal (sub bituminous) basin in the Red River Delta with reserves of hundreds of billion of tonnes was discovered, and exploration and survey work have already been done for this coal basin; Vietnam is carrying out studies and calling for foreign investment in order that this coal basin will be mined in the next 10 to 15 years. Vietnam's coal production increased steadily from 4.6 million tonnes in 1990 to 25 million tonnes in 2004, an average annual growth rate of 13 percent. In 2005, Vietnam produced about 30.8 million tonnes of coal. These increases of coal production have resulted in a growth in exports and domestic demand. In 2005, Vietnam exported 14.7 million tones, a record amount of coal. Exports made up nearly 50% of the coal industry's sales for the year 2005. Vietnam coal was exported to many economies such as China, Japan, Korea, Taiwan, Thailand, and France. Primary coal demand increased by 11.1 percent per year throughout period 2000 to 2004 from 4.37 Mtoe to 6.66 Mtoe. In 2004 coal used for power generation was about 1.68 Mtoe (accounting for 20 percent); for the industrial sectors (namely, primarily producing construction material: glazed terra-cotta, porcelain, glass, chemical fertilizer, paper, metallurgy etc) about 4.94 Mtoe (59 percent); other sectors 1.7 Mtoe (21 percent).

The electricity generation of Vietnam has increased from 26.56 TWh in 2000 to 44.53 TWh in 2004 at an annually growth rate of 13.8 percent. The structure of primary energy use for Vietnam power plants has changed within the last decade. Oil product use has declined substantially, falling from 8.8 percent of total generation in 1995 to 3.7 percent in 2004. The contribution of gas to electricity generation has increased from 5.1 percent of total generation to 42.7 percent. The share of electricity generation from coal has slightly increased from 13.8 percent to 15.3 percent. Since 1995, hydropower use has decreased at the expense of natural gas; hydropower production has

decreased rapidly from 72.2 percent of total generation to 38.4 percent in 2004. Foreign companies are becoming involved in the growing Vietnamese power market. In 2004 electricity production generated from IPP's was about 6 TWh and accounted for 13 percent of total electricity generation. In 2004, the total installed capacity operated by Electricity of Vietnam (EVN) and IPP's was 8,831 MW and 2,224 MW respectively, making a total of 11,055 MW, of which 4227 MW (or 38 percent) was hydropower, coal fired power was 1380 MW (13 percent), gas fired power was 4100 MW (37 percent) and oil fired power 1348 MW (12 percent.).

Biomass for the most part is not commercially traded, but it is an important source of energy in the residential sector in rural areas, although its share in total energy use has been declining. For the lower income groups in rural areas, the primary source of cooking fuel is wood and biomass. Biomass has been the predominant energy source in Vietnam for a number of years, accounting for 47 percent of the country's TPES in 2004, while biomass's share of TPES has decreased significantly from 1995 when it was 70 percent of the total.

Table 42 Energy supply & consumption for 2004

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	39,404	Industry Sector	6,956	Total	46,029
Net Imports & Other	-14,341	Transport Sector	7,242	Thermal	28,363
Total PES	24,350	Other Sectors	4,997	Hydro	17,666
Coal	6,664	Total FEC	19,195	Nuclear	-
Oil	11,546	Coal	4,669	Others	-
Gas	4,614	Oil	11,085		
Others	1,526	Gas	21		
		Electricity & Others	3,420		

Source: Energy Data and Modelling Center, IEEJ. See http://www.ieej.or.jp/cgi-bin2/J101outbcgi.sh

FINAL ENERGY CONSUMPTION

Vietnam's total final energy consumption (TFEC) has grown at a steady annual growth of 13 percent from 2000 to 2004. In 2004, the TFEC was 19,195 ktoe, up 13 percent from that of 2003.

By fuel source, oil products contributed the largest share with 58 percent of consumption, followed by coal at 24 percent, electricity at 18 percent, and gas at 0.1 percent. Between 2000 and 2004, consumption of electricity grew the fastest of all energy sources at an annual rate of 15 percent.

Industry is the one of biggest energy consumers, energy demand accounted for 36 percent of final energy consumption in 2004, slightly down from 39 percent in 2000. Steel, construction materials manufacturing, pulp and paper and fertilizer are the sectors that consumed the most energy. From 2000 to 2004, that annual average growth rate of energy consumption in industry was 11 percent.

