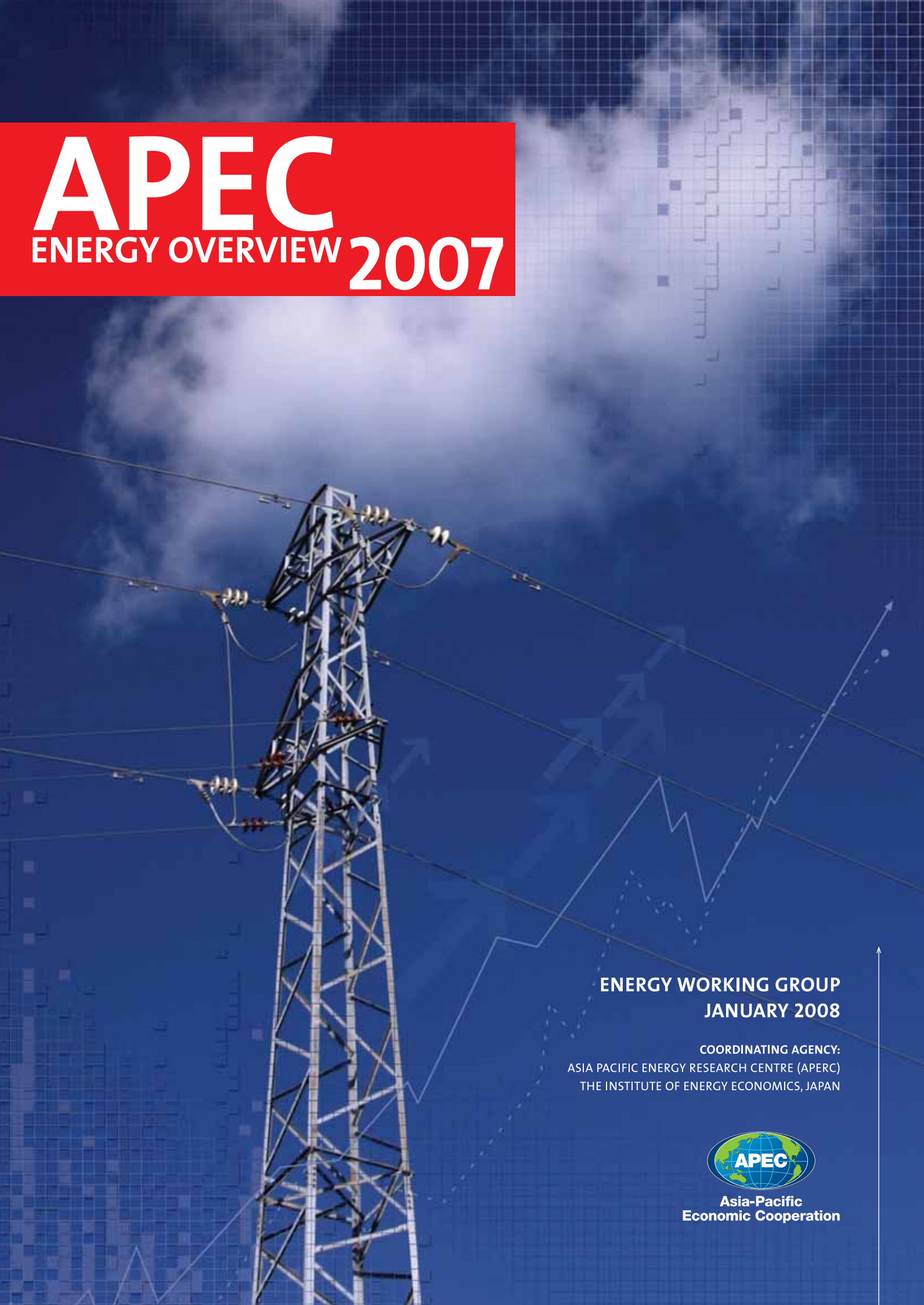
APEC ENERGY OVERVIEW 2007



ENERGY WORKING GROUP
JANUARY 2008

COORDINATING AGENCY:
ASIA PACIFIC ENERGY RESEARCH CENTRE (APERC)
THE INSTITUTE OF ENERGY ECONOMICS, JAPAN

APEC
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Economic Cooperation

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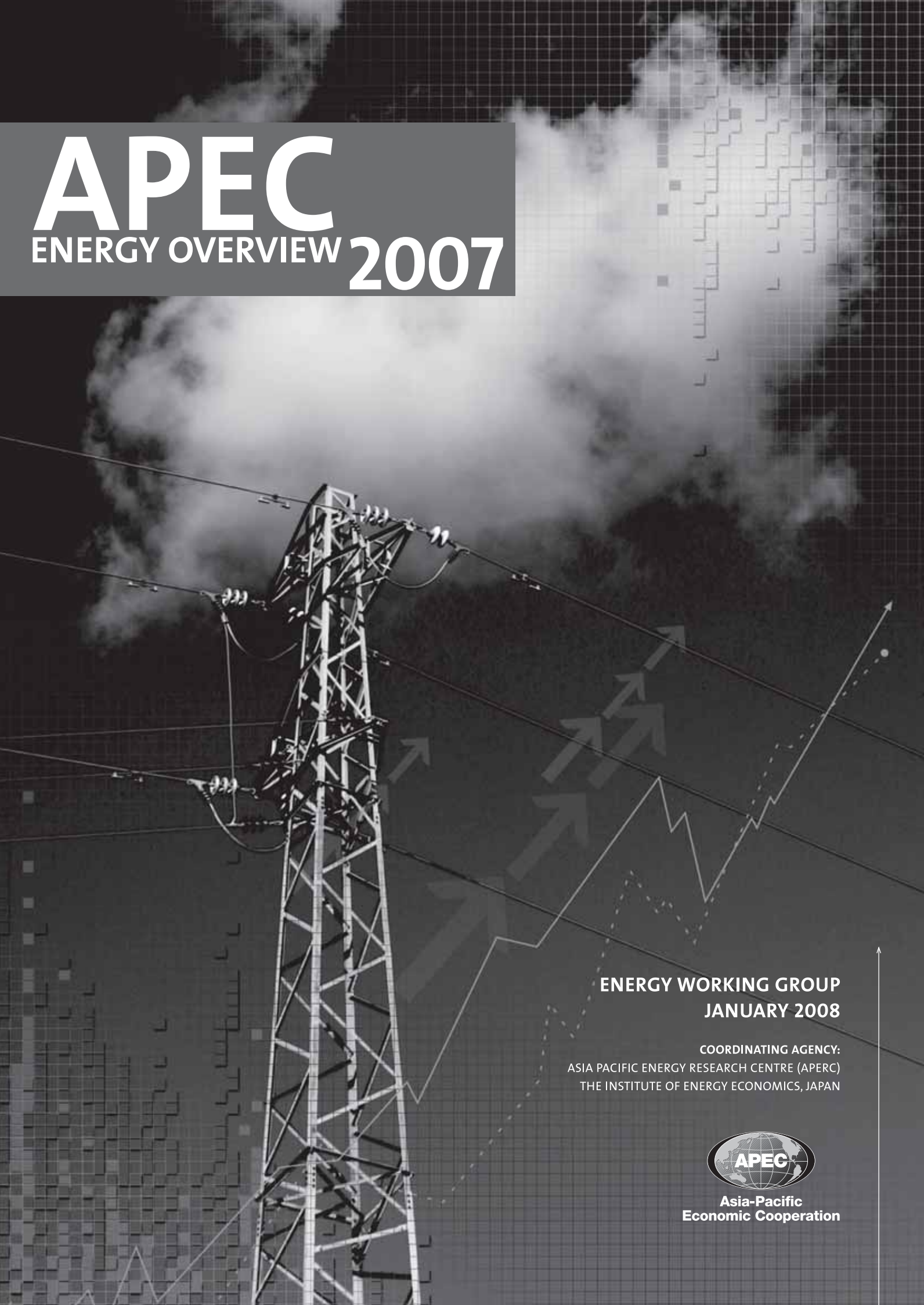

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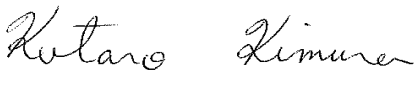
FOREWORD

World energy demand is projected to grow dramatically over the coming decades and global warming is expected to intensify in the business as usual scenario. In 2007, oil prices rose continuously and set a new record at the end of the year. The causes behind this are complex, but continued growth of oil demand, especially in the transportation sector, is an essential background factor. Also in 2007, the IPCC fourth assessment report was published, showing a higher confidence in global warming through anthropogenic GHG emissions. Moreover, continued extreme weather phenomena reported globally-- including light snowfall, heavy rains, and persistent drought-- were considered as a warning sign among the general public.

Today, both energy security and environmentally sustainable energy development are emphasised together in policy formulation and implementation across many APEC economies. Handling these two issues has become the defining energy challenge of our age. APEC pursues this challenge through promotion of efficiency, conservation and diversity of energy. A wide range of policies and instruments are available to promote such policy challenges, like market reform, technology RD&D, and facilitating trade and investment. Promoting broader energy cooperation and sharing views on our common energy challenges are also important.

The APEC Energy Overview is an annual publication to promote information sharing. It contains updated energy demand/supply data as well as descriptions of energy policy and notable energy developments-- including energy efficiency improvement, infrastructure development, energy source diversification, upstream development, regulatory reform and environmental protection.

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 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 helps to deepen mutual understanding among member economies on current energy issues in the region.



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January 2008

CONTENTS

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 economy and the 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 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 2005, GDP reached US$575.02 billion (2000 US$ at PPP) from US$559.36 billion in 2004, 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 (2005)

Key data		Energy reserves*	
Area (sq. km)	7,600,000	Oil (MCM)	667
Population (million)	20.33	Gas (BCM)	2,610
GDP Billion US$ (2000 US$ at PPP)	575.02	Coal (Mt)	78,500
GDP per capita (2000 US$ at PPP)	28,286		

Source: Energy Data and Modelling Centre, IEEJ. * Proved reserves at the end of 2004 from BP Statistical Review of World Energy 2005.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2005, the total primary energy supply reached 121,894 ktoe. Coal contributed the largest share of about 45 percent, followed by oil at 31 percent, and natural gas at 19 percent. Since 1980, supply from gas exhibited the greatest growth at 4.4 percent, followed by coal at 2.9 percent, and oil (the least) at 0.9 percent per annum. Supply from other sources (i.e. wood, bagasse, hydro, geothermal, solar, etc.) has also shown significant growth on average at 1.5 percent over the period from 1980 to 2005.

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 2005, total coal production reached 204,667 ktoe, 73 percent (or 150,312 ktoe) of which was exported to other economies. Coal plays a central role in the Australian economy, accounting for approximately 12 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 steadily grown, with exports increasing in 2005 by approximately 5 percent over the previous year.

In 2005, 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 areas. Total supply from natural gas in 2005 reached 35,226 ktoe. About 65 percent of this, or 22,966 ktoe was consumed domestically, while the rest was exported, as liquefied natural gas (LNG), almost entirely to Japan. 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. These exports initially grew rapidly but levelled off after the 1997 Asian financial crisis.

Australia is a net importer of oil and petroleum products. Despite its 24,139 ktoe crude oil and condensate production in 2005, total demand exceeded domestic supply. In 2005, import dependency for crude oil and petroleum products was around 26 percent. Oil reserves in 2005 stood at 667 million cubic metres (MCM), up from 557 MCM in 1990. The reserve to production ratio is around 20 years.

About 251,120 GWh of electricity was generated in 2005, mostly from thermal sources (93 percent) with a modest amount (about 6 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 3.9 percent per year for the past 25 years.

Table 2 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	270,773	Industry Sector	23,574	Total	251,120
Net Imports & Other	-147,,875	Transport Sector	30,243	Thermal	232,312
Total PES	121,894	Other Sectors	22,673	Hydro	15,886
Coal	54,306	Total FEC	76,489	Nuclear	-
Oil	37,882	Coal	3,473	Others	2,922
Gas	22,966	Oil	39,182		
Others	6, 741	Gas	11,981		
		Electricity & Others	21,853		

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 2005, the total energy consumption in Australia reached 76,489 ktoe. Total energy consumption was divided between the industry (31 percent), transport (40 percent) and the other sectors (30 percent, which include residential and commercial). By fuel source, petroleum products accounted for 51 percent of consumption, natural gas for 16 percent, and coal 5 percent. Electricity accounted for 29 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 2.9 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

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[1].

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. [2]

UPSTREAM ENERGY 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

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

[2] July 2006 update to the 2004 EWP available at http://www.pmc.gov.au/energy_reform/docs/energy_update_july2006.rtf

- Commercial decisions should determine the nature and timing of energy resource development, with government interventions being transparent and allowing commercial 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 ain 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 April 2007 APPEA released the Strategic Leader's Report for the Upstream Oil and Gas Industry Strategy. The Report titled "Platform for Prosperity" proposes a vision and targets for the industry over the next decade

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 is based on two areas: 1) general taxation regime that applies to all projects; and 2) secondary taxation system that applies 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 (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 designated as "frontier areas" attracting a tax concession. This concession takes the form of a 50 percent increase in the value of exploration expenditure tax credits. To enhance further interest in these areas Geoscience Australia, the geological research arm of government, has collected seismic and sample data in a number of the frontier blocks. 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.

In 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 by the end of 2007.

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 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 enhance the international competitiveness of Australian renewable energy businesses, and to generate benefits for Australia's economy. In May 2005, the Australian Government announced the establishment of a Bio fuels Taskforce to examine the latest scientific evidence on the impacts of ethanol and other bio fuel 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. Based on the findings of the Taskforce announced in September 2005, the government reaffirmed its commitment to achieving the target of 350 ML of biofuels production by 2010, the progress of which will be monitored every six months from June 2006 onwards[4].

NOTABLE ENERGY DEVELOPMENTS

ENERGY EFFICIENCY OPPORTUNITIES (EEO)

A regulatory programme was announced as one of a raft of measures to improve efficiency under the Energy White Paper. The programme was introduced by the government in order to prompt the business sector's action 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 this programme is to encourage large energy users to take a more rigorous approach to energy management and ensure company executives to place a higher emphasis on reducing energy costs and improving energy management practices. The programme will be applied to all large energy consuming businesses and encompasses more than 250 businesses in the transport, manufacturing, mining, refining and commercial sectors, which accounts for about 60 percent of Australian business energy consumption, and 40 percent of Australian total energy use). EEO is expected to lead to: (1) identification and uptake of cost-effective energy opportunities, (2) improvement of productivity and (3) reduction of 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 in order for Australia to become an innovative leader in technology development. The three main programmes are:

Low Emissions Technology Demonstration Fund: The $A 500 million LETDF supports the commercial demonstration of technologies that have the potential to lower Australia's energy sector

[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: http://www.pmc.gov.au/biofuels/index.cfm.

greenhouse gas emissions by at least 2 percent per annum from 2030 at a realistic uptake rate. The Australian Government has announced funding of $A 310 million from LETDF for five projects covering solar, coal and gas technologies including capture and sequestration of carbon dioxide.[5]

Renewable Energy Development Initiative: REDI is a $A 100 million competitive grant programme designed to stimulate innovation in technology, products, processes, and services that have a strong early-stage commercialisation and emissions-reduction potential. Since its commencement in 2005, grants of $A 46 million have funded 24 renewable energy projects nation-wide. These project 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.

Advanced Electricity Storage Technologies (AEST): A five-year, $A 20.4 million, programme was announced in 2004 in the Australian Government's Energy White Paper. 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; batteries, electro-mechanical, chemical and thermal storage technologies in either on-grid or off-grid situations. Expressions of Interests closed in April 2006, with successful projects expected to be announced in 2007.[6] In May 2007, five projects were selected as demonstration projects, which include solar energy storage system based on ammonia dissociation into hydrogen and nitrogen, the same system using graphite blocks and 500 kilowatt hours zinc-bromine battery, etc.

ENERGY EFFICIENCY POLICY

Australia has taken significant steps to coordinate developments in energy efficiency policy and programmes through formation of the National Framework for Energy Efficiency (NFEE) in 2004. NFEE reduces duplication and improves coordination between national, state and territory governments.

Assessment of the NFEE measures implemented to date demonstrates clear progress towards achieving the goals defined in 2004. Estimates of the impact in 2015 of the Appliance and Equipment minimum energy performance standards, Energy Efficiency Opportunities and commercial and residential building code regulation programmes which commenced implementation between July 2004 and September 2006 show savings in 2015 of approximately 42 PJ of energy, 7.8 Mt CO2-e and $380 million.

Australia is improving its data framework for energy efficiency by linking policy issues with key indicators. Energy efficiency data resources were reviewed and action is undertaken to fill the identified gaps. A major project on energy intensity is being carried out. The project will use indicators and data analysis methods that are consistent with international practice. (The presentation was made at a joint IEA-APEC workshop on energy indicators held in Canberra in November 2006)

NATIONAL ENERGY MARKET REFORM

Australia has made significant progress in implementing its energy market reform programme, involving coordinated actions by federal and state governments through the Ministerial Council on

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

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

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:

- 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:
- 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. In November 2006, MCE accepted the GMLG's key recommendations. Work is now under way to establish a new national Gas Market Operator, a Bulletin Board to improve transparency, and a Short Term Trading Market for national gas.
- Exposure drafts of the new National Gas Law (NGL) and National Gas Rules (NGR) were released in November 2006 for consultation. As well as incorporating the MCE response to the PC review, these will bring the economic regulation of gas transmission and distribution under the new governance and institutional arrangements. Following finalisation of details in response to the consultation, these are expected to come into force in July 2007.
- Together with the NGL and NGR exposure drafts, in November 2006 the MCE released for consultation new provisions to strengthen consumer advocacy across the energy sector. This includes the availability of consumer advocacy for both electricity and national gas projects to encourage active participation of energy users in the energy market decision-making process. After finalisation of the consultation process, the new consumer advocacy arrangements are anticipated to commence in July 2007.
- An exposure draft of amendments to the National Electricity Law was released in January 2007. An exposure draft of the national distribution revenue and pricing rules is expected to be released in early 2007 for industry consultation.

Further work is progressing on:

- The development of national retail and distribution laws and rules that is intended to harmonise laws across all Australian legislative jurisdictions by January 2008. This would transfer the non-economic distribution and retail functions to the national framework.
- 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, including network owner incentives, effectively valuing demand-side response, regulation and pricing of distributed and embedded generation and end user education; and
    - Progressive roll out of "smart" electricity meters from 2007 to allow users to manage their demand for peak power better[7].

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

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 May 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 years acreage release also includes six Designated Frontier Area blocks[8]..

NEW LNG PROJECTS

New LNG projects, involving capital expenditure in the order of $A40-50 billion are projected to increase Australian LNG exports from the current 15 million tones per annum (mtpa) to over 60 mtpa with a decade, including Gorgon, Pluto, Pilbara LNG, Browse basin projects and additional trains at the North West Shelf and Darwin[9].

The Board of Woodside Petroleum Ltd. has approved commitments of up to $A1.4 billion for the Pluto LNG development. The approval allows funding for site preparation and long lead items ahead of a final investment decision. Site work commenced in January 2007, with first LNG expected by the end of 2010. The Gorgon project has overcome a significant hurdle with the Western Australian Environment Minister upholding an appeal by the joint venture against recommendations from the State's Environment Protection Agency. The plan to sequester carbon dioxide contained in feed gas from Gorgon reservoirs has approved, to which $A 60 million will be provided from the federal government Low Emission Technology Demonstration Fund.

NEW GAS DISCOVERIES

In late 2006 Chevron announced a significant gas discovery at its Chandon-1 well. This was closely followed by an additional discovery at the Clio-1 exploration well, which Chevron claims is "one of the top wells in Australia in terms of the total net gas pay". Both discoveries could be tied back to the Chevron operated Gorgon project.

GAS SUPPLY OUTLOOK

The two ministerial councils responsible for upstream and downstream energy matters at the national level are collaborating on a study into the role that natural gas is expected to play in Australia's energy mix over the next 25 years. Although Australia has extensive reserves of natural gas, unprecedented growth in LNG export demand and the increasing use of natural gas domestically has raised issues around the balance between exports and Australia's long-term energy security. The Ministerial Council on Mineral and Petroleum Resources (MCMPR) and the Ministerial Council on Energy (MCE) have established a joint working group to consider issues surrounding the domestic supply/demand balance, consider options that will deliver natural gas resources for export and into domestic market taking into consideration national security issues. The working group hopes to deliver a report to the council during 2007.

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

[9] ABARE(2007b). "Notable Energy Developments in Australia." Document submitted to the 34th APEC EWG Meeting, September 2007, Hong Kong, China.

ASIA PACIFIC PARTNERSHIP ON CLEAN DEVELOPMENT AND CLIMATE (APP)

The inaugural meeting of APP 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.

The eight Task Forces are developing Action Plans for their respective sectors that will outline both immediate and medium-term specific actions, including possible "flagship" projects. Australia has announced funding of US$100 million to be allocated over five years to the initiative, with 25 percent earmarked specifically for renewable projects. Australia also chairs the Task Forces on cleaner fossil energy and aluminium taskforce as well as co-chairs the renewable energy and distributed generation taskforce.

The work of APP aims to complement existing initiatives, such as the Kyoto Protocol, rather than to duplicate their work. However, the work of the Partnership may seek to leverage, or work with other initiatives, to progress projects of mutual interest where appropriate. These opportunities would be considered on case-by-case basis as the APP Task Forces develop their work plans and identify projects. [10] In October 2007, Canada joined APP as its seventh member.

DOWNSTREAM PETROLEUM

In October 2006, the Petroleum Retail Legislation Repeal Bill 2006 gained Royal Assent, which allows the Government to introduce a mandatory industry code, the Oilcode under the Trade Practices Act 1974. The repeal Act commenced in March 2007.

The new Oilcode applies to all market participants and intends 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.

The Liquid Fuel Emergency Amendment Act 2007 gained royal assent in June 2007. It will commence in December 2007 or an earlier date once the Minister has set in place the guidelines. This Act amended the Liquid Fuel Emergency Act 1984 which covers planning and dealing with a national liquid fuel emergency.

In October 2006, the Australian Government entered into a Memorandum of Understanding with the New Zealand Government Covering Petroleum Stocks Contracts which enables stocks to be held in Australia on New Zealand's behalf. The stocks are held as part of the 90 days net of imports commitment for membership of the International Energy Agency.

[10] Further information on the AP6 is available at: http://www.dfat.gov.au/environment/climate/index.html.

EMISSIONS TRADING

In November 2006 the Prime Minister announced the establishment of a joint government-business Task Group to examine in detail the form that an emission trading system, both in Australia and internationally, might take in the years ahead. The need to maintain Australia's competitive advantage in any future systems was also emphasised.

Following the receipt of the Report of the Task Group on Emissions Trading, the Prime Minister announced his support for an emissions trading scheme during a speech to the Liberal Party Federal Council in June 2007.

In July 2007 the Australian Government released Australia's Climate Change Policy - Our economy, Our environment, Our future. The below includes key features of the Policy.

- Australia would set a long-term aspirational goal for reducing emissions, to enhance investment certainty and contribute to international efforts.
- The Government would introduce an emissions trading scheme, no later than 2012, as the primary mechanism for achieving the long term emissions reduction goal.
- The Government endorsed the key design features of the emissions trading system set out in the Report.
- Responsibility for designing an Australian emissions trading scheme will rest with the Department of Prime Minister and Cabinet.
- Treasury will advice the Government on an appropriate emissions goal and pathway that progressively stabilises emissions and then allows for deeper reductions.
- In setting an appropriate pathway the Treasury will model the effects on key economic indicators including growth, employment, income, and prices as well as the impact on different sectors of the economy, with particular regard to the impact on households.
- The regulator of the Australian emissions trading system will be established in the Treasury portfolio.
- The Government will review all greenhouse programmes in 2008 to ensure that they are complementary to the emissions trading system.
- The Government will also consider incentives for abatement action taken prior to commencement of the scheme.

NUCLEAR POWER

In December 2006 the Prime Minister released the final report of the Uranium Mining, Processing and Nuclear Energy Review Task Force.[11] The Task Force undertook an objective, scientific and comprehensive study into the medium to longer-term benefits of increasing Australia's role in the mining, processing and enrichment of uranium, and whether it is economically feasible to contemplate nuclear power stations in Australia.

In January 2007, the Minister for Industry, Tourism and Resources established the Uranium Industry Framework Implementation Group to oversee the execution of recommendations arising from the Uranium industry Framework (UIF) Steering Group report. The report identified a range of impediments to the industry including the areas of Regulation; indigenous engagement; Transport; and Skills, Training and Education.

[11] The report is available at http://www.dpmc.gov.au/publications/umpner/docs/nuclear_report.doc

The Government is establishing a single national register for radiological dose records. Regulation, particularly between jurisdictions, will be streamlined such as having joint assessment processes between the relevant state and Commonwealth departments. The UIF is also developing a national incident reporting regime; and establishing a uniform uranium royalty regime in the Northern Territory.

On transport, the UIF is working to ensure the consistent application of domestic transport standards and the removal of regulations that go beyond international best practice in relation to health and safety outcomes.

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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 2005, the population of Brunei Darussalam was about 0.37 million.

The real gross domestic product (GDP) at current price in 2005 was recorded at US$6,650 million and the GDP per capita was at US$17,788, almost the same level as the previous year.

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 2005 averaged 206 thousand barrels per day. Similarly, gas production for 2005 was about 32 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 (2005)

Key data		Energy reserves*	
Area (sq. km)	5,765	Oil (MCM)	175
Population (million)	0.37	Gas (BCM)	340
GDP Billion US$ (2000 US$ at PPP)	6.65	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)*	17,788		

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 fourth-largest oil producer in Southeast Asia, and is also the tenth largest producer of liquefied natural gas in the world. In 2005, the total primary energy supply of Brunei Darussalam reached 2,322 ktoe, increasing by 5 percent compared to 2004. Brunei's oil and gas production was 21,630 ktoe, decreasing 1.2 percent over production levels in 2004 of 21,895 ktoe, of which 89 percent was exported in 2005. Natural gas represents 68 percent of the total energy supply while oil represents 32 percent.

Total proven crude oil reserves are 175 MCM. Oil is exported mostly to Australia, Japan, Korea, Thailand, Indonesia and India. Brunei Darussalam has natural gas reserves of 340 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 2005, total final energy consumption was 776 ktoe, up by 1.8 percent over 2004. 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 64 percent of consumption, followed by electricity at 34 percent and gas at 2 percent.

Table 4 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	21,630	Industry Sector	96	Total	3,264
Net Imports & Other	-19,319	Transport Sector	418	Thermal	3,264
Total PES	2,322	Other Sectors	263	Hydro	-
Coal	-	Total FEC	776	Nuclear	-
Oil	735	Coal	-	Others	-
Gas	1,587	Oil	499		
Others	0	Gas	13		
		Electricity & Others	264		

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). [12] 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

[12] Further information available at http://www.brunei.gov.bn/government/plan.htm

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, when oil production was peaked at 240,000 barrels per day (BPD). It came into effect in 1981 and has resulted in the gradual oil production decrease from 175,000 BPD to 150,000 BPD. In November 1990, the government removed the ceiling on production levels given under the Conservation Policy. Since then, oil production has been gradually recovering over the past 17 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. [13]

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

[13] 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 (50%), Mitsubishi (25%) and Conoco-Phillips (25%).

- 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 park. 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).[14]

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.

In February 2007, the BEDB signed a contract for Sungai Liang Industrial park site preparation works with a local contractor.

LNG SIXTH TRAIN EXPANSION OPPORTUNITY

Brunei LNG has embarked on a programme 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. In support of the LNG extension/expansion projects, the two existing gas suppliers, Brunei Shell Petroleum and Block B Joint Venture(BBJV) operator, Total have embarked on an active gas development and exploration campaign extending over the next few years.

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. Meanwhile, Block M was awarded to China Oil USA (Macao) Company Ltd (China Oil), Valiant International Petroleum Ltd and Jana Corporation Sdn Bhd, with both awards under a Production Sharing Contract .

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

[14] Further information available at http://www.bedb.com.bn/sgliang.asp

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 were about 553 MW and 258MW respectively, which combined total installed capacity in 2005 ??? was about 811 MW. 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 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[15]. 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),

[15] 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.

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 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 33 million, of which approximately 39 percent is concentrated in the province of Ontario. Canada is known for its wealth of energy and other natural resources. In 2005, its GDP amounted to roughly US$959 billion (in 2000 US$ at PPP), or US$29,693 per capita. Canada's real GDP increased by 3.1 percent compared with that of 2004. Inflation remained low and stable, with consumer prices at 2.2 percent in 2005. Unemployment averaged 6.8 percent in 2005. Due to high standard of living, cold climate, long distances between major cities, and many energy intensive and bulk goods industries, Canadians are large energy consumers. Canada's primary energy consumption per capita in 2005 was 6.2 toe or about four times the APEC average.

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, British Columbia, Newfoundland, Ontario, and Manitoba. It also has significant offshore oil and gas deposits near Nova Scotia and Newfoundland. Installed electricity generation capacity amounted to some 120 GW. Energy production is very important to the Canadian economy, accounting for 6 percent of GDP and 330,000 jobs, representing 1.9 percent of the Canadian labour force, in 2005.

Table 5 Key data and economic profile (2005)

Key data		Energy Reserves**	
Area (square km)*	9,984,670	Oil (MCM)	2,716
Population (million)	32.30	Gas (BCM)	1,632
GDP Billion US$ (2000 US$ at PPP)	959.05	Coal (Mt)	6,578
GDP per capita (2000 US$ at PPP)	29,693	Oil Sands (MCM)***	27,601

Source: Energy Data and Modelling Center, IEEJ. * Statistics Canada. ** BP World Energy Statistics.
*** Oil sands established reserves, by National Energy Board.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2005, Canada's primary energy production exceeded 402 Mtoe. Natural gas accounted for most of the supply at 38 percent, followed by oil (36 percent), coal (8 percent), hydropower (8 percent), nuclear power (6 percent) and other sources (4 percent). For domestic primary energy supply, its total was 273 Mtoe in 2005. Oil accounted for 36 percent, gas 30 percent, hydropower 12 percent, coal 10 percent, and nuclear power 9 percent, respectively.

Gas production in 2005 totalled 154 Mtoe, 2.6 percent increase from the previous year. This is due mainly to record high drilling levels and increasing coal bed methane production. Almost 98 percent of Canadian gas is produced from the Western Canadian Sedimentary Basin (WCSB) which is the largest source of gas and crude oil production. Alberta accounts for approximately 80 percent, followed by British Columbia 16 percent and Saskatchewan 4 percent.

Net natural gas exports totalled around 87 Mtoe, a slight increase from 86 Mtoe in 2004.Higher Canadian natural gas exports can be attributed to lower domestic demand due to milder weather

and slightly higher production. In addition, Canadian natural gas was needed to offset U.S. natural gas supply losses from hurricanes in 2005. Overall natural gas pipeline capacity is adequate while applications for new pipeline facilities are continuously considered. However, there may be limitations at some points depending on markets, storage and seasonal shifts because the flow of natural gas through Canadian pipelines can be varied as the demand for natural gas changes seasonally.

In 2005, crude oil production slightly declined to 148 Mtoe from 150 Mtoe in 2004 due to unscheduled interruptions at the major integrated mining and upgrading operations. As there is a continuous decline in conventional oil production in the WCSB, oil production from offshore fields in the Atlantic Ocean and the oil sands deposits of northern Alberta almost offset the decrease. In 2005, Alberta's oil sand accounted for over 39 percent of total crude oil and equivalent production, which indicates that oil sands are an important source of crude oil production. 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 2005, 86 Mtoe of crude oil was exported mainly from western Canada. These exports accounted for 58 percent of all Canadian production. However, nearly 47 Mtoe of crude oil was imported into eastern Canada, so that net oil exports were equivalent to 26 percent of production. The 2005 total crude oil exports consisted of 34 percent light crude oil and equivalent and 66 percent blended heavy crude oil. Canada is also a net exporter of the main petroleum products, including motor gasoline and middle distillates. Oil pipeline capacity is tight and is expected to remain tight through 2008, even with the current ongoing expansions and new pipelines to accommodate growing oil sands production.

Table 6 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	402,031	Industry Sector	54,110	Total	628,194
Net Imports & Other	-133,982	Transport Sector	56,849	Thermal	161,954
Total PES	272,706	Other Sectors	89,967	Hydro	363,626
Coal	27,975	Total FEC	200,926	Nuclear	92,040
Oil	98,098	Coal	2,892	Others	10,574
Gas	80,655	Oil	91,884		
Others	65,978	Gas	51,029		
		Electricity & Others	55,121		

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

Canada generated about 628 TWh of electricity in 2005, 4.7 percent more than in 2004. As Canada is the world's largest producer of hydroelectricity, hydropower dominated with a 57 percent share, followed by thermal plants with 26 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 2005, Canada exported 42.9 TWh of electricity to the United States while importing 19.3 TWh. Net electricity exports to the US in 2005 increased to roughly 3.8 percent of production from 1.8 percent in 2004.

Canada's coal production in 2005 was 65.3 million tonnes, which was one percent drop from 2004. In 2005 Canada exported 28.2 million tonnes, of which 26.7 million tonnes was coking coal. Canada exports more than 40 percent of its coal production to Asia, with the rest going chiefly to Europe and Latin America. On the other hand, Canada imported 21.2 million tonnes, mostly from

the United States, of which 17 million tonnes was thermal coal, mainly for coal-fired electricity generation in the provinces of Ontario, Nova Scotia and New Brunswick.

Canada remains the world's leading producer and exporter of uranium, of which it accounted for about 29 percent of global mineral production in 2004. Canada's recoverable uranium resources amounted to 444,000 tonnes of uranium as of January 1, 2005, three percent increase from the 2004 total of 432,000 tonnes of uranium. Uranium production is centred in northern Saskatchewan.

In 2005, alternative and renewable energy production increased by 3.7 percent over 2004 and accounted for 4.0 percent of total energy production in Canada. Rapid growth in the wind industry was observed in electricity market. Although wind generation currently accounts for less than 1 percent of generation capacity in Canada, it is expected to grow rapidly over the next several years.

FINAL ENERGY CONSUMPTION

In 2005, total end use energy consumption in Canada reached approximately 201 Mtoe. Industry accounted for 37 percent of energy use, residential and commercial buildings 32 percent, transport 28 percent, and agriculture 2 percent. By energy source, petroleum products accounted for 46 percent, natural gas 25 percent, electricity 27 percent, and coal 1 percent.

Total final energy consumption decreased by 0.6 percent. Energy consumption in the industrial sector decreased by 3.9 percent while energy consumption in the transport sector increased at 2.0 percent. Petroleum products dominated the transportation sector, accounting for 92 percent of energy consumption of this sector in 2005. Demand for freight transport explains the positive growth in the transport energy sector, while Canada's passenger transport – mainly road motor gasoline showed decline in 2005. For example, passenger transportation energy intensity excluding non-commercial aviation (MJ/passenger-km) decreased to 2.05 in 2005 from 2.10 in 2004[16].

In the residential and commercial sectors, space and water heating accounted for about 70 percent of energy use while lighting, space cooling, and electronic equipment occupied the other 30 percent. Growth in consumption in the residential and commercial sector has been slow, averaging merely 0.7 percent per annum since 2000. The energy efficiency of buildings, HVAC (heating, ventilation and air conditioning) and electronic equipment have significantly improved. However, 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.

POLICY OVERVIEW

In Canada, jurisdiction over energy matters is shared between the provincial and federal governments. Under the Canadian Constitution, provinces are the owners and managers of energy resources (except for uranium); 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 primarily market-based. Due to its abundant 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

[16] In 2005, although passenger vehicle ownership annually increased by 1.1 percent, the annual growth rate of energy use by small cars (0 to 1,181 kg) and large cars (1,182 kg or more) decreased by 2.2 percent and 1.1 percent, respectively.

adequately support these policy objectives: regulation to protect the public interest and promote health and safety; policies and programmes which encourage scientific and technological research promote energy efficiency and assist the development of renewable and alternative energy sources.

OIL AND GAS MARKETS

Wellhead oil and natural gas prices in Canada have been fully deregulated since the Western Accord and the Natural Gas Agreement on Prices between the federal government and energy-producing provinces were agreed to in 1985. The Accords opened up the oil and gas markets 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 reporting through the Minister of Natural Resources, to Parliament has the main responsibility for regulating international and interprovincial 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 continues to develop and maintain regulations regarding exploration and development activities in non-Accord Frontier Lands.

ELECTRICITY MARKETS

Province-owned utility companies dominate generation, transmission, and distribution activities and are primarily regulated by provincial regulatory bodies. Provinces, in general, 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. Electricity pricing varies by province or territory. Electricity prices in Alberta are more market-based than other provinces and territories where the electricity regulator set prices to cover costs and allow for a reasonable rate of return to investors. In Ontario, electricity market is partially restructured.

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.

Institutional arrangements were made to improve reliability in electricity market. The creation of the Electric Reliability Organization (ERO) was authorized under the U.S. Energy Policy Act of 2005. The ERO plays a critical role to address the operating reliability concerns of the North American grid that came to the forefront following the 2003 blackout. In July 2006, the Federal Energy Regulatory Commission (FERC) certified the North American Electric Reliability Corporation (NERC) as the newly formed ERO so that NERC is authorized to enforce reliability standards on the owners, operators and users of the bulk power system. 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, NRCan and provincial energy ministries can discuss issues of mutual concern.

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, research and development, and energy efficiency standards for household appliances, office equipment and industrial motors. The Energy Efficiency Act, which came into force in 1992, provides for the making and enforcement of regulations on performance and labelling requirements for energy-using products.

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* and the statistical reference *Energy Use Data Handbook*.

ENERGY AND ENVIRONMENT

In December 2002, the federal government officially ratified the Kyoto Protocol. 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. The federal government released the *Climate Change Plan for Canada* to support its ratification decision, which took a three-step approach. First, the Plan established that measures underway at the time of its release were expected to achieve 80 Mt of emissions reductions. Second, the Plan highlighted measures to reduce emissions by an additional 100 million tonnes mainly through the negotiations of covenants with large final emitters to reduce industrial emissions by 55 million tonnes. Third, the Plan suggested 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. This is the first phase of Project Green, which is the national project for a healthier environment, a stronger economy, and ultimately a more sustainable future. 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.

NUCLEAR ENERGY

The nuclear energy program in Canada is an important component of Canada's energy mix. In 2005, Canada's nuclear plants generated more than 15 percent of Canada's electricity. The federal government regulates the development and application of nuclear energy whereas the provinces and the provincial electric power utilities are authorized to plan and operate nuclear power plants. Most of the nuclear electricity plants are located in the province of Ontario where nuclear accounts for 54 percent of its electricity generation mix. The Federal Canadian Nuclear Safety Commission (CNSC) regulates all matters pertaining to nuclear energy in Canada.

Atomic Energy of Canada Limited (AECL), which is wholly owned by the Government of Canada, not only is the designer and builder of CANDU (acronym for Canada Deuterium Uranium) power reactors but also delivers R&D support and services such as consulting and maintenance to nuclear utilities. In June 2006, with funding of $520 million over the next five years, the Government of Canada requested AECL to move forward on a path to achieve international best practices for managing Canada's decommissioning and waste management obligations for its nuclear facilities.

OIL SANDS

Canada is endowed with abundant oil sands reserves (180 billion barrels of proven oil reserves). Canada ranks the second largest in terms of global proven crude oil reserves after Saudi Arabia, if oil sands reserves are included. Between 2002 and 2005, Canada's crude oil production increased at an annual rate of 4.7 percent. This robust increase – compared with history - is substantially supported by the growth in oil sands production. For example, oil sands production accounted for 67 percent of Canada's incremental growth in total crude oil production (2002-2005).[17]

[17] For example, between 1990 and 2002, Canada's crude oil production increased at an annual rate of 2.4 percent – a rather slow pace compared with the recent trend.

The majority of the reserves are located in Alberta, and the economy's oil sands reserves are estimated to reach 174 billion barrels in 2005. According to the Alberta Energy and Utilities Board, production averaged 1.26 million barrels per day (bpd) of bitumen in 2006. Of this total, approximately 660,000 bpd is sold as synthetic crude oil and distillates, and approximately 466,000 bpd is sold as bitumen.

Oil sands development is driven by several factors including higher oil prices, concerns surrounding the global supply of oil, market potential in the U.S. and Asia, and stable generic fiscal terms for producers. By 2015, oil sands production is expected to reach 3 million bpd.

There are two types of oil sand production methods, mining and in-situ. An open-pit mine operation is used to produce reserves close to the surface. For deep-water oil, some form of an in-situ recovery is required to produce bitumen. In-situ technologies include thermal (steam) injection through vertical or horizontal wells such as cyclic stem stimulation (CSS), pressure cyclic steam drive (PCSD) and steam assisted gravity drainage (SAGD). New technologies and extraction methods emerge such as vapour recovery extraction (VAPEX) and toe-to-heel air injection (THAI).

As a recently developed technology, in November 2006, Shell Canada 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.[18] Shell's enhanced froth treatment technology will be utilised in the first expansion of the Athabasca Oil Sands Project (AOSP), which was formally launched in November 2006.

NOTABLE ENERGY DEVELOPMENTS

CANADA'S CLEAN AIR AGENDA

The Government of Canada is pursuing an integrated strategy to address climate change and air quality problems through its Clean Air Agenda. The centrepiece of this strategy is to integrate measures for national regulation of greenhouse gas (GHG) and air pollutant emissions from major sources – industry, transportation, and consumer and commercial products. The government is also developing regulations to address indoor air quality. In addition, investments are being made in a series of complementary programs to help Canadians use energy more efficiently, boost renewable energy supplies, and develop cleaner technologies.

This holistic approach is designed to allow Canada to achieve real and sustainable emissions reductions. The Government has committed to reduce Canada's total GHG emissions by 20 percent by 2020 and by 60 to 70 percent by 2050 compared with 2006 levels and improve air quality in Canada. The majority of Canada's air emissions result from energy production and use.

The Regulatory Framework for Air Emissions

Industrial Air Emissions

The proposed industrial air emissions regulations will establish a new GHG emissions intensity improvement targets. Existing facilities are required to meet a target of an 18-percent reduction in emissions intensity from 2006 level by 2010, with an annual intensity improvement of 2 percent. New facilities are provided with a three-year grace period; initial targets will be based on emissions intensities achievable through the use of cleaner fuels, with an annual intensity improvement of 2 percent. In addition to conventional abatement measures such as energy efficiency improvement

[18] 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.

and improved energy management systems, firms will have other several options to meet their legal obligations. Those options include investments in a technology fund that will support research and development and technology deployment and infrastructure, domestic emissions trading (including access to offset credits), international Clean Development Mechanism credits, and a credit for early action for firms that took verified actions beyond normal business practice from 1992-2006.[19] This approach will lead to reductions of 60 megatonnes of GHG emissions by 2020 compared with 2006 level.

In addition, the proposed regulations will establish national emissions caps for major air pollutants. Proposed targets have been benchmarked to standards as rigorous as those in the other environmental performance-leading countries. To comply with the target, industries can either (1) implement in-house emissions reductions measures or participate in the domestic emissions trading schemes for SOx and NOx, with the possibility of linking to existing U.S. trading systems. These regulations will lead to significant reductions in emissions of the air pollutants that cause smog and acid rain.

Transportation Sources

The Government will establish regulated fuel-efficiency standards under the *Motor Vehicle Fuel Consumption Standards Act* that will be effective for the 2011 model year, following the expiry of the Memorandum of Understanding (MOU) between the auto-industry and the Government. The Government is undertaking additional measures to reduce emissions from the rail, marine and aviation sectors and on-road and off-road vehicles and engines.

Consumer and Commercial Products

Proposed amendments to the *Energy Efficiency Act* will allow the Government to set energy efficiency standards and labelling requirements for a wider-range of consumer and commercial products that affect or control energy consumption. The amendments will include: new energy performance standards for 18 currently unregulated products, such as commercial clothes washers and commercial boilers; and more stringent requirements for 10 currently regulated products, such as dishwashers and dehumidifiers. The Government will also reduce air emissions by regulating a number of consumer and commercial products that contain compounds that cause smog.

Indoor Air Quality

The Government will develop a priority list of indoor contaminants requiring government action and will gather information on these contaminants to guide decisions on the development of guidelines and product regulations.

Other Federal Initiatives

The Government is implementing a list of complementary measures in support of the Regulatory Framework for Air Emissions.

ecoENERGY Initiatives

The $300-million ecoENERGY Efficiency Initiative will promote smarter energy use and support energy-efficiency improvements in homes, and small buildings and industries.

[19] Those firms that have already reduced their GHG emissions prior to 2006 will be rewarded with a limited one-time carbon credit. The maximum allocation for emissions reductions would be one credit for one tonne of carbon dioxide equivalent reduction. A maximum of 15 Mt would be allocated, with no more than 5 Mt to be used in any one year.

- The ecoENERGY for Buildings and Houses program is designed to encourage the construction, operation and retrofit of more energy efficient houses and buildings through a range of complementary activities such as rating, labelling and training.
- The ecoENERGY Retrofit Initiative provides direct incentives and support to homeowners, small buildings and business owners to invest in energy efficiency retrofits.
- The ecoENERGY for Industry program encourages the accelerated uptake of energy-saving investments by Canadian industry by promoting the transfer of knowledge, new technologies and best practices.

The ecoENERGY Renewable Initiative will invest more than $1.5 billion through two initiatives to boost Canada's renewable energy supplies and create up to 4,000 megawatts of renewable energy.

- The ecoENERGY for Renewable Power program offers incentives for the production of power from emerging renewable energy sources.
- The ecoENERGY for Renewable Heat initiative is designed to support the increased use of renewable energy technologies in space heating and cooling and water heating in residential, commercial and institutional buildings.

Under the ecoENERGY Technology Initiative, the Government fund $230 million to the research, development and demonstration of clean energy technologies.

In addition, the Government of Canada and the Government of Alberta have established the Canada-Alberta ecoENERGY Carbon Capture and Storage Task Force. The Task Force is responsible for assessing the economic, technical and regulatory hurdles to large-scale implementation of carbon capture and storage, and developing an implementation plan for Canada to demonstrate global leadership and take advantage of its world-class opportunities for advancing the large-scale application of carbon capture and storage technology.

ecoTRANSPORT Initiatives

The ecoTRANSPORT Strategy includes a series of initiatives designed to reduce the environmental impacts of transportation and secure Canada's future prosperity and competitiveness, by making the transportation system more sustainable, both economically and environmentally.

- The ecoAUTO program encourages Canadians to buy fuel-efficient vehicles by offering rebates ranging from $1,000 to $2,000 towards the purchase of new light-duty vehicles that meet the required criteria.
- The ecoMOBILITY program, an investment of $10 million to help municipalities cut urban-passenger transportation emissions and develop programs, services and products for urban areas.
- The ecoTECHNOLOGY for Vehicles Program and the ecoENERGY for Personal Vehicles Program, with up to $36 million in funding for: testing and promoting environmentally friendly vehicle technologies; building partnerships with the automobile industry; and providing fuel consumption information and decision-making tools to encourage consumers to purchase fuel-efficient vehicles that are currently available in the market.
- The ecoFREIGHT initiatives, totalling up to $61 million, are designed to reduce the environmental and health effects of freight transportation through accelerated adoption of emissions-reducing technology.

In the 2007 federal Budget, the Government also announced a Green Levy on fuel-inefficient vehicles and funding of $36 million to support measures to remove older, high-emitting vehicles from Canadian roads.

Support for Public Transit

Since July 1, 2006, the Government of Canada has offered individual Canadians a non-refundable tax credit to help cover the cost of monthly or longer duration public transit passes. In addition, the 2006 federal Budget dedicated $1.3 billion to public transit capital improvements through the Public Transit Fund and the Public Transit Capital Trust.

Biofuels Initiatives

In December 2006, the Government announced its intention to regulate a minimum 5 percent renewable content in gasoline by 2010 and a minimum 2 percent renewable content in diesel and heating oil by 2012. At the same time, the Government is providing substantial support for the production of renewable fuels.

- Supporting the expansion of Canadian production of renewable fuels through the ecoENERGY for Biofuels Initiative, where up to $1.5 billion will provide operating incentives to producers of renewable alternatives to gasoline and diesel.
- Assisting farmers to seize new market opportunities in the agricultural bioproducts sector through the $200 million ecoAGRICULTURE Biofuels Capital Initiative, which provides up to $25 million towards the capital costs of each new facility based on the level of farmer ownership, and the Biofuels Opportunities for Producers Initiative, which assists farmers to develop business plans and feasibility studies to expand biofuels production capacity.
- Accelerating the commercialization of new technologies by providing $500 million to Sustainable Development Technology Canada to invest with the private sector in establishing large-scales facilities for the large scale demonstration of next-generation renewable fuels.

Trust Fund for Clean Air and Climate Change

The Government's $1.5 billion trust fund for clean air and climate change supports provincial and territorial initiatives aimed at reducing GHGs and air pollution. Each province and territory has identified specific technology, energy efficiency, and other projects that will deliver concrete emissions reductions to which their share of funding will be applied.

LNG PROJECTS PROGRESS

In Canada there are several LNG receiving terminal construction projects under going at various stages of development. Some projects have received EA and construction approval from federal and provincial governments, while other projects are under the process of technical and environmental assessments as well as public hearings.

Canaport LNG, the plant is located at Saint John, New Brunswick, will be the first one to become operational in Canada. With Irving Oil and Repsol the joint owners, the plant is now under construction, and expected to become in service by the end of 2008. The plant has a send out capacity of 1.0 Bcf/d and the gas will be distributed for the markets in Canada and the United States.

In October 2007, Rabaska LNG received approval for construction from Quebec government following a joint federal- provincial environmental review board approval. Rabaska LNG is jointly backed by Montreal based Gaz Metro, Enbridge and Gaz de France. The plant is located across the Saint Lawrence River from Quebec City, with a maximum output of 0.5 Bcf/d. The construction is scheduled to start in 2008, with operations expected to begin at the end of 2011.

In June 2007, the Energy Cacouna LNG, a joint project of Petro-Canada and TransCanada Corporation, received approval for construction from the Quebec government. The plant, which

has a capacity of 0.5 Bcf/d, is located on Gros Cacouna Island in the Saint Lawrence River, Quebec. The construction is expected to start in early 2009, with terminal operation to begin in 2012.

The gas from Rabaska LNG and Cacouna LNG will be supplied to Quebec, Ontario and Northeastern US. The Gazprom of Russia is interested with these projects to take a foot hold in North American LNG market.

Kitimat LNG (0.6 Bcf/d) in British Columbia has already received regulatory approval from federal and provincial government. However it has not yet determined further project schedule. The gas will be consumed locally or be transported to other areas in the interior including oil sands projects in Alberta.

Possible LNG projects under review process include WestPac LNG (0.5 Bcf/d) in British Columbia, Energie Grande-Anse LNG in Quebec, Keltic/Maple LNG (1.0 Bcf/d) in Nova Scotia

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CHILE

INTRODUCTION

Chile is one of the two APEC economies in South America. Located in the southern South America, it is bordered by the South Pacific Ocean between Argentina and Peru, and stretches along a coastline of 6,435 km. Its area covers nearly 757,000 square kilometers. Most of its 16.3 million populations (as of December 2005) live in urban areas, with nearly one-third residing in Santiago, the capital city. Chile is the largest producer and exporter of copper in the world.

Chile's GDP in 2005 reached US$174 billion with GDP per capita of US$10,700, both in terms of purchasing power parity (PPP) in 2000 US$. The economy grew at an average annual rate of 4.94 percent during the period 1980 to 2005. The global economic 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 other FTAs have subsequently been signed with the United States, European Union and China aside from its previous FTAs with its neighbors in Latin America. Chile plans to continue its focus with Asia by negotiating trade agreements with Japan, Thailand, Malaysia and Australia.

Chile has very limited indigenous energy resources and has to rely on imports to meet all of its energy needs. In 2005, its energy reserves consisted of 23.8 MCM of oil, 99 BCM of natural gas and 1,302 Mt of coal. In 2005, roughly 31 percent of the 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 northern, central and southern parts of the economy.

Table 7 Key data and economic profile (2005)

Key data		Energy reserves*	
Area (sq. km)	757,000	Oil (MCM) – Proved*	23.8
Population (million)	16.30	Gas (BCM) – Proved*	99
GDP Billion US$ (2000 US$ at PPP)	174.35	Coal (Mt)	1,302
GDP per capita (2000 US$ at PPP)	10,700		

Source: Banco Central de Chile, Energy Data and Modeling Center, IEEJ.

Energy security is Chile's main concern which was exacerbated by insufficient natural gas supplies, high price of oil and the less-than- adequate hydrological levels, among many other reasons.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Chile's total primary energy supply (TPES) grew at an average annual growth rate of 4.1 percent from 1980 to 2005. In 2005, TPES reached 29,971 ktoe, of which 43.2 percent comes from crude oil, 23.5 percent from natural gas, 9.8 percent from coal and 23.4 percent from other sources, mainly biomass and hydropower. Natural gas and other sources (renewable energy – hydropower and biomass) together contributed almost half of the TPES. The introduction of natural gas from Argentina in 1997 has led to a change in Chile's TPES mix. Oil however remained the major energy source, 43.2 percent of the share in 2005 compared with 44 percent in 1990. This change has

subsequently caused a reduction in coal, the share decreasing by almost half from 18 percent in 1990 to just 9.8 percent in 2005.

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 2005, this proportion has reversed, with 71 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, on the other hand, 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 suffered an energy crisis, forcing it to cut natural gas exports to Chile. Since then, exports to Chile have fluctuated between 20-50 percent below contracted volumes, with natural gas flows ceasing completely on some occasions.

Empresa Nacional del Petróleo (ENAP), a state-owned enterprise, is the major oil producer and refiner in Chile. Because of the 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 from others (17 percent). 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).

Table 8 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	9,310	Industry Sector	7,628	Total	52,484
Net Imports & Other	21,285	Transport Sector	8,149	Thermal	23,405
Total PES	29,971	Other Sectors	6,022	Hydro	26,214
Coal	2,947	Total FEC	21,798	Nuclear	-
Oil	12,938	Coal	903	Others	2,864
Gas	7,048	Oil	11,436		
Others	7,038	Gas	1,277		
		Electricity & Others	8,182		

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

In 2005, Chile's power generation, in the primary systems was 52,484 GWh. During the period 1980 to 2005, generation increased at around 6.2 percent per year. Over the last two decades, hydropower has accounted for the bulk of electricity generated. However, thermal is becoming more significant, and in 2005, thermal generation reached 23,405 GWh, 44.6 percent of total generation, mainly from natural gas, fuel oil and coal. The use of petroleum coke (petcoke) is allowed in some plants, but under strict monitoring for environmental control of air pollution.

There are four separate power grids in Chile: Sistema Interconectado Central or Central Interconnected System (SIC), Sistema Interconectado del Norte Grande or Great North

Interconnected System (SING), Sistema Aysén and Sistema Magallanes. SIC is the most important as it serves over 93 percent of the population and more than 40 percent of the land area. SING, 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 with installed capacity of 8,288 MW in 2005 (57 percent is hydroelectric) while peak demand reaches around 5,764 MW. In adverse hydrological conditions however, the system could face the risk of power shortages. The SING has excess installed capacity with 3,596 MW including 643 MW in Argentina for a demand of 1,570 MW. Gas supply restrictions increase generating costs (around US$190/MWh vs. US$33.1/MWh) and could cause problems in terms of unabated increases in fuel costs and could also produce environmental restrictions due to 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 percent from 1980 to 2005 and reached 21,798 ktoe in 2005. The growth rate increased by 0.7 percent compared with 2004. The main energy consuming sectors were transport (37 percent) and industry (35 percent); with residential, commercial and public sectors consuming 28 percent. By energy source, oil products accounted for 52 percent of final consumption, with electricity and "other" sources, natural gas and coal at 38 percent, 6 percent, and 4 percent, respectively.

The transportation sector has recently been the fastest growing end-use sector, with an average increase of about 5.2 percent per year from 1980 to 2005.

The industry sector, on the other hand, grew by an average of 4.2 percent from 1980 to 2005 which was driven by both energy-intensive and non-energy-intensive industries. Booming prices for Chile's mineral exports, especially copper, becomes the principal drivers of high energy consumption and economic growth rates. While copper and other minerals remain the mainstays of Chile's exports, trade of other non-traditional products, such as forestry, agricultural and marine products have grown considerably over the past two decades reflecting higher energy consumption from these sectors.

In the residential, commercial and public sectors, growth in energy consumption averaged about 2.6 percent per year from 1980 to 2005. The residential, commercial and public sectors accounted for almost 28 percent (6,022 ktoe) of the total energy consumption in 2005.

POLICY OVERVIEW[20]

Energy security has emerged as one of the main challenges facing Chile today. The economy depends on imports of different fuels to produce the energy they require for transport, electricity generation, industrial uses, home heating and all other energy needs. In this context, the Chilean government has drawn up the Energy Security Policy (ESP) which seeks to diversify the economy's energy matrix (in terms of both fuels and suppliers), achieve greater energy autonomy and encourage the efficient and intelligent use of energy.

FRAMEWORK FOR ACTION

The regulatory framework for Chile's electricity sector (Short Law I of 2004 and Short Law II of 2005) provides adequate incentives for private sector investments in electricity projects.

[20] Chile's Energy Security Policy (ESP), Nov. 1, 2006

The Short Law I regulated transmission, creating incentives for investments in this segment of the industry. The Short Law II, on the other hand, created the conditions for the economy's energy development by providing regulatory and economic incentives for private sector investments in generation, including both conventional projects (hydroelectric and thermoelectric) and Alternative Renewable Energy (ARE) sources[21].

Short-term Measures

Quintero LNG Project

With a capacity of 10 MCM/day (expandable to 20 MCM/day), the Quintero LNG plant will be able to provide the supply needed to meet the restrictions on the import of Argentine gas.

The pool of local companies participating in the project – Chile's state oil company ENAP, the Endesa Chile generator, the Metrogas natural gas distributor and GNL Chile – signed in September 2006 an agreement with BG Group that establishes the structure of the project, identifies and regulates the activities to be undertaken and, most importantly, defines the terms of LNG supply and storage and re-gasification services. This agreement addresses the basic aspects of the gas sale contracts and the development of the Engineering Procurement Construction (EPC) including the option of early supply to bring forward the start of operations of the LNG complex.

LNG Project in Northern Chile

The government instructed the state copper company, CODELCO, to lead a pool of northern Chile's energy users in studying the possible construction of an LNG plant to supply the SING's needs based on the likelihood that restrictions on supply of Argentine gas will increase over the years. CODELCO, the other large mining companies and the electricity generators are assessing the technical and economic feasibility of different alternatives for this project.

Promotion of Hydrocarbons Prospection

After the discovery of a continuous flow of gas from the Lago Mercedes II well, ENAP is conducting a new test in the Lago Mercedes III to assess the extent of the reserves. At the same time, ENAP is continuing with its prospection program in the Dorado-Riquelme block to the north of Punta Arenas city.

In addition, a number of overseas companies have expressed interest in signing Oil Prospection and Production Contracts (CEOPs) with the State of Chile, represented by the Mining Ministry. By the end of 2006, ENAP would have put out a tender to incorporate private partners in its hydrocarbons E&P in the far south of Chile.

International Tenders for Energy Supply

Under the Short Law II, distributors must issue public tenders for the energy required to supply their regulated clients. In order to guarantee supply availability in the medium term, the system establishes a payment mechanism based on stable long-term prices. The introduction of this incentive has triggered a major investment boom[22] in this sector.

In a bid to attract new players to Chile's electricity sector, the Foreign Investment Committee assisted the distributors – grouped together in the Empresas Eléctricas association – in organizing different international events and road shows. These events served as an opportunity to heighten awareness of the excellent regulatory and economic conditions that Chile offers for new investments in the electricity sector. Thus, in October 2006, the CGE, Chilquinta, Saesa, Chilectra and Emel distribution companies received offers for the first block of tenders totaling 2,750 MW

[21] This involves an innovative process of tenders for the supply of regulated clients under which generators must compete on price to sell electricity to distributors and the price of the resulting contracts is indexed to each bidder's input costs.

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

with the second block of tenders for supply of more than 2,832 MW scheduled for award in the second quarter of 2007. The CNE has already formally approved the tender terms proposed by the three distributors, namely: CGE, Chilquinta and Chilectra.

Operational Security Plans (102 bis, Short Law II)

Under the Short Law II, the authorities can require Economic Load Dispatch Centers (CDECs) to adopt a more conservative operating plan in the SIC with the aim of optimizing the use of the system's water resources to ensure adequate supply.

The draft of the corresponding regulation has already been reviewed by the CNE and the Mining and Energy Ministries. The electricity companies have also provided their comments and once these are finalized by the CNE, the Economy Ministry will send the regulation to the General Comptroller's Office for its approval and subsequent publication to the *Diario Oficial* (Law Gazette).

Incentives for Electricity Savings (90 bis, Short Law II)

The Short Law II introduced a mechanism to encourage consumers to limit electricity use. Under this mechanism, generators will offer rewards or incentives to their regulated clients who conserve energy.

The design details of this mechanism which will improve the allocation of energy resources are close to competition. The draft of the corresponding regulation has been drawn up and was presented to the electricity companies, the CDECs and the Panel of Experts for comments which have already been received by CNE for review and subsequent approval.

Survey of Locations for Back-up Turbines

No new power plants will come on line until 2010 and with an expected dry spell in 2008-2009 which will directly impact on hydroelectric output, would mean that the SIC would require back-up diesel turbines[23] to reinforce its existing installed capacity.

From May to June 2006, electricity generators and distributors were consulted on the possible locations of these back-up diesel turbines and 25 sites were identified for turbines of 50, 70 and 100 MW or a total of 2,170 MW. The CNE together with the National Commission for the Environment issued in October 2006 a tender for the preparation of baseline environmental studies of these sites which seeks to speed up the approval process for private companies that wish to install back-up turbines in these locations.

Issue of Emission Standards for Thermoelectric Plants

Thermal plants that use fossil fuels are a major source of particulate matters, sulfur dioxide and nitrogen oxide. Their installation in any part of the economy has a significant impact on air quality. For this reason, it is important to establish emission standards for these power plants and new power plant installations to provide a clear signal for investors about the restrictions with which they have to comply and the type of technology they should use. This will not only safeguard the health of the population but at the same time simplify the environmental evaluation process of power projects.

CONAMA's Council of Ministers approved in May 2006 the reactivation of the process of drawing up these standards and agreed to include them in the Priority Program for New Standards which it prepares in accordance with Law Nº 19.300. At present, the first study of these standards is being prepared, with financing from the CNE, and the corresponding Operational Committee has been set up.

Strengthening the National Efficiency Program (PPEE)

[23] These turbines, which take only six months to install, have capacities that range from 30 to 120 MW and can be put up in different locations in the country.

The National Energy Efficiency Program is a public-private initiative that seeks to create, publicize and consolidate a National Energy Efficiency System covering housing, transport, manufacturing, mining and the public sector.

Using energy efficiently in all sectors of the economy is a process by which the developed countries have embarked long ago. The main objective is to manage to "uncouple" energy consumption from economic growth and the developed countries have been successful in reducing the growth in energy consumption to rates that are considerably lower than the expansion of their economies.[24]

Measures for the National Energy Efficiency Program	
1. An active media campaign managed by the National Consumer Service, the Economy Ministry and the CNE;	6. Incorporation of energy efficiency considerations in the design and construction of public buildings and works;
2. Preparation and launch of a manual on Efficient Energy Use;	7. New insulation standards for housing;
3. Compulsory labeling of refrigerators, light bulbs and other artifacts with information about their energy consumption;	8. Audit and certification;
4. Incorporation of energy efficiency parameters in public procurement decisions;	9. Energy efficiency incentives for companies; and,
5. A manual for the introduction of efficient street lighting (prepared by the CNE, the UN Development Program (UNDP) and the Chilean Association of Municipalities (ACHM));	10. Incorporation of energy efficiency into Clean Production Agreements.

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, at the same time, to reduce environmental impact and risks to the population. This implies:

- Increasing the available storage capacity and ensuring conditions that facilitate the fuel's transport by road. In October 2006, the CNE completed a study to assess the requirements and to evaluate the response of storage and distribution facilities for both liquid and solid fuels in different supply and demand scenarios.
- Monitoring environmental restrictions in emergency situations and speeding up procedures for approving projects.
- Facilitating the operation of a task force composed of SING generators, clients and the system's CDEC.

[24] A study carried out recently for the CNE examined the many different initiatives developed economies have implemented and, on the basis of this information, estimated around 1.5 percent annual reduction in the total energy consumption. Projected over a ten-year horizon, this would mean savings for Chile of 247 million barrels of oil equivalent.

- Setting up a government action group with membership from the central and regional government agencies to coordinate measures to ensure the system's security.

Medium-term Measures

Development of Alternative Renewable Energy (ARE)

The government is currently promoting measures that will ensure 15 percent of the new generating capacity installed through 2010 corresponds to ARE sources. Consistent with this purpose, the government has implemented activities/regulations to give the correct signals to the market to allow for new investments on ARE, including among others:

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

Historically, Chile's regulatory framework has been neutral as regards the technologies and energy sources used to generate electricity. However, the Short Law I marked a change in this policy and established preferential conditions for ARE projects of less than 20 MW through trunk transmission tolls exemption. The Short Law II further established additional benefits by securing 5 percent of the energy tendered by distributors to come from ARE sources aside from the many other salient measures and incentives introduced to achieve the 15 percent ARE target by 2010.

Government Policy for the Development of Biofuels

A number of studies are being prepared to compile information relevant for the introduction of biofuels in Chile. These include an economic evaluation of the production and marketing of biofuels being carried by the Universidad Santa María for the government's Office for Agricultural Research and Policies (ODEPA), the Agricultural Innovation Fund (FIA) and the CNE. In conjunction with the UN Food and Agriculture Organization (FAO), two other studies are being prepared analyzing the legal framework for biofuels in other Latin American countries and the potential raw materials in the region for large-scale biofuel production. The Ministry of Transport is also carrying out a survey on the use of biofuels by vehicles in Chile.

In May 2006, 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. An ad hoc group was subsequently created to define the national quality standards and specifications for ethanol and biodiesel to be sold in Chile.

A public-private working party including the National Association of Agronomists has also been formed and, as its first initiative, organized the international seminar on Biofuels in July 2006 at the Headquarters of the FAO in Santiago with the participation of the Argentine and Brazilian Ministries of Agriculture and experts from Argentina, Brazil, Canada, Germany and Spain as well as several public and private Chilean institutions. Before the end of 2006, three more seminars would have been conducted in different regions of Chile to increase local awareness.

In October 2006, the working party was further strengthened with the incorporation of additional organizations, namely: CORFO, CONAMA, the Wood Corporation (CORMA), the National Agricultural Society (SNA), the Small and Indigenous Farmers' Movement (MUCECH), the FIA, the Universidad de Chile, Chile Sustenable, the IANSA sugar producer and Biodiesel America. This will help the party in its effort to form a broad vision of the development of biofuels in Chile.

NOTABLE ENERGY DEVELOPMENTS

INTERNATIONAL ENERGY INTEGRATION

The decision of Argentina to continually reduce natural gas exports 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 government is currently pursuing preliminary LNG supply agreements with Indonesia and other economies of the APEC region.

In June 2005, Suez Energy International, a subsidiary of Belgium's Tractebel, began a formal feasibility study for a pipeline linking Peru's Camisea natural gas project with northern Chile. The project would feature a 930-mile pipeline system between Pisco, Peru and Tocopilla and Chile with installed capacity of 810 Mmcf/d. In addition, the pipeline would have connects to the GasAtacama and NorAndio, which may allow potential exports to Argentina in the future.

The pipeline is part of the natural gas "ring" proposed by Peru, Chile, Argentina, Uruguay and Brazil which would utilize new and existing pipelines to link natural gas reserves in those countries, facilitating greater energy integration in the Southern Cone. The ring would also reduce the dependence of some countries, notably Brazil, upon Bolivian natural gas production.

LNG TERMINAL FOR PACIFIC LNG GAS

In 2004 to 2006, Chile was confronted by an import restriction of natural gas supplies from Argentina that reached almost 50 percent of the total volume previously supplied, with natural gas flows ceasing completely on some occasions. For example, Argentina completely cut exports to Chile for two weeks in August 2006. The import cuts have caused shutdowns at power plants and methanol facilities forcing generators to switch to costlier fuels.

In February 2006, ENAP awarded a US$400 million tender to BG Group for the construction of an LNG re-gasification terminal near Quinteros in central Chile. BG plans to begin construction by the end of 2006 and hopes to bring the plant onstream by 2009 with an estimated sendout capacity of 330 Mmcf/d. ENAP has already signed supply contracts with large distributors.

In another development, the Chilean government announced in August 2006 that CODELCO would lead an effort to develop another LNG terminal in the northern part of the economy which would supply power plants and major industrial consumers.

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 (9 MW and below) to the generation mix through simplified commercial and operation regulations in the electricity market and the distribution systems. The streamlining of the law has been a key issue in the policy of the 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 2006, the CNE in conjunction with Congress has been studying a new law for renewable energy projects with the purpose to remove all commercial barriers for its development. The objective is to send this new revision in 2007 for the discussion and approval of Congress. This initiative is a priority in the government's energy policy and will be a complementary measure to address energy security.

In October 2006, an international seminar and a round of business meetings were held in Santiago, organized by CORFO, in a bid to attract investments in ARE sources. During this event, 400 business meetings took place involving 140 business representatives from 18 countries. At the seminar, CORFO announced that it would make available US$100 million for ARE projects through its lines of intermediate finance for loans of up to 12 years at preferential interest rates. In

addition, CORFO announced that it would be making resources available for the creation of investment funds that support ARE projects.

To date, Environmental Impact Studies have been submitted for 19 ARE projects, representing a total capacity of 492 MW (12 small-scale hydro plants, 2 biomass projects and 5 eolic projects). These projects will complement the existing 285.7 MW generating capacity using ARE sources which represent 2.4 percent of the economy's total capacity.

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, CNE developed, printed and distributed in 2006 the document "Guía del mecanismo de desarollo limpio para proyectos del sector energía", as a way of providing local and foreign investors a clear guidelines of the required information for CDM projects in Chile and at the international level. These guidelines will help reduce the transaction costs for small-scale energy projects in Chile.

In another area, the government approved in 2006 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 Energy Security 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 of new generation capacity projects to be installed by the private sector. The outcomes of this work will be published by end 2007. CONAMA acts as coordinator of the government's environmental programs and is chaired by a Minister and is joined by several different Ministries e.g., Economy, Public Works, Telecommunications, Agriculture, Health, among others.

OLADE (*Organización Latinoamericana de Energía*) estimated that CO_2 emissions from electricity production in 2003 were 13.82 million tons of CO_2 which represents 25 percent of total emissions of the energy sector.

As of September 2007, there are eight energy-related CDM projects in Chile, based on UNFCC database, with expected total emissions reductions of about 2 million tons of CO_2 per year. The breakdown of the projects is as follows: (i) 3 projects on electricity production from biomass (953,216 tCO2/year); (ii) 3 hydropower projects (578,456 tCO2/year); (iii) 1 landfill gas project (582,425 tCO2/year); and, (iv) 1 cogeneration project (2,226 tCO2/year).

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CHINA

INTRODUCTION

China is the fourth largest economy in the world when measured by nominal GDP, next to Germany, Japan 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 2005, the energy consumption growth rate amounted to 10 percent. However, GDP per capita in 2005 was still quite low, at US$6,012 (2000 US$ at PPP).

China is rich in energy resources, particularly coal. In 2006, China was the largest producer and consumer of coal in the world, as well as the fifth 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 million tonnes and proven natural gas reserves of 2,450 BCM. In addition, China is endowed with 400 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 (2005)

Key data		Energy reserves*	
Area (sq. km)	9,600,000	Oil (Million tonnes) – Proven	2,200
Population (million)	1,296.16	Gas (BCM) – Proven	2,450
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)**	400

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

**Source: Embassy of the People's Republic of China in the United States of America (http://www.china-embassy.org/eng/xw/t168257.htm, retrieved on 10th December 2007)

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 2005, the total primary energy supply (TPES) reached 1,544 Mtoe. Of this total, coal accounted for 73 percent, oil for 21 percent, and natural gas for 3 percent, while hydropower, nuclear power and other sources accounted for the remaining 3 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 five years. In 2005, coal production reached 1,143 Mtoe and climbed to 1,442 Mtoe[25] in 2006, reaching a new historic high.