Transport has seen a slight rise in the share of TFEC, going from 32 percent in 2000 to 38 percent in 2004; the annual average growth rate was 18 percent over the same period, more than two times as much as the average GDP growth rate between 2000 and 2004. Oil products (diesel, gasoline and fuel oil) are mainly used in transportation. Road transportation makes up about 80 percent of total energy consumption in the transportation sector. The remaining 20 percent is used in marine/river ways, railway and air transportation.

The others sectors (residential and commerce sectors) consumed 26 percent of Vietnam's final energy consumption, but the share reduced from 29 percent in 2000, but grew at an average growth

rate of 9.23% per year over this period. However, in remote and rural areas, non-commercial energy such as wood and agricultural by-products is still the main source energy for households.

POLICY OVERVIEW

The Ministry of Industry (MOI) is responsible for the state management of all energy industries, namely electricity, new and renewable energy, coal, and the oil and gas industries. MOI is also in charge of presiding over the formulation of law, policies, development strategies, master plans and annual plans with respect to these sectors, and submits them to the government and Prime Minister for issuance or approval. MOI is also responsible for directing and supervising development of the energy sector and reporting their findings to the Prime Minister.

Vietnam is trying to diversify its consumption of energy. By developing regional indigenous resources and expanding regional cooperation, Vietnam hopes to minimise its dependence on oil. Another priority is to ensure that energy supplies are adequate to meet the needs of a growing population and to support socio-economic development.

ENERGY SECURITY

After the year 2010, Vietnam is expected to move from a net energy exporting economy to become a net importing economy. Energy security policies need a special consideration and it is necessary to prepare a long-term policy to assure energy supply. There are many challenges to assure energy security of Vietnam, for example, all oil products have to be imported; there is no strategic oil stockpiling; the electricity system is still underdeveloped and there are electricity shortages, and the system operates without reserve. Investment for energy development, especially for electricity generation is insufficient given rising demand. In the coal sector there are also many problems such as environmental protection; readily available coal reserve exploitation is gradually decreasing; thus adequate coal supply to meet increasing demand will face with many difficulties. The potential of oil and gas is high but proven reserves is quite low; reserves of the big oil fields which are in production such as Bach Ho, Block 06-1 etc. will gradually decrease and will be depleted in the next ten to fifteen years.

To lessen oil product import dependency and ensure energy security, Vietnam is implementing the following policies:

- Strengthening domestic energy supply capacity, through legislative reforms, and the expansion of infrastructure;
- Appling preferential policies for financing and widening international cooperation in order to strengthen exploration and development of indigenous resources thereby increasing reserves and exploitability of oil, gas, coal and new and renewable energy (NRE);
- Strengthening the exploitation and use of domestic energy resources to reduce dependence on imported energy that is prone to volatility, especially petroleum.
- Supporting Viet Nam's national oil company to invest in the exploration and development of oil and gas resources overseas;
- Intensifying regional and international energy cooperation and diversifying energy import sources; and
- Developing clean fuels, especially nuclear and NRE.

ENERGY EFFICIENCY

In April 2006, the Prime Minister of Viet Nam signed Decision No. 79/2006/QD-TTg approving the national target programme for the economical and efficient use of energy for the

period 2006-2015. The programmes overall objectives cover activities of community stimulation, motivation and advocacy, science and technology and mandatory management measures for the purpose of carrying out coordinated activities related to economical and efficient use of energy within the entire society. The aim of program is savings of 3 to 5 percent of the total energy amount consumed nationwide in the period 2006-2010 and 5 to 8 percent in the period 2011-2015. The program includes nine schemes: 1) devising the legal framework on the economical and efficient use of energy in industrial production, in management of construction projects, and on energy-using equipment; 2) communication to raise people's awareness about the economical and efficient use of energy; 3) incorporating educational content on the economical and efficient use of energy in the national education system; 4) carrying out on a pilot basis the campaign for "Building a model of economical use of energy in every household."; 5) developing standards and using energy-saving product labels on certain selected appliances; 6) providing technical assistance for local manufacturers that comply with energy output standards; 7) building models of management of economical and efficient use of energy in enterprises; 8) assisting industrial production companies in upgrading, improving and rationalizing their technological chain for the economical and efficient use of energy; and 9) enhancing the capacity and deployment of activities that enhance the economical and efficient use of energy in construction, designing and management of buildings.