The supply of petroleum products in 2005 grew by about 1.45 percent compared with the preceding year while domestic oil output also increased slightly to 181 million tons, while China imported approximately 127 Mtoe of oil. Import dependence on oil reached around 42 percent of total oil consumption in 2005. Primary natural gas supply totalled 45 Mtoe in 2005 while its share in total primary energy supply remained at 3 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 15 percent over the last five 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 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	1,426,025	Industry Sector	525,932	Total	2,497,942
Net Imports & Other	138,109	Transport Sector	107,889	Thermal	2,045,018
Total PES	1,544,602	Other Sectors	270,778	Hydro	397,017
Coal	1,122,099	Total FEC	904,599	Nuclear	53,088
Oil	324,386	Coal	347,385	Others	2,819
Gas	44,665	Oil	248,495		
Others	53,452	Gas	56,176		
		Electricity & Others	216,544		

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 10 percent over the period 2001 to 2005, to reach 517.2GW[26] at the end of 2005 with a corresponding growth in power generation to 2,498 TWh. By fuel type, 76 percent of the total installed capacity was from thermal plants, 23 percent hydro, 1 percent nuclear, and 0.2 percent other[27]. The corresponding shares of power generation were 86 percent for thermal power, 16 percent for hydropower, 2 percent for nuclear power and 0.1 percent for other.

[25] China Statistical Yearbook, 2006

[26] China Electric Power Yearbook, 2006

[27] China Electric Power Yearbook, 2006

FINAL ENERGY CONSUMPTION

Final energy consumption in China reached 905 Mtoe in 2005, or 8 percent higher than the previous year. Industry was the largest consumer accounting for 58 percent of total final energy consumption. This was followed by the transportation sector accounting for 12 percent of energy use and other sectors – including residential and commercial – 30 percent. In terms of energy sources, coal (38 percent) remained the most important fuel in 2005, followed by oil (31 percent), electricity, heat and other fuel (24 percent), and natural gas (6 percent).

Coal consumption in 2005 reached 347 Mtoe from 327 Mtoe in 2004. The China's electricity sector is the biggest coal consumer. In 2005, around 50 percent of coal consumption came from the power sector, followed by metallurgical industry (29 percent), building materials sector (9 percent), chemical sector (9 percent) and others (3 percent) [28].

Electricity demand increased by 16 percent from the previous year and reached 2,197 TWh in 2005. The high demand growth resulted mainly from the increase in consumption in commercial and residential, industrial and transport sectors at 11 percent, 7 percent and 10 percent respectively. The highest consumption for electricity was from the industrial sector at 68 percent, followed by residential sector (14 percent), agriculture (4 percent), commercial sector (4 percent), transport sector (2 percent) and others (7 percent).

China consumed 284 million tons of oil in 2005, the second-biggest oil consumer behind the US. The industry sector was the largest oil consuming sector, accounting for 39 percent of total final oil consumption. The transport sector, the second largest oil consumer and the fastest-growing oil consuming sub-sector, accounted for 35 percent of total oil consumption, an increase of 11 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 56 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. Based on the Outline of the 11th Five-Year Plan (2006-2010) for National Economic and Social Development released last year, the National Development and Reform Commission (NDRC) published the "11th Five-Year Plan for Energy Development" in April 2007 (see notable energy developments for further details).

According to the 11th Five-Year Plan, the government has set the target of decreasing energy consumption per unit GDP by 20 percent through to 2010 from the 2005 level; and reducing emissions of major pollutants by 10 percent through to 2010. However, energy consumption per unit of GDP in 2006 dropped by only 1.2 percent, far behind the expected reduction at the beginning of the year. The failure could be explained by two main reasons – slow industrial

[28] China Industrial Maps – Energy, 2006-2007

restructuring and overheated growth of heavy industry in particular the high energy intensive industries. Another reason is inadequate support from some local governments and enterprises, which could not endure the laws and rules related to environmental protection and energy saving.

In December 2007, the Office of National Energy Leading Group published a draft of the Energy Law to seek public opinions until 1st of February 2008. The drafted energy law comprises of 15 chapters and 140 articles aiming to improve energy efficiency and environmental quality (see notable energy developments for further details).

COAL

Based on the Guidelines on Promoting the Health Development of the Coal Industry established in 2006, the 11th Five-Year Plan for Coal Industry Development was established in January 2007. According to the plan, 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

Oil market reform has been making progress steadily. The Ministry of Commerce (MOC) publicised the crude oil market management regulations and the oil product market management regulations in December 2006. However, those regulations would not affect the current retail price of gasoline and diesel, therefore, the domestic retail prices continue to be set by the NDRC. On the other hand, the government tried to use tax and price leverage to adjust domestic oil market. At the beginning of 2007, the government lowered oil products prices when the international crude oil price dropped. Due to the increase in international crude oil prices in recent years, the NDRC decided to increase domestic oil products prices and provide subsidizes to the taxi driver, public transportation, agricultural sector and others.

Another measure to keep more oil resources at home and ensure the national energy supply security, the Ministry of Finance and the General Administration of Customs jointly issued a new tax policy on crude oil export in June 2007. The new tax policy stated that a 5-percent duty would be levied on the export of crude oil owned by foreign oil companies in offshore oil production joint ventures if production-sharing contracts (PSCs) are signed after 1st of August 2007. But a 5-year interim would be granted to the foreign oil companies if they sign PSCs and execute them before 1st of August 2007.

NATURAL GAS

Natural gas demand grew robustly in the past few years, but domestic supply is not sufficient to meet the increase in demand. The NDRC released China's Natural Gas Utilization Policy in August 2007 in order to relieve the tension between natural gas supply and demand, optimize natural gas utilization structure, and improve energy efficiency and lower pollutant emissions. The Policy emphasized that priority is given to the towngas sector in utilizing natural gas, and it prohibits the production of methanol from natural gas. The Policy also prohibits the construction of gas-fired power plant located in the giant coal production bases, and prohibits producing LNG from domestic natural gas fields (see notable energy developments for further details).

ELECTRIC POWER

With economic growth pushing electricity demand beyond generation capacity, the economy has experienced power shortages since 2002. Stimulated by the severe strain on the power supply, there has been 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 five years, which was higher than the growth rate of the economy's GDP during the same period. China's total power

installed capacity has reached 622 GW in 2006, and more than 90 GW of new installed capacity was expected to start operation in 2007. Power supply and demand was balanced nationwide in 2007, although short-term power shortages will still exist in a few regions, in particular during summer season.

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 within the 11th Five-Year Plan period (2006-2010). In February 2007, the government announced the plan to shut down all power generation facilities under 50MW in size by 2010, accounting collectively for more than 10 percent of total electricity generation. China has closed 365 small thermal power generators with a total capacity of 111 MW from the beginning of 2007. On average, the closed generators had a single-set capacity of 30 MW with a 28-year average operational year, and consuming 488 grams of coal to generate one kilowatt-hour of electricity.

According to China's power development project in the period 2006-2010, China will redouble efforts to develop clean energy such as hydropower, nuclear power and replace small coal-fired or oil-fired power generation units with large, coal-fired units. In addition to the clean energy development, China will further adjust the pricing mechanism for electricity. In November 2007, the government announced a series of measures to deepen electricity price system reform and improve the transmission and distribution electricity price mechanism.

The Chinese government also decided to speed up nuclear power development. According to a Long and Mid-term Nuclear Power Development Plan released in October 2007, the installed nuclear power capacity will reach 40 GW by 2020, accounting for 4 percent of total installed capacity of China. Currently, the nuclear power installed capacity is 9 GW and eight generating units are now under construction. 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.

DEVELOPMENT AND UTILIZATION OF RENEWABLE ENERGY

In the coming years, China is moving ahead rapidly with its construction of renewable energy projects, with the target of 10 percent of total primary energy demand from renewable energy by 2010 and 15 percent by 2020. To lay-out road map to reach the target, the State Council released the Long and Mid-term Renewable Energy Plan in August 2007. The Plan sets target for the installed capacity expansion for hydropower, bioenergies, wind power, solar power and others renewable energies. The Plan also includes the proposed locations for plant construction

Water resources of China are mainly clustered in the western region with 70 percent scattering in the south-western area. The priority of hydropower construction is given to the areas of Jinsha, Yalong, Dadu, Lancang, Yellow and Nu River. The total installed capacity from hydropower is planned to reach 190 GW by 2010 and 300 GW by 2020, of which 75 percent from large hydro power plants.

Bioenergies is expected to replace 1 billion tonnes of standard coal in the future by annually utilizing 1 million tons of biomass solid fuel, 19 BCM of biogas, 0.2 million tons of bio-diesel and 2 million tonnes of non-grain ethanol fuel. Total biomass installed capacity is planned to have 5.5 GW in 2010 and hit 30 GW by 2020.

The Chinese government also encourages electricity generation by wind power, solar power and tidal power. By 2010, the total installed capacity of wind and solar power is planned to reach 5 GW and 0.3 GW, and by 2020 the respective installed capacity will reach 30 GW and 1.8 GW. In addition, tidal power station will be able to generate 100 MW per annum by 2020.

ENERGY CONSERVATION AND EMISSIONS REDUCTIONS

In response to the rapid growth of energy consumption and environmental problems, China has initiated a number of special programmes and action-plans to improve energy efficiency. The NDRC issued a Comprehensive Work Plan for Energy Conservation and Pollutant Discharge Reduction in June 2007, aiming to reduce the discharge of major pollutants by 10 percent during the 11th Five-Year Plan period (2006-2010). According to the Work Plan, both government and enterprises are urged to achieve the targets of:

- energy consumption per RMB10,000 of GDP to be reduced from 1.22 tonnes of standard coal in 2005 to below one ton, down by about 20 per cent;
- water consumption per unit of industrial value added to be reduced by 30 per cent;
- discharge of major pollutants to be reduced by 10 percent;
- discharge of sulphur dioxide to be reduced from 25.49 million tonnes in 2005 to 22.95 million tonnes;
- chemical oxygen demand (COD) to be reduced from 14.14 million tonnes in 2005 to 12.73 million tonnes;
- the ratio of national urban treated sewage to reach at least 70 percent;
- the ratio of comprehensive utilization of industrial solid wastes to reach 60 percent or more.

China will also reform energy pricing mechanisms for oil products, natural gas and electricity, and restrict the export of high-energy consuming and heavy-polluting products. In addition, auditors will investigate whether the central government's proposed measures for energy intensity improvement is implemented at the local industries. China will also promote the use of renewable energy resources. The plan states that government departments have to purchase highly efficient energy-saving, water-saving and environmental-friendly products in governmental procurement, in particular air conditioners and office equipment. Starting from 2008, governors at all levels are obliged to report to the central government their efforts in saving energy and reducing pollutant emissions. The temperature of all China's air-conditioned public rooms should be kept at or above 26 degrees centigrade, and residents are asked to do the same at home, in a bid to save more energy.

To ensure the achievement of energy efficiency improvement and pollution reduction targets, the Chinese government established a team in June 2007, called National Leading Group for Climate Change and for Energy Conservation and Reduction of Pollutant Discharge – headed by Premier Wen Jiabao and Vice Premier Zeng Peiyan – showing the government responsibility and its dominant role in addressing the energy conservation and emissions reductions.

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 emitter in the world. In 2006, the total sulphur dioxide emission in China reached 25.88 million tonnes, of this 22.35 million tonnes came from industrial discharge and 3.54 million tonnes from domestic discharge. The amount is 1.5 percent over that of the 2005 level. In 2006, China's coal consumption increased by more than 135 million tonnes, or 12 percent increase from the previous year. With this substantial increase in coal consumption, large amount 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 making efforts to reduce the emissions 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 economy's fuel mix. The national investment on environmental protection reached its historical highest in 2006 at RMB 256.78 billion, accounting for 1.23 percent of national GDP.

The Chinese government published the first "China's National Climate Change Programme" in June 2007 to address climate change and show its determination to reduce greenhouse gas (GHG) emissions. According to the Programme, China pledges to change its industry structure, promoting clean technologies and improving energy efficiency. The strategic goal of the programme is to make significant achievements in controlling greenhouse gas emissions, to enhance the capability of continuous adaptation to climate change, to promote climate change related science, technology and R&D to a new level, to remarkably raise public awareness on climate change, and to further strengthen the institutions and mechanisms on climate change. To realize the objectives and tasks presented in the Programme, China will adopt a series of institutional, legal, economic and technological instruments.

The NDRC and the State Environmental Protection Administrative jointly formulated a new regulation to cut greenhouse gas emissions, called "Electricity price of coal-fired power plants with desulphurization facilities and desulphurization facilities operation management". The new regulation is to speed up the construction of flue gas desulphurization facilities on coal-fired power plants, improve desulphurization efficiency and reduce sulphur dioxide emissions, and promoting environmental protection. According to the regulation, all new and old plants fitted with desulphurization facilities will be given an additional price of RMB 0.015 (US$ 0.002) per kWh of electricity produced. Older plants must be fitted with desulphurization units and any power plants discontinued using a desulphurization unit would be penalized. In order to facilitate the desulphurization facilities, the power companies are requested to install smoke supervision systems. The new regulation came into effective on 11 June 2007 and it expected helping China to reach its 2006 to 2010 target of cutting sulphur dioxide emission volume by 10 percent.

NOTABLE ENERGY DEVELOPMENTS

THE 11TH FIVE-YEAR PLAN FOR ENERGY DEVELOPMENT

In April 2007, the National Development and Reform Commission (NDRC) published the 11th Five-Year Plan for Energy Development. In the plan, the national primary energy demand is expected to grow at an annual average rate of 4 percent during the period of the Five-Year Plan, and will reach 2.7 billion tons of standard coal by 2010. Demand of coal, oil, natural gas, nuclear power, hydro power and other NRE will account for 66.1 percent, 20.5 percent, 5.3 percent, 0.9 percent, 6.8 percent, 0.4 percent of TPED respectively. Compared with that in 2005, the share of coal will be reduced by about 3 percent as the government decided to make more efforts of reducing the coal consumption and improving the environmental quality. To compensate for the reduced coal share, the government will promote the utilisation of natural gas and NRE. During the period, the primary energy output is projected to increase at 3.5 percent per annum and reach 2.446 billion tons of standard coal by 2010. The breakdown for the output of coal, oil, natural gas, nuclear power, hydro power and other NRE is 74.7 percent, 11.3 percent, 5.0 percent, 1.0 percent, 7.5 percent and 0.5 percent respectively. Obviously, the domestic oil and gas output could not satisfy the demand.

The Plan is to map out the overall energy development, including i) to develop coal industry in an orderly manner; ii) to speed up the exploitation of petroleum and natural gas resources; iii) to actively develop hydropower, to optimize thermal power development, and to promote nuclear power construction under the condition of protecting the environment and properly migrating the people,; iv) to place great efforts to develop new and renewable energy resources; v) to moderately accelerate exploration and development of coal in Sanxi region (Shanxi, Shaanxi and the western part of Inner Mongolia), of oil and gas from the offshore and Midwest of China, of hydropower resources in Southwest of China; vi) to optimize eastern coal and onshore oil and gas resources exploration in order to stabilise the supply and ease energy transportation pressure. The Plan also indicated that the government will intensify sector reforms in relation to the market and energy pricing systems.

The Plan also highlighted the importance of building up strategic oil reserves. A three-level of oil stock system would be gradually developed regarding government-funded strategic oil stock, enterprises-funded compulsory oil stock, and commercial oil stock.

ENERGY LAW

Since 2006 China has set up a taskforce to draft Energy Law. The Energy Law will serve as to provide the basic guiding principles for the existing energy related laws on (1) coal industry, (2) electric power, (3) energy conservation and (4) renewable energy, as well as local rules and regulations related to energy. The fifth edition of the draft Energy Law was released in December 2007 to seek public comments until the 1st of February 2008. The government plans the draft of Energy Law to be submitted to the legislature in 2008 and to be effective in 2009. The draft covers the areas of energy management, energy supply and service, energy saving, energy reserve, and energy price and tax.

According to the draft, the government will establish energy pricing system that is partially based on market mechanism. The new energy pricing system also internalize a part of environmental cost. A new administration under the State Council would be formed to coordinate energy management of economy's energy industry, while smaller independent departments would be in charge of other pertinent energy issues. The proposed new administration would have to approve any mergers or acquisitions that may critical to state security and the national economy. However, major investments in energy industries would still be controlled by the State Council. The government would establish an energy reserve system to cope with the critical situation such as energy supply disruption. The Law required oil companies to build up their own government-managed reserves to supplement government stockpiles that began filing in 2006.

In terms of technology development, the government would adopt tax policies encouraging development and use of renewable energy, advanced technology products and imports of related technologies. In terms of investment, the government would aim to encourage diversified investment sources, improve the energy resources tax regime and expand consumption taxes for adjusting energy consumption and promoting efficient use. In terms of environmental concerns, the Law suggested that enterprises which over-exploit energy resources would face a fine up to five times their illegal gains.

COAL INDUSTRY DEVELOPMENT

The 11th Five-Yea Plan for Coal Industry Development was established in January 2007. The plan outlines the overall situation of coal industry, and reviews the 10th Five-Year Plan of coal industry development, the measures and objectives of coal industry development, the environmental impact assessment and the new policy measures. China's coal industry makes efforts to create larger mining conglomerates with the expectation that such conglomerates would be more efficient in terms of production, safer in terms of operation and easier for the government to regulate. Five to seven giant coal mine conglomerates are to be created over the next three to five years to better compete with the international market and improve mine safety. Large enterprises will be encouraged to take over smaller mines through mergers and acquisitions in order to eliminate obsolete technology and less efficient small mines. Those enterprises are expected to use advanced technology equipments for exploration and production in order to improve the recovery ratio higher than 40 percent. Safety in the production process is to be improved and the death rate would be below 1.6 per one million tonne of coal. Measures would be taken to lower the environmental impact from the production process.

The government also released strategy policy measures to promote the implementation of giant coal mine conglomerates and large enterprises. By 2010, thirteen giant coal mine conglomerates are expected to establish with total coal production at 2.24 billion tons, accounting 86 percent of total national production. In addition, six to eight large-sized enterprises (each with annual production of more than 100 million tons) and eight to ten medium-sized enterprises (each with annual production of more than 50 million tons) would be established.

Coal market reform has been completed in 2007. The coal production and sales are basically based on market demand, especially the thermal coal price for electricity generation. In May 2007, the State Council was permitted to establish the first coal trading centre, namely "China Taiyuan Coal Trade Centre", and it started operations in November. Then, another two centres have been set up, Qinhuangdao Coal Trade Centre and Guangdong Coal Trade Centre respectively.

Coal production cost is expected to increase particularly in China's largest coal producing provinces as the government would introduce new measures and various taxes or special fees or funds into the coal industry, or would revise the existing tax rates. Existing taxes include Coal Resources Tax, Coal Resource Compensation Fee, and Future Development and Maintenance Fee, Production Safety Fund. Additional taxes are applied to Shanxi province only, including Sustainable Development Fund (launched in March 2007), Mine Restoration Management Fund, and Mine Transformation Development Fund (launched in October 2007).

The world's first commercialized direct coal-to-liquid (CTL) production project will soon start operation in Inner Mongolia by the end of 2007. The whole project – led by Shenhua Group – is planned to be completed in two phases. The first phase of the CTL project is expected to produce 3.2 million tons of oil products, and the second phase, expected to be completed by 2010, will have annual production capacity of 2.8 million tons. The total investment is estimated to be RMB 24.5 billion (around US$ 3 billion). With the completion of the first production line among the three in the first phase, the annual coal consumption is estimated to be 3.45 million tons and the produced oil products includes diesel (720 thousand tons), LPG (102 thousand tons), naphtha (250 thousand tons), and others (8 thousand tons).

NEW OIL FIELD AND OIL RESERVE

In May 2007, PetroChina announced a discovery of oil field in Jidong Nanpu (in the shallow water of Bohai Bay). In August 2007 the Ministry of Land and Resources reported that the new oil field has 445 million tons of proven oil reserves and 86.59 million tons of economically recoverable oil reserves, and the recovery rate of the field is around 19 percent. This new oil field is the most significant oil that was found in the past forty years in China. In fact, this oil field accounts for about 50 percent of the nation's newly-added proven oil reserves in recent years. PetroChina plans to invest RMB 8 million annually from now until 2012 for the oil field development.

To ensure the nation's energy supply security, the Chinese government has decided to establish a strategic oil stockpile since the Tenth-Five Energy Plan. According to the 11th Five-Year Plan, the general principle of establishing oil stock system is to speed up the pace of building strategic oil stock, moderately develop enterprise compulsory oil stock and encourage the development of commercial oil stock. 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. The combined crude oil storage capacity is estimated to be 10 to 12 million tons. The first strategic oil reserve was completed in August 2006 and went into operation in October 2006. In addition, it began filling another two strategic oil reserve bases last year and is expected to start filling the forth one in the city of Dalian at the end of 2007. It is expected that the first phase of oil stockpiling will be completed by 2008.

NATURAL GAS UTILISATION POLICY AND INFRASTRUCTURE DEVELOPMENT

China's Natural Gas Utilisation Policy was released by the NDRC on 31 August 2007. According to the Policy, natural gas use in China is mainly categorized into the four sectors, namely towngas, electricity generation, industrial fuel and chemical feedstock. Considering the social, environmental and economic benefits as well as the users' characteristics, gas end-users are also categorized into four groups, namely prioritised, permitted, restricted and prohibited. The prioritized category is mainly focused on the users under the towngas sector, including city gas for residential and commercial sector, gas-powered vehicle, and distributed CHP & CCHP. Regarding the electricity generation sector, gas-fired power plant is permitted to be built in the areas where electricity supply is in short, and natural gas supply is sufficient. However, gas-fired power plant is

forbidden to be built in the 13 giant coal mining bases located at Shanxi, Shaanxi, Inner Mongolia and etc. With respect to the industrial fuel sector, natural gas use is permitted if it were to replace oil, LPG and coal-gas in such industries as (1) construction materials, (2) electronic machinery, (3) textile, (4) metallurgical, and (5) petrochemicals. For the chemical feedstock, natural gas is allowed to be used for producing hydrogen, if the project consumes small amount of natural gas and ensures profitable operation. Also, nitrogen fertilizer projects will be permitted if surplus natural gas is locally available. For those companies using natural gas as feedstock to produce methanol or LNG for transportation to other areas, they would have to consider how to step out of the field. It is forbidden to build or expand gas-to-methanol projects, or to replace coal with natural gas for the production of methanol. The Policy also mentioned that if the balance between domestic natural gas supply and demand is tight, the state would strengthen the examination and approval procedures for any electricity generation projects or chemical projects using natural gas as feedstock.

In order to utilise natural gas efficiently and effectively, China already made a plan on developing a nationwide natural gas pipeline network in the 11th Five-Year Plan, including the first and second West-East gas pipelines, the Puguang-Shanghai gas pipeline, the Sino-Turkmenistan gas pipeline, and the existing first and second Shaanxi-Beijing gas pipelines.

The first West-East gas pipeline started operation in 2004, providing around 12 BCM per year of natural gas from Xinjiang to Shanghai. The second West-East gas pipeline is designed to delivery 30 BCM of natural gas a year to Guangdong and Shanghai through the main truck and branch line respectively. The main truck will run southwards to the capital of Guangdong province – Guangzhou, and the main branch line eastwards to the East of China – Shanghai. The main truck and branch line of the pipeline has a length of 4,859 km passing through 13 provinces, autonomous regions and municipality, namely Xinjiang, Gansu, Ningxia, Shaanxi, Henan, Anhui, Hubei, Hunan, Jiangxi, Guangxi, Guangdong, Zhejiang and Shanghai. If all branch lines are included, the total length of the second pipeline surpasses 7,000 km. Construction of the second pipeline will start in 2008 and complete in 2010. Gunorta Eloten gas field – the largest gas field in Turkmenistan – is one of the key natural gas sources for the second pipeline and it will produce 13 BCM of natural gas a year. In July 2007, the Chinese government signed an agreement with Turkmenistan government on importing 30 BCM of natural gas per year for 30 years. The rest of 17 BCM will be supplied from other regions of Turkmenistan. In addition, Kazakhstan will also export a small amount of natural gas through the second pipeline to China. Both China and Kazakhstan government agreed to build a Sino-Kazakhstan natural gas pipeline, part of the Sino-Central Asian gas pipeline travelling through Turkmenistan, Uzbekistan and Kazakhstan to China. The Sino-Kazakhstan natural gas pipeline will connect the second West-East gas pipeline.

The construction of the Puguang-Shanghai gas pipeline project – another key project to supply natural gas from the Middle to the East of China – has formally started in August 2007. The pipeline with the total length of 1,702 km will connect the Puguang gas field and Shanghai, via Sichuan, Chongqing, Hubei, Jiangxi, Anhui, Zhejiang and Jiansu. The transportation capacity of the pipeline is designed at 12 BCM per year and can be pressurised up to 17 BCM per year. The project includes exploration on Puguang gas field, building of natural gas purification plant, and laying of natural gas pipelines. As a whole, the project investment is estimated to be RMB 62.7 billion.

ELECTRICITY PRICE SYSTEM REFORM

A notice on the cancellation of preferential power price policies was issued jointly by the NDRC, the Ministry of Finance and the State Electricity Regulatory Commission (SERC) in October 2007. Some energy intensive-energy enterprises are allowed direct negotiation on power prices with the grid companies, and consequently this led to provide them with lower power prices. The notice stated that the cancellation of preferential power price policies is applied to the enterprises of electrolytic aluminium, ferroalloy and chlor-alkali. In June 2007, the NDRC and the SERC has started inspection for energy-intensive and high emissions industries to check their practices on power purchase prices. According to the notice, all incremental income resulting from the cancellation of preferential power price policies would be turned over to local treasuries and

would be included in provincial financial budgets in order to support the adjustment of local economic structures and promote energy savings and emissions reduction.

ENERGY EFFICIENCY AND CONSERVATION

From January to September of 2007, the energy consumption per unit of GDP dropped by 3 percent and the emissions of main pollutants – sulphur dioxide and chemical oxygen demand (COD) – fell 1.81 percent and 0.28 percent respectively. To achieve the goal of 10 percent reduction in emissions pollutants, China has encouraged companies to eliminate outdated production facilities and allocated funds to promote technological innovation. The current decrease in the two major pollutants emissions is mainly due to the installation of more desulphurizing facilities in coal-fired power plants, the increase of sewage handling capacity and the closure of a large number of polluting factories. In 2007, there were 741.2 MW of new coal-fired generating units installed with desulphurizing facilities. The national daily sewage handling capacity in cities went up 9 million tons. From 2005, China closed 253 small coal-fired generating units with a combined installed capacity of 90.3 MW; and more than 900 paper mills were suspended its operation while they were renovated or were asked to improve their waste-water processing facilities.

In 2006, NDRC issued a detailed action plan called Proposal on Implementing Ten Key Projects for Energy. The Plan targets to save 240 million tonnes of coal equivalent (tce) during the 11th five-year programme. The targeted area would account for 40 percent of the economy's goal of a 20-percent reduction in the energy consumption per unit of GDP in 2010 from the 2005 level.

The Chinese government called on ordinary people to help save energy and reduce pollution. The Government launched on a campaign – "All Actions to Implement the Comprehensive Work Plan for Energy Conservation and Pollutant Discharge Reduction" – in August 2007 emphasising the importance of life style change, education, and scientific technologies and encouraging enterprises to become the major force in the campaign. The campaign was co-organised by 17 departments of the Party and government including the NDRC, the Ministry of Finance, State Environmental Protection Administration and State-owned Assets Supervision and Administration Commission of the State Council.

The Top-1,000 Enterprise Energy Efficiency Action Plan was also formally launched by the NDRC in September 2007. The 1,000 largest domestic enterprises, regarding the petrochemical, coal mining, metallurgical, electricity, transportation, iron & steel and construction materials sectors, are required to take the lead in the field domestically as part of the national endeavours to reduce energy consumption. Based on the plan, the energy saving target is 100 million tce by 2010.

In November 2007, the Ministry of Finance announced a 23.5-billion-yuan (US$ 3,132 million) package to promote energy efficiency and reduce pollution, including a 7-billion-yuan (US$ 933 million) reward scheme aiming at encouraging companies to conserve energy and reduce emissions. The rewards would be granted to enterprises that fulfil the requirements in reduction of emissions and be used to support technical innovation.

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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 6.9 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 2005, the GDP per capita of Hong Kong, China was US$30,989 (2000 US$ at PPP), one of the highest GDP per capita in APEC region. GDP of Hong Kong, China expanded by a robust 6.8 percent in real terms in 2006, down from the 2005 rate of 7.1 percent. 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 2006. Along with improving labour demand growth, the average unemployment rate reached 4.1 percent in the third quarter of 2007, a low record for the past five 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 38 service areas in the Mainland China, effective from January 2008. 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. Trade and logistics, tourism, financial services, and professional services and other producer services are the four pillar economic sectors in which Hong Kong, China possesses a competitive advantage over Mainland China.

In October 2007, Hong Kong, China's Government announced undertaking 10 major infrastructure projects, including some cross-boundary infrastructure projects such as the Guangzhou-Shenzhen-Hong Kong Express Rail Link, Hong Kong-Zhuhai-Macao Bridge, and Hong Kong-Shenzhen Airport Cooperation. It is expected that the valued added of the 10 major projects would be more than HK$100 billion annually, amounting to 7 percent of GDP in 2006, and some 250,000 additional jobs would be created.

Table 11 Key data and economic profile (2005)

Key data		Energy reserves	
Area (sq. km)	1,103	Oil (MCM)	-
Population (million)	6.94	Gas (BCM)	-
GDP Billion US$ (2000 US$ at PPP)	215.18	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	30,989		

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 17.7 Mtoe in 2005, increasing 9 percent from 2004. Oil maintained the highest share in the total primary energy supply at 46 percent, followed by coal (39 percent) and gas (11 percent). Electricity imports from China accounted for the remaining 4 percent.

As of the end of 2007, 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. 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 for installing the first gas combined-cycle generator unit. The unit was commercially operated in October 2006 and its installed capacity was 335 MW. Natural gas used in this station is mainly imported through sub-marine pipeline from Dapeng LNG terminal in Guangdong, China. HEC has also operated the first commercial wind turbine since February 2006. As it was a pilot project for the company, the rated capacity of the wind turbine is 800kW.

FINAL ENERGY CONSUMPTION

Table 12 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)*	
Indigenous Production	81	Industry Sector	574	Total*	38,451
Net Imports & Other	23,447	Transport Sector	6,001	Thermal	38,451
Total PES	17,762	Other Sectors	3,788	Hydro	-
Coal	6,870	Total FEC	10,364	Nuclear	-
Oil	8,219	Coal	1	Others	-
Gas	2,033	Oil	6,332		
Others	641	Gas	586		
		Electricity & Others	3,444		

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.

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, the former using natural gas and naphtha as dual feedstock (since October 2006) and the latter using naphtha as

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.

In 2005, the total final energy consumption in Hong Kong, China reached 10.4 Mtoe, or 4 percent higher than the previous year. The transport sector accounted for the largest share at 58 percent, followed by the residential/commercial sector (37 percent) and the industrial sector (5 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 and city gas production.

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 consumption, and promote the efficient use and conservation of energy.

In keeping with Hong Kong, China's free market economic policy, 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.[29]

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.

The Government is also discussing with the two power companies the terms of the new Scheme of Control Agreements after the current ones with them expire in 2008. Emission caps have been imposed onto four power plants through their renewed licences. The Government has asked the power companies to accelerate the timing of emissions reduction to fully achieve the emission reduction targets in 2010.

In the latest 2007-08 Policy Address, the Government will continue to support environmental protection and promote sustainable development through taking vigorous measures for air quality improvement. For example, the Government seeks to achieve a reduction in energy intensity of at least 25 percent by 2030 with 2005 as the base year. In December 2007, the Government launched a three-month public consultation on the proposed mandatory implementation of the Building Energy Codes by means of legislation. In addition, the Government will implement a pilot project on Carbon Audit and an emission reduction campaign. Furthermore, the Government will propose to replace industrial diesel with ultra low sulphur diesel in all industrial and commercial processes. To improve roadside air quality, the Government proposes require motorists to switch off idling

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

vehicle engines subject to views received in public consultation. The Government has injected HK$1 billion into the Environment and Conservation Fund (ECF) for educational, research and technology demonstration projects as well as environmental protection and conservation activities.

NOTABLE ENERGY DEVELOPMENTS

ENERGY EFFICIENCY PROMOTION

Hong Kong, China's Government has continuously promoted energy conservation through the voluntary 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, 791 venues have been registered as of November 2007. Likewise, more than 3,400 models have been registered under the voluntary EELS for appliances by the Government as of the end of December 2007. As a continuous effort to promote energy efficiency, the Government has proposed to introduce a mandatory EELS, covering room air conditioners, refrigerating appliances and compact fluorescent lamps in the initial phase. The proposed legislation is being examined by the Hong Kong Legislative Council.

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 2005 basic data) from the database was published in September 2007 and is made available for public access at the Electrical & Mechanical Services Department (EMSD) website.

RENEWABLE AND CLEAN ENERGY

To promote public awareness in renewable energy, the Hong Kong, China's Government has implemented various projects on renewable energy systems. As of mid-2007, the total peak capacity of renewable energy systems including solar, wind and biogas installed by the Government and the utility companies have reached about 2,700 kW.

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

Since 2000, the Government has launched a pilot scheme for the use of fresh water cooling towers in air conditioning systems, with 6 designated areas in the beginning. Over the years, the number of designated areas has been expanded to 82 in December 2007, covering about 73% of the non-domestic floor area of the economy. As at December 2007, 108 installations of fresh water cooling towers have been completed and put into operation. It is estimated that these completed installations could save 89 million kWh of electricity consumption and reduce carbon dioxide emission by 62,400 tonnes annually.

ENERGY SAVING PROGRAMMES IN THE PUBLIC AND PRIVATE SECTORS

To demonstrate its commitment to protect the environment, in March 2003 the Government started implementing various measures to reduce 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, the Government has reduced its electricity consumption by 6.9% between 2003 and 2007.

The Hong Kong, China's Government has continued to raise the community's awareness of environmental protection and conservation with enhanced participation by implementing a range of

programmes and initiatives. In October 2007, the Government launched the "I Love Hong Kong, I Love Green" campaign to engage the public in protecting the environment and called for collective efforts of society to help make a change in various aspects of daily living to nurture a cleaner, greener and better lifestyle.

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INDONESIA

INTRODUCTION

Indonesia is a large archipelago located between mainland Southeast Asia and the continent of Australia, and between the Pacific Ocean and the Indian Ocean. The population of Indonesia in 2005 was 219,205 million; the third largest population in the Pacific Rim (behind China and the United States). Indonesia has an area of 7.89 million square kilometres (including the marine Exclusive Economic Zone of 2.70 million square kilometres); the economy's territory encompass 17,508 large and small islands straddling the equator, and large bodies of water of 5.87 million square kilometres or 74.3 per cent of its total area, total land mass area is about 2.02 million square kilometres.

In 2005, Indonesia had a gross domestic product (GDP) of US$779.719 and a per capita GDP of US$ 3,557 billion, at 2000 US$ PPP. Since 1990, manufacturing was the major contributor to Indonesia's economy. Manufacturing accounted for 28.1 per cent of total GDP, in 2005. Agriculture, livestock, forestry and fishery contributed 13.4 per cent; retail, hotel and restaurant 15.8 percent; mining and quarrying contributed 10.4 percent; transport and communications 6.4 percent; finance, leasing and other services 6.6 per cent; construction 6.4 percent; while electricity, gas and water supply contributed the remaining 0.92 per cent. Indonesia attained average economic growth of 5.7 per cent in 2005, higher than the 5.1 per cent growth achieved in 2004. Indonesia's average GDP growth over the period of 2000-2005 is 4.75 per cent.

Indonesia's fossil reserves of oil, gas and coal play an important role in the economy, as source of energy, industrial raw material and foreign exchange earner. In 2005, oil and gas contributed US$ 19.230 billion or 22 % of total export earnings and 24 % of the government budget.

Indonesia's proven oil reserves at end of 2005 was 683.6 million cubic metres; oil reserves had declined by comparison to previous year end of 2004, at 747.2 million cubic metres. Proven gas reserves at end of 2005 was 2.76 trillion cubic meters, an increase by comparison to end of 2004, at 2.56 trillion cubic meter; while proven coal reserves in 2005 at 4.968 billion tons, remained constant by comparison to end of 2004.

Table 13 Key data and economic profile (2005)

Key data		Energy reserves*	
Area (sq. km)	7,893,250	Oil (MCM)	683.6
Population (million)	219,205	Gas (BCM)	2,770
GDP Billion US$ (2000 US$ at PPP)	779,719	Coal (Mt)	4,968
GDP per capita (2000 US$ at PPP)	3,557		

*Source: BP Statistical Review of World Energy, 2007

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply (TPES) in 2005 was 130,970 ktoe. Indonesia's primary energy supply mix is 48.0 per cent oil, 28.8 per cent gas, 18.1 per cent coal, and 5.0 per cent other energy such as geothermal, hydro and new and renewable energy resources. In 2005, Indonesia produced 48,137 ktoe of crude oil; in addition, Indonesia also produced condensates and natural gas liquids totalling 5,798 ktoe. Indonesia's total crude oil export in 2005 was 19,567 ktoe.

In 2005, Indonesia exported combined total of 115,627 ktoe of crude oil, condensates, gas, liquefied gas, petroleum products and coal, which makes Indonesia a net energy exporter. On the other hand, to meet domestic requirements, in 2005, Indonesia required imports of crude oil and petroleum products of 20,471 ktoe and 21,235 ktoe respectively, to a total of 41,760 ktoe.

Indonesia's crude oil production in 2005 was 48,137 ktoe, of this amount, some 19,567 ktoe were exported. Total crude oil supply was thus 49,041 ktoe, of which 44,642 ktoe went to refineries, towards the production of 37,089 ktoe of petroleum products.

Most of Indonesia's crude oil is produced on-shore, from two of Indonesia's largest oil fields, the Minas and Duri oil fields located in Riau, in the eastern coast of central Sumatra. The Minas and Duri oil fields are however mature fields; the Duri field is noted as the site of the world's largest steam flood, enhanced oil recovery (EOR). Total production from oil fields in Riau was 21.610 ktoe in 2006. Other principal oil producing regions are off-shore northwest of Java, the Natuna Sea, and onshore and offshore of East Kalimantan. Over the past decade, Indonesia's oil production had declined significantly; in this effect, BP Migas, the regulatory body for the downstream oil and gas industry had set a target in 2005, to increase oil production to 1.3 million barrel in 2009[30].

In 2005, Indonesia produced 68,663 ktoe of natural gas, a decrease from production in 2004 at 69,693 ktoe. About 50.6 percent of Indonesia's gas production in 2005 was converted to LNG for exports. The destinations of Indonesia's LNG exports are Japan 62.8 percent, Korea 22.6 percent, and Chinese Taipei 14.6 percent. In addition, in 2005 Indonesia also exported 4,169 ktoe of gas or 6.1 per cent of total production by pipeline, to Singapore and Malaysia. Out of total production, 56.6 percent is dedicated to the export, and the remainder is consumed domestically.

Indonesia's large natural gas reserves are located near Arun in Aceh; around the Badak field in East Kalimantan; off the Natuna islands, which includes the Natuna D-Alpha field, considered as one of the largest gas reserve in the region; and a number of gas fields in Papua; smaller fields are found off-shore north of Java; and off-shore east of Java, includes the Kangean field. BP's LNG project in Tangguh, Papua, will be based on gas reserves on-shore and off-shore from the Wiriagar and Berau Blocks, estimated to have reserves of at least 14 Tcf.

In 2005, Indonesia produced 82,754 ktoe of coal, an increase of 15.0 percent from the production in 2004 at 71,960 ktoe. Domestic consumption of coal at 23,742 ktoe in 2005 was utilized in power generation (62.1 percent); in the cement and ceramic industries (12.8 percent); the pulp and paper industry (2.9 percent); and other use (22.1 percent). Most of the total coal production of 57,745 ktoe or 70.0 percent was exported. Indonesia's coal export destinations in 2005 are, Japan (22.3 percent), Chinese Taipei (13.5 percent), Republic of Korea (9.3 percent) Hong Kong (8.4 percent), India (8.1 percent); Thailand (4.0 percent), Malaysia (3.7 percent), the Philippines (2.5 percent), Singapore (1.2 percent), China (1.1 percent), Europe (13.4 percent), and others (15 percent).

About 57 percent of Indonesia's total recoverable coal reserves are lignite, while 27 percent is sub-bituminous coal, 14 percent is bituminous coal, and less than 0.5 percent is anthracite. Most of Indonesia's coal reserves are located in South Sumatra and East Kalimantan; relatively smaller deposits of coal are found in West Java and in Sulawesi. Indonesian coal has a heating value range of 5,000-7,000 kcal/kg and is distinctive for their low ash and sulphur content; sulphur content is typically less than 1 percent.

Indonesia has 28,903.14 MW of total installed grid power generating capacity, production of electricity in 2005 was 127.369 GWh, of this total, and 20.5 percent was generated by independent power producers. The primary energy mix in the production of electricity in 2005 was, coal 40.4

[30] 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.

percent, oil 26.2 percent, hydroelectric 13.3 percent, natural gas 11.2 percent, geothermal 8.9 percent.

Table 14 Energy Supply & Consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	206,158	Industry Sector	29,104	Total	127,369
Net Imports & Other	-73,868	Transport Sector	25,858	Thermal	110,006
Total PES	130,970	Other Sectors	19,789	Hydro	10,759
Coal	23,742	Total FEC	74,750	Nuclear	-
Oil	62,914	Coal	8,499	Others	6,604
Gas	37,710	Oil	45,952		
Others	6,604	Gas	11,093		
		Electricity & Others	9,205		

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 in 2005 declined to 74,750 ktoe from 79,124 ktoe in 2004. Lower final energy consumption was observed in the industrial sector, declining by 7.4 per cent and significantly lower decline in the combined residential and commercial sectors by 21.0 per cent. Final energy consumption in the transport sector increased by 14.3 per cent, compared to that of 2004.

Consumption of final energy in the industrial sector accounted for 38.9 percent of total final energy consumption in 2005, the transportation sector at 34.6 percent, while other sectors accounted for the remaining 26.5 percent. Oil accounted for the largest share in final energy consumption at 61.5 percent, followed by gas at 14.8 percent, electricity at 12.3 per cent and coal at 11.4 percent. Notably, oil consumption declined by 4.5 percent to reach 45,952 ktoe in 2005 from 48,138 ktoe in 2004. Consumption of non-commercial energy specifically biomass is still important in the economy, estimated at 36,599 ktoe in 2005.

POLICY OVERVIEW

THE ENERGY LAW

On the 10th of August 2007, Indonesia promulgated Law No. 30/2007 on Energy, designated as the Energy Law. The Energy Law ruled important institutional and legal changes on how Indonesia's energy policy will be formulated in the future. The Energy Law stipulates that the President would establish the Dewan Energi Nasional (DEN) – National Energy Council, within 6 months from promulgation of the Law. The President chairs DEN, vice chaired by the Vice President, and in its daily duties, is chaired by the minister in charge of energy affairs. BAKOREN (Badan Koordinasi Energi Nasional) – the National Energy Coordinating Board, will continue its role and function on matters of energy policy, until the time DEN is established.

The tasks of DEN include, formulation and drafting of national energy policy to be endorsed by the executive branch of government, with prior consent of DPR – the parliament; endorse the national energy plan; endorse steps to overcome an energy crisis or an energy emergency; and to provide oversight on the implementation of energy policies. The national energy policy should address: 1) the availability of energy to meet national requirements; 2) energy development priority; 3) utilization of national energy resources; and 4) national energy reserves. To perform its function, DEN is supported by a secretariat general.

The Energy Law states that Indonesia's energy policy has two major policy objectives, specifically: 1) to achieve an energy elasticity to GDP of less than unity by year 2025; 2) to attain an optimal primary energy consumption mix by 2025 specifically, the proportion of oil to become less than 20 percent; gas at more than 30 percent; coal at more than 33 percent; biofuels at more than 5 percent; new and renewable energy and other energy including nuclear at more than 5 percent; liquefied coal at more than 2 percent. Primary policy measures include: diversification of energy; energy conservation; protection of the environment on principles of sustainable development; and pricing of energy to reach economic price levels with due regard to provide aid for the poor.

PRIOR TO THE ENERGY LAW

Prior to the enactment of the Energy Law, Indonesian energy policy is formulated by a cabinet level, inter-ministerial coordinating body, the BAKOREN, created in 1980. The main function of BAKOREN is to formulate government energy policy on development and utilization of national energy resources and to coordinate implementation of the policy. BAKOREN is assisted by PTE (Panita Teknis Sumber Daya Energi) – the Technical Committee on Energy Resources. The task of PTE is to draft national energy policy, and to assume the daily cross-sector coordinating function in the implementation of energy programmes to meet energy policy targets, including development targets of energy supply, to meet foreseeable energy demand. Members of PTE are, high rank officials in the government responsible for energy supply infrastructure and policies related to energy; the heads of state-owned energy enterprises; prominent representatives of research institutions, and other members.

The objective of the national energy policy is to secure adequate, reliable and affordable energy to support economic growth and increase welfare, with due regard to protect the environment. Indonesia's energy policy has three main policy measures specifically: 1) diversification of energy, away from the use of oil to other sources of energy, 2) intensification in the search of new energy resources, and 3) energy conservation.

At the executive level, the Ministry of Energy and Mineral Resources has overall responsibility and regulatory roles 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 Generals of the Ministry.

The Directorate General of Oil and Gas (MIGAS) is responsible in regulation and supervision of the upstream and downstream oil and gas industry. MIGAS is also responsible for offering of 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, including regulating and determining the supply and distribution of oil based fuels, 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 price setting of natural gas for household and small consumers.

The Directorate General of Geology and Mineral Resources (DGGSM) renamed to the Directorate General of Minerals, 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.

The Directorate General of Electricity and Energy Utilization (DGEEU) is responsible for policy planning and supervision of the electricity industry and new and renewable energy development.

DIVERSIFICATION OF ENERGY

The objective of the policy on diversification of energy is to reduce the share of oil in the economy's total energy mix, by utilizing other energy including gas, coal, geothermal and other renewable energy.

To realize greater demand for natural gas in the domestic market, Indonesia is implementing the Gas Transmission and Distribution Network National Master Plan. The objectives are to bring gas located far from demand centres to the economy's largest energy demand centre, the island of Java, and other emerging demand centres in Sumatra. A 4,200 kilometre long extensive integrated gas transmission system, which requires crossing waters of the Sunda Strait and the Java Sea will link Sumatra, Java and East Kalimantan. In addition, Indonesia is considering to build LNG receiving terminals in West Java. LNG is expected to come from East Kalimantan and in the future from Tangguh, in Papua as fuels for power generation. Development of mini-LNG transportation systems is also under consideration, the system will require mini-LNG receiving terminal, and the expected initial phase of implementation is in South Sulawesi.

Reform of the oil and gas industry to introduce competition and greater role of the private sector, the possibility of direct negotiations of gas contracts between buyer and seller; and government policy to phase out subsidies of diesel fuel for industrial use, is expected to increase the competitiveness of natural gas.

Although coal has been mined since early 1900s, Indonesia began to develop coal reserves on a large-scale in the early 1980's; currently the economy is a major world exporter of steam coal. Recognizing the significant share of oil in power generation and rapid power demand growth, the government instructed the state owned electricity company PLN to expedite fuel diversification and implement the 10,000 MW coal power generation crash program; in addition to on-going capacity expansion plans. The program is intended to phase out old power generation units, and replace oil-fired power generation units by coal-fired generation units. Besides coal use in power generation, Indonesia is considering to implement large-scale coal liquefaction and coal gasification technologies.

The archipelago's location in a volcanic active region of the Pacific Rim explains Indonesia's significant geothermal potential, estimated at 27,000 MW; currently, only 3.2 percent or 855.5 MW of this potential is generating power. To increase the role of geothermal in power generation, the government is carrying out exploration and assessment of geothermal potential, to reduce some of the risks associated with exploration, towards commercial development these resource.

Indonesia expects to increase biodiesel and bioethanol use in transportation. Biodiesel and bioethanol production could reach 1,000,000 tonnes and 390,000 tonnes respectively by 2009. The economy expects greater production of crude palm oil for biodiesel and is seeking the possibility of using other raw materials aside from molasses in producing bioethanol; both biodiesel and bioethanol are however competing with demand from overseas markets.

DEVELOPMENT FOR NEW ENERGY RESOURCES

The objective of the policy measure on intensification of the search for new energy reserves is to increase Indonesia's energy resource base, particularly to transform, indicated, inferred and hypothetical hydrocarbon reserves to become proven reserves.

Indonesia's proven and indicated hydrocarbon reserves are estimated as follows, 185.8 TCF of natural gas; 8.71 billion barrels of oil; and 23.0 billion tons of coal, when hypothetical and inferred coal reserves are considered, potential coal reserves is 60.4 billion tons.

The policy encourages exploration of oil, gas, coal and other sources of 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, particularly for exploration in deep sea and frontier regions. 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 bidders within the prescribed time, the sole bidder will be awarded the block. The new production sharing policy will allow increase share of 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 intensified search of energy resources in Indonesia, the policy also encourages expansion of Indonesia's presence in oil and gas projects overseas. By 2007, Pertamina secured oil exploration concessions in the Middle East in Iraq and Qatar; in Africa, in Libya and Sudan; and in South East Asia in Vietnam and Malaysia, by joint operations.

ENERGY CONSERVATION

The promulgation of Presidential Decree No. 43/1991 on Energy Conservation led to the National Master Plan for Energy Conservation in 1995. The plan includes 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.

Indonesia along with all other ASEAN members, with the exception of Brunei Darussalam, adopted voluntary building energy codes that were initiated in 1992. Full adoption of these codes could result in estimated energy savings of 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 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 Demand Side Management (DSM) since 1992, to reduce peak electricity demand.

SUPPORTING POLICIES

On January 25th, 2006, Indonesia's recent national energy policy was promulgated by Presidential Regulation 5/2006, the National Energy Policy is supported by government policies which include: Presidential Instruction 1/2006 on Supply and Utilization of Biofuel as Fuel Substitute; and Presidential Instruction 2/2006 on Supply and Utilization of Coal as a Fuel Substitute. The detailed programme and targets are set out in the Blue Print National Energy Management 2005 to 2025 issued in July 2005.

Other policies include Ministerial Decree 1128/2004 on National Coal Policy; Ministerial Decree 1122/2002 on Business in Small Scale and Scattered Electricity Generation; Presidential Decree 76/2000 on Utilization of Geothermal Resources for Electricity Generation; and the policy on Development of Renewable Energy and Energy Conservation, 2003.

Energy policy accelerates energy infrastructure development; promotes rational market based energy pricing; provides targeted subsidies to the poor; enhances participation of the private sector; protect the environment.[31]; and enhances energy research and development.

OIL AND GAS

Law 22/2001 on Oil and Gas, designated as the Oil and Gas Law, governs the oil and gas sector. The law states that the government holds exclusive right of oil and gas mining; and furthermore, that the oil and gas industry is competitive and promotes fair and transparent

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

competition among businesses in exploration and exploitation of oil and gas; and in processing, transportation, storage and trade of oil and gas.

Law 22/2001 mandates implementation of market based pricing of petroleum product in the domestic market. In 2004, Indonesia's Constitutional Court rejected the provision of market based pricing and mandated that retail price of petroleum products be set by government. Nonetheless, the government sets price of non-subsidized petroleum products based on a formula which take into account average petroleum product price of Mid Oil Platts Singapore (MOPS).

The law mandates the government to transform the state oil and gas companies Pertamina and PGN from monopolies with regulatory functions into limited liability companies. Pertamina's transformation started in 2002, when the company was legally transformed into a government owed limited liability company; the process was completed in 2005, when all privileges and special governmental entitlements given to the company were removed entirely. Pertamina however still retain ownership and operation of all seven of Indonesia's refineries, with total capacity of 1.03 million barrels per day.

PGN a government owned gas transmission and distribution 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 and 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.

ELECTRICITY LAW AND MARKET

In 2004, the Constitutional Court of Indonesia annulled Law 20/2002 on Electricity, and thereafter, reinstated the electricity law that it had replaced, specifically Law 15/1985 on Electricity; this law currently governs Indonesia's power industry, until a new electricity law is promulgated.

Under Law 15/1985, the government is responsible for providing electricity across Indonesia; executed by a state owned electricity enterprise namely, Perusahan Listrik Negara (PLN) – State Electricity Company. Under the provisions, PLN is a vertically integrated monopoly; however, in the case the company is unable to provide electricity, it can establish cooperation with other entities including the private sector in areas of power generation, transmission and distribution. In any event that PLN cannot provide the necessary services, consumers could develop their own electricity generation for their own use; excess production may be sold to PLN.

Since the reinstatement of Law 15/1985, the government had issued a number of regulations on the power sector to be more relevant to changes of structure of government, including, role of autonomous provincial governments, and role of private sector. Regulations include, Government Regulation 3/2005 and 26/2006 on Supply and Utilization of Electric Power.

The power system of Indonesia currently constitutes of one large interconnected system, which integrates the power systems in the islands of Java, Bali and Madura; and several large and small isolated and partially interconnected power systems in the other islands. These isolated systems are developed around major load centres; electricity is often delivered through mini-grids. The initial step in restructuring the electricity industry in Indonesia began in 1994 through conversion of PLN from a state enterprise with social missions to a government owned limited liability company.

Restructuring efforts continued in 1995 through unbundling of PLN's Java, Bali (and Madura) generation, distribution and transmission assets. Generation assets were unbundled into two generation companies namely, Pembangkit Jawa-Bali (PJB) and Indonesia Power. The distribution unit was separated into four-distribution entities (East, West, and Central Java, and Jakarta). Each distribution unit operates semi-autonomous; operational budget is allocated to cover operational expenses to meet the performance targets as set out in their contract with PLN holding. The Java-Bali transmission is transferred to the Java-Bali Electricity Transmission Unit and Load Dispatch Centre. The market structure has since become a single buyer market, where PLN transmission unit coordinate dispatch of PLN and IPP generators. Outside of Java, Bali and Madura, restructuring is

taking place in the form of decentralization of PLN's assets. Under the annulled Law 20/2002, the government had expected more robust competition and a transition from a single buyer market to a fully competitive multi-buyer/multi-seller market (MBMS)[32].

The government sets electricity tariffs, taking into consideration the cost of supply and a reasonable rate of return for PLN. The government also provide electricity at subsidized tariffs to particular electricity consumers, in this case, PLN need to consult with the government to recover cost of its supply. Since Indonesia's economic crisis of 2007, government subsidies to the power sector had increased significantly.

COAL

Business in general mining, including coal is governed by Law 11/1967 on Principle Regulation on Mining; and Government Regulation 25/2000 on Role of Government and Role of Province as an Autonomous Region. Implementation of Law 11/1967 is governed by Government Regulation 32/1969 and 75/2001.

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 company referred to as the contractor is restricted from mining other minerals, and takes full responsibility of all risks of investments. It must complete a general survey and must 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. There are specific provisions governing general survey and exploration upon completion of the general survey.

Following the enactment of the regional autonomy law, a new Coal Contract of Work (CCOW) establishes a the royalty scheme to include the regional governments. The CCOW terms require that Indonesian company to eventually have the majority ownership of the mining project. During the first 10 years of production, foreign shareholders must transfer shares according to a fixed timetable so that Indonesian companies will eventually hold 51 percent of the mining project.

Upon production, companies 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

Law 27/2003 on Geothermal states that geothermal mining is granted by authority of the state and executed by the government and provincial governments. The Ministry of Energy and Mineral Resources on behalf of the government, and the provincial governments, including the district governments, holds exclusive right to establish policy, regulation, and licensing of geothermal exploration and exploitation.

Geothermal exploration and exploitation is granted based on award of license. The process involves the government offering geothermal working areas for competitive bidding to prospective investors; specifically business entities public, private or cooperatives, may submit 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 awarded entity is mandated to complete a feasibility study within two years, during the exploitation stage, the awarded entity could be granted a 30 year exploitation right (which is extendable). Working areas are subject to tax, land rent, and royalties determined by

32 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.

the government. The utilisation of geothermal energy for electricity is subject to electricity regulation and policy.

NOTABLE ENERGY DEVELOPMENTS

TENDER REGULATION REVISIONS

In June 2006, the Minister of Energy and Mineral Resources issued Ministerial Regulation 40/2006 on the Procedures for Oil and Gas Blocks Allocation and Offering.[33] The regulation aims to provide increased transparency and clarity regarding tender procedures, including the selection criteria for the winners of tender bids; and includes provisions aimed at securing exploration commitments from the winners of tender bids. Tender participants 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.

OIL & GAS ACERAGE AWARD

In December 2006, the government announced that eighteen companies and consortia have won the 2006 direct-offer tender for oil and gas exploration in 18 work areas or blocks; from the total of 21 blocks offered. In January 2007, sixteen of the eighteen companies signed contracts to commit investments in exploration activity worth US$ 201 million over the first 3 years to include, geological and geophysical study, three-dimensional seismic survey of 1,280 square kilometres, two-dimensional seismic survey of 8,260 kilometres and drilling of 32 exploration wells. The contract includes a signature bonus of US$ 29.16 million. The awarded exploration blocks are, Duyung and Pari in the Natuna Sea; Tongga in North Sumatra; Batu-Gajah and Batanghari in Central Sumatra; Karang-Agung and Sekayu in South Sumatra; North-Kangean and Sibaru offshore East-Java; West-Sangata offshore East Kalimantan; Wain and Kutai offshore and inland East Kalimantan; Budong-Budong offshore West Sulawesi; Kuma offshore West Sulawesi; Karana in the Makassar Strait; and Buton offshore and inland South-East Sulawesi.

In early March 2007, the government announced that nine companies and consortia have won the 2006 second-round regular-offer tender for oil and gas exploration in 9 blocks, from 20 blocks offered for bid. In the end of March 2007, the nine companies signed contracts to commit investments in exploration activities worth US$ 411 million over the first 3 years; to include, geological and geophysical study, three-dimensional seismic survey of 5,500 square kilometres, two-dimensional seismic survey of 8,560 kilometres and drilling of 22 exploration wells. The contract includes a signature bonus of US$ 30.09 million. The awarded exploration blocks are, South-East Mahakam offshore East Kalimantan; West Air Komering in South Sumatra; Tuna in the Natuna Sea; Karama offshore West Sulawesi; Mandar offshore West Sulawesi; Sageri offshore South Sulawesi; Ujung Kulon offshore and inland Banten; Enrekang in South Sulawesi.

NEW BIDDING ROUND

In 2007, Indonesia offered 26 new work area acreage or blocks for oil and gas exploration to investors, in two rounds. In the first round in May 2007, 21 blocks were offered; in the second round in October 2007, 24 blocks were offered. The blocks offered include the Semai-I to Semai-V Blocks, located offshore of West Papua, estimated to have recoverable oil reserves of some 1,069

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

million barrels. The government expects to announce winners of this tender in 2008, six months from receiving bids.

GEOTHERMAL DEVELOPMENT

In January 2007, the Geology Agency of the Ministry of Energy and Mineral Resources announced completion of a series of geothermal explorations in fourteen areas, and had collected geophysical and geochemical data, topography data and assessment of geothermal power generation potential. The fourteen areas and estimates of geothermal potential are, Seulawah (160 MW) and Jaboi (50 MW) in Aceh; Sekincau (238 MW) in Lampung; Cisolok (45 MW), Tangkuban Perahu (220 MW) and Gunung Tampomas (20-50 MW) in West Java; Gunung Ungaran (50 MW) in Central Java; Telaga Ngabel - Gunung Wilis (120 MW) in East Java; Mataloko (65 MW) and Atadei (40 MW) in East NusaTenggara; Marana (40 MW) Central Sulawesi; Suwana (65 MW) in Gorontalo; Jailolo (75 MW) and Songa-Wayaua (140 MW) in North Maluku.

On behalf of the government, the Directorate General of Minerals, Coal and Geothermal in June 2007, offered five work areas of the fourteen geothermal potentials for bid, specifically work area Jailolo in North Maluku; Telaga Ngabel - Gunung Wilis in East Java; Gunung Ungaran in Central Java; and Gunung Tampomas in West Java.

In August 2007, Chevron Corporation announced commercial operation of the 110 MW Derajat-III geothermal plant in West Java to bring the company's total geothermal capacity in Derajat to 255 MW. The company also owns the 377 MW Salak geothermal plants in West Java and is currently a major geothermal power producer in Indonesia; power is sold to PLN.

Head of Agreement was signed by PLN, Pertamina, Medco, Ormat and Itochu Corporation in August 2007 to develop the Sarulla geothermal field in North Sumatra, for a capacity of 330 MW, expected operational in 2010. The consortium of Ormat International, Medco Energy International and Itochu Corporation, had won the tender issued by PLN in July 2006, to develop the Sarulla geothermal field, at an estimated total project cost of US$ 600 million.

LNG PROJECT IN CENTRAL SULAWESI

Indonesia's state-owned oil and gas company Pertamina signed an agreement with Mitsubishi and Medco E&P, to develop a natural gas liquefaction plant project in Central Sulawesi. The supply of gas will come from the Senoro field in the Senoro Block with proven gas reserves of 1.53 Tcf; as well as supply from the Donggi, Matindok, and Maleo-Raja and Minahaki fields in the Matindok Block, with current proven reserves at 0.70 Tcf.

The shareholder structure of the project is Mitsubishi with 51 percent share, Pertamina 29 percent and Medco E&P 20 percent. Mitsubishi, which reportedly failed in its bid to get an upstream shareholding in the blocks, will finance the downstream development of the liquefaction plant of 2 million tonnes per year capacity, at an estimated cost of US$1.1 billion; the entire LNG production will be shipped to Japan, commencing in 2010. In the up-steam part, Pertamina and Medco E&P will jointly develop and operate the Senoro block, while the Matindok block will be developed and operated by Pertamina.

COAL BED METHANE

For the first time, Indonesia had granted work area for coal bed methane development. The award was given to the consortia of Medco-Ephindo on their direct offer for exploration and development of coal bed methane field over an area of 1,200 square kilometres, in South Sumatra. Direct offer from two other consortia are also expected for approval, while another 43 proposals for coal bed methane exploration are being processed. The government announced that coal bed methane development would be commonly governed by regulations that apply for the oil and gas industry, and would fall under the oversight and regulation of BP Migas; the government stated that

production sharing spilt for coal bed methane is more favourable to the part of the investors by comparison to the production sharing spilt for oil and gas.

Coal bed methane resource potential has been revised in 2007, up-graded to 453.3 Tcf in eleven basins, mainly in South Sumatra and East Kalimantan. Resources are categorized as highly prospective basins specifically, South Sumatra (183.0 Tcf), Barito (101.6 Tcf), Kutei (80.4 Tcf), Central Sumatra (52.5 Tcf); moderately prospective basins specifically, North Tarakan (17.5 Tcf), Berau (8.4 Tcf), Ombilin (0.5 Tcf), Asam-Asam (3.0 Tcf), Jatibarang (0.8 Tcf); and less prospective basins specifically, Sulawesi (2.0 Tcf) and Bengkulu (3.6 Tcf).

POWER PURCHASE AGREEMENTS

Over the period of October 2006 to October 2007, Indonesia's state owned electric company PLN secured thirty power purchase agreements (PPAs) from competing independent power producers (IPPs). Eight of the PPAs for a total capacity of 5,939 MW on investments of about US$ 5.6 billion was secured under the 10,000 MW crash programme, declared by Presidential Regulation 71/2006. Total PPA secured under the crash programme has reached 7,469 MW; five of the contracts have begun construction. The government is confident that the remaining capacity will be secured by the year-end, and expect power plants to initially come on line in 2009, as planned. PLN also signed nineteen transmission and sub-station contracts, worth a total of about US$ 2.62 billion, to meet increase in generation capacity under the crash program.

In August 2007, the government issued Presidential Regulation 91/2007; this regulation states that the government will fully guarantee financing of new power plants offered by PLN to investors under the 10,000 MW crash programme. The government expect that 85 percent of the programme's US$ 8.7 billion total cost will come from investors, most of whom are consortia from China, while the remaining will come from PLN's internal cash reserves and from issue of PLN bonds.

The remaining twenty two PPAs or a total capacity of 2,571.6 MW were secured under PLN's power expansion programme and programme to overcome power crisis in certain regions of Indonesia. Notably, sixteen of the PPA was for small-scale coal fired power plants, with plant capacity ranging from 12 MW to 30 MW, and these are intended for small and isolated power systems. Small-scale coal power plants were recently introduced in Indonesia, and are expected to significantly reduce oil consumption in power generation. In August 2007, a Memorandum of Agreement was signed by PLN and Paiton Energy Company towards construction of the 800 MW Paiton III & IV coal power plants.

Other notable development over the observed period was the completion of two power projects in October 2006 that were delayed by the economic crisis of 1997, specifically PLN's 210 MW Musi hydropower plant in South Sumatra; and the 1,320 MW Tanjung Jati B coal power plant located in the north coast of Central Java, which was finalized by an agreement of PLN to lease the plant.

GAS DEAL

In October 2007, several gas producers signed gas supply agreements worth a total of US$ 6.79 billion, for supply of 1,672.13 trillion British Thermal Unit (BTU). The contracts were categorized into four categories.

- Firstly, a contract between Kangean Energy Indonesia Ltd and PLN Unit Gresik Combined Cycle Power Plant was singed, for gas supply of 369 trillion BTU to 2010, worth US$ 1.364 billion.
- Secondly, various contracts between gas providers and Kangean Energy Indonesia Ltd. were signed. Those gas providers include PGN and Husky Oil (Madura) Ltd.; Riau Andalas Pulp & Paper and Kalila (Bentu) Ltd.; gas providers for the Payo Selincah gas turbine plant, Jambi and ConocoPhillips (Grissik) Ltd. Also a contract

of gas provider for Medan industrial estate (North Sumatra) and Pertamina-JOB (Joint Operation Base) Costa Ltd. was signed.

- Thirdly, Kangean Energy Indonesia Ltd and Petro Kimia Gresik, and Medco Malaka and Pupuk Iskandar Muda signed a contract for a total supply of 389.5 trillion BTU, worth US$ 1.69 billion.
- Fourthly, a contract of gas supply for East Java and Pertamina EP, PetroChina International Java Ltd., Medco E&P Tuban were signed for supply of 13.14 trillion BTU to 2008, worth US$ 21.02 million.

COAL LIQUIFACTION

In 2007, an agreement was signed between PT Nuansa Cipta Coal Investment and Kenertec Co., Posco Engineering & Construction Co. Ltd., and Samsung Securities Co. Ltd., to develop a coal liquefaction project on investments of US$ 5.5 billion. The Ministry of Energy and Mineral Resources, JBIC, PT Bumi Resources, Kobe Steel and Sojitz Corporation signed a cooperation on feasibility study on commercialization of brown coal liquefaction in Satui, South Kalimantan.

BIOFUEL DEVELOPMENT

In January 2007, sixty-seven contracts were signed towards biofuel development under the Joint Initiative for Bio fuel Development programme; investment commitments that was pledged total US$ 1.24 billion. The signatories include financial institutions, business joint ventures, developers, and institutions involved in R&D. Certain national banks have also pledged to commit loans under government subsidized interest rates for a total loan of US$ 25 million; the loans will be made available to eligible *plasma* farmers and farmer cooperatives, involved in the bio fuel industry.

Since then, more companies have expressed their pledge to investment in biofuel development, increasing total possible investments to about US$ 1.7 billion. The government is confident that acreage for biofuel development will reach the target of 5,250,000 hectares in 12 provinces in 2010; the biofuel programme is expected to involve a work force of 3.5 million people.

In 2007 there are 201 biodiesel retail stations in Jakarta and 15 retail stations in Surabaya. In 2007, biodiesel was consumed in certain PLN diesel power plants, serving small grids, specifically in 24 diesel power plants total capacity of 16 MW, in 8 provinces. Pertamina's gasoline-bioethanol blend, sold under the company's trade mark Bio-Pertamax, is available in 4 retail stations in Jakarta; in 5 retail stations in Surabaya and in 3 retail stations in Malang, both of the latter cities are in East Java. By end of 2007, Indonesia expect to have 9 biodiesel plants and 4 bioethanol plants in production, with combined bio fuel production capacity of 755,000 tons.

RENEWABLE ENERGY

In 2007, the government funded the installation of thirty-three thousand photovoltaic solar home system (SHS) units, distributed to 30 provinces across Indonesia, at a cost of about US$ 2.5 million.

In May 2007, the government inaugurated operation of the 2 MW Hanga-Hanga-II and 1 MW Kalumpang small hydro power plants in Luwuk, Central Sulawesi, developed at a cost of about US$ 0.4 million. These hydropower plants are expected to relieve power shortage in the region. The Central Sulawesi province is known to have numerous hydro potential with twenty-two small and large hydropower sites identified. Indonesia's small scale hydroelectric potential is estimated at 7,500 MW, from the total hydropower potential of 75,624 MW; installed small scale hydroelectric capacity is about 600 MW.

The government had issued fiscal and non-fiscal incentives to support greater use of renewable energy including solar, wind, and small hydroelectric power to reach the target of 5 % share of renewable in the national primary energy mix, in 2025.

NUCLEAR

Indonesia is advancing in preparations to possess the first nuclear power plant; current plans expect the first series of four nuclear power plants of about 4000 MW to be introduced in 2025. A strong candidate for these plants is the Muria peninsular in the north coast of Central Java; the site site studies have been conducted since the early 1980's.

In 2007, the government established the Nuclear Power Development Preparatory Team; whose task is to take the necessary preparatory measures and plans to build Indonesia's initial nuclear power plants. The legal basis of Indonesia's nuclear power development includes, Law 17/2007 on Long Term Development Year 2005-2015, and Government Regulation 43/2006 on Licensing of Nuclear Reactor.

Indonesia has developed an indigenous nuclear fuel cycle, although certain stages are still at the laboratory scale; the economy also has a well-established nuclear research program, which spans nearly 5 decades. Indonesia's National Nuclear Energy Agency (BATAN) currently operates three nuclear research reactors specifically, the GA Siwabessy 30 MW MTR pool type reactor in Serpong; the Kartini-PPNY 100 kW Triga Mark-II reactor in Yogyakarta; and the Bandung 1,000 kW Triga Mark-II reactor in Bandung. A fourth 10,000 kW pool type reactor is planned.

Indonesia currently has two uranium mines, specifically, the Edo-Remaja prospect of the Remaja-Hitam Ore Body, a uranium vein in fine grained metamorphous rock, estimated to contain uranium between 5,000-10,000 tons, of grade range of 0.10-0.30; and the Riang Tanah Merah Ore Body, a uranium vein, which may contain uranium of less then 5000 tons, grade range is 0.30-1.00. The uranium mines are located in West Kalimantan. By IAEA estimates, Indonesia could produce about 770 tons of uranium per year.

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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 2005 was about US$ 3,554 billion (2000 US$ at PPP). With a population of 128 million people, per capita income was US$ 27,817.

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 2005, 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 (2005)

Key data		Energy reserves	
Area (sq. km)	377,800	Oil (MCM) – Proven	9
Population (million)	127.77	Gas (BCM)	40
GDP Billion US$ (2000 US$ at PPP)	3,554.24	Coal (Mt) – Proven	359
GDP per capita (2000 US$ at PPP)	27,816.7		

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 2005, an increase of 0.53 percent from the previous year. By fuel, oil represented the largest share at 47 percent, coal was second at 21 percent, followed by natural gas (14 percent) and others represented the remainder. In 2005, net import of energy sources, accounted for 82 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 2005, Japan was the world's third largest oil consumer after the US and China[34], and almost all of the oil was imported. The bulk of these imports (89 percent in 2005) came from economies in the Middle East such as the United Arab Emirates (UAE), Saudi Arabia, Iran, Qatar and

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

Kuwait.[35] In 2005, the primary oil supply was 244.5 Mtoe, increase by 0.54 percent from the previous year.[36]

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 2005 primary coal consumption decreased by 0.1 percent from the previous year, reflecting the decline in the use for iron and steel making.

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[37], which come mostly from Indonesia (24 percent of imports in 2005, Malaysia (23 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 70 Mtoe, or increase by 1.7 percent from the previous year.

Japan has 274 GW of installed generating capacity and generated about 1,153 TWh of electricity in 2005. The generation amount by energy type is broken-down as: thermal (coal, natural gas and oil) at 63 percent, nuclear (25 percent), hydro (8 percent) and geothermal, solar and wind taking up the remainder.