RESTRUCTURING OF THE ENERGY SECTOR

Power Sector

Electricity of Vietnam (EVN) is a state owned utility founded in 1995, and is engaged in the generation, transmission and distribution of the electricity for the whole of Viet Nam. EVN is responsible for the electricity supply to meet the demand for development of the economy and the consumption needs of the people with the power tariffs approved by the Government. EVN is responsible for the investment to power generation and network expansion to meet the power demand of the country.

In accordance with the Strategy for Electricity Sector Development approved by the government in October 2004, a policy to gradually establish a domestically competitive power pool, diversify investment and trading methods, and stimulate the participation of several economic sectors was instigated. The State maintains a monopoly in transmission, construction and operation of big scale hydropower and nuclear power plants.

The Electricity Law was approved by the Vietnam National Assembly and came into effect in July 2005 outlines the major principles for the establishment of the power market in Vietnam. In October 2005, the Decision No. 258/2005/QD-TTg, was signed by the Prime Minister, and clearly stipulates the functions, duties, and organization of the Electricity Regulatory Authority of Vietnam (ERAV). ERAV's main function is to assist the Minister of the Ministry of Industry in implementing regulatory activities in the electricity sector and contribute to a market that is safe, stable, and provides a high-quality supply of electricity; the economical and efficient consumption of electricity; and upholding of equity, and transparency of the sector in compliance with the law.

Coal Sector

In August 2005, the Prime Minister through Decision No. 199/2005/QD-TTg, transformed the state-owned Vietnam National Coal Corporation (VINACOAL) to a new Vietnam National Coal and Mineral Industry Group (VINACOMIN), which will operate in the form of a holding company, becoming the first state-owned enterprise (SOE) in the country with diversified business interests. VINACOMIN will be formed by restructuring the Vietnam Coal Corporation and its subsidiaries into a robust economic group, with advanced technology, modern management methods and diversified fields of business, including the coal industry, energy engineering, mining, shipbuilding, the automobile industry, and mineral exploitation and processing.

The restructured VINACOMIN will comprise of 11 businesses, including three coal companies, a financial company, a mining company, and a rescue centre for miners, a human resources development centre, two coal project management boards and a clinic.

Oil & Gas Sectors

Participants in the oil and gas sector belong to different private and public organizations and ministries. Among them, only the Vietnam Oil and Gas Corporation (Petrovietnam), established in 1975 and supervised by the Ministry of Industry since July 2003 (instead of the Prime Minister) is vested with the responsibility for all the oil and gas resources in Vietnam. Petrovietnam is entrusted with the responsibility of developing and adding value to these resources. Its business activities cover all the operations from oil and gas exploration and production to storage, processing, transportation, distribution and services.

ENVIRONMENT

Vietnam fulfils all requirements to be a host economy for development of Clean Development Mechanisms (CDM). Vietnam signed the United Nations Framework Convention on Climate Change (UNFCCC) in November 1994, and ratified the Kyoto Protocol (KP) in August 2002.

The government is highly interested in the climate change issue and considers that the climate change due to anthropogenic greenhouse gases is a real threat with Vietnam being one of the most vulnerable countries. By participating in CDM, Vietnam wants to show its willingness to contribute to global environmental protection while looking for additional investment and for technology transfer. In June 2003, the government designated the National Office for Climate Change and Ozone Protection (NOCCOP), part of the International Cooperation Department (ICD) of the Ministry of Natural Resources and Environment MONRE as CDM National Authority CNA. Moreover, the CDM National Executive and Consultative Board were established in April 2003. It is composed of government officials from MONRE and other Ministries.