Table 16 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	97,558	Industry Sector	152,957	Total	1,153,054
Net Imports & Other	425,227	Transport Sector	86,785	Thermal	731,503
Total PES	519,382	Other Sectors	115,004	Hydro	87,503
Coal	110,949	Total FEC	354,746	Nuclear	293,038
Oil	244,518	Coal	37,249	Others	41,449
Gas	70,481	Oil	199,782		
Others	93,435	Gas	26,276		
		Electricity & Others	91,439		

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.[38] In early August 2004, an accident occurred in one of the Kansai Electric Power Company's nuclear reactors caused by a fracture on one of the secondary piping

[35] 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.

[36] 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.

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

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

systems at Mihama Unit 3[39]. As a result of these incidents, public opposition against nuclear power generation has increased.

FINAL ENERGY CONSUMPTION

In 2005, Japan's total final energy consumption was 355 Mtoe, or 0.3 percent lower than the previous year. The industrial sector consumed 43 percent of the total, followed by the other sectors mainly residential/commercial at 32 percent and the transportation sector at 24 percent. By energy source, petroleum products accounted for 56 percent of total final energy consumption, followed by electricity and others (26 percent), coal (11 percent) and city gas (7 percent).

Energy consumption for the industrial sector showed a decline at 2.5 percent in 2005 compared with a steady growth at 1.4 percent per year between 2001 and 2004. The decline of industrial energy consumption in 2005 reflects the industrial structure shift from energy intensive industry to non-energy intensive one.

The residential/commercial sector's energy consumption in 2005 increased at 2.8 percent, while it had been declining at 0.4 percent per year (2001-2004). The recent upturn in energy consumption of this sector was driven mainly by the residential demand for space heating, and the commercial floor space increase. [40]

Energy consumption of the transport sector declined at 0.3 percent in 2005 from the previous year. The modest decrease in transport's energy consumption in 2005 is explained by such factors as shift to small-sized passenger vehicles, operational improvement in freight transport, and the overall improvement in fleet efficiency. In addition, slow population growth has contributed to the negative growth of passenger-km in 2005. All these factors translated into the decline in transport energy consumption.

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

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

[40] The average temperature was lower in 2005 than in 2004. Japan's heating degree days in 2005 was 1,116 compared with 965 in 2004.

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.

Japan's oil supply structure is vulnerable to supply disruption incidents since Japan imports almost all of its crude oil. Middle East dependency in 2006 was high at 81 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.

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. According to the New Japan's Energy Strategy – released in 2006, Japan further aims to reduce the ratio of oil to total primary energy consumption to reach 40 percent in 2030. In addition, as a means to enhance oil supply security, the New Energy Strategy aims to increase the ratio of oil import from those Japanese overseas projects to 40 percent in 2030 from 15 percent in 2004.

NATURAL GAS

Demand for natural gas has been increasing rapidly over the last two decades. Between 1980 and 2005, natural gas demand grew at an annual growth rate of 4.8 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 was further amended in April 2007, and those customers with contracted amount of 0.1 million m^3 are allowed to choose their suppliers. With this amendment, about 59 percent of total city gas customers, or 10,100 customers can choose their suppliers.

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.[41]

In addition, some Japanese gas and electric utilities have purchased upstream stakes in order to ensure security of gas supply. Such example include Darwin project in Australia, to which TEPCO and Tokyo Gas hold 6.72 percent and 3.36 percent share respectively. Also, Osaka Gas purchased 3 percent upstream stake of Qalhat LNG.

COAL

In 2005, coal accounted for 21 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 2005. 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 driven the steady increase in electricity consumption in recent years.

Japan's 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.

[41] 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.

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 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. The Japanese government launched on a three-year programme from the fiscal cycle 2007 to strengthen the university educational programmes in nuclear studies.

To ensure the efficient use of nuclear resources, it is essential to work out countermeasures to establish 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 2,000m^2 to report the energy conservation measures to the local governments.

NOTABLE ENERGY DEVELOPMENTS

JAPAN'S BASIC ENERGY PLAN

On 9 March, 2007, the Agency for Natural Resources and Energy (ANRE) under METI released an amendment of Japan's Basic Energy Plan. The original Plan was released in 2004 to delineate about a ten-year pathway to achieve Japan's three basic energy policy goals, namely (1) ensuring a stable energy supply, (2) improving environmental conditions and (3) utilising market mechanisms to address energy/environmental issues. Following the Basic Law on Energy Policy-Making, ANRE made the amendments in order to fully reflect changing circumstances surrounding the energy sector.

Main points of revision include the followings.

- Promotion of nuclear power generation, and steadily increase the use of new energy sources
    - To introduce biomass fuels in the transport sector to reduce oil dependence
- Enhancement of stable energy supply
    - To increase diplomatic efforts to secure energy resources through close cooperation with the private sector
    - To build strategic relationships with energy exporting countries through provision of ODA
    - To develop JOGMEC's risk money supply function
- Energy efficiency improvement, and taking the initiative for global warming issues
    - To introduce a sectoral benchmarking system to evaluate energy efficiency by sector
    - To take the leading role in establishing international mechanisms for global warming issues
- Market diffusion of advanced energy technologies
    - To develop a roadmap for market diffusion of advanced technologies
    - To promote energy/environmental cooperation with economies in Asia

INTERNATIONAL COOPERATION

Japan has held a number of high-level meetings on energy cooperation – at both bilateral and multilateral levels. Japan's energy ministers had bilateral meetings in recent years with those counterparts from China, India, Indonesia and Saudi Arabia. In addition, Japan takes part in regional framework such as ASEAN, and APEC. Such bilateral/multilateral meetings were held in

order to promote cooperation on (1) technology/know-how transfer on energy conservation, and (2) securing energy supplies with exporting economies.

Examples from bilateral meetings are summarised as below.

- To enhance energy supply security, Japan's Energy Minister had a bilateral meeting with Indonesia's Energy Minister in November 2006. The two Ministers signed an MOU, which confirms (1) importance of strategic partnership between the two economies in terms of resources development, (2) Japan's financial support to develop energy infrastructure in Indonesia, (3) continued Japan's support to Indonesia in terms of human resources development and public awareness for the safety in nuclear power generation, and (4) cooperation on energy efficiency improvement.
- In April 2007, the first China-Japan Energy Ministers' meeting was held in Tokyo. At the meeting, Ministers signed an MOU on cooperation for such areas as (1) energy conservation, (2) coal mines safety, (3) nuclear power promotion, and (4) new and renewable energy promotion. The MOU recognised that Japan's technology/know-how can contribute to improve China's energy efficiency, and environmental conditions. Therefore, both parties committed to cooperate with project implementation in order to transfer Japan's technology/know-how to China's needed areas.

REVISION OF PLAN TO MEET THE KYOTO PROTOCOL TARGET

Kyoto Protocol requires Japan to reduce greenhouse gas emissions by 6 percent compared with 1990 level by 2012. This target poses a challenge to Japan as its greenhouse gas (GHG) emissions have steadily been increasing since 1990. For example, in 2005, Japan's GHG emissions were about 7.7 percent higher than 1990 level. Between 1990 and 2005, driven by the substantial increase in the residential, commercial and transport sectors, CO_2 emissions from energy consumption – Japan's main greenhouse gas - increased by 13.4 percent, compensating the reduction of such GHG emissions as CH_4, N_2O and CFC respectively by 28 percent, 22 percent and 64 percent.

On 21 December, 2007, the joint study committee under METI and Ministry of Environment released the revised plan to meet the Kyoto target. The revised plan sets quantified CO_2 emissions reduction by sector. It encourages the life style change through the use of public transport, and promotes the use of energy efficient appliances. In addition, it calls for additional emissions reduction for those industries that have already met the target level.[42] The revised plan also identified the needs to introduce a mechanism through which government can evaluate the progress of each sector.

ABU DAHBI'S INTERNATIONAL PETROLEUM INVESTMENT COMPANY (IPIC) TO INVEST IN COSMO OIL CO., LTD.

On 18 September, International Petroleum Investment Company (IPIC), 100 percent owned by the Government of the Emirate of Abu Dhabi, the United Arab Emirates (UAE), announced that it would acquire capital in Cosmo Oil Co., Ltd. This investment reflects the outcomes from the joint statement between UAE and Japan announced at the time of former Japanese Prime Minister Abe's visit in April 2007. In the joint statement, two parties confirmed the reciprocal benefits in terms of developing further cooperation in the oil sector. The UAE is the second largest exporter of crude oil to Japan – after Saudi Arabia – and the UAE's crude supply accounts for 37 percent of oil resources developed by Japanese companies. Therefore, the IPIC's investment is considered to enhance oil supply security of Japan.

[42] 18 industries' association announced higher emissions reduction target as their voluntary scheme.

NEW VEHICLE FUEL ECONOMY STANDARDS

In February, 2007, METI and Ministry of Land and Transport announced the new vehicle fuel economy standards. With this announcement, the Energy Conservation Law on vehicle fuel economy was amended on 2 July, 2007. Due to the amendment of the Law, automobile manufactures are required to improve fuel economy of new passenger vehicles by 23.5 percent by 2015 compared with 2004 level. In other words, fuel economy standard of new passenger vehicles would increase from 13.6 km/l in 2004 level to 16.8 km/l in 2015. Aside from passenger vehicles, the amended Law requires that by 2015 automobile manufactures should improve fuel economy of small buses by 7.2 percent and small freight trucks by 12.6 percent respectively compared with 2004 levels.

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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 6.8 percent per year over the period 1980 to 2005, reaching US$946.5 billion (2000 US$ at PPP) in 2005. Per capita income in 2005 reached US$19,598, 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 2005, there were only 80 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 (2005)

Key data		Energy reserves*	
Area (sq. km)	99,538	Oil (MCM)	-
Population (million)	48.29	Gas (BCM) - Recoverable	250
GDP Billion US$ (2000 US$ at PPP)	946.48	Coal (Mt) - Recoverable	80
GDP per capita (2000 US$ at PPP)	19,598		

Source: Energy Data and Modelling Center, IEEJ.

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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 2005. 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 4.4 toe in 2005. This is a level similar to that of Japan and most European economies.

In 2005, Korea's total primary energy supply was 214 Mtoe, 0.27 percent increase from the previous year. By energy source, oil represented the largest share at 45 percent, coal at 23 percent, and gas at 13 percent. The remaining 19 percent of primary energy came from nuclear, hydro and other fuels. Korea imported around 82 percent of its total energy needs in 2005, including all of its oil and gas requirements and 95 percent of its coal supply.

The oil consumption in 2005 was 96 Mtoe, a 5.1 percent decline from the previous year. The decline in oil took place as a result of the fuel switching to gas in the industry and residential/commercial sectors, and energy conservation efforts in the transport sector. In 2005,

the amount of imported crude oil decreased from 72 million barrels in 2004 to 69 million barrels in 2005 in accordance with the decline in domestic demand for oil products. 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 2005 totalled 49.5 Mtoe, 1.2 percent lower than the previous year, reflecting the decline for the industrial use. 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 demand 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 27 Mtoe in 2005, with its share in the primary energy supply mix increasing to 13 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 2005 was 389 TWh, 5.8 percent increase from 2004. Nuclear accounted for 40 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 2005 was 62.3 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 2005

Primary Energy Supply (Ktoe)		Final Energy Consumption (Ktoe)		Power Generation (GWh)	
Indigenous Production	44,158	Industry Sector	40,689	Total	389,344
Net Imports & Other	175,525	Transport Sector	32,434	Thermal	236,937
Total PES	214,300	Other Sectors	72,779	Hydro	5,189
Coal	49,462	Total FEC	145,902	Nuclear	146,779
Oil	96,536	Coal	8,050	Others	439
Gas	27,415	Oil	84,812		
Others	40,887	Gas	15,986		
		Electricity & Others	37,053		

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 2005 was 146 Mtoe, a 0.6 percent increase from the previous year. Industry accounted for the largest share at 51 percent, followed by residential and commercial sector (28 percent) and transport (22 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 58 percent of total demand, followed by electricity (25 percent), coal (6 percent) and natural gas (11 percent). Because of strong policy measures to promote the utilisation of natural gas, consumption has increased significantly, particularly in the residential/commercial sector, from 3 percent in 1990 to 31 percent of the sector's energy consumption in 2005.

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.[43] 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).

[43] 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

PROMOTION OF HIGH-EFFICIENCY EQUIPMENT

Guided by the Rational Energy Utilisation Act, the Korean government partially amended operating regulations for energy efficient products labeling, which has been implemented under the Energy Efficiency Standards & Labeling Programme. The amendment was held in order to further promote production and market diffusion of energy efficient products.

With the change in regulation, the government renewed the label design to keep consistency among different types of products, and make it more user-friendly. The new label will be attached to those products manufactured from January 2008. The key indicator to represent the products' energy efficiency level will be also renewed to increase understanding of customers.

Currently the labeling scheme includes 18 products list. With the regulation change, the government added 2 items, namely (1) three-phase induction motors, and (2) air purifiers.

The Government also revised the regulation of the above Act, which is designed to promote the efficient equipment under the High-Efficient Equipment Certification Programme. Through this revision, three items were added to the list, namely (1) LED induction lamps, (2) heat storage burners, and (3) turbo blowers. The number of products covered under this Programme now amounts to 37.

The revision also aims to upgrade the standards in the Programme, where certifications are awarded to those equipments which performance is above the standards. The standards for seven items were revised reflecting the recent technology developments. These items include transformers, heat recovery ventilators and direct-fired absorption chiller-heaters.

OVERSEAS RESOURCES INVESTMENT

In March 2007, MOCIE announced that Korea's overseas investments in oil, gas and minerals would increase by 81 percent in 2007 compared with 2006 level. This became clear as a result of survey for 35 state-owned and private companies between December 2006 and January 2007. To secure long-term energy and minerals supply, Korean companies planned to invest US$3.2 billion in oil and gas projects in 2007, increasing from US$ 1.9 billion in 2006. In addition, planned investment in minerals for 2007 amounted to US$577 million, increasing from US$186 million in 2006. In total, the number of overseas resources development projects that Korean companies are involved would reach 140, which is held in 37 countries.

Currently Korea's crude oil supply from the overseas equity projects accounts for 120,000 barrels per day or 4 percent of total oil consumption. According to the MOCIE's third overseas resources development plan, released in August 2007, the government plans to increase the share of equity oil to 20 percent of total oil consumption by 2013. For this target to be realised, the National Assembly passed a bill to double KNOC's capital to 10 trillion won (US$ 10.8 billion) by 2013. MOCIE also plans to separate the oil exploration business from KNOC, and will be partially privatised so the company will be operated efficiently.

PROMOTION OF BIOFUEL

The government of Korea aims to raise biofuel contents in diesel from the current 0.5 percent to 3.0 percent in 2012. In July 2006, Korea began to supply biodiesel fuel in all of the economy's gas stations for the first time in Asia. To further increase the biodiesel supply, the government of Korea decided to extend the time period for providing tax breaks until 2010 from the original plan by 2007. There are 16 firms in Korea registered with the government to produce biodiesel.

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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 25.35 millions in 2005. The Gross Domestic Product (GDP) grew steadily over the 15 year period (1990-2005) at an average of 6.2 percent per year. Between 2004 and 2005 GDP grew at 5.16 percent, to reach US$245.39 billion (2000 US$ at 2000 purchasing power parity (PPP) in 2005. GDP per capita likewise experienced an improvement reaching US$9,681 (2000 US$ at PPP) in 2005 compared to US$9,374 (2000 US$ at PPP) in 2004.

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 2005, the proven reserves including 5.2 billion barrels of oil, 85.2 tscf of gas and 1,843 million tonne 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 2007.[44]

Table 19 Key data and economic profile (2005)

Key data		Energy reserves*	
Area (sq. km)	330,242	Oil (Bbl) - Proven	5.2
Population (million)	25.35	Gas (Tscf) - Proven	85.2
GDP Billion US$ (2000 US$ at PPP)	245.39	Coal (Mt) -Recoverable	1,843.0
GDP per capita (2000 US$ at PPP)	9,681		

Source: Energy Data and Modelling Centre, IEEJ. *National Energy Balance Malaysia, 2005

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary supply in 2005 was 61,730 ktoe. Oil accounted for 46 percent of total primary supply, while gas, coal and others accounted for 43 percent, 11 percent and 1 percent respectively.

Malaysia produced about 727 thousands barrels per day of crude oil in 2005.[45] 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 2007, Malaysia's total international reserves reached 6.31 billion barrel of oil equivalent (boe), representing almost 25 percent of PETRONAS' total reserves.[46]

Gas production in Malaysia reached about 6,723 million scf per day in 2005.[45] A total of 24,841 ktoe of 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 was exported to Singapore by pipeline. Domestically gas is used for electricity generation and as a feedstock in the petrochemicals industry (a total of 20,175 ktoe).

[44] Key Statistics November 2007, Department of Statistics, Malaysia

[45] National Energy Balance Malaysia 2005, Ministry of Energy, Water and Communications, Malaysia

[46] Petronas Group Results for the Financial Year Ended 31 March 2007, PETRONAS

In 2005, total electricity generation was 87,306 GWh. Thermal generation, mostly from natural gas and coal accounted for 93 percent of production and hydropower for the remaining seven percent.

Table 20 Energy supply & consumption (2005)

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	91,969	Industry Sector	14,960	Total	87,306
Net Imports & Other	(30,636)	Transport Sector	15,319	Thermal	81,523
Total PES	61,730	Other Sectors	7,257	Hydro	5,784
Coal	6,620	Total FEC	37,536	Nuclear	-
Oil	28,198	Coal	1,280	Others	-
Gas	26,414	Oil	22,995		
Others	497	Gas	6,322		
		Electricity & Others	6,940		

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

FINAL ENERGY CONSUMPTION

In 2005, total final energy consumption in Malaysia was 37,536 Mtoe. The transport sector consumed 41 percent of this total, followed closely by the industrial sector at 40 percent and other sectors (agriculture, residential/commercial and non-energy) at 19 percent. By fuel source, petroleum products contributed the largest share with 61 percent of consumption followed by electricity (18 percent), gas (17 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

RENEWABLE ENERGY (RE)[47]

The Renewable Energy Action Plan

Malaysia has encouraged the development of RE through policy and various strategies. For example, Five Fuel Policy on 2000 has placed RE as the fifth fuel of the economy after oil, coal, gas and hydro while the Ninth Malaysia Plan (2006-2010) has specified the target of electricity grid-connected generation to be 350MW from Peninsular Malaysia and Sabah.[48]

In order to fast track the development RE in Malaysia, a few programmes have been introduced. One of the programmes is Small Renewable Energy Power Program (SREP) that was launched in 2001. Under SREP, 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 or pay' basis. RE electricity producers receive a 21-year license, and are allowed to export to the grid up to a maximum of 10 MW. Under this program, the utilisation of all types of renewable energy including biomass, biogas, municipal solid waste, solar, mini hydro and wind are permitted. However, the progress of the program is quite slow as up to date only 12 MW is connected to grid from the SREP projects.

Consequently, the government is now in the process of establishing an Action Plan for RE, which was scheduled to be completed by the end of 2007. The Plan will among others includes;

- In short term (up to 2010); to review the obstacles faced by prospective RE developers. Measures to remove the identified obstacles and to stimulate and re-energize the RE program – particularly SREP program,, will be proposed,
- To review REPPA and its major issues, and to recommend how the terms and conditions can be simplified and standardized, with differentiation between the bigger projects and the smaller and rural projects,
- In longer term (beyond 2010), to establish new targets for RE utilisation by type of RE sources and by region; and
- To establish cohesive policies, funding mechanisms, conductive institutional and administrative support and processes for RE development sustainable growth.

In the meantime, enactment of the National Biofuel Policy, which was launched in March 2006, was postponed because of the current high price of raw palm oil. The policy is, among others, promotes the use of biofuel, known as EnvoDiesel, however, it is decided unwise to implement the act now.

ENERGY EFFICIENCY (EE)[49]

EE initiatives for the Industrial Sector in Malaysia

The Malaysian Industrial Energy Efficiency Improvement Program (MIEEIP) is co-funded by the government of Malaysia, UNDP/GEF and the private sector in Malaysia with a total cost of

[47] Notable Energy Developments- Malaysia (from Notable Energy Developments EWG34, Hong Kong, China, 5-6 September 2007)

[48] Apart from grid-connected RE projects, Malaysia has achieved a considerable success in off-grid RE generation. Currently, electricity generated by the system is amounting to about 700 MW, mostly from palm oil waste biomass.

[49] Notable Energy Developments- Malaysia (from Notable Energy Developments EWG34, Hong Kong, China, 5-6 September 2007)

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; wood/timber, food, glass, cement, rubber, pulp and paper, iron and steel, ceramic, oleo-chemical, plastic and textiles industries.

Recently the project has successfully developed the Energy Efficiency and Conservation Guidelines Part 1: Electrical Energy-Use Equipment. The Guideline, which was launched in July 2007, will encourage industries to adopt EE practices and to manage and improve their energy utilization and environmental management. It covers a number of commonly-used equipments such as fans, motors, pumps, chillers, transformers, air-compressors. The Guideline also highlights the best practices in the selection and design with standard efficiency values as well as best practices in operation, monitoring and maintenance of the equipment.

EE in Buildings Sector

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.

Apart from LEO building, the Zero Energy Office (ZEO) Building[50] is also one of the Malaysia's showcases for Building Integrated Phtovoltaic (BIPV) technology. The ZEO Building design incorporates both RE and EE features. 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*[51]. Apart being fitted with many EE features, a solar PV system is 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'.

In order to improve EE in buildings, Government agencies in Malaysia have also been directed to reduce energy consumption by 10%. Presently, the government of Malaysia is embarking on energy audits on seven government buildings as to create EE awareness in the government sector.

EE Regulations

Currently, the Ministry of Energy, Water and Communications and the Energy Commission are working on Efficient Management of Electrical Energy Regulations, under the new Electricity Supply Act. The Regulations will specify that all installations that consume 3 million kWh or more electricity over a period of six months will be required to engage a registered electrical energy manager who shall, among others, be responsible to analyse the total consumption of the electrical energy, to advise on the development and implementation of measures to ensure efficient management of electrical energy as well as to monitor the effectiveness of the measures taken. In order to ensure that the implementation of EE and RE in buildings conform to requirements, the MS 1525 which is Code of Practice on the Use of Renewable Energy and Energy Efficiency in Non-Residential Buildings has been introduced. Energy efficiency requirements under the MS1525 will be incorporated in the amendments to the Uniform Building By-Laws (UBBL). Once the UBBL is enforced, all non-residential buildings will have to comply to the energy efficiency requirements of the UBBL.

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[50] ZEO Building is housing Pusat Tenaga Malaysia, which is located at Bandar Baru Bangi, Selangor. Pusat Tenaga Malaysia is a non-profit organization administered by the Ministry of Energy, Water and communications>

[51] 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

In order to enhance the development of EE in Malaysia, the Government of Malaysia is in the midst of formulating the EE Action Plan which is expected to be ready by middle of 2008. The action plan shall be able to put in place the strategic direction of EE development in the country in the support of green development. The EE initiatives will focus on buildings and the industrial sector.

OIL AND GAS SECTOR

As in January 2007, the total domestic reserves for Malaysia were 20.18 billion barrels of oil equivalent; 5.36 billion boe of crude oil and 14.82 billion boe of natural gas. At the current production rate, the reserve life for Malaysia for crude oil and gas is 19 years and 33 years respectively. Reserve Replacement Ratio (RRR) for oil and gas combined is 1.4, which is comparable to the industry's average. To boost oil and gas reserves, Malaysia has been intensifying the exploration of deepwater and extra-deep water areas.

A total of 39 new exploration wells were drilled and about 250,000 line km of 3D seismic data was acquired in the year under review. Four new Production-Sharing Contracts (PSCs) were signed where two of the PSCs were for deepwater blocks. Including the new PSCs, the total number of production fields in operations reached 85, the highest number historically. The deepwater discoveries currently under development are the Kikeh, Gumusut-Kakap and Malikai fields. Kikeh deepwater field started its production in August 2007, with a peak production rate planned at 125,000 BPD. Kikeh field is located about 1120 km from Kotakinabalu in the east Malaysian state of Sabah at a water depth of some 1,300 metres.

To increase the national reserve, the Government through its national oil company-PETRONAS, is involved oil and gas exploration and production internationally. As in January 2007, Petronas's total international reserves amounted to 6.31 billion boe. Petronas was awarded six new PSCs internationally, thus bringing the number of international ventures to 58 in 22 countries.

Natural Gas

The power sector in Malaysia remains as the largest single domestic gas consumer, consuming 62.5 percent of gas sales through the Peninsular Gas Utilisation (PGU) system. The industrial, petrochemical and other users accounted for 31.2 percent; significantly increased from 558 mmscfd in the previous year to 665 mmscfd in 2007. The balance of 6.3 percent was exported to Singapore through gas pipeline.

Due to increasing domestic natural gas demand, supply was obtained from the offshore Terengganu gas field and additionally through imports from he Malaysia-Thailand Joint Development Area (JDA), Indonesia and Vietnam; gas imports have increased by 16.7 percent from the previous year to reached 497 mmcsfd in 2007 - representing 23 percent of total gas supplies through the PGU system.

Liquefied Natural Gas (LNG)

During 2005, PETRONAS – the national oil company – has sold a total of 24.1 million tonnes of LNG, an increase of 2.1 percent over the previous year. This is sustained by the higher volume produced and sold mainly by the PETRONAS LNG complex in Bintulu. The LNG produced in Bintulu was exported to Japan (25 percent), South Korea (22 percent) and Chinese Taipei (17 percent). During the year under review, PETRONAS has secured a long-term contract to Shanghai LNG Company ltd.

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.

Trans-Peninsula Pipeline

A plan to lay a crude oil pipeline across northern Malaysia that would bypass the Straits of Malacca was announced by Trans- Peninsula Petroleum, the owner and promoter of the project, in

May 2007. The pipeline is 300km long, beginning with an import facility on the west coast of Kedah and ending with a re-export facility on the east coast of Kelantan. The project aims to direct 20 percent of crude oil that is now being transported via Straits of Malacca. The plan calls for an initial 48 inch pipeline with a throughput of two million barrels a day and storage capacity of 60 million barrels.

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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 a total population of 103.9 million in 2005, and steadily growing at an average of 1.0 percent annually over the last 5 years. Due to industrialisation and urbanisation in recent years, around 76 percent of the population lives in urban areas. Mexico City is one of the largest urban centres in the world, with around 19.4 million people within the city.

Mexico's economy continued to rebound in 2005 from years of slow economic performance. This economic recovery has been linked to high global oil prices and economic recovery in the United States. The real gross domestic product (GDP) reached US$985.99 billion (2000 US$ at PPP), an increase of 2.96 percent over 2004. In the same year, the GDP per capita grew at 1.92 percent to settle at US$9,564 (2000 US$ at PPP).

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 2007, proven oil reserves were the seventeenth largest in the world, totalling 1,964 MCM (including gas liquids), gas reserves were 412 BCM and coal resources were 1,211 Mt.

Table 21 Key data and economic profile (2005)

Key data		Energy reserves	
Area (sq. km)	1,964,375	Oil (MCM) – Proven**	1,964
Population (million)	103.9	Gas (BCM) – Proven**	412
GDP Billion US$ (2000 US$ at PPP)	986	Coal (Mt) –Recoverable***	1,211
GDP per capita (2000 US$ at PPP)	9,564		

Sources: Energy Data and Modelling Center, IEEJ

* INEGI, Información geográfica. 2006

** As of January 2007. Oil & Gas Journal.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

CRUDE OIL AND PRODUCTS

Mexico's total primary energy supply (TPES) in 2005 was 176,372 ktoe, a growth of 7 percent compared with 2004, which was 164,848 ktoe. Oil and gas (with contributions of 59 percent and 25 percent respectively) dominate primary energy supply with a combined share of 84 percent. Coal's share had the largest incremental growth in 2005, increasing by 22.5 percent from 7,131 ktoe in 2004 to 8,736 ktoe in 2005.

Mexico had 12.4 (including gas liquids) billion barrels of proven oil reserves as of January 1, 2007, the 17th largest in the world. Mexico's proven reserves have declined in recent years; in 2006 reserves were 10.7 percent less than the previous year. The state oil company, Pemex, is 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 2005 reached around 164.5 Mtoe, 17.3 Mtoe or 9.5 percent less than the previous year. Domestic consumption accounted for 44 percent of the total volume produced, with 72.8 Mtoe; the remaining 56 percent or 91.7 Mtoe was exported. Of this amount, about 86 percent went to the US, followed by 11 percent to Europe. In 2005, Mexico was world's sixth-largest oil producer and the world's eighth-largest crude oil exporter. Pemex also controls the downstream oil sector. It has six major refineries with a total refining capacity of 1.54 million barrels per day. The total volume distributed to refineries in 2005 was 68.6 Mtoe, 6.3 percent less than 2004. Despite its status as one of the world's largest crude oil exporters, Mexico is a net importer of petroleum products. In 2005, Mexico imported 405 thousand bpd of petroleum products, while exporting 191 thousand bpd. Of these imports, gasoline represented about 47 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.

NATURAL GAS

Mexican natural gas proved reserves as of January 2007 were 412 BCM. Most of the proved reserves are associated gas, 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 2005 was 45.3 Mtoe, an increase of 4.3 percent compared with 2004. Total natural gas consumption in Mexico rose from 33.5 Mtoe in 2000 to 44.4 Mtoe in 2005, at an annual average growth rate of 5.8 percent. Over this period, consumption growth was driven by the electricity generation sector, whose share of natural gas consumption increased from 21 percent in 2000 to 36 percent in 2005. Mexico is currently a net importer of natural gas; it imported 7.5 Mtoe in 2005.

COAL

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. Total coal supply in 2005 was 8.7 Mtoe and accounted for around 5.0 percent of total primary energy, an increase of 22.5 percent from 2004. In 2005, indigenous coal production was 5.2 Mtoe. To supplement production, coal is imported from the US, Canada, and Colombia. It is mostly used for the electricity generation and steel sectors.

ELECTRICITY

Electricity demand has grown rapidly over the past decade, with an average growth rate of 4.7 percent per year. Electricity consumption reached 191.3 TWh in 2005, an increase of 4.0 percent from 2004. It is expected to increase by an average of 4.8 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 2005. Electricity generation capacity in Mexico in 2005 was 53,858 MW, of which 71.1 percent is owned by the two state-owned electric utilities, Commission Federal de Electricidad (CFE, 69.5percent) and Luz y Fuerza del Centro (LFC, 1.6 percent). The remaining capacity is owned by IPPs (15.3 percent), self-supply (7.3 percent), co-generators (2.8 percent), and small own-users (1 percent).

The total power generation for 2005 was 234, 895 GWh. Most of the power was generated by thermal generation (80 percent). Mexico has interconnections with the US in the north and Belize in the south. In 2005, Mexico imported 470 MWh and exported 1,600 MWh to the United States.

Tale 22 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	259,003	Industry Sector	27,084	Total	234,895
Net Imports & Other	-81,233	Transport Sector	47,668	Thermal	189,010
Total PES	176,372	Other Sectors	33,358	Hydro	27,732
Coal	8,736	Total FEC	108,110	Nuclear	10,805
Oil	103,456	Coal	1,284	Others	7,348
Gas	44,418	Oil	70,556		
Others	19,762	Gas	13,787		
		Electricity & Others	22,483		

Source: Energy Data and Modelling Center, IEEJ and Secretaria de Energia, Mexico 2006.
For full details of the energy balance table see http://www.ieej.or.jp/cgi-bin2/J101outbcgi.sh

FINAL ENERGY CONSUMPTION

In 2005 the total final energy consumption in Mexico reached 108,110 ktoe, an increase of 2.63 percent relative to the previous year. Total energy consumption was divided between the industry, transport and other sectors. Industry consumed 25 percent of energy, the transport sector 44 percent, and other sectors (including residential, commercial and agriculture) 31 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.

POLICY OVERVIEW

NATIONAL ENERGY POLICY FRAMEWORK

Mexico's Energy Secretariat is responsible for Mexico's energy policy within the current legal framework. The Energy Sector Program 2007-2012 was established to compliment The National Development Plan 2007-2012. The main objective of the National Energy Policy of Mexico is to ensure the supply of energy required for development, while achieving competitive prices, minimizing environmental impacts, and operating at high quality standards. Furthermore, Mexico would like to promote the rational use of energy and energy resource diversification.

The Energy Sector Program 2007-2012, distinguishes the main policies, strategic goals, and measurable targets set for the energy sector. The main driving principles of Mexico's energy policy are to:

- Ensure the sustainability and competitiveness of the country's hydrocarbon industry,
- Promote adequate tariff levels to cover the costs associated with the efficient operation of public agencies in the electricity sector,
- Promote a diversified portfolio of primary energy sources that includes renewable energy sources,
- Promote the efficient production and use of energy and the mitigation of greenhouse gas emissions, and
- Strengthen the operational standards of the electricity sector's public agencies to enhance the quality and reliability of the network.

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" recognised 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.

ENERGY AND ENVIRONMENT

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

In April 2007, the Mexican congress approved the Law for the Development and Promotion of Bioenergy. The law promotes the production of ethanol and other biofuels, as a means to reduce Mexico's dependence on fossil fuels; promote cleaner and environmentally friendly fuels; and develop Mexico's rural economy, specifically through the participation of the economy's agriculture sector. The law established the need to focus on research and development, as well as technology transfer related to bio-fuels; tax exemptions and subsidies to organizations involved in bio-fuel production and development, and the establishment of a national bio-fuels strategy.

NOTABLE ENERGY DEVELOPMENTS

OIL SECTOR DEVELOPMENTS

Mexico's challenges in the oil sector is not only focused on discovering more reserves and increasing hydrocarbon production volumes, but is 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 2006, the Cantarell Complex's total production was 1.8 million bpd, representing 55 percent of Mexico's total crude oil production. Pemex estimates that production levels in the Cantarell complex for 2007 will be approximately 1.7 million bpd, a volume similar to the average in 2006. Projections reveal that total production in this project will decrease at a rate of 14.1% per annum between 2006 and 2016, averaging a volume of 921 mbd during the period. Nevertheless, Cantarell is expected to remain the country's main producing field until 2012, at which point the production decline of the field should be offset by increased production of the Ku-Maloob-Zaap, A.J.Bermúdez, Jujo-Tecominoacán, and other fields.

LNG FACILITIES

In order to increase Mexico's supply of natural gas, the national energy policy has established strategies to diversify the economy's natural gas supply. This policy has promoted 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, Mexico's Energy Regulatory Commission has awarded several LNG storage permits.

In September 2006, the Altamira Terminal, located on the coast of the Gulf of Mexico, began operation with an initial capacity of 500 MMcf/d. The terminal, which is a joint venture of Royal Dutch Shell, Total and Mitsui & Co., is the economy's first LNG regasification terminal. This project plans to increase to a peak capacity of 1.3 Bcf/d. On the Pacific coast, the Energia Costa Azul LNG terminal of Sempra is now under construction, and scheduled to begin operation in early 2008. The terminal with the capacity of 1.0 Bcf/d will supply gas to local power utilities as well as exports to Arizona in the US. The natural gas will be sourced from Indonesia and, possibly, Sakhalin, Russia. There are two other LNG terminal projects in progress, i.e. Sonora Pacific LNG and Manzanillo LNG, both located on the Pacific coast. As LNG supply is getting tied up in the Asia Pacific region, securing the supply source is the underlining challenge for these projects. Manzanillo terminal would be sourced from Peru LNG.

POWER SECTOR DEVELOPMENTS

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 2007-2016 was made in 2007. In this document, electricity demand is expected to grow rapidly over the next decade with an annual average growth rate of 4.8 percent. From 2007 to 2016, Mexico will need to add approximately 22,737 MW of generation capacity. It is expected that the greatest share of this additional capacity, 51 percent, will be met by combined-cycle technologies. The investment needed for the electricity sector for the period 2007-2016 is estimated by Mexico's Energy Secretariat to amount to US$64 billion, US$28 billion of which will be required for additional generation capacity and US$36 billion for additional transmission and distribution infrastructure. The funding for this expansion will predominately come from the Government's work budget.

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 period 2006-2014. Currently, Mexico has a total installed capacity of 87 MW. In 2006, La Venta II, the first large-scale wind power plant in Mexico (83 MW), began operations. 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.