In August 2004, the Prime Minister of Vietnam signed the Decision No 153/2004/QD-TTg issuing Viet Nam Agenda 21 in order to develop the economy in a sustainable manner on the basis of close, reasonable and harmonious coordination of economic and social development and environmental protection.[75] According energy is the one of the key industries of the economy and also has the biggest impact on the environment due to coal mining activities, oil and gas exploitation on the seabed and the release of waste from energy production and consumption. The main environment policy for the energy sector from the strategy is the following:

- Strengthen the legal basis for production and business activities, energy consumption and environmental protection.
- Support research, development, transfer and application of energy systems that cause little impact to the environment including new and renewable energy sources. Priority should be given to developing renewable energy sources through financial incentives, other policies in the strategy for national energy development.
- Actively participate in international co-operative and exchanging activities related to the UNDP framework convention on climate change in 1992, which Vietnam signed in November 1994.

In Vietnam, Renewable Energy plays an important role in rural development. The government has provided very significant support and issued a number of legislation polices to promote rural electrification and renewable energy development. The Renewable Energy Action Plan (REAP) was launched in 1999. REAP aims "to support an acceleration of renewable electricity production, to meet the needs of isolated households and communities that cannot receive electricity services from the national grid, and to supplement grid supply cost effectively in remote areas".

Some pilot projects and programmes that are put in place are expected to increase the utilisation of RE, particularly in rural area as yet not electrified. However, power generation by RE

[75] Information on this decisions can be found at the following link the Strategic Orientation for Sustainable Development in Vietnam (Vietnam Agenda 21)

resources is still not significant. The installed RE capacity in Vietnam can be broken down as follows: small hydro power 121 MW; biomass power 150 MW; 35,000 units of household-sized biogas systems; and 1,000kWp of solar PV systems.

NOTABLE ENERGY DEVELOPMENTS

POWER SECTOR

Thermal power plants use gas, mainly using technology combined cycle; the centres of thermal power plant using natural gas are concentrated in the Eastern and Western Zones of the Southern Region of Vietnam. Total capacity of power plants using natural gas will increase from 4.0 GW in 2004 to 6.5 GW in 2010, consuming about 5.5-6.2 BCM of natural gas. In 2020, total capacity is expected to be 11 GW, consuming about 12 BCM of natural gas.

According the Master Plan Development of Power sector of Vietnam for the period 2006 to 2025 that has been submitted to the Prime Minister, the electricity sector needs total investment of around US$79.9 billion up until 2025, around US$52 billion of this amount will be invested in power generation and the rest in the electricity transmission and distribution network. The capital can be sourced from the Electricity of Vietnam (EVN), the national budget and loans.

In relation to the development of a competitive electricity market that attracts investment from both foreign and domestic companies operating in the electricity sector, as well as, gradually reducing the economy's investment in the electrcity sector, the Prime Ministerial Decision 26/2006/QD-TTg was approved in January 2006. With the establishment of this legislation Vietnam's power market will be established and developed through three levels, of which each will be implemented in 2 steps, namely pilot and completed, before becoming a feasible foundation:

- Level 1 (2005-2014): a competitive generation power market will replace the current monopoly and subsidised power situation.
- Level 2 (2015-2022): the establishment of a competitive wholesale power market.
- Level 3 (after 2022): The realisation of a competitive electricity retail market.

The other main benefits of this legislation are aimed at reinforcing the effects of production and business activities within the electricity sector, to decrease pressure on electricity price rises, to ensure the stable supply of electricity that is reliable and increases in quality over time, and to ensure to the robust development of the electrcity sector.

In terms of reform within the electricity sector, EVN has been proceeding with plans to privatise member enterprises since the early 2000s, including the settlement of financial issues and reduction in the number of unnecessary employees.[76] By April 2006, EVN had completed the privatisation of 21 subsidiaries and successfully converted five others into one-member limited liability companies, and EVN has also begun the process to privatise a further 18 companies and restructure five others. EVN expects to complete the restructuring and privatisation process of the generating companies by 2007. However, power transmission companies, hydropower plants including Hoa Binh, Tri An and Yaly, as well as the nuclear power programme will remain under the management of EVN. Under the 2006-2010 development plan, EVN plans to privatise or restructure all provincial power companies and a number of key distribution companies.

[76] In the case of Vietnam, privatization means the allocation of a certain share of the company to outside investors both domestic and foreign (limited to 30 percent equity), but does not mean the total privatisation of the company, in other words, the government still maintains the dominant share.