Integrated Energy Services for Small Rural Communities (SIEPRCM): This project is coordinated by the Ministry of Energy with the joint participation of the Commission for the Development of Indigenous People and the World Bank. The program will bring electricity within the next 5 years to 50,000 rural households isolated from the national electric grid, in the states of Chiapas, Guerrero, Oaxaca and Veracruz.

Thermo-solar generation project: In October 2006, the World Bank approved a $49.35 million grant from the Global Environment Facility (GEF) for the installation of a new hybrid power plant (combined cycle + thermo-solar). The Solar Thermal Project Agua Prieta II plant will be located in Agua Prieta, State Sonora, with 480 MW (net) of thermal capacity and 31 MW (peak) of thermo-solar capacity. The plant is expected to reduce carbon-dioxide emissions by 391,270 tons of carbon dioxide over its 25-year lifespan.

ENERGY EFFICIENCY

Mexico does not have any specific law mandating energy efficiency programs and regulations. However, under the Federal Law on Metrology and Standards, the Secretary of Energy (SENER) was given a sanction to create mandatory energy efficiency standards. The National Commission for Energy Conservation (CONAE), a decentralised administrative body of the Energy Ministry, was founded to implement these energy saving measures. CONAE serves as a technical consultant for public federal administration entities, such as state and municipal governments, for issues of energy efficiency and renewable energies.

Green mortgages program: In January 2007, CONAE and the Mexican National Fund for Workers' Dwelling (INFONAVIT) launched the Green Mortgages Program. The program will establish financing mechanisms, such as loans and special mortgages, to promote the integration of energy efficiency and other green features in housing. The program will begin with a pilot project of 100,000 houses that are supported by INFONAVIT credits. The additional financing that INFONAVIT will provide these households is between six to eight thousand pesos, which is approximately USD 720.

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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 2005. GDP has grown by an average of around 3.3 percent per annum (1990-2004), reaching about US$91.15 billion in 2005 (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 2005, hydro, geothermal and wind resources currently meet around 64 percent of electricity demand.

Table 23 Key data and economic profile (2005)

Key data		Energy reserves*	
Area (sq. km)	268,680	Oil (MCM)**	49.8
Population (million)	4.10	Gas (BCM)	24.6
GDP Billion US$ (2000 US$ at PPP)	91.15	Coal (Mt)	571
GDP per capita (2000 US$ at PPP)	22,238		

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 2005 was 17,625 ktoe. A variety of energy sources are used to meet these needs comprising of oil (39 percent), gas (18 percent), hydro (11 percent), coal (11 percent), geothermal & solar (15 percent), and others (5 percent). Self-sufficiency in 2005 was 73 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 2005, self-sufficiency had continued to decline to 16 percent. 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.

In terms of power generation, in 2005 New Zealand generated 42,909 GWh, which was almost same level as the previous year. Around 64 percent of generation was from hydro and renewable resources. Hydro at 55 percent was the most important source of generation. Thermal generation showed a increase of 29 percent to 15,290 GWh compared with the previous year increasing. 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 44 percent of electricity consumption in 2005. The residential sector consumed around 35 percent with the commercial sector consuming the balance of 21 percent.

Table 24 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	12,916	Industry Sector	2,627	Total	42,909
Net Imports & Other	4,922	Transport Sector	5,627	Thermal	15,290
Total PES	17,625	Other Sectors	4,480	Hydro	23,470
Coal	2,003	Total FEC	12,735	Nuclear	0
Oil	6,819	Coal	486	Others	4,149
Gas	3,195	Oil*	6,795		
Others	5,608	Gas*	1,365		
		Electricity & Others	4,088		

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 decreased by 5.2 percent in 2005 to 12,735 ktoe compared with the previous year. The industrial sector consumed 21 percent of energy used, the transportation sector 44 percent and other sectors 35 percent. In 2005 final energy consumption was dominated by oil, comprising 6,795 ktoe (53 percent), followed by gas 1,365 ktoe (11 percent), coal 486 ktoe (4percent) and 4,088 ktoe (32 percent) for electricity and others (heat etc).

With the exclusion of international transportation, domestic transport is the main consumer of petroleum products, accounting for 82 percent of the total oil consumption in 2005. Consumption in the other sectors was shared between agriculture (4 percent), industrial (10 percent), commercial (3 percent) and residential (1 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 has been prepared under the auspices of the Ministry of Economic Development (MED), and a final report was released in October 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 16 percent in 2005. 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 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.

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

NOTABLE ENERGY DEVELOPMENTS

NEW ZEALAND ENERGY STRATEGY (NZES)

The final publication "New Zealand Energy Strategy to 2050-Powering Our Future" was released in October 2007 along with the New Zealand Energy Efficiency and Conservation Strategy (NZEECS).[53] The strategy focuses on key questions for the energy sector to identify the strategic directions and priorities in the face of uncertain future events and developments. The strategy also provides policy measures and government's initiatives, which are discussed under six broad chapter headings as follows:

1. Resilient, low carbon transport

The government has made in-principle decisions to set a target of halving domestic transport emissions per capita by 2040, and for New Zealand to be one of the first countries to widely deploy electric vehicles.

2. Security of electricity supply

3. Low emissions power and heat

The renewable electricity target is to increase the proportion of electricity generated from renewable sources to 90 per cent (around 70 per cent at present) by 2025.

4. Using energy more efficiently

5. Sustainable energy technologies and innovation

New Zealand needs to keep up to date with international research into emerging technologies and practices, particularly in relation to vehicles, CCS and renewables.

6. Affordability and wellbeing.

NATIONAL ENERGY OUTLOOK TO 2030

The final-publication edition of "New Zealand's Energy Outlook to 2030" was released in November 2006. Under the base case "business as usual", by 2030 New Zealand's energy demand is expected to be about 35 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" 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[54].

53 The final publication available at http://www.med.govt.nz/templates/MultipageDocumentTOC____31948.aspx

54 Final publication available at http://www.med.govt.nz/upload/38641/eo-2006-final.pdf

ENERGY EFFICIENCY

In June 2007 the Government announced the EnergyWise Homes package which sets out a range of programmes designed to help people live in warm, dry, healthy homes that are energy efficient and better for environment.

Increased funding is allocated to new and existing government programmes such as the solar water heating programmes, home insulation and clean heating retrofit programmes, and the review of the Building Code.

The main elements in the package are:

- An interest-free loans scheme to help homeowners pay for energy efficiency and clean heating upgrades.
- The trial implementation of a Home Energy Rating Scheme, as a tool to measure the energy efficiency of a house and provide this information to home buyers.
- Funding to maintain the current rate of 12,000 annual energy efficiency retrofits for low-income households under the EnergyWise Home Grants programme.
- Funding for increased research on energy efficient technologies, partnering with industry to promote these technologies and develop new funding mechanisms, providing support for businesses that supply or install energy efficient technologies, and providing support for councils to implement the new Building Code and promote energy efficiency to households.
- An information campaign to provide consumers with clear, practical advice on actions they can take to improve the energy efficiency of their homes, and the benefits of doing so.

While the main focus of the package is on energy efficiency, it also contains elements to address environmental issues such as air quality.

EMISSIONS TRADING SCHEME

In late 2006 New Zealand released for public consultation a number of discussion documents on possible directions for climate change and sustainability. These documents cover a wide range of policy options to achieve New Zealand's overall climate change objectives. The options included emissions trading, a narrowly based carbon tax, incentives, subsidies, direct regulatory measures, and voluntary approaches.

The feedback showed broad – although not universal – support for the use of emissions trading as the preferred approach for reducing emissions in the long run. In response to this consultation, the government has decided in principle that New Zealand will adopt an emission trading scheme (ETS), rather than an emissions tax, as its core price-based measure for mitigating climate change, alongside other policies and measures to reduce overall domestic emissions.

In September 2007, the New Zealand government released Framework for a New Zealand Emissions Trading Scheme. Over the next few months, the New Zealand government intends to consult on the framework for an economic-wide emissions trading scheme that is likely to, over time, include all sectors and all greenhouse gases.[55]

[55] Further information on New Zealand's emission trading scheme is available at http://www.climatechange.govt.nz/nz-solutions/trading-scheme-reports.shtml

PETROLEUM EXPLORATION

In 2006 the Government released a blocks offer for permits to explore the Great South Basin. Recent data indicates that Great South Basin may have the greatest petroleum volume potential of all New Zealand's basins. A large number of companies from around the world took interest up to the final stages of the tender round.

In July 2007, Petroleum Exploration Permits were awarded to the following investors:

- A consortium led by ExxonMobil New Zealand (Exploration) Limited (USA) which includes local company Todd Exploration Limited (New Zealand). The block awarded comprises approximately 20,000 square kilometres, and is located 100 kilometers from shore in a water depth of 500 to 1000 meters.
- A consortium led by OWV New Zealand Limited (Austria) which includes PTTEP Offshore Investment Company Ltd (Thailand), Mitsui Exploration and Production Australia Pty Ltd (Japan) The blocks awarded comprise approximately 540,000 square kilometers.

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 result was a report that identified the demand restraint options that New Zealand could employ during an emergency disruption of oil supplies.

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.

OIL STOCKS

A statement of an agreement with Japan on oil stock holding was issued in the margins of the East Asia Summit Energy Ministers Meeting which was held in Singapore in August 2007. The agreement would complement existing arrangements that New Zealand has with the governments of Australia, the Netherlands and the United Kingdom. The statement affirms that both governments:

- Intend to initiate a discussion regarding an agreement Between Japan and New Zealand regarding bilateral cooperation on petroleum stocks;
- Express their expectation that the bilateral cooperation will help New Zealand to meet its 90 days oil stock holding requirement as a member of the IEA;
- Expect that this cooperation will provide a positive model for the energy cooperation among economies in East Asia.

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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$2,280) is 6.2 percent higher than previous year at US$2,146. In 2005, real GDP at 2000 US$ at PPP was estimated at US$13.42 billion, which increased by 8.3 percent compared to the previous year which was at US$12.39.

PNG's primary energy use per capita at 0.3 toe is far below the APEC average of 2.35 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 (2005)

Key data		Energy reserves*	
Area (sq. km)	462,840	Oil (MCM) - Proven	63.6
Population (million)	5.89	Gas (BCM)	430
GDP Billion US$ (2000 US$ at PPP)	13.42	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	2,280		

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 2005, PNG's net primary energy supply was 1,786 ktoe, a increase of 28 percent compared with 2004. Light crude oil and petroleum products accounted for 89 percent, gas 7 percent while hydro and other fuels, the remaining 4 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 crude oil production started in 1992 and peaked at over 150,000 bbl/day the next year. However since then, the production has been declining in spite of the exploration activities resulting in some additional oil fields developments. The oil production in 2005 is 47,000 bbl/day from three oil fields. With the commissioning of its first refinery plant (Napanapa Oil Refinery of InterOil) 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's total proven and probable gas reserves are over 14TCF, half of which constitutes 1P reserves (proven). Much of these reserves are undeveloped, except for the Hides Gas Field which is supplying about 14-15 MMSCF per day of natural gas power generation to supply electricity to the Porgera Gold Mine in the central highlands of PNG. The Hides gas fields has about 4TCF of proven gas reserves.

In the mean time, ExxonMobil and co-ventures are targeting the Hides fields plus a string of other gas and associated fields to develop PNG's first LNG project. Under the proposal, ExxonMobil will build an LNG plant with an annual production capacity of 6.3 million tonnes (2 trains) and aim to deliver the first sales in 2013.

Front End Engineering Design (FEED) decision on this project is expected to be announced in the first quarter of 2008.

Table 26 - Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	2,651	Industry Sector	673	Total	3,805
Net Imports & Other	-865	Transport Sector	387	Thermal	2,914
Total PES	1,786	Other Sectors	116	Hydro	891
Coal	-	Total FEC	1,176	Nuclear	-
Oil	1,589	Coal	-	Others	-
Gas	120	Oil	867		
Others	77	Gas	-		
		Electricity & Others	309		

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 2005, PNG had generated 3,805 GWh of electricity (a 10 percent increase from 2004). 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 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 are still been reviewed by the PNG Government Task Force on Policy.

The Electricity Industry Policy [EIP] has been completed basically to introduce competition in the electricity industry. The policy document will be endorsed to the National Executive Council [NEC] for approval by 2008.

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

A number of international companies are showing their great interests in investing in the PNG's upstream oil and gas sector for the first time in many years. By the end of 2007, the total number of petroleum prospecting licenses (PPLs) reached 37 compared with 17 in 2003. In 2005, 10 new PPLs weren't granted by the Government to oil companies. Additional 17 applications for PPLs are currently under screening by the regulator.

The surge in the interest has been principally attributed to two factors. The PNG Government's introduced internationally competitive fiscal incentives in November 2002 to attract oil exploration. A key component of these incentives is to reduce tax rate from 45 percent to 30 percent.

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 those retail and distribution assets owned by Shell PNG Limited in PNG upon Government's approval.

LNG PROJECTS

Three LNG projects are under planning stage.

For the last several years, Oil Search Ltd and British Gas have been evaluating an LNG project. The possible plant annual production capacity is 3.5-7 million tonnes, with feed gas being sourced from Kutubu/Gobe/Moran oil fields associated gas. Oil Search is an operator of these oil fields.

In April 2007, ExxonMobil, Santos and Oil Search signed an agreement for a detailed pre-front end engineering and design (FEED) study on a LNG project. The proposed plant annual production capacity is 5-6.5 million tonnes, and feed gas is sourced from Hide/Juha/Angore gas fields. The reserves of these gas fields are estimated at 8-9 TCF. A front end engineering design study is projected to start at the end of 2007 or early 2008, with a target to start production in 2013. ExxonMobil is an operator of these gas fields.

In July 2007, InterOil, Merrill Lynch Commodities, Inc (a wholly owned subsidiary of Merrill Lynch & Co., Inc) and Pacific LNG Operations Ltd (an affiliate of Clarion Finanz AG) signed an agreement for the development of an LNG project. The possible plant annual production capacity is 4-9 million tonnes and feed gas is sourced from Elk/antelope gas fields. InterOil is an operator of these gas fields and also operates an oil refinery (capacity 32,000 barrel per day) in Port Moresby.

On the other hand, the PNG Gas Project of delivering natural gas to Australia through an underwater pipeline was suspended in January 2007, with alternative gas developments options like LNG or Petrochemical projects being highlighted as a means to maximize the long-term value of PNG gas resources. The gas commercialisation projects under consideration include dimethylether (DME), methanol and urea/fertilizers plants, which are envisioned to be constructed at the Konebada Petroleum Park in Port Moresby.

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Mining and Petroleum Sector Update 2006

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 27.97 million people are spread over an area of 1.28 million square kilometres, 73 percent of which live in urban areas. 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 2005 was US$150.27 billion while GDP per capita was US$5,373 (both in 2000 US$ at PPP). In the same year, the real gross domestic product (GDP) grew at 6.5 percent, up from 5.2 percent in 2004. Overall real GDP growth is projected to remain favourable in 2006, at around 8.0 percent, with mineral exports, construction, and the long-expected Camisea energy project driving Peru's economy.

Peru is currently a net importer of energy. In comparison to 2004, Peru increased its primary energy imports by 13.8 percent. Crude oil comprised the largest share of the total energy imported, at 88 percent, since domestic crude is not of adequate quality to use as a refinery feedstock. The remainder of Peru's energy imports consist of coal. Its proven energy reserves in 2005 included 60.31 MCM of oil, 337.91 BCM of gas and 49.9 Mt of coal.

Table 27 Key data and economic profile (2005)

Key data		Energy reserves*	
Area (million sq. km)	1.28	Oil (MCM) – Proven*	60.31
Population (million)	27.97	Gas (BCM) – Proven*	337.91
GDP Billion US$ (2000 US$ at PPP)	150.27	Coal (Mt) - Proven*	49.9
GDP per capita (2000 US$ at PPP)	5,3723		

Source: Energy Data and Modelling Center, IEEJ.

* 2005 data from Ministry of Energy and Mines, Peru.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Peru's total primary energy supply (TPES) in 2005 was 11,127 ktoe, growing slightly from a TPES of 11,016 ktoe in 2004. Oil remained the largest share of TPES (59 percent), while the share of gas grew from 8 percent in 2004 to 20 percent in 2005. Coal's share in 2005 remained constant at 8 percent, contributing 928 ktoe to TPES.

The increase in TPES primarily resulted from the enhanced production of natural gas and liquids. This large increase in natural gas production, approximately 168 percent from 2004, was due to the coming on stream of the Camisea natural gas field in August 2004. The Camisea field, one of the largest fields in South America to begin upstream operations, 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.

Peru has the potential to produce much more gas than it does currently as domestic gas demand and gas export markets grow. Specifically, the power generation and industrial sectors are expected to be major gas consumers.

In contrast, over the past few years, crude oil production has been declining because of a decrease in the yields coming from existing operational wells. Although production has been declining, the number of wells drilled has increased from 34 in 2004 to 43 in 2005[56]. Current production areas are located in the northern jungle along the Ecuador border, north eastern and central Peru, and offshore. Offshore production, which consisted of an initial production of 1,200 bbl/d, commenced in 2005 when Petro-Tech announced Peru's first offshore oil discovery. In order to increase production to 11,000 bbl/d, Petro-Tech plans to drill additional wells and to extend its offshore exploration. Overall, the current administration continues to take several measures, including holding oil licensing rounds, to attract more investors.

Peru decreased its energy imports by 25 percent, from 3,795 ktoe in 2004 to 2,838 ktoe in 2005. These imports comprised 26 percent of its energy requirements and consisted of mostly oil from Colombia, Ecuador, Venezuela and Nigeria.

Table 28 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	8,064	Industry Sector	3,454	Total	25,510
Net Imports & Other	2,838	Transport Sector	3,491	Thermal	7,453
Total PES	11,127	Other Sectors	2,026	Hydro	17,977
Coal	928	Total FEC	8,971	Nuclear	0
Oil	6,240	Coal	591	Others	80
Gas	2,221	Oil	6,299		
Others	1,739	Gas	179		
		Electricity & Others	1,902		

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 6,016 MW in December 2004 to 6,201 MW in December 2005. Hydropower with a 52 percent and thermal with a 48 percent share almost equally account for all of the electric generating capacity. However in 2005, hydropower produced 70 percent of the electricity and thermal plants produced the remaining 30 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 2005, of the 25,510 GWh of electricity generated in the economy, 98 percent was delivered through the SEIN and the remaining 2 percent was delivered through several smaller isolated systems (SSAA).

Of all electricity traded in 2005, 54 percent was traded in the regulated market and 46 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.

[56] World Oil Magazine

FINAL ENERGY CONSUMPTION

In 2005, final energy consumption in Peru amounted to 8,971 ktoe, of which, the transport sector consumed 39 percent, industry sector 38 percent and other sectors 23 percent. Petroleum products dominated end use consumption, accounting for 70 percent of demand in 2005, a decrease of 3 percent from 2004. The share of electricity from final energy consumption was 21 percent. Coal accounted for 7 percent while gas was less than 1 percent.

POLICY OVERVIEW

ELECTRICITY MARKET

Peru's economy is becoming more market-oriented. 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, which allowed for the privatization of the electricity sector in terms of power generation, transmission, and distribution, was established in 1992 in order to help promote competition and efficiency within the sector. 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. Even with the passage of the above laws, the Peruvian government still retains a significant position within the electricity sector. 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.

There currently exists a free electricity market in Peru; however the government acknowledges that there are barriers that impede the efficient running of this market. As such, in July 2006 the Government elaborated on the rules established in the Law of Electrical Concessions with the purpose of:

i. Ensuring the supply of "sufficient efficient generation" so as to reduce the economy's exposure to price volatility and help assure the final consumer a more competitive electrical tariff;

ii. Reducing the administrative intervention for the determination of the prices of generation by means of market solutions;

iii. Taking the necessary measures to create effective competition in the generation market; and,

iv. Introducing a mechanism of compensation between the SEIN and the Isolated Systems so that the prices incorporate the benefits of natural gas production and reduce their exposure to the volatility of the fuel market.

In this context, the Government has enabled 1) the introduction of biddings and incentives for the optimal supply of electrical energy, 2) the establishment of a spot market, 3) the modification of functions held by the Comite de Operacion Economica del Sistema (COES) with the purpose of forming an independent operator for the electricity system, and 4) an adjustment of the legal framework corresponding to the formation of transmission prices.

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. As a result, exploration contracts have been increasing from solely 29 exploration contracts that were still in force in 2005 to 61 exploration contracts in 2006.

ENHANCING ENERGY SECURITY

Increasing energy imports, combined with depleting domestic resources, have raised concerns over energy supply security within Peru. As such, the government is promoting the utilisation of natural gas in order to reduce oil import dependency. The new fuel mix that will include natural gas as an integral element is being undertaken in accordance with the "Plan Nacional de Transformación de la Matriz Energética".

In addition, the Government has begun the promotion of biofuels prioduction. In the coastal and forest regions of Peru, suitable soil and climatic conditions exist for the development of crops that provide the volumes of adequate raw material to produce both anhydrous ethanol and biodiesel. As such, legislation related to the introduction of biofuels, specifically *Ley 28054 de Promoción del Mercado de Biocombustibles,* has been passed. The goal of this legislation is to promote investment in the production and commercialization of biofuels; and 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.

NOTABLE ENERGY DEVELOPMENTS

NATURAL GAS ADVANCES ATTRIBUTED TO THE CAMISEA GAS PROJECT

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. The Camisea gas project alone is expected to deliver between 250-729 million scfd of natural gas and 70,000 B/D of condensate by 2015. As such, the enhancement of natural gas reserves from these fields is expected to make Peru a regional gas exporter, with potential customers in Mexico and the western US. This potential drew the PERU LNG Consortium to implement their project. In 2006, Enginering, Procurement & Construction (EPC) contract for the project was awarded to Chicago Bridge & Iron Company. The entire project is expected to take 4 years to complete.

This LNG facility is expected to deliver its first exports in 2010, with its operating capacity of 4.2 million tons per year. The initial investment to build the plant was between 1,600 and 2,000 million dollars. Repsol YPF, which entered into the LNG Company, reached an agreement to buy all the production from the 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.

The government, in cooperation with the private sector, is also carrying out an aggressive plan to expand gas utilisation in Peru so as to create 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 addition, it is expected that Peru will create natural gas pipeline interconnections with surrounding economies such as, Brazil, Uruguay, Paraguay, Argentina, Chile, and Bolivia.

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 56 kilometre transmission line has been 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.

RURAL ELECTRIFICATION

Within the framework of the National Rural Electrification Program of Peru, which is coordinated by the Ministry of Energy, the government aims to reach a goal of 91 percent electrification coverage of rural household's by 2012, and improve the electric generation systems for isolated rural communities. The intention of this plan is to contribute to the economy's sustainable socioeconomic development, improve the quality of life within the population, and to deter the migration of people from rural regions to cities. The government has assumed a subsidiary roll in the execution of the Rural Electrical Systems and the participation of regional and local governments is expected to be carried out in direct consultation or coordination with the Ministry of Energy and Mines.

In order to ensure the program's effectiveness, the projects that correspond with the PNER are subject to a technical and economic evaluation in order to guarantee that they achieve social gains and long term administrative, operative, and financial sustainability. For this, the Ministry of Energy and Mines will coordinate and offer technical expertise to the regional and local governments, in addition to other organizations. Short-term plans will be developed and will include projects that can be developed, within corresponding budgetary limits, by the national, regional, and local governments and the private sector.

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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 kilometers of land, which is carved out into an archipelago of 7,107 islands and islets. The total population in 2005 was 83.05 million and more than half of the population lives in Luzon, the largest among the three major island groups in the Philippines.

Between the period 2000 to 2005, the economy's Gross Domestic Product (GDP) grew by 1.85 percent to reach US$ 379.61 billion (2000 US$ at PPP) in 2005. GDP per capita likewise experienced an improvement reaching US$ 4,571 (1995 US$ at PPP) in 2005 compared with US$4,431 (1995 US$ at PPP) in 2004.

The Philippines' indigenous energy reserves are relatively small with only about 24 million cubic meters (MCM) of crude oil, 107 billion cubic meters (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 (2005)

Key data		Energy reserves*	
Area (sq. km)	300,000	Oil (MCM) – Proven	24
Population (million)	83.05	Gas (BCM) – Proven	107
GDP Billion US$ (2000 US$ at PPP)	379.61	Coal (MMt) –Recoverable	399
GDP per capita (2000 US$ at PPP)	4,571		

Source: Energy Data and Modeling Centre, IEEJ. *Philippine Department of Energy

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2005, the total primary energy supply (TPES), excluding traditional biomass fuels, amounted to 31,999 Mtoe. The economy imports 17,814 (or 55.7 percent) of the total energy supply; the remainder was supplied through domestic production of indigenous resources, at 14,031 Mtoe. The main energy sources were oil (46 percent), others (29 percent), coal (16 percent), and gas (8 percent). Gas production increased from 2,059 ktoe in 2004 to 2,683 ktoe in 2005. Oil production also increased from 478 ktoe in 2004 to 610 ktoe in 2005. As for coal, most of the economy's total coal requirements are supplied through imports, however, coal production improved from 1,310 ktoe in 2004 to 1520 ktoe in 2005.

In 2005, electricity generation reached 56,597 GWh. Thermal generation, mostly from natural gas, fuel oil and coal, accounted for 68 percent of total electricity production, followed by hydropower (15 percent) and others (17 percent).

FINAL ENERGY CONSUMPTION

In 2005, total final energy consumption in the Philippines was 17,750 Mtoe. The transport sector consumed 48 percent of this total, while the industrial sector and other sectors (agriculture, residential/commercial and non-energy) each accounted for about 26 percent. By energy source, petroleum products contributed the largest share with 71 percent of consumption followed by electricity (22 percent), and coal (7 percent).

The 2005 Philippine Energy Plan 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 38 percent share. Electricity, coal and natural gas will post an average share of 15 percent, 3 percent, and 2 percent, respectively.[57]

Table 30 Energy supply and consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	14,031	Industry Sector	4,583	Total	56,597
Net Imports & Other	17,814	Transport Sector	8,452	Thermal	38,260
Total PES	31,999	Other Sectors	4,715	Hydro	8,387
Coal	5,230	Total FEC	17,750	Nuclear	-
Oil	14,847	Coal	1,208	Others	9,950
Gas	2,683	Oil	12,625		
Others	9,239	Gas	0		
		Electricity & Others	3,917		

Source: Energy Data and Modeling Centre, IEEJ.

For full details of the energy balance table see http://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 of energy self-sufficiency and an efficient and globally competitive energy sector. The Philippine Energy Plan was further updated in 2007 and the major issues covered by the update include:

ENERGY SELF-SUFFICIENCY

The government targets a 60 percent energy self-sufficiency level by 2010 and to maintain this level through 2014 (In 2006, it is 56 percent). In order to achieve this target, the government is aiming to increase oil and gas resources by 20 percent, increase indigenous coal production to meet local demand and increase RE-based capacity. Furthermore, the use of alternative fuels will be increased and energy efficiency and conservation programs will be strengthened.

Indigenous crude oil production in 2006 was 0.18 million barrels, which account for only 5 percent of the economy's crude oil requirement. On the other hand, local natural gas production reached 108,606 million cubic feet of gas, which is now self sufficient. The most of the gas is

[57] The Philippine Energy Plan 2005-2014

produced from Malampaya gas field, which also produces condensate with output reaching 5.1 million barrels for the year.

The government is actively promoting the intensive upstream exploration and development through the Philippine Energy Contracting Round (PECR). The Philippine National Oil Company PNOC) has historically dominated the economy's oil sector, however, market reforms beginning 1998 aimed at deregulating the oil industry have brought many new oil companies to the Philippines. PNOC remains the primary player in upstream oil market activities, although it frequently partners with foreign companies on its major projects. The principal government agency charged with monitoring the energy sector, including oil, is the DOE which holds responsibility for issuing exploration and production licenses and ensuring compliance with relevant regulations.[58]

The Philippines has about 19 coal districts that contain significant coal deposits. Total coal resources in these areas are estimated at about 2.3 billion metric tons. In 2006, the economy's in-situ reserves stood at 323.3 MMt, registering a 3.0 percent increase from its 2006 target of 313.2 MMt. This is mainly due to the exploration activities conducted by the new coal exploration contractors of the DOE.

Among the renewable energy fuels, geothermal resource contributed the biggest share of indigenous energy of about 9.0 Mtoe in 2006. Harnessing geothermal energy remains a primary goal to support the economy's goal of becoming the largest producer of geothermal energy in the world. Aside from the existing programs in geothermal energy development, the government will also pursue optimization of geothermal energy using the cascading scheme of development through the project study on: *"Resource Assessment of Low-Enthalpy Geothermal Resources in the Philippines"*. This will be implemented for a five-year period to commence in 2007. The project aims to promote and accelerate the development of small and low enthalpy geothermal resources in the Philippines through the conduct of detailed geo-scientific investigations, socio-economic and environmental baseline studies.

The economy's total installed capacity from hydropower reached 3,257 MW in 2006 which represents 61.9 percent of the total RE capacity. The government identifies 70 hydropower projects with a total potential capacity of 2,603.5 MW. This is composed of 34 large hydropower projects, 27 mini-hydropower projects and nine micro-hydropower projects. In addition, there are 14 mini-hydropower projects with completed feasibility studies which are estimated to provide an additional 237.56 MW to the economy's existing hydropower capacity.

To further develop hydropower as the mainstay of the economy's power generating options, the government is currently pursuing: (i) to obtain greater private sector participation in the development of hydropower; (ii) to allow PNOC to take up to 20.0-percent stake in all its proposed hydropower projects to attract private investors to participate in the project; (iii) for the passage of the RE bill that will provide incentives to developers of hydropower; and, (iv) to administer R.A. 7156[59].

To promote the wide scale use of other RE sources, about 707 MW of generating capacities from biomass, wind and solar energy sources are identified for possible development. About 551 MW will come from wind power projects and the balance of 156 MW will be from biomass and solar.

On the alternative fuels development, the Biofuels Act was promulgated in 2006. The government has implemented a mandatory blending of 1 percent biodiesel in all diesel-fed vehicles in May 2007 to reach 2 percent biodiesel blend by 2009. The 1.0 percent mandated blend would correspond to a total of 78.8 million liters of diesel fuel displacement in 2008, while the 2.0 percent biodiesel blend is expected to displace a total of 163.9 million liters of diesel fuel to reach 198.4

[58] EIA, *Economy Analysis Brief* for the Philippines.

[59] The Philippine Mini-hydropower Law which promotes the development of mini-hydropower projects through the provision of incentives and the necessary environment.

million liters by 2014[60]. Meanwhile, an economy-wide mandatory blending of 5 percent bioethanol in all gasoline-fed vehicles will start in 2009 to reach 10 percent by 2011. The implementation of the 5.0 percent mandatory blend of bioethanol in 2009 would displace a total of 222.9 million liters of gasoline fuel, while the 10.0 percent blend would result in displacement of a total of 482.3 million liters in 2011 to reach 537.2 million liters by 2014[61].

Meanwhile, in April 2006, the DOE issued a policy directive which aims to ensure a unified and coordinated effort in establishing a successful and robust natural gas industry. To continue its tie-up with the CNG-NGV industry at the international level, the DOE renewed its membership with the Asia Pacific Natural Gas Vehicle Association (ANGVA) in February 2006. Coordination meetings are also continuously being held with the accredited bus operators[62] for regular updates on the program.

It is also targeted through the National Energy Efficiency and Conservation Program that the average energy savings during the planning period will reach 25.7 Mtoe[63].

EFFICIENT AND GLOBALLY COMPETITIVE ENERGY SECTOR

The energy conservation efforts of the government generated energy savings of about 0.88 MTOE with equivalent carbon dioxide (CO_2) emission avoidance of 2.1 MMt in 2006. This includes savings accounted from the energy management activities conducted by DOE such as the *spot check* program of government agencies nationwide and the continuing energy standards and labeling program and the conduct of energy audit of various commercial and industrial establishments.

The actual quantification of savings derived from the various energy efficiency measures and activities undertaken by the end-use consumers is now the subject of an ongoing study by the government which seeks to formulate a more effective monitoring mechanism of energy savings.

The continued implementation of the government's energy efficiency and conservation program is expected to yield an estimated savings of 7.5 MMBFOE (1.08 ktoe) in 2010 and up to 9.1 MMBFOE (1.31 ktoe) by the end of the planning period.

For the energy labeling and efficiency standards program, the DOE will look into a minimum of 15 percent increase in the average efficiency ratings of new appliance models within the planning period. This program is also expected to generate the biggest contribution of energy savings from 6.7 MMBFOE (0.97 ktoe) in 2010 to reach 8.1 MMBFOE (1.17 ktoe) in 2014. To realize this target, the government will:

[60] Computations are based on DOE (PEP 2006 Update) demand projections for diesel and the biodiesel mandatory blending requirements.

[61] Computations are based on DOE (PEP 2006 Update) demand projection for gasoline and bioethanol mandatory blending requirements.

[62] NGVPPT Accredited Bus Operators: HM Transport Inc., RRCG Transport System Inc., KL CNG Bus Transport Corp., Paradise Transport Corp., BBL Transport System Inc., Greenstar Express Inc., CNG Vehicles Corporation

[63] PEP 2006 Update.

Pursue the standardization of technical specification requirement in the procurement of energy efficient lighting systems and other electrical equipment and devices in government offices (e.g. the use of 32-watt instead of 40-watt CFLs and the use of energy-efficient LCD computer monitors).

Formulate a benchmark in government buildings (in Kwh/m^2 subject to the age of building, usage/function, height/number of floors and floor area, among others), which will serve as reference in managing energy consumption.

Promote a market-based application under the *Demand Reduction Program* in the absence of utility-based demand-side management (DSM).

Strengthen product testing and research through the establishment of a lighting testing facility using a goniophotometer to determine and recommend better efficient lighting designs for office buildings and street lighting.

Conduct of inventory of legitimate and accredited testing laboratories to encourage the private sector to venture into setting up of independent and competent testing laboratories.

Review and formulate policies and guidelines on the disposal of mercury-containing lamp wastes.

The economy's continuing reforms in the power sector and the downstream oil and gas industries are expected to provide an efficient and globally competitive energy sector. In an effort to reform the energy sector, the government will continue to create a transparent privatization process of the government's generation and transmission assets and enhance the investment climate for greater private sector participation. Thus, the government has devised ways to improve the conditions of the generation and transmission assets like allocating supply contracts for all generating capacities for privatization and expanding the network of investors to generate more interest and competition. The privatization of the transmission asset is the economy's biggest privatization effort thus far.

To counter the impact of increases in the price of electricity, some measures will be enhanced including: (i) energy conservation and demand side management, (ii) the National Power Corporation's (NPC's) internal efficiency measures, (iii) economic dispatch, (iv) time-of-use pricing, and (v) implementation of the wholesale electricity spot market (WESM) and working towards open access to provide economic price signals, power of choice, market-based and retail competition.

As for the developments on the Electric Power Industry Reform Act (EPIRA), there are many initiatives that are pursued and will continuously be pursued, among others: (i) commercial operation of the WESM, (ii) privatization of NPC generating assets, (iii) privatization of the TransCo transmission assets and its concession, (iv) implementation of retail competition and open access, (v) administration of universal charge for missionary electrification and environmental charge for the preservation of the environment, and (vi) loan relief of electric cooperatives' (EC's) loans.

The government also targets 100 percent barangay (village) electrification by 2008 and will continue to energize small pockets of communities (sitios) to achieve the target of 90 percent household electrification level by 2017.

Meanwhile, the deregulation of the downstream oil industry through RA 8479 is introduced with the objectives of: (i) creating an environment that will promote competition in the downstream oil industry; (ii) creating a level playing field among industry stakeholders; and, (iii) promoting consumer welfare through more choices and better products and more reasonable prices of oil and oil-derived products. The DOE ensures the reasonableness of domestic prices of petroleum products through international price monitoring, such as Dubai, Brent and WTI for crude and Mean of Platts Singapore (MOPS) for petroleum products. Corresponding adjustments

in domestic prices are estimated considering the movements in these international benchmarks and the foreign exchange.

NOTABLE ENERGY DEVELOPMENTS

OIL AND GAS

With the launching of the Philippine Energy Contracting Round (PECR), there is a resurgent interest among local and foreign investors on the economy's petroleum exploration activities. The economy now has 28 service contracts (SC). Four of these are approved under PECR 2005 and three negotiated SCs are firmed up in 2006. Work programs under these contracts have committed additional investments of about US$ 155.1 million and US$ 46.2 million, respectively.

The work program commitments for 2007 include exploration activities in three exploration wells:

- Singapore-based Premiere Oil to drill one exploration well in Ragay Gulf under SC No. 43
- Malaysia's Petronas Carigali Overseas Bhd. to drill one exploration well in offshore Mindoro. Petronas is the operator of SC 47 and its contract area covers at least 1,466.7 hectares;
- Japan Petroleum Exploration Philippines, Ltd. (JAPEX) to drill one exploration well over offshore Tañon Strait under SC 46.

In view of the positive results of the PECR on the petroleum sector, the DOE conducted another round of the PECR in December 2006. Nine areas are offered in the PECR 2006 covering 72,639 square kilometers (sq. kms.) for exploration and development. These sites are located in Central Luzon, Cagayan, Agusan-Davao, Mindoro-Cuyo and East Palawan basins. The DOE expects to award the PECR 2006 service contracts before the end of 2007.

Galoc oilfield, which is located off shore Northwest Palawan island at the water depth of 290 m, is now under development. The start of the production is expected in 2008, with initial rate of 15,000 BPD (estimated reserves is 16 million barrels). This is the first oilfield development in the Philippines in the last 15 years.

In October 2006, Forum Energy announced that a natural gas prospect at the Sampaguita field could hold up to 20 Tcf of possible natural gas reserves based on seismic data. The field was originally discovered in 1976 but never pursued because companies believed it to hold few reserves. Some industry analysts said that previous exploration work at Sampaguita field revealed a more likely range of 3.5 to 5 Tcf of natural gas reserves. Forum Energy plans to test drill at Sampaguita field in the future and if testing confirms substantial natural gas reserves, the company will reportedly consider a liquefied natural gas (LNG) project.[64]

COAL

As of May 2006, the economy has 38 active coal operating contracts (COCs) with development, production and exploration commitments. A new COC to develop and explore coal resources in Negros Occidental is issued in 2006. This is in addition to 15 COCs awarded to 11 local companies in 2005 for the exploration and development of coal areas in Southern Luzon, Cebu and Mindanao.

The economy's coal operating contractors produced 2.30 MMt or about 1.0 MMt less than the targeted 3.33 MMt. The reduced operation of the Semirara Mining Corporation due to maintenance and repair of its power plant, as well as man-made and natural occurrences such as mine accidents

[64] EIA, *Country Analysis Brief* for the Philippines.

in the coal mining areas of Cebu and Albay, and the damages brought about by typhoons during the last quarter of 2006 all contributed to the drop in production level.

GEOTHERMAL

In 2006 the share of geothermal energy in the primary energy supply increased to 22.8 percent from 21.5 percent in 2005. The completion of rehabilitation works for Mak-Ban and Tiwi geothermal power plants in the last quarter of 2005 resulted in the increased power capacities of 32.8 MW and 14 MW, respectively. In February 2007, the Philippine National Oil Company – Energy Development Corporation's (PNOC-EDC's) first merchant power plant – the 49.37 MW Northern Negros Geothermal Power Plant (NNGPP) – started its commercial operation providing additional power capacity for the Visayas grid and bringing the economy's geothermal generating capacity to 2,027.07 MW.

Potential capacity addition of 819.38 MW from geothermal resource could be developed until 2014. The Nasulo Geothermal Power Project in Palinpinon, Negros Oriental and the Mindanao III in Mt. Apo, North Cotabato are already committed and expected to be available in 2008 and 2011, respectively.

BIOMASS, WIND AND SOLAR

A total of 146.2 MW rice hull or bagasse-fueled co-generation projects are lined up through 2014. Initiatives from private sectors provided indication on the potential of biomass energy development in the economy. This is evidenced by the 12-MW Cogeneration Plant of JG Summit Holdings, Inc. in Negros Oriental endorsed by DOE to the Board of Investments for registration under the Omnibus Investment Code. Said cogeneration plant will use the bagasse generated from the sugar milling operations of the Kabankalan, Negros Occidental and Manjuyod, Negros Oriental sugar mills and refineries of Universal Robina Corporation, one of the subsidiaries of JG Summit Holdings, Inc.

Wind power is steadily gaining interest from the potential investors. Seven applications for Production-Sharing Contracts (PSC), such as Pre-Commercial Contract (PCC) and Pre-Negotiated Commercial Contract (PNCC), have been processed. The PCC covers the detailed wind resource assessment and feasibility study phase while PNCC covers the actual project implementation phase.

The Energy Logics Philippines Inc. will develop at least 100-MW wind power plants in the following areas in the economy: Morong (Bataan), Subic (Zambales), and Pasuquin (Ilocos Norte). The PNOC-EDC – the economy's leading geothermal energy developer – now ventures into the development of other RE sources through its application for a PSC with DOE for wind power development in Nagsurot, Burgos (Ilocos Norte) while another application by UPC Asia covers areas located at Burgos and Pagudpud both in Ilocos Norte. Moreover, 16 wind sites in different regions are promoted during the year with a total potential capacity of 345 MW.

On solar power development, 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. Most of the solar PVs are used to energize remote rural villages or for off-grid electrification under the government's Expanded Rural Electrification Program.

The 25-MW per year initial capacity of the Sunpower Solar Wafer Fabrication Plant was raised to 50 MW in 2005 and 108 MW in 2006. It is planned to gradually increase to 400 MW by 2010. The solar cell fabrication plant is the first large-scale solar cell facility in Southeast Asia which started operating in 2004. It is located in Sta. Rosa, Laguna where it manufactures high-efficiency photovoltaic cells.

ALTERNATIVE FUEL

R.A. 9367 [65] was signed on 12 January 2007, which provides the impetus for the full development and utilization of biofuels in the economy. The importance of biofuels was highlighted during the 24th ASEAN Ministers on Energy Meeting (AMEM) held in Vientiane, Lao PDR in July 2006. Emphasis was given on the need for closer cooperation and exchange of experiences among ASEAN countries in promoting the development, production and utilization of biofuels, including the relevant fiscal incentives, funding facilities and regulatory infrastructures. Similarly, the East Asia-ASEAN Declaration on Energy Security[66], acknowledged the significance of biofuels as one of the measures in realizing the common goals of Regional Energy Security.

As of end 2006, local CME production reached 111.9 million liters while sales of manufacturers/retailers reached 522,734 liters of pure CME and 42,309 liters of the CME blend (*B1*). The *B1* blend is commercially available in 38 stations of Flying V with the same price as pure petroleum diesel.

On bioethanol development, the introduction of *E10* (10 percent bioethanol blend) in the market is initiated by new industry players such as Seaoil and later, Flying V in at least four of its stations in Metro Manila. The Pilipinas Shell also launched the "*Shell Super Unleaded E10"* in 31 gasoline stations in Metro Manila with a 50-centavo *cheaper price than its regular unleaded gasoline* at the pumps. A major breakthrough in the program is the Php 1.0 billion investment commitment of Ford Philippines for the building of a flexible fuel engine plant in Sta. Rosa, Laguna. This is followed by the commercial launching of the first Ford Flexi-Fuel Vehicle (FFV) model in April 2006 to boost the economy's bid of becoming the ASEAN Center of Excellence for Flexible Fuel Technology. The FFV can run on regular gasoline or a blend of 85.0 percent ethanol (E85) and 15 percent gasoline.

As a result of the initial operation of CNG refilling stations, 70 CNG buses are expected to be on commercial operation in 2007, which increase to 200 in 2008 for the full pilot phase implementation. The number of CNG buses will reach a total of 3,000 in 2010 for the full implementation of the program. In addition, ten CNG refilling stations will be put up by 2010 and additional five CNG refilling stations by 2014.

To regulate the fast-growing autoLPG industry in the economy and protect the consuming public, the DOE issued D.C. No. 2007-02-0002[67] in February 2007. There is a growing demand for LPG use in the transport sector in view of the cheaper autoLPG prices as compared to conventional fuels. From nine dispensing stations, the number has abruptly increased to over 80 and continuously increasing, while the garage-based dispensing stations reached 35.

IMPLEMENTING POWER SECTOR REFORMS

The government's continuing efforts to advance the privatization of the NPC's generation and TransCo's transmission assets, notwithstanding several setbacks, demonstrate firm resolve to pursue the implementation of reforms in the power industry. The successful bid-out of the 112-MW Pantabangan-Masiway Hydroelectric Plant in Nueva Ecija in September 2006, the 360-MW Magat Hydroelectric Plant in Ramon Isabela in December and the 600-MW Masinloc coal-fired plant in Zambales in June 2007 resulted in a 24.8 percent privatization level of the economy's generation assets. The Power Sector Assets and Liabilities Management Corp. (PSALM) is set to launch more aggressive marketing efforts to further expand its investment base. It is also

[65] "An Act to Direct the Use of Biofuels, Establishing for this Purpose the Biofuels Program…" or the Biofuels Act of 2006

[66] The East Asia Declaration on Energy Security was espoused during the 12th ASEAN Summit in Cebu City in January 2007.

[67] *"Providing for the Rules and Regulations Governing the Business of Supplying, Hauling, Storage, Marketing and Distribution of LPG for Automotive Use"*

determined to increase the existing 24.8 percent privatization level to 50.0 percent by end-2007 and 70.0 percent by end-2008.

On the other hand, the Wholesale Electricity Spot Market (WESM) was commercially operated in Luzon in June 2006 signaling an important phase in promoting open access in accordance with the EPIRA. As of latest billing date for 2006 (25 December), the volume of electricity traded since its initial operation reached 21,513,788 MWh. There are 20 power generators and 15 customers who have applied as participants to WESM as of end 2006.

In power generation, the economy's self-sufficiency level increase to 66.0 percent in 2006 from 62.0 percent in 2005. Natural gas provided the largest contribution of 16,366 gigawatt-hours (GWh) or 29.0 percent of the total power generation while coal accounted for 27.0 percent.

The DOE continued to ensure the reliability of energy supply through the installation of new power plants and uprating of existing power projects. In the last months of 2006, the commissioning of the Mindanao 210-MW coal-fired power plant located in Villanueva, Misamis Oriental brought significant improvement in the power supply in the grid. To further boost this effort is the ongoing capacity uprating of Units 1 and 2 of Agus 6 Hydroelectric Power Plants. In February 2007, the PNOC-EDC inaugurated the 49.37-MW Northern Negros Geothermal Power Plant[68] located in Bago City, Negros Occidental.

PROMOTING THE DOWNSTREAM OIL INDUSTRY DEREGULATION

The downstream oil industry has been experiencing a steady growth eight years after the implementation of R.A. 8479[69]. As of December 2006, there are 622 new players engaged in the different activities of the downstream oil industry indicating a 2.9 percent increase from the 604 industry players in 2005. Total investment of independent players reached Php 30.74 billion in 2006, up by 8.2 percent from the 2005 level of PhP 28.4 billion.

To counter the effects of intermittent increases in the price of oil to the economy, the DOE ensured consumer protection and healthy competition among the industry players. As a safety net, the DOE issued and implemented for a six-month period (June to November 2006) Executive Order (E.O.) 527 *"Temporarily Modifying the Rates of Import Duty on Crude Petroleum Oils and Refined Petroleum products Under Section 104 of the Tariff and Custom Code of 1978 as Amended"*. The various oil players have also offered price discounts for diesel sold at the pump nationwide for the public transport sector.

NUCLEAR POWER PROGRAM

In collaboration with the Department of Science and Technology (DOST), the DOE is undertaking a review of scientific and technical options to revive the economy's nuclear power program. With nuclear viewed as one of the cheapest options in ensuring electricity supply, the joint DOE-DOST initiative will prioritize capability-building activities to develop the required local expertise. A comprehensive human resource development program is a vital component of a science-based approach to nuclear option. Training of young nuclear scientists and technical experts in various aspects of nuclear power is necessary through internship and scholarship grant from countries with advanced nuclear technology. It will also look into all possible measures to address emerging environmental issues and concerns consistent with the Philippine Sustainable Development Agenda. At the ASEAN level, prospects of nuclear energy as a future subject of regional cooperation are moderately in progress**.** The global development in nuclear power has already confronted the issues on nuclear safety and radioactive waste.

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[68] The plant is a critical installation for the Visayas Grid.

[69] The *Downstream Oil Industry Deregulation Act of 1998* which liberalize and deregulate the economy's downstream oil industry to ensure a truly competitive market under a regime of fair prices, level playing field and adequate and continuous supply of environmentally-clean and high-quality petroleum products.

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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 being very sparsely populated. Urban population accounts for 73 percent of the economy's total population. Since 1990 the permanent population declined from 148.4 million to 142.8 million as of 1 January 2006.

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. The recovery was triggered by the ruble devaluation in the aftermath of the 1998 financial crisis and its positive impact on the country's competitiveness. In parallel, it was increasingly driven by the soaring world prices of oil and natural gas. The Russian Oil Stabilisation Fund (OSF) was established in January 2004 with the purpose of (a) reducing the vulnerability of the state budget to the volatility of world oil prices (stabilisation function), and (b) decreasing the impact of oil-related foreign exchange inflows on the money supply and inflation (sterilisation function). By the end of 2006, the OSF had built up assets worth more than RUB 2.3 trillion (or 90 bln US dollars), which consist some 10 percent of Russia's 2006 GDP. Russia's economy is continuing to develop strongly and achieved the 8th year of positive economic recovery in 2006, reaching an average growth rate of 6.9 percent since 1999. GDP in 2005 was estimated at US$1,381 billion (at 2000 US dollars PPP) and inflation was 11.7 percent. The unemployment rate in 2005 was 7.6 percent.

In terms of proven reserves, Russia holds the quarter of world's gas, 7 percent of oil reserves and 17 percent of coal. Even more resources remain undiscovered. 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 some 45 percent of total energy produced being exported, the largest exporter of natural gas, and the second largest oil exporter. The energy sector is very important to Russia's economic development. In 2006, export of crude oil, petroleum products and natural gas accounted for 65 percent of the total economy's exports and approximately for 30 percent of GDP.

Table 31 Key data and economic profile (2005)

Key data		Energy reserves*	
Area (sq. km)	17,075,200	Oil (MCM) - Proven	12,640
Population (million)	143.1	Gas (BCM) - Proven	47,650
GDP Billion $ (2000 US$ at PPP)	1380.8	Coal (Mt) - Proven	157,010
GDP per capita (2000 US$ at PPP)	9,648		

Source: Energy Data and Modelling Center, IEEJ. * The BP Statistical Review of World Energy, 2007.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Russia's total primary energy supply in 2005 was 646.7 Mtoe, or 4.5 toe per capita, a level similar to that of Japan and Korea. This total is broken down into 54 percent of natural gas, 21 percent of crude oil and petroleum products, 16 percent of coal and 9 percent others including nuclear and hydro. However, 531 Mtoe of primary energy (27 percent of coal, 29 percent of natural gas, and 50 percent of oil), produced in Russia is exported, making it the top energy exporter in the world. Regionally export is overwhelmingly concentrated on Western and Eastern Europe (including the Commonwealth of Independent States), which accounted for more then 92 percent of Russia's total energy exports by destination. In attempts to secure its future ever increasing export flows, Russia is currently diversifying energy export routes towards Asia-Pacific regional markets, aiming to deliver coal, electricity, oil and natural gas to such APEC economies as China, Japan, and South Korea in the East Asia, and NAFTA region in the North America.

In terms of oil, in 2005 Russia produced 471.1 million tonnes of crude oil and gas condensate (NGL), where West Siberia, the main oil producing province, accounting for approximately 70 percent of total crude oil and NGL production. The exports of crude oil reach 233.1 million tonnes and additional 96.5 million tonnes of petroleum products, or respectively 49 percent and 62 percent of total production. 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.

Natural gas production in 2005 was reached 640.6 BCM. Net exports accounted for 187 BCM or 29 percent of production. About all of the natural gas exports were destined for Western and Central Europe, including Turkey, with small amounts piped to the Transkaukasian states - Armenia, Azerbaijan and Georgia. Huge but non developed resources of natural gas are located in remote regions and a lack of infrastructure prevents the start-up of upstream operations.

Russia produced 296 million tonnes of coal in 2005, where hard coals hold 75 percent. Coal exports reached 80 million tonnes, or 27 percent of production. The main coal production areas are Kuznetsky and Kansko-Achinsky basins, which are landlocked in the Asiatic part of Russia – some 4-6 thousands kilometres to the nearest coal shipping terminal destined either to the Atlantic or Pacific markets. Enormous prospective coal deposits have been found in even less developed and more remote areas of Eastern Siberia, South Yakutia and the Russian Far East. Russia produced 953 TWh of electricity in 2005, of which 66 percent by thermal power plants, 18 percent from hydro and 16 percent from nuclear energy.

Table 32 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	1 184,697	Industry Sector	136,601	Total	953,086
Net Imports & Other	-531,152	Transport Sector	94,850	Thermal	625,981
Total PES	646,730	Other Sectors	188,514	Hydro	174,604
Coal	103,338	Total FEC	419,965	Nuclear	149,446
Oil	133,616	Coal	17,934	Others	3,055
Gas	349,591	Oil	95,237		
Others	60,185	Gas	128,025		
		Electricity & Others	178,769		

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 2005, total final energy consumption in Russia was 420 Mtoe, a decrease of 1.2 percent compared with the previous year. Russia has the highest final energy intensity among APEC economies. By sector, industry accounted for 33 percent share, transport for 23 percent and other sectors for 44 percent. By energy source, coal accounted for 4 percent, petroleum products 23 percent, natural gas 30 percent and electricity, heat and others – 43 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 seems to become one of the major drivers for economy development. Measures to improve energy efficiency for existing industries along with increasing share of less energy intensive services and high technology industries are considered as a major energy policy issues. Russia has a huge untapped technical potential for energy savings ranging from one-third to almost half 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 secure domestic energy consumption, energy export obligations, and efficiency improvement along the whole energy supply chain. Among others instruments there are: energy pricing based on market approach, tax and custom policies. Russia will perform institutional reform in the energy sector by improving state positions in key areas – natural gas supply, nuclear energy development, and transportation of energy by pipeline mode.

The main pricing policies considered in the "*Energy Strategy of Russia to 2020*" include:

- Gradual expansion of the application of market pricing for fuel and energy within domestic and export energy markets;
- Provision for the financial stability and improving the investment attractiveness of the energy business.

Another key factor in Russia's energy policy is its cooperation, as the world's largest supplier of energy resources, towards improvements of the international energy security. To achieve these objectives, Russia has adopted the following strategic initiatives:

- Modernisation and development of energy infrastructure, including construction of the main trunk oil and gas pipeline systems to enhance economy's energy export capacity;
- Development of a closed nuclear fuel cycle and expansion of nuclear power generation;
- Development of new hydrocarbon provinces;
- Increasing energy exports to the Asia-Pacific regional international market.

In October 2006, the government approved the Federal Programme for development of the nuclear industry until the year 2015. The programme includes reorganisation of industry and the state owned facilities. 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. In 2006 Rosatom announced a target of nuclear energy share in electricity production in 23 percent by 2020 and 25 percent by 2030. Rosatom's long-term strategy up to 2050 involves moving to inherently safe nuclear plants using fast reactors with a closed fuel cycle and

MOX fuel. Starting from 2020-25 fast neutron reactors will play an increasing role in Russia, and under optimistic scenario nuclear capacity by 2050 has expansion plans to 90 GW_e.

The General Scheme for the development of Power Industry up to year 2020 was approved by Federal Government in April 2007. The basic assumptions for the document are consistent with the "*Energy Strategy of Russia to 2020*".

To facilitate the energy export-oriented development of the East Russian territories, three state programmes were adopted in 2007. In February 2007 power monopoly UES of Russia adopted programme to increase export of electricity to the Northeast provinces of China up to 60 TWh in 2030. The Programme is in line with the General Scheme for the development of Power Industry up to year 2020. In September 2007 the Federal Government approve the programme to develop natural gas fields and build extensive trunk gas pipeline system in Eastern Siberia and Russian Far East up to 2030, which includes export pipelines to the East Asia economies. The project of the "Programme for chemical and petrochemical industry development in Russia up to 2015" is under development, primarily aiming at Siberian and Russian Far East utilities.

ENVIRONMENTAL POLICY

Russia's President signed the bill ratifying the economy's accession to the Kyoto Protocol in November 2004. This decision reconfirmed Russia's strong commitment to addressing climate change and to working with the international community in dealing with this global problem. The ratification by the Russian Federation satisfied the "55 percent" clause and brought the treaty into force, effective February 16, 2005.

Russia is deemed as the largest potential host for Joint Implementation (JI) projects in the world. In May 2007, Russia adopted procedures for approval and verification of Russia-based JI GHG's reduction projects under the Kyoto Protocol. Assignment was made on organisation and procedures for setting up and keeping the Russian Registry of Carbon Units, thus paving the way to practical implementation for GHG mitigation projects in Russia

One of the major concerns for world energy development is nuclear safety. Russia adopted the concept of "*the closed fuel cycle*" which includes spent nuclear fuel processing and mandatory return of fission nuclear materials to the fuel cycle. 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.

MARKET LIBERALISATION

Oil market in Russia has been deregulated since the 1990s. Currently oil industry consists of 9 large companies that produce about 90 percent of crude oil in Russia, and some 300 small-scale enterprises extracting the remaining 10 percent, while operators of three Production Sharing Agreements make less than 0.5 percent. There is no state control on petroleum products prices except under the Federal Antimonopoly Supervision Agency. Refining sector consists of 27 large and more than 50 small refineries and is controlled by 8 vertically integrated oil companies leaving 20 percent share of this market to 8 large and some 40 small independent refineries. Major international oil companies like ConocoPhillips, ExxonMobile, Royal Dutch Shell, BP, Total, *etc.* through their stake in both state and private companies hold up to 10 billion barrel of oil and natural gas reserves in Russia, according to different assessments methodologies (SEC or SPE), and produce 14 percent of crude oil and 7 percent of natural gas in Russia, at least. Foreign investments accounted for 44 percent out of US$ 60.6 bln cumulative investments into the Russian energy sector in 2003-2006 years.

After merger of crude oil and petroleum products pipelines owners Transneft and Transnefteprodukt, the state will control 75 percent of combined company's shares. However, private oil pipelines already exist in Russia (Caspian Pipeline Consortium), and some are under construction in North-West and Siberian regions.

The Federal Government remains the key shareholder in the economy's gas monopoly, Gazprom (extractor of 85 percent of the natural gas in Russia and owner of the nation gas pipelines system), holding 51 percent of its shares. Independent companies produce 15 percent of natural gas and supply some 25 percent to domestic consumers. 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 is important for enhanced access by independent companies to Gazprom's natural gas pipeline system. Gradual transition to European prices on domestic market is scheduled to complete in 2011, based on increasing share of free trading for domestic supplies.

The coal sector has been restructured and fully privatised in nineties, and foreign participation in the Russian coal sector is practically absent. There are not any restrictions for coal export; however the geographical size of Russia's vast economy requires the haulage of coal over long distances. Coal is the single largest commodity transported by Russia's railway network, accounting for over 27 percent of the rail freight. Although price controls have been removed, many coal producers fight to compete with low natural gas prices.

Market liberalisation is almost completed within power industry. All thermal generation and regional power distribution companies will be privatised before the middle of 2008. The hydro, nuclear generation facilities and backbone transmission lines are to remain under the government's control. Timetable was scheduled to complete transition to the national-wide electricity wholesale market trading in 2011. Total of 262 organisations have joined the electricity wholesale trading system as of July 2007, including 104 of them as independent actors.

ENERGY PRICES DEREGULATION

One of the main issues is a gradual move from state-regulated energy pricing to free market regulation for natural gas and electricity, as coal and petroleum prices are currently fully liberalised. During the transition period, the Federal Government will keep 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 centralised heat tariffs.

Non commercial partnership "Administrator of Trading System of the Wholesale Power Market" (NP ATS) was established in November, 2001 pursuant to the Russian Federation Government Resolution in July 2001. The main purposes of NP ATS are to organise trade and arrange financial payments in the wholesale electricity/power market; to increase efficiency of power generation and consumption; and to protect interests of both buyers and suppliers. NP ATS renders infrastructure services (which are related to organisation of trade) in the wholesale power market, thus ensuring closing of transactions, fulfilment of mutual obligations and execution of transactions.

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 electricity and electric power. The day-ahead market cover all power produced and consumed, except that by regulated contracts. The new model includes new pricing methods: now there are no opportunities for arbitrage between the purchase and sale of electricity at regulated prices and closing of transactions at unregulated prices. Since January 2007 volume of regulated contracts market are limited by 95 percent of electricity consumption. In April 2007 the Federal Government specifies further reduction of electricity consumption volumes traded under regulated contracts:

- second half of 2007 – 90 percent
- first half of 2008 – 85 percent
- second half of 2008 – 75 percent
- first half of 2009 – 70 percent
- second half of 2009 – 50 percent
- first half of 2010 – 40 percent

- second half of 2010 – 20 percent

Since from January 2011 any regulation will be eliminated (excluding direct residential supply) and all electricity will be sold at competitive prices.

The Gazprom's regulated natural gas prices for industry were raised by 15 percent in 2007. It is expected that in 2008 this tariff will be increased by 25 percent, and then every six month over the next two years, to reach the European price level under the net-back pricing mechanism for the industrial sector in 2011. In July 2007, new regulation was introduced with schedule for industrial contracted gas prices setting up to 2011. Upper limits are set for 15 percent in 2007, 25 percent in 2008, and 13 percent for each half of the year in 2009 and 2010. Regulated prices for the residential sector will be eliminated by 2015, as the pace of price increase for residential consumers will be lower than that for industry. While independent gas producers provide some 15 percent of natural gas production in Russia, they did not fall under current price regulation.

The first free trades for next month deliveries of natural gas were started in November 2006. Daily trading is being planned to start in April 2008. The share of natural gas free trading is expected to increase from 2 percent of domestic consumption in 2007 to 8 percent in 2008, gradually increasing thereafter. In December 2007 record price was set at 107 USD per thousand cubic metres (approximately 2.9 USD per MMBTU) for gas delivering to the Moscow region starting from January 1st 2008.

In December 2006, Government approved decision to liberalise natural gas and electricity prices simultaneously in 2011, thus ensuring the smooth development of natural gas and restructuring of power industry. The decision to synchronise price liberalisation was important for both industries, as power industry share is more than 40 percent of the total domestic natural gas consumption, while gas provides overwhelming 70 percent of the power plants fuel mix.

POWER INDUSTRY RESTRUCTURING

Russia started restructuring of the power industry in 2000. The very first step was the development of the reform concept. Then Federal Laws and Federal Government decrees identified the main principles related to future functioning of the electric power industry under competitive conditions. The existing regulatory and legal framework pertaining to the power sector restructuring includes more than forty documents. From July 2008 generation and transmission assets in Russia are separated by binding regulation. Federal Antimonopoly Service of the Russian Federation is in charge of monitoring the transportation market, where the threshold settled is less than 20 percent of transmission lines capacity per actor. In April 2007 Federal Government approved the general scheme for the development of power industry up to year 2020. This document provides guidelines for the future owners of privatised generation companies on projected electricity demand by regions of the Russian Federation.

Generation assets are already consolidated into interregional companies of two types: seven wholesale generation companies (WGCs) and fourteen territorial generation companies (TGCs). Six thermal WGCs are constructed according to extraterritorial principles, while TGCs contemplate facilities within neighbouring regions. The configuration of WGC's is such that it provides them with roughly equal starting conditions in the market (as far as installed capacity, asset value, and average equipment wear are concerned). Each WGC will consist of power plants, situated in different regions of the Russian Federation, to prevent possible monopoly abuse. Six out of seven WGCs are being formed on the basis of thermal power plants, one (Hydro WGC) – on the basis of hydropower. Thermal WGCs, while being independent, will become the largest wholesale market competitors. Shares of all thermal WGCs have been admitted to trading on the stock market. Besides, HydroWGC has been formed as a Holding company. All TGCs predominantly consist of rather small combined heat and power plants (CHPs) and their shares also supposed to be traded.

Backbone transmission lines pass on to the Federal Grid Company, distribution grids are to be transformed into eleven interregional distribution grid companies (IDGCs), functions and assets of regional dispatch administrations are transferred to the System Operator. By now main

organisations responsible for the operation and development of the wholesale electricity market have already been formed. Wholesale market infrastructure includes the following organisations:

- NP ATS – "Non-profit partnership Administrator of Trading System" – non profit partnership to manage trading activity on the wholesale power market.
- SO_CDA UES – "System Operator – Central Dispatch Administration of the Unified Energy System" – the organisation, which renders dispatching services to wholesale market participants. State share in the company should be more than 75 percent.
- FGC UES – "Federal Grid Company of the Unified Energy System" controls operation of the Unified National Power Grid (UNPG), thus providing consistency of technological management, and renders paid services to market entities on a contractual basis.

In October 2007 amendments to the Laws on the Electric Power Industry related to its reorganization came into force. The law specifies the procedure for reorganisation of RAO "UES of Russia" during the final phase of the Russian power industry reform. The final phase of the reorganisation and *pro rata* distribution of RAO UES assets is scheduled to be completed on the 1st of July, 2008. In December 2007 shares of six thermal WGC's and fourteen TGC's are already traded on stock exchanges, raising US$ 25 billion to the industry.

NUCLEAR INDUSTRY RESTRUCTURING

Russia's nuclear industry restructuring started in 2001, when Rosatom took over all civil reactors (including those under construction) and related infrastructure. In February 2007 new Law on nuclear industry was adopted. This provides legal framework for the industry restructuring by separating military and civil facilities, and also it introduced regulations for nuclear materials management.[70]

In April 2007, a single vertically-integrated state-owned nuclear power company was established. This new corporation - AtomEnergoProm (AEP) - will include uranium production, engineering, design, reactor construction, power generation and research institutes, but will not handle fuel reprocessing or disposal facilities for the time being. Entities from AEP itself down to various third-level subsidiaries eventually will be transformed to the public companies. In November 2007 this holding company was set up by acquiring 31 former state enterprises.

In November 2007, a bill to create Rosatom corporation was passed. Rosatom – one hundred percent state-owned corporation – will take over the functions of the Rosatom Agency. This will be a non-profit company holding all the shares in AEP, and provide control over the remaining nuclear industry assets outside of AEP. It is supposed that Russia would require another three years to finalise restructuring within the nuclear industry.

INTERNATIONAL NUCLEAR CENTERS

According to Global Nuclear Infrastructure Initiative announced by Russia in early 2006, Russia will host several types of international nuclear fuel cycle service centres as joint ventures with other economies. These centres would be strictly controlled by the IAEA. Uranium enrichment, reprocessing and storage of used nuclear fuel facilities are the most important roles of such centres, complimented by standardisation, uniform safeguarding practice, training and certification activities, as well as research and development centres.

In 2007 the International Uranium Enrichment Centre (IUEC) was established in Angarsk, Siberia as a joint venture between Russia and Kazakhstan, while it is open to other interested parties. The function of IUEC is to provide low-enriched uranium to those new economies interested in nuclear energy development while concerned to comply with IAEA non-proliferation regulations.

[70] Russian corporate entities will be allowed to hold civil-grade nuclear materials from now on, however it is still under the state control.

The existing enrichment plant in Angarsk will be utilised to serve for the IUEC. In February 2007, the IUEC was certified by the IAEA. The programme for the IUEC expansion at Angarsk up to 2015 was developed, which include three phases:

- Use part of the existing capacity in cooperation with Kazatomprom and under the IAEA supervision,
- Expand capacity with funding from new partners, and
- Full internationalisation with involvement of many customer nations under the IAEA auspices.

Russia has also announced that guaranteed reserves of 160 tonnes of low-enriched uranium hexafluoride (equivalent of full core load for two 1000 MW reactor) would be created at the IUEC as a fuel bank under IAEA control and available at IAEA discretion.

NOTABLE ENERGY DEVELOPMENTS

ATLANTIC MARKET INFRASTRUCTURE EXPANSION

At the beginning of 2001, there was no single oil export terminal on the Baltic Sea. Since that time the Baltic Pipeline System (BTS) and sophisticated facilities has been developed for an overload on sea transport crude oil and petroleum products delivered to the Vysotsk oil export terminal through pipelines. The general capacity of such system has reached 75 million tonnes in 2006. In November 2007 front-end engineering design (FEED) started to double these capacities. If the expansion plans for the BTS-2 project proposed in June 2007 is implemented, all crude oil and petroleum products pipeline transport to Central and Northern Europe from Russia could be transferred to the maritime transportation mode.

In November 2007, Dutch Gasunie joined the Northern Stream natural gas pipeline project, the joint venture among Gazprom and the German companies BASF and E.ON. The project aims to meet the growing demand in the European gas market, particularly in Germany, the U.K., the Netherlands, France and Denmark.

In July 2007 Gazprom and TOTAL finalised commercial negotiations on the first stage of the Shtokman project in Arctic's Barents Sea. This project aims to produce about 13.6 million tonnes of LNG. The front-end engineering design has already begun, and construction is scheduled to start in 2010 with the first LNG deliveries in 2014.

In October 2007 Gazprom and the Norwegian state-owned company StatoilHydro have signed an agreement on cooperation in the development of the first phase of the Shtokman gas field.

EAST SIBERIA – PACIFIC OIL PIPELINE CONSTRUCTION

Construction of main oil pipeline from Eastern Siberia to the Pacific coast (ESPO) was launched in April 2006. In the first phase, the pipeline with an annual transport capacity of 30 million tonnes will be built from Taishet in the Irkutsk region to Skovorodino on the Baikal-Amur railway, just 60 kilometres from the Russian Chinese border. The first phase is scheduled to be finalised at the end of 2008, together with branch to China and oil export terminal in Nakhodka at Japan Sea. By the time the second phase of pipeline construction is completed, deliveries of Siberian crude oil to the Asian-Pacific market via Nakhodka will be supported by 2,000 kilometres of railway operations. The second phase is to extend the route to the Pacific coast. Ultimate capacity of the system will reach 80 million tonnes of crude oil deliveries per year. However, in November 2007 Transneft found that subcontractors lag behind the originally planned schedule, which could lead to the project delay.

SAKHALIN ISLAND OIL AND GAS DEVELOPMENT

The Russia's first natural gas liquefaction plant is to be commissioned in 3Q 2008 on Sakhalin Island within Sakhalin-2 project. Two LNG tankers were brought in July and October from Indonesia and Alaska to test the liquefaction plant equipments. The first pipeline deliveries from gas fields located about 800 km from the liquefaction plant will start in early 2008. In 2008 drilling of the first gas wells is expected to provide the natural gas for LNG production under the Sakhalin-2 project.

In April 2007, Gazprom has become a major share holder of the Sakhalin-2 PSA project. Gas monopoly acquired 50 percent + 1 share, while Shell, Mitsui and Mitsubishi will respectively own 27.5 percent, 12.5 percent, and 10 percent of the project share.

In October 2007, the international consulting company "AEA Technology" has released the environmental assessment report of the Sakhalin-2 project and ensured that the project appropriately followed the international environmental standards.

In March 2007 Rosneft and CNPC made an agreement to develop Sakhalin-3 project. CNPC is participating in exploration activity in the Sakhalin-3 project. In the summer of 2007, CNPC started drilling activities on the Veninsky block.

PROGRAMME FOR NATURAL GAS DEVELOPMENT IN EASTERN RUSSIA

In September 2007, Federal Government approved the so-called "East Gas Programme", which is to develop natural gas fields and build extensive trunk gas pipeline system in Eastern Siberia and Russian Far East up to 2030. The Programme also includes export pipelines to the East Asia economies. Gazprom is assigned as the Coordinator of the Programme, and long-term sales contracts with China and South Korea for natural gas deliveries for 2010-2030. The contracts with China and South Korea are scheduled to be signed sometime starting from 2008.

Gazprom and TNK-BP reached an agreement to sell all of the TNK-BP owned assets in Kovikta project to Gazprom, which is to be finalised in the first quarter of 2008. The option for TNK-BP is to buy back 25 percent plus one share after creation of a joint company with Gazprom.

THE FINAL UNIT OF THE BUREYSKAYA HYDRO POWER PLANT COMMISSIONED

In October 2007 the final hydropower unit of Bureyskaya Hydro Power Plant started operation. After commissioning of the sixth 335 MW power units, the Bureyskaya Hydro Power Plant has become the largest hydropower plant in Russia's Far East. In 2008 the first two temporary installed units will be replaced with permanent ones. As a result, total installed capacity of Bureyskaya Hydro Power Plant will reach 2 GW, and the plant will generate an average of 7 TWh annually.