DEVELOPMENT OF NUCLEAR POWER PLANTS

In January 2006, the Prime Minister of Vietnam signed the decision No.01/2006/QD-TTg on the approval of the strategy to apply nuclear energy for peaceful purposes by 2020, which aims to build and develop a nuclear technology industry and to actively contribute to socio-economic development and strengthening of the economy's scientific and technological capacity vis-à-vis nuclear. According to the strategy, by 2010 the investment report for construction of the first nuclear power plant project will be approved. By 2020 Vietnam will complete construction and commissioning of the first nuclear power plant in the economy. At the same time, the country has to prepare the infrastructure for development of a long-term nuclear power programme.

Vietnam Ministry of Industry (MOI) has submitted to the government for approval the pre-feasibility study on building a 2,000 MW nuclear power plant either in Ninh Phuoc or Ninh Hai (two districts of Ninh Thuan province, in central Vietnam). Development of nuclear power will have many benefits for the economy, such as diversification of energy sources, energy security, the environment, and development of national science and technology.

ENERGY INTERNATIONAL COOPERATION

In Oil & Gas sector: The governments of Vietnam and Malaysia have authorized PETROVIETNAM and PETRONAS to sign the Commercial Arrangement Agreement (CAA) for Joint Development of Petroleum from overlapping areas between the two economies. Vietnam has joined the ASEAN economies in signing a memorandum of understanding (MOU) to build the Trans-ASEAN gas pipeline project at the ASEAN Energy Ministerial Meeting in Bali in 2001, Indonesia.

During the first ASEAN, China, Japan and Korea Energy Ministers Meeting (AMEM+3) in June 2004 held here in Manila, Japan's Minister of Economy, Trade and Industry (METI) offered to provide technical assistance to conduct feasibility studies on the possibility of oil stockpiling. The first step for the conduct of the Master plan for development of oil stockpiling in Vietnam was completed in 2006, the next step of the feasibility study utilizing funds from JICA will be complete in 2007.

In Power sector: The governments of Vietnam and Laos have signed an Agreement on energy cooperation. Under this accord, Vietnam will import about 2,000 MW of electricity from Laos. The governments of Vietnam and Cambodia have also signed an agreement on energy cooperation, through which Vietnam will supply 80-200 MW of electricity to Cambodia via a 220 KV transmission line between 2007 and 2008. In the future, when Cambodia builds some hydro power plants and starts participating in the regional electricity market, Vietnam will conversely buy electricity from Cambodia. Vietnam joined The Inter-Governmental Agreement on Regional Power Trade in the Greater Mekong Sub-Region (the "IGA"), which was signed by all six GMS countries in November 2002.

At present, Vietnam supplies electricity to Laos and Cambodia by medium voltage lines at some places and buys electricity from China by 110 kV lines. In 2005, Vietnam imported nearly 400 GWh from China. Vietnam will buy more electricity from China over the next few years as power shortages are expected. To provide access to Chinese power, EVN began to build in early 2005 two 220 kV transmission lines, the Ha Khau (China) to Viet Tri (Vietnam) line and the Van Son (China) to Soc Son (Vietnam) line; these lines will be completed in early 2007. With a total transmission capacity of more than 500 MW, the lines will meet a part of the rising demand for electricity in 2007.

In Coal sector: Vietnam and Japan will cooperate to explore deep underground coal deposits in southern Quang Ninh province and in the Red River delta.

OIL AND GAS SECTOR

Oil

In the area of exploration and production, by October 2006, Petrovietnam has signed 54 oil and gas contracts with its foreign counterparts. Foreign companies active on the market mostly operate through production sharing contracts (PSC) or joint operating contracts (JOC) with Petrovietnam. The international players are companies such as JNOC, KNOC, Shell, Total, BP, Mobil, ConocoPhillips, Unocal etc. Currently, 23 of the 54 oil and gas contracts have been completed and the remaining 31 contracts are being implemented. In 2005, Petrovietnam discovered a number of oil wells with a combined reserve of 40.6 million tonnes of oil equivalent and conducted exploratory drilling at 23 oil wells and exploited 20 others over the past year.

Petrovietnam has begun to expand its activities overseas, which includes exploration and production contracts that have been signed in Iraq and Algeria, and a share of acquisition oil from international oil companies in Mongolia and Malaysia. PetrovVietnam plans to speed up exploration work inside and outside the country in a bid to successfully accomplish the target of increasing reserves by 65 million tonnes of oil equivalent in 2006. The corporation plans to discover about 30-35 million tonnes of oil equivalent a year from 2006 to 2010, pump about 20 million tonnes of crude oil and bring ashore 11 Bcm of natural gas.

The Prime Minister in August 2006 approved the scheme on forming the Vietnam National Oil and Gas Group. The Group shall be a multi-owned group, in which the government holds the dominant share, formed on the basis of rearranging and reorganizing PetroVietnam and its subsidiary units. The aim is have bring in more modern technology and management personnel; do business in multiple branches, namely exploration, exploitation, production, processing and distribution of oil and gas; closely combine production and business activities with that of science, technology, research and training; act as a core for the Vietnam oil and gas industry to sustainable develop, effectively compete and integrate into the international economy and ensure energy security for the development of the country.

The restructured PetroVietnam will comprise of four businesses, which will hold 100 percent of the assets by PetroVietnam, namely, the Petroleum Exploration and Production Corporation; the Gas Corporation; the Electricity Production and Trading Corporation (newly established when power plants invested by the Vietnam National Oil and Gas Group come into operation); and the Oil Refining and Petrochemical Corporation (newly established when refining and petrochemical plants invested by the Vietnam National Oil and Gas Group come into operation). PetroVietnam also include Joint stock companies, Joint Venture enterprises, Scientific & technological enterprises, and Training organizations.

Gas

In the South-West part of the country, Petrovietnam is developing the Ca Mau gas-power-fertilizer complex, which comprises a 332 km-long gas pipeline from the offshore PM 3 field to Ca Mau with a capacity of 2 BCM per year, a 720 MW power plant, and a fertilizer production plant with a capacity of 800,000 tons per year. Construction of the Ca Mau complex started in 2005, and created a 1.5 BCM gas market for the Bunga Kekwa field of Block PM3 and Cai Nuoc field of Block 46. These projects are expected to be completed in 2007.

Vietnam has planned to build a 500-kilometer pipeline from gas fields in Blocks B and 52 to O Mon, Can Tho province. The pipeline capacity is to be 5 bcm per year; with this project expected to be operational in 2010. Natural gas production is projected to jump from 4.3 bcm in 2004 to 16.5 bcm in 2020. Depending on how soon future discoveries are developed and brought on-stream, imports will likely play a major role in meeting the projected increase in gas demand after 2020. For long term security of gas supply, the connection between Vietnam and the Trans-ASEAN Gas Pipeline is incepted in the framework of ASCOPE cooperation. Gas could be imported via this gas network.

DOWNSTREAM OIL AND GAS SECTOR

While having exported crude oil for last two decades, Vietnam's petrochemical industry is still only in its preparatory phase; all fuels and other oil products consumed in the country have to be imported, due to the fact that there is no refinery in Vietnam yet. This constraint is considered as a potential threat to energy security in specific and to the economic stability of the nation in general. According to the development strategy for the oil and gas industry, Vietnam has planned to build 3 oil refineries with a total capacity of about 20 millions tonnes of crude oil. The first major refinery located in Dung Quat in central Vietnam will be commissioned by the year 2009. Two more refineries each capacity about 7 millions tones of crude oil located in north and southern Vietnam will be built in periods 2010-2020. After 2020, refineries shall be continuously developed to meet the local demand for oil products. In the case that local crude oil fails to meet requirements, it will be necessary to import crude oil. With the above-mentioned plan, refineries will supply about 40 percent of oil product demand in 2010, and then increase to 60 percent in the period 2015 to 2020.

The economy's first gas-fuelled fertiliser plant was operated in Phu My Industrial Park in 2005. The Phu My Fertiliser Plant has a designed capacity of 2,200 tonnes of urea and 1,350 tonnes of ammonia per day. The second Fertiliser Plant with capacity of 0.8 million tone per year is being built in Ca Mau province and will be completed in 2007.

Oil products are not only used as a fuel but also considered as an input material for petrochemical plants. To the year 2020, four petrochemical centers will be completed. Three of them are combined with oil refinery plants and the other in the western area of the south of Vietnam using natural gas resources in this area to produce fertilizer and other products from Ammonia.

COAL SECTOR

Vietnam National Coal and Mineral Industries Group (VINACOMIN) had discovered a major coal deposit in the Red River Delta of northern Vietnam estimated to contain up to one hundred billion tonnes. The coal bed covers an area of 25 km^2 situated about one km below the surface, stretching from Khoai Chau District of Hung Yen Province to Thai Binh Province's Dong Hung District. According VINACOMIN, about 28 billion tonnes of sub-bituminous coal could be viably exploited from the bed and used for electricity generation.

Vietnam produced about 30.8million tonnes of coal in 2005. VINACOMIN plans to exploit more than 36 million tonnes in 2006. Domestic demand for coal, however, is forecast to increase sharply to 40 million tonnes by 2010, and over 70 million tonnes by 2020. Coal consumption is expected to increase substantially as the economy builds more coal-fired power plants to meet electricity demand.

VINACOMIN has begun construction on three key projects in 2006, including two thermal power plants at Son Dong and Cam Pha, and the Dac Nong aluminium plant. The Son Dong power plant with an installed capacity of 220 MW is fired by low-quality coal from the Dong Ri mine. The 600 MW Cam Pha thermal power plants in the northern province of Quang Ninh are estimated to cost $600 million, of which Vinacoal is providing 65 percent of the source fuel. VINACOMIN has focused on thermal power plants to provide a market for lower-quality coal products which are otherwise difficult to market. The Dac Nong aluminium processing plant with an investment of $544 million and annual capacity of a million tonnes began operation in early 2006.

ENERGY EFFICIENCY

The UNDP and the Vietnam Ministry of Science and Technology will implement a project to raise the effectiveness of energy use at small and medium enterprises (SMEs). It will be funded by the Global Environmental Fund through the United Nations Development Programme (UNDP) and over the next five years, US$29 million will be spent to implement the project at 500 SMEs operating in the areas of clean production, ceramics, weaving, paper and pulp and food processing.

The project includes six sub-programmes: supporting policy and institution development, improving communications and awareness, building technical capability, supporting providers of energy saving services, financial assistance and guidance in using energy economically and effectively. The project will help save about 136,000 tonnes of fuel oil and reduce CO_2 emissions by 962,000 tonnes by 2009.

RENEWABLE ENERGY (RE)

Vietnam is rich in renewable energy resources. Renewable energy resources suitable for electricity generation include small hydro, solar, biomass, wind, and geothermal. The potential for small hydro-power resources is estimated to be about 1600 MW; total capacity of geothermal is estimated at 200 MW; wood and agricultural residues and by-products are about 50 million tonnes per year. Wind, solar and biogas is relatively abundant. About 75 percent Vietnam's 82 million population is living in rural areas with currently about 8.5 percent of households in these regions having no access to electricity.

The Electricity of Vietnam (EVN) will spend VND3.1 trillion (about US$194.7 million) for building 37 small-scale hydroelectric power stations in the Northern provinces bordering China. Of these, 10-13 stations, with a maximum capacity of 5 MW each, will be built from now until 2010 in the bordering districts of Lai Chau, Lao Cai, Ha Giang and Lang Son provinces.

Since the 1980s, Vietnam has reviewed the implementation of wind turbines for power generation in islands and remote grid connected areas. Some of the recent wind power developments are the following: 15 kW solar PV-wind power hybrid systems in one of the smaller village with 40 households; the project was implemented by Institute of Energy (IE) with a grant from Tohoku Electric Company of Japan. The 800 kW wind power generator in Bach Long Island was financed completely by the Government of Vietnam. Future wind energy developments in the economy with a total installed capacity of 120 MW include the following: Ly Son Island (2 MW); Phuong Mai wind farm in Binh Dinh Province (15 MW); Wind Power Project in Phuong Mai (84 MW), the main investor is Grabowski Renewable Energy Company. Phu Quoc Island (2.5 MW); Wind farm in Phu Yen Province (15 MW); and Con Dao Island (2.5 MW).

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