MOSCOW REGION FINALISE PROGRAMME TO INSTALL PEAK LOAD GENERATION

Measures have followed after serious black-out in May 2005 in the Moscow region. The programme was started in 2006 to increase the reliability of power supply in this region. After finalisation of the programme in November 2007, peak load gas turbine generators of total capacity of 225 MW were installed and ready for operation.

ROSATOM START CONSTRUCTION OF THE FIRST FLOATED NUCLEAR POWER PLANT

Rosatom has approved construction of floating nuclear power plant to supply 70 MW of power and 590 GJ per hour of heat to Severodvinsk, Archangelsk Oblast. The plant is expected to start operation in sometime after 2010. Plant refuelling will take place once in three to four years. At the end of a 12-year operating cycle, the whole plant shall be bring back to a shipyard for a 2-year maintenance procedure, before being returned to service. The facility consists of a pair of 35 MW reactors on a 49,000 tonne barge.

AMENDMENTS OF SUBSOIL LAW

Two major amendments of "The Subsoil Law" were adopted in December 2007. Firstly, the duration for the offshore exploration license was extended from 5 to 10 years. Secondly, 31 natural gas fields in Yakutia, West Siberia, Barents, Kara, and Okhotsk seas were announced as "the strategic fields". The strategic status of such gas fields make them inaccessible for foreign companies unless they establish joint project operators with Russian companies.

OIL AND GAS RESERVE REPLACEMENT EXCEEDS PRODUCTION IN 2007

In 2007, oil and gas reserves replacement ratio was 120 percent and 103 percent respectively. In the same year, there were 44 new hydrocarbon deposits discoveries. Between 1991 and 2005, oil and gas reserves replacement ratio was respectively below 100 percent. High oil prices and tightening control of the state regulator over license holders has led to more intensive oil and natural gas exploration activity and have resulted in the improvement in reserves replacement ratio.

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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 704.0 square kilometres and a population of 4.34 million (2005 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) experienced 6.38 percent growth, reaching US$114.58 billion, while per capita GDP was US$26,390 (all numbers in 2000 US$ at PPP). The economy depends heavily on exports, and major industries include electronics, chemicals, petroleum refining and exploration services, ship repair, and life sciences/bioengineering. International financial services also make up a key component of the local economy. 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 and one of the busiest marine cargo ports in the world. Singapore, however, relies almost entirely on imports to meet its energy requirements.

Table 33 Key data and economic profile (2005)

Key data		Energy reserves	
Area (sq. km)*	704.0	Oil (MCM)	-
Population (million)	4.34	Gas (BCM)	-
GDP Billion US$ (2000 US$ at PPP)	114.58	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	26,390		

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 2005 Singapore's total primary energy supply was 27,314 ktoe. Oil accounted for 81 percent of the domestic supply and natural gas the remaining 19 percent. Coal supply was almost zero. Approximately half of Singapore oil import was re-exported as refinery product, while the rest was retained for domestic consumption. Natural gas supply increased by 12.3 percent in 2005, down from a 41.9 percent increase the previous year, while oil supply grew by 22.4 percent in 2005, up from 8.7 percent growth in the previous year.

The amount of electricity generation in 2005 was 37,176 GWh in Singapore, all of it from thermal plants. Installed capacity was 10,106 MW in 2005, an increase of 6.3 percent from the previous year, though this level was already approximately twice peak demand. By 2007, of the six licensed and generating operators, the installed capacity was approximately 39 percent steam, 40 percent combined cycle, 18 percent cogeneration, and 2 percent incineration plants (according to EMA, Statistics Singapore, and individual operators). In 2005, gas represented 75 percent of Singapore's electricity production fuel inputs, up from 67 percent in 2004, and only a 15 share in 2000. Singapore relies primarily on Indonesia for its gas resources.

FINAL ENERGY CONSUMPTION

In rough terms, the industrial sector in 2005 accounted for over half of final energy consumption and the transportation sector one-third, with the residential and commercial sectors accounting for the small remainder. Industrial energy consumption was Singapore's fastest growing sector in 2005, at 17.5 percent, accounting for four-fifth of incremental final energy consumption growth. Nearly four-fifths of final consumption are in the form of oil, mostly for transport and industry, while about one-fifth is electricity.

Singapore's final energy consumption increased from 13,208 ktoe in 2004 to 14,744 ktoe in 2005, showing high growth of 11.6 percent, though down from the previous years 21 percent increase which resulted from Singapore's recovery from the SARS-induced economic downturn.

Table 34 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)*		Final Energy Consumption (ktoe)*		Power Generation (GWh)*	
Indigenous Production	-	Industry Sector	8,058	Total	37,176
Net Imports & Other	55,410	Transport Sector	4,726	Thermal	37,176
Total PES	27,314	Other Sectors	1,960	Hydro	-
Coal	1	Total FEC	14,744	Nuclear	-
Oil	22,078	Coal	-	Others	-
Gas	5,234	Oil	11,688		
Others	-	Gas	96		
		Electricity & Others	2,960		

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

POLICY OVERVIEW

PRICES AND EFFICIENCY

Singapore attempts to ensure that energy prices are largely market-driven so as to encourage efficient energy use. Electricity tariffs are reviewed to be cost effective, and natural gas and oil prices are set by the individual companies and reflect international market prices of fuel.

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, which supplied 75 percent of electricity generated in 2005, provide a cleaner and more efficient alternative to the traditionally used oil-fired plants, and gross thermal efficiency of the system reached 44 percent by 2006. In order to avoid being replaced, some oil-fired power plants have tried to improve efficiency by using other alternative fuels. For example, Power Seraya, one of three major generating companies in Singapore, uses orimulsion, a bitumen based fuel, to keep its existing steam plants competitive.

Efficiency programs have also been introduced for energy consumers. For industry, the largest energy consuming sector in Singapore, the Energy Efficiency Improvement Assistance Scheme, the Investment Allowance Scheme, and the Innovation for Environmental Sustainability Fund all aim to this end. For commercial users, government-lead audits are now carried out for large public buildings, expanding by 2010 to cover educational institutions and all air-conditioned public buildings of 15,000 square metres.

NATURAL GAS USE AND LNG IMPORT

Natural gas has become the major fuel used for electricity generation in Singapore. In 2005, it was responsible for 75 percent per cent of total electricity production. Natural gas was introduced for electricity generation in 1992 when Singapore started importing gas from Malaysia via pipeline. Today, three main pipelines supply the Singaporean network: Senoko Power Ltd imports approximately 150 million cubic feet per day (mmcfpd) from Malaysia for power generation; SembCorp Gas Pte Ltd imports 325 mmcfpd from the West Natuna gas fields in Indonesia for both generation and industrial users, and; since 2003, Gas Supply Pte Ltd has supplied 350 mmcfpd natural gas from South Sumatra for power generation, industrial uses, and city gas. Gas transportation to consumers is a natural monopoly operated by PowerGas Ltd and regulated by the Singapore Energy Market Authority (EMA).

With gas representing such a large share of electricity production, in particular, diversification of supply has become an important issue. This was highlighted by a number of power outages since 2003, including a brief one in 2006 that resulted from a gas supply disruption from Malaysia. Such risk has made the high potential cost of previously shelved Liquefied Natural Gas (LNG) importation plans more palatable. With a favourable feasibility study completed in 2005, the EMA expects for an LNG receiving terminal to be operational by 2012, depending on market demand. EMA is currently reviewing the gas procurement process and relevant regulatory frameworks for the 3 million tonne per year facility, which will be located on a 30 hectare site in south-western Jurong Island. As of September 2007, a request for proposals was issued by the EMA for an LNG aggregator who would be licensed to import and sell regasified LNG having secured supply as necessary. Meanwhile, EMA has indicated that pipeline gas contracts will limited or allowed to expire so as to build up demand for the imported LNG once available.

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.

ENVIRONMENT AND CLIMATE CHANGE STRATEGY

In Singapore, the primary anthropogenic GHG emitted 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.

Actions taken domestically to address climate change and other environmental issues in Singapore are known as the Singapore Green Plan 2012 (SGP2012). The ten-year SGP2012, which is reviewed and updated every three years, covers six focus areas: air and climate change; water; waste management, nature, public health, and; international environmental relations. Two new energy-related targets from the 2006 edition include a reduction of ambient PM2.5 concentrations to 15 μg /Nm 3 by 2014 and reducing carbon intensity to 25 percent below the 1990 level by 2012.

From a regulatory standpoint, a number of schemes ranging from measures to improve energy efficiency to increasing use of cleaner energy have been adopted. To this end, in 2002 a voluntary Energy Labelling Scheme for air-conditioners and refrigerators was launched. Mandatory labelling has been in effect for all air-conditioners and refrigerators since mid-2007, and mandatory fuel-economy labelling is currently under consideration for all passenger car models. In addition, the

Energy Smart Buildings Scheme will also be mandated to promote energy efficiency in buildings. Regarding NRE, Singapore has indicated that although its geography is unsuitable for wind, hydro, or tidal power generation, solar energy could be promising if cost and technological barriers could be overcome. Considering this, Singapore committed US$230 million for R&D, test-bedding, and pilot projects for clean energy.

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 the first of three phases of liberalization was begun. Phase two was completed in February 2006, allowing about 10,000 consumers, representing 75 percent of Singapore's total electricity consumption, are able to buy electricity from competitive electricity retailers. The last phase of liberalisation to introduce full retail contestability involves 1.3 million mostly household consumers, and is currently under investigation. To achieve this, EMA is developing a pilot Electricity Vending System (EVS) which would reduce back-end costs by allowing electricity retailers to post electricity pricing schedules at public points of sale such as the internet or convenience store payment kiosks so that consumers could chose from a list of competitive offers.

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CHINESE TAIPEI

INTRODUCTION

Chinese Taipei, consisting of the islands of Taiwan, Penghu, Kinmen, Matsu, and several islets is 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.

There was still an increase of population in Chinese Taipei in recent years, but the speed is relatively mild. As one of the most densely populated areas in the world, the population of Chinese Taipei was about 22.88 million in 2006 and grew at a rate of 0.47 percent between 2005 and 2006, slower in comparison with the 0.66 percent annual growth rate between 1995 and 2005. The rate of urbanisation growth has been seen to slow down as well, the percent of urban population increased to 70 percent from 69 percent in 2005.

Driven by rapid economic development in the past decade, the economic structure of Chinese Taipei has substantially changed. In the structure of domestic production, the service sector was 71.3 percent, industrial was 27.1 percent and the agriculture sector was 1.7 percent in 2005. The GDP of Chinese Taipei reached US$572.41 billion, the GDP per capita was US$ 25,228 in 2005 in 2000 PPP term. In addition, the unemployment rate fell from 4.13 percent in 2005 to 3.91 percent in 2006.

Chinese Taipei has very limited domestic energy resources and relies on imports for most of its energy requirements. No oil and coal reserves in Chinese Taipei, and gas reserves are around 7.7 BCM. In 2006, electricity generation installed capacity totalled 43,162 MW.

Table 35 Key data and economic profile (2005)

Key data		Energy reserves**	
Area (sq. km) *	36,188	Oil (MCM) – Proven	-
Population (million)	22.69	Gas (BCM)	7.7
GDP Billion US$ (2000 US$ at PPP)	572.41	Coal (Mt) - Recoverable	-
GDP per capita (2000 US$ at PPP)	25,228		

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 106.6 Mtoe in 2005, up 2.2 percent from the previous year. By fuel, oil represented the largest share at 42 percent; coal was second (37 percent), followed by natural gas (10 percent), and others (12 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.

Chinese Taipei imports almost all its crude oil requirement, with the Middle East being the major supply source accounting for 80 percent of total imports. West African countries also are important suppliers. In 2005 Chinese Taipei imported 54.5 million ton of crude oil. As the refining capacity of the economy exceeds the domestic demand, Chinese Taipei is a net exporter of petroleum products, which amounted at about 10 million ton in 2005. 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 1.23 million barrels per day (B/D), of which 58.5 percent is operated by CPC Corporation, Taiwan (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 510,000 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. In the end of 2006, there were 2,592 gas stations in Chinese Taipei. CPC directly operates 661 gas stations, while 1,253 gas stations are jointly operated or franchised (privately operated). FPCC runs 678 gas stations.

As natural gas resources are also limited in Chinese Taipei, domestic demand is met almost entirely by imports of LNG, which mostly come from Indonesia and Malaysia. LNG imports in 2005 stood at 10 million toe, a 4 per cent increase from the previous year. CPC operates Chinese Taipei's only LNG receiving terminal at Yungan, Kaohsiung, with a handling capacity of 8.56 million tons per year. To meet the increasing demand for natural gas, CPC has already started building its second terminal at Taichung Harbor, with a design capacity of 3.00 million tones per year. This terminal will start partial operation with a handling capacity of 690 thousand tons in 2008 and is due to be completed by the end of 2009.

Coal is used for power generation as well as for the steel, cement and petrochemical industries. Coal has been totally imported from foreign countries, mainly from Indonesia (39 percent), Australia (36 percent) and Mainland China (21 percent). In 2005, primary coal supply was 39.2 million toe or 7.5 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 43,162 MW of installed generating capacity and generated about 227 TWh in 2005. By fuel type, the generation is broken-down as thermal at 76 percent, nuclear at 17.6 percent, and hydro at 3.5 percent and geothermal, solar and wind making up the remainder. Taipower, the state-owned electric power utility, dominates Chinese Taipei's electric power sector, with Independent Power Producers (IPPs) accounting for about 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. Currently, two 1,350 MW advanced light water reactors in the Fourth Nuclear Power Project are under construction. 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 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	13,152	Industry Sector	35,873	Total	227,449
Net Imports & Other	96406	Transport Sector	14,701	Thermal	175,001
Total PES	106,638	Other Sectors	13,677	Hydro	7,909
Coal	39,183	Total FEC	64,251	Nuclear	39,972
Oil	44,343	Coal	6,706	Others	4,567
Gas	10,476	Oil	38,737		
Others	12,635	Gas	1,986		
		Electricity & Others	16,822		

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

FINAL ENERGY CONSUMPTION

The final energy consumption in Chinese Taipei was 64.2 million toe in 2005, or 0.6 percent higher than the previous year. Elasticity of energy requirement was 0.57 in 2005. The industrial sector consumed 56 percent of the total, followed by transportation (23 percent) and the other sectors mainly residential/services (21 percent). By energy source, petroleum products accounted for 60 percent of total final energy consumption, followed by electricity (26 percent), coal (10 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 the industrial structure change and increased motorisation of the economy. Due to the rise in national income and improvements in the transportation system, the energy consumption in the transportation sector has increased significantly, reaching 14.7 Mtoe in 2005 from 13.8 Mtoe in 2004, 6.8 percent increase. The consumption in the commercial and residential sectors showed an increase of 0.8 percent.

By energy source, petroleum accounted for 60 percent of total consumption, electricity and others 26 percent, coal 10 percent and gas 3 percent. With improvement in living standards, technological progress and diffusion of electrical appliances, electricity consumption has steadily increased over the past 25 years at 6.9 percent per year on average.

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 including nuclear, fossil fuels and new and renewable energy. Two National Energy Conferences were convened in Taipei on May 26th and 27th, 1998 and June 20th and 21st, 2005, to formulate strategies and measures in response to the impact of the United Nations Framework Convention on Climate Change and to seek a balance among economic development, energy supply, and environmental protection in Chinese Taipei. 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) Stabilizing energy supply to increase energy independence; (b) Increasing energy efficiency and reinforcing management of energy efficiency; (c) Further promoting liberalization of the energy market; (d) Coordinating the development of 3E (energy, environment, economy); (e) Reinforcing research and development; (f) Promoting education campaigns and expanding public participation. The aims of Chinese Taipei energy policy are to establish a liberalized, orderly, efficient, and clean energy supply and demand system based on the environment, local characteristics, future prospects, public acceptability, and practicability.

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, the Government announced the "Nuclear-Free Homeland" 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 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

RATIONALIZATION OF ENERGY PRICE

Chinese Taipei modified its oil products pricing mechanisms twice in 2007 so as to better reflect the fuel cost , and environmental cost, and to improve transparency of the adjustment procedure.

First, in January 2007, weekly gasoline and diesel prices were recalibrated to be benchmarked against NYMEX WTI crude oil price rather than Platts. Furthermore, respective price adjustment parameters were reduced from 100 percent to 80 percent of the changes in WTI crude oil price.

Chinese Taipei once again modified the oil pricing system in September 2007 to link domestic wholesale prices of gasoline and diesel to Dubai (70 percent) and Brent (30 percent) crude oil prices rather than WTI. The new formula is calculated monthly rather than weekly and is based on the change in the average price for Dubai and Brent crude oil over the previous two months. As for

price adjustment of fuel oil, the average price change of HSFO180 between current month and preceding month posted by Platts is used as a reference.

CO2 EMISSIONS VOLUNTARY REDUCTION PROGRAMME AND ENERGY INDUSTRY AUDITING

The 2005 General Energy Conference identified the need for Chinese Taipei to commit itself to the global efforts to mitigate climate change. In 2006, the Ministry of Economic Affairs (MOEA) conducted four projects including establishing the "auditing, registry, verification, and certification systems of energy industry", "the emissions reduction capacity building of energy industry and promotion program of CO2 emissions voluntary reduction", "the environmental accounting system of the energy sector," and "greenhouse gases emissions management system". Main achievements of these and related activities include:

1. Establishment of a domestic GHG emissions auditing tool
2. Selection of forty energy industry companies to participate in demonstration projects
3. Provision of education and training to demonstration companies
4. Assistance for five demonstrative companies to obtain international certification

DEEPENED LIBERALIZATION OF THE PETROLEUM MARKET

In late 2006, Chinese Taipei formulated a draft of the Amendment of Petroleum Administration Act in order to further liberalize the petroleum market. The government is now coordinating with the relevant agencies for their implementation. Key proposed revisions include:

1. Relaxation of the threshold of statutory oil security stockpile for oil importers, reducing requirement from 50,000 kilolitres to 10,000 kilolitres. Such relaxation is expected to attract more enterprises, both domestic and international, to enter into the market, thereby benefiting consumers and further promoting industrial competitiveness.
2. Limitation of oil products exports so as to first ensure the demand of domestic industries and people's livelihood under situations in which oil products exports might otherwise threaten the domestic supply security.
3. Inclusion of ethanol gasoline and bio-diesel under the petroleum management mechanism.
4. Extension of the scope and utilization of the Petroleum Fund so as to further enhance security of oil and natural gas supply, promote reasonable and effective energy use, stabilize oil supply, and maintain market order of oil products.

DRAFT REVISION OF THE ENERGY MANAGEMENT ACT

In 2007, Chinese Taipei proposed revision of the Energy Management Act in order to strengthen the tools for future energy management. Key proposed revisions are as follows:

1. Formulation of guiding principles on energy development, establishment of an evaluation mechanism for energy utilization, and implementation of preliminary management on energy utilization for large energy users.
2. Formulation of related regulations on energy conservation and energy efficiency aimed at specific energy users.
3. Establishment of a mandatory energy efficiency labelling system to provide complete information for consumers so as to prompt manufacturers to produce products with higher energy efficiency.

BIO-DIESEL FUEL STRATEGY AND IMPLEMENTATION

To decrease the use of fossil fuels and thus reduce CO2 and other GHG emissions, Chinese Taipei has actively promoted bio-diesel development. Current projects include encouraging the planting of energy crops, regulating and implementing regulations on the use of biofuels, providing technical training and transfer assistance, strengthening biofuel education and awareness among the public, and popularizing the use of biofuels.

Four stages have been identified for the promotion of bio-diesel fuel use in Chinese Taipei:

1. Implementation of the *"Green Bus"* promotion plan and to encourage public-operated buses to switch to bio-diesel fuel. Presently, a total of 507 buses in Kaohsiung City and Chiayi County are participating in this activity (428 buses in Kaohsiung City and 79 buses in Chiayi County). These cities are the second and third cities, after Kyoto, Japan, in terms of timing for adopting bio-diesel fuel for all of their municipal buses.
2. Development of the *"Green County"* promotion and application plan to integrate resources across the government sectors (including the Council of Agriculture, the Environmental Protection Administration, the Ministry of Economic Affairs, and others). This programme calls for the establishment of a "dirt-to-tank" B1 regional supply system through the provision of subsidies and counselling services. These will be provided to the production of raw materials, and bio-diesel fuel to sales and distributions. Taoyuan County and Chiayi County and City have been selected as the areas for implementing demonstration projects in July 2007. Through the implementation of this programme, Chinese Taipei expects that by 30 June, 2008, the consumption of bio-diesel fuel will reach 1,700 kilolitres in Chiayi County and City and 4,800 kilolitres in Taoyuan County from a total of 392 gas stations.
3. Economy-wide sale of B1 by 2008. In 2007, there were about 289 gas stations and 3,000 passenger vehicles.
4. Increase the proportion of the bio-diesel fuel to 2 percent by 2010 from the current 1 percent, to reach the 100,000 kilolitre bio-diesel target, and to advance development of the bio-diesel fuel industry.

NATURAL GAS BUSINESS ACT

For enhancing the administration of public gas utilities as well as to provide a general legal basis for gas production and importation, the Natural Gas Business Act has been drafted and was approved by the Executive Yuan on February 22, 2006. Coordination with the Legislative Yuan for the passage of the Natural Gas Business Act is being carried out.

EXPANDING DOMESTIC NATURAL GAS CONSUMPTION PROJECT

Currently Chinese Taipei consumes about 8 million tonnes of LNG. Because of the low environmental impact and its ease of use factor, natural gas consumption is expected to increase into the future. However, the market situation is not favourable to the consuming economies. Tight market conditions have led to high LNG prices in recent years.

To strategically find a means to secure LNG, and increase the consumption, Chinese Taipei has developed a roadmap. Within the road map, Chinese Taipei expects to increase the natural gas consumption from 8 million tonnes in 2005 to 10.50 million tonnes in 2010, 16 million tonnes in 2020, and 20 million tonnes in 2025.

ELECTRICITY MARKET REFORM

In order to stabilise the power supply, the Chinese Taipei's electricity market was opened to Independent Power Producers (IPP) in 1995 through three stages. However, in recent years, due mainly to environmental reasons, some of TaiPower's new power plants were unable to meet construction schedules. As a result, the proportion of reserve margin has remained at about 10 percent since 1990-- below the desired 15-20 percent reserve level. To prevent electricity supply outages, MOEA released the *Fourth Stage of Opening Electricity Market to IPPs* in June 2006, aiming to encourage IPP investment, so that about 1,980 MW new generation capacity will be built between 2011 and 2013. It is hoped that such investment might provide the private sector with new business opportunities, stabilize electricity supply, enhance operating efficiency, and generally promote the liberalization of electricity supply.

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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 2005. In 2005 the Gross Domestic Product (GDP) was US$ 495.88 billion (at 2000 US$ at PPP) with GDP per capita of US$ 7,720.

Thailand is highly dependent on energy imports, particularly oil. In 2005, net energy imports accounted for 57 percent of energy supply in the economy; down significantly from 96 percent in 1980.

Table 37 Key data and economic profile (2005)

Key data		Energy reserves*	
Area (sq. km)	513,115	Oil (MBBL)	192
Population (million)	64.23	Condensate (MBBL)	261
GDP Billion US$ (2000 US$ at PPP)	495.88	Gas (TCF)	10.74
GDP per capita (2000 US$ at PPP)	7,720	Lignite (Mt) - Recoverable	2,121

Source: Energy Data and Modelling Centre, IEEJ. * Proved reserves, Department of Mineral Fuels, Ministry of Energy (2004 data).

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary supply in 2005 was 85,242 ktoe. Oil accounted for 51 percent of total primary supply, while gas, coal and others accounted for 34 percent, 13 percent and 2 percent respectively.

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 2005, coal supply was 10,680 ktoe, a 1.8 percent increased from the previous year, mainly due to increasing consumption from the industry sector. In terms of oil, total supply was 43,645 ktoe in 2005, a 8.5 percent decreased from 47,683 ktoe in 2004.

For natural gas, in 2005, natural gas supply was 28,905 ktoe, a huge increase from the 2004 value 22,484 ktoe. The 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 2005, Thailand had proven reserves of petroleum both onshore and offshore as follows: 192 million barrels of crude oil, 261 million barrels of condensate, and 10.74 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 2005, total electricity generation was 132,195 GWh, a 5.2 percent increase from 2004. Thermal generation, mostly from natural gas and coal accounted for 85 percent of production and hydropower for the four percent. 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 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	37,525	Industry Sector	17,070	Total	132,195
Net Imports & Other	48,669	Transport Sector	23,491	Thermal	112,695
Total PES	85,242	Other Sectors	14,302	Hydro	5,798
Coal	10,680	Total FEC	54,863	Nuclear	-
Oil	43,645	Coal	6,827	Others	13,702
Gas	28,905	Oil	35,580		
Others	2,011	Gas	2,069		
		Electricity & Others	10,387		

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 2005 was 54,863 ktoe, a decrease of 2.6 percent over the previous year.

The transportation sector was the largest energy consuming sector and accounted for 43 percent of total final energy consumption at 23,491 ktoe. The second largest consumer of energy was the industry sector, which consumed 17,070 ktoe in 2005, a slight increase of about 1.0 percent over 2004. In terms of fuel types, oil accounted for 65 percent share (35,580 ktoe) of the total energy consumed by Thailand in 2005, followed by electricity and others, coal and gas at 19 percent, 12 percent and four percent respectively.

The consumption of oil and natural gas has decreased in 2005 compared to the previous year. Oil consumption also decreased at 6.8 percent to reach 35,580 ktoe in 2005 compared to 38,177 ktoe in 2004. Similarly, natural gas decrease by 11.6 percent to reach 2,069 ktoe in 2005 compared to 2,341 ktoe in 2004. On the other hand, coal consumption has increase 15 percent from 2004 to 2005, to reach 6,827 ktoe in 2005.

As a result of economic expansion, domestic electricity demand increased by 5.4 percent from the previous year. The demand growth resulted mainly as a result of increased consumption in both the industrial and commercial sectors.

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. Thailand also has given high priority to energy efficiency and conservation and the use of alternative 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 take part 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 the 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 percent 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; plan to remove 95 octane gasolines from the market in 2007 and 91 octane gasoline's 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 EFFICIENCY AND ENERGY CONSERVATION

The energy conservation targets have been set in each sector and the implementation in both the public and the private sectors, including the general public, is being speeded up in order to achieve a tangible outcome and to foster energy conservation consciousness.

In the transportation sector, key energy saving measures introduced are the improvement of public transport and logistics systems, e.g. providing "Park & Ride" areas and facilitating passengers by providing feeder transport to the central part of a city, and the development of energy saving vehicles. Thailand's board of Investment (BOI) has announced new incentives for manufacturing of low cost, fuel efficient automobiles, or the so-called "ECO Cars"[71].

In the power generation sector, support has been given to the purchase of power from power producers using the cogeneration system, or Combined Heat and Power (CHP) system, via the Regulations for the Purchase of Power from Small power Producers (SPPs) and the Regulations for the Purchase of Power from Very Small Power Producers (VSPPs).

The establishment of energy efficiency standards of energy-intensive appliances, machinery and engines will be accelerated, including the labelling of the products fro which the standards have been established.

In order to streamline the promotion of energy efficiency and energy saving, a study is being undertaken by the Ministry of Energy on the establishment of the National Demand Side

[71] BOI to Promote Eco Cars, Maximum Incentives for Integrated Car Assembly and Key Parts Manufacturing projects, June 15,2007

Management Office to be the focal point in forging ahead the demand side management so that energy conservation would be carried out in a flexible, efficient and continuous manner.

DEVELOPMENT AND USE OF ALTERNATIVE ENERGY

In order to reduce oil import, Thailand has promoted greater use of natural gas in the industrial and transportation sectors. In the industrial sector, the target is to replace 5 percent of oil consumption by natural gas. The Gas District Cooling and Co-Generation is promoted in large industries & buildings and industrial estates.

In the transportation sector, the target is to replace 10 percent of oil consumption by compressed natural gas, or the so-callled "NGV" (natural gas for vehicles), by December 2008. To promote the use of NGV, the development of related infrastructure, involving natural gas pipelines and service stations, is required. The establishment of NGV stations will be accelerated from 99 stations (as of December 2006) to 270 stations in 2007 and 740 stations in 2010.

To accommodate the increasing natural gas demand, the 3rd offshore natural gas pipeline is being constructed, divided into 3 phases:

- Phase 1 (comprising 2 compressor stations and 2 pipeline routes) has been partly in operation, starting July 2006, and will be fully completed in early 2009.
- Phase 2 will start commercial operation during 2007-2010
- Phase 3 is planned for commercial operation in early 2012

When the construction of 3rd pipeline is completed in 2012, the total capacity will increase from the current 4.8 billion cfpd to 7.6 billion cfpd. Besides, the government is considering the development of natural gas pipeline networks with the Union of Myanmar and Indonesia.

GASOHOL AND BIODIESEL PROMOTION

The current use of fuel ethanol is about 350,000 litters per day, which equals to the use of gasohol at 3.5 million litters/day. As of December 2006, 3,466 gasohol service stations are in operation. In 2007, the Ministry of Energy has set a target to increase the use of gasohol to 9 million litters per day to replace about 50 percent of octane 95 gasoline consumption.

At present, there are 6 ethanol plants in operation, with a total capacity of 855,000 litters per day, but the actual total production is averaged at 685,999 litters per day (a major producer with a capacity of 200,000 litters per day started production in December 2006). In order to accelerate and promote the production and distribution of fuel ethanol, the cabinet approved the liberalization of the establishment of fuel ethanol production plants and fuel ethanol distribution in December 2006. The target by 2011 is to have 45 ethanol production plants, with a total production capacity of 12 million litters per day.

As for biodiesel promotion, a target is set to reduce diesel consumption in the transport sector by 10 percent in 2012. Demonstration projects of biodiesel production at the community level, with the trial blending ratio of biodiesel at 2 percent, or "B2" have proved to be very successful as the product is well accepted by consumers and it causes no problem to the engines. The blending of biodiesel has now reached to 5 percent and will increase to 10 percent in 2012.

Biodiesel specification has been announced for both commercial scale and community scale biodiesel production. For commercial biodiesel, the distribution is still limited. One major barrier to the increase of biodiesel production is the availability of raw materials, such as raw palm oil, coconut oil and used cooking oil. So, the current promotion of biodiesel focuses on community scale demonstration projects (with a production capacity of 100-200litters per day) to educate people about the management and production process of biodiesel, which will create their

confidence in biodiesel utilization. So far, prototype systems have been installed in 70 communities in various provinces; they can further share knowledge and skill in small scale biodiesel production to other nearby communities.

OIL AND GAS DEVELOPMENT

The exploration and development of petroleum resources, both in Thailand and in overlapping areas with neighbouring economies, is promoted by, among others:

- Speed up additional procurement of natural gas from the production fields in the Gulf of Thailand and in the Thailand-Malaysia Joint Development Area (JDA)
- Develop the natural gas pipeline networks with neighbouring economies, i.e. from Blocks M7/M9 and A1 of the Union of Myanmar and Natuna field of Indonesia, and/or procure LNG from foreign sources;
- Speed up the negotiation on petroleum resource development in the Thailand-Cambodia continental shelf overlapping area: and
- Promote the role of PTTEP in the exploration and development of petroleum resources both domestic and overseas.

The 19th Petroleum Concession Bidding Round (July 2005-June 2006) has been completed, with a total of 16 concessions for 21 exploration blocks awarded (9 onshore, 9 in the Gulf of Thailand, and 3 in the Andaman Sea). The 20th Petroleum Concession Bidding Round was announced in May 2007, and the bid submission is open for one year for 65 exploration blocks: 56 onshore and 9 in the Gulf of Thailand.

The plan for LNG procurement from foreign sources has been developed to ensure adequate gas supply in the long term. The LNG Receiving Terminal will be located on the eastern coast at Map Ta Phut Industrial Estate in Rayong province. The EIA report is under consideration by the concerned authority; the approval is expected by the 2nd quarter of 2007. The construction is expected to complete by the end of 2010, with a total investment estimated at one billion US dollars. LNG import is expected from 2011 onwards.

ELECTRICITY SUPPLY

The present domestic supply is mainly from the Electricity Generating Authority of Thailand (EGAT), and from the private sector producers in the forms of Independent Power Producers (IPPs), SPPs, and a small portion from VSPPs. According to the current Power Development Plan 2004-2015, four combined power plants of EGAT, with the installed capacity of about 700 MW each, will be on stream during 2008-2010. Another three IPPs, with the installed capacity of 1,400 MW each, will be fully on stream by the middle of 2008. After 2011, power purchase will be required from new IPPs and neighboring economies.

Import of electricity from Nam Theun 2 project (920 MW) in Laos is already underway, which will start commissioning in 2009 and from Nam Ngeum 2 (615 MW) in 2011. MOU are being prepaed for another two projects, i.e. Nam Theun 1 (523 MW) and Nam Ngeun 3 (440MW); the commercial operation will be in 2013 for both projects.

In June 2007, Thailand Power Development Plan 2007-2021 (PDP2007) was approved by the National Energy Policy Council (NEPC) and the Cabinet. According to PDP2007, the net additional capcity during 2007-2021 amounts 30,532 MW, which includes 81.7 MW of electricity from renewable energy projects by EGAT.

DEVELOPMENT OF NUCLEAR POWER GENERATION

In order to be prepared for the increasing energy demand, Thailand is contemplating on the development of nuclear power generation. In PDP2007, nuclear power plants are envisaged, with a total generating capacity of 4,000 MW (2,000 MW in 2020 and another 2,000MW in 2021). The road map for nuclear power generation is divided into 2 phases:

1st Phase (2007-2014) - a preparatory stage (7 years), involving:

- A feasibility study for the development of a nuclear power generation project;
- Human resources development;
- The selection of an appropriate technology and possible plants sites;
- Establishment of the standards of nuclear power plants and related laws; and
- Public campaigns.

2nd Phase (2015-2020) - a construction stage of nuclear power plants (6 years)

Supply to the grid can begin from the year 2020 onwards.

In April 2007, the Nuclear Power Infrastructure Preparation Committee (NPIPC) was appointed to develop and recommend plans, measures and guidelines on the implementation of the mentioned preparatory work for the establishment of a nuclear power plants. In June 2007, 6 Sub-committees have been appointed to assist with the various work aspects of the Committee, especially the creation of correct understanding and acceptance of the general public of nuclear power deployment for electricity generation. Before making the final decision on the nuclear power plant construction, public consultation will be organized and a final approval from the cabinet must be obtained.

PROMOTION OF AN APPROPRIATE ENERGY PRICE STRUCTURE

This is aimed to have energy pricing methodology that is transparent and fair and that reflects the actual costs of energy service provision.

The oil pricing is currently monitored pursuant to the market mechanism, which is transparent and fair. For electricity, the calculation method of automatic adjustment mechanism will be revised to be more appropriate and fairer, allowing the pass-through of fuel costs and power purchasing prices while the operating efficiency is also taken into account. The price of fuel ethanol has been adjusted to be based on the Brazilian ethanol price. The price structure of and subsidization for cooking gas (LPG), which has long been subsidized by the government, are under review in order to better reflect the costs and reduce the distorted use of LPG.

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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$11.0 trillion (in 2000 US$ at PPP) in 2005. The US is located in North America between Canada and Mexico. It has a population of 296 million people (2005), 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 4.1 percent per annum in real PPP terms. A brief recession slowed growth to 0.8 percent in 2001, gradually recovering to 4.2 percent by 2004 before dipping to 3.2 percent in 2005. The unemployment rate of 6.0 percent in 2003 decreased to 5.1 percent in 2005 as economic growth recovered, though in 2007 concerns strengthened over a economic slowdown in the wake of real-estate market-induced credit worries as the US Dollar weakened.

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 2005, there were 3,398 MCM of proven oil reserves, 5,451 BCM of natural gas reserves and 246.6 billion tonnes of coal reserves. Total electricity generating capacity was 1067.0 GW in 2005, of which 80 percent was thermal, 10 percent was nuclear, 9 percent was hydro and 1 percent was other renewable energy (biomass, geothermal, solar and wind etc). Due to a large, wealthy population and broad industrial base, the economy consumed 5.4 toe per capita in 2005, nearly four times the APEC average and far in excess of production.

Table 39 Key data and economic profile (2005)

Key data		Energy reserves	
Area (sq. km)	9,631,418	Oil (MCM) – Proven*	3,398
Population (million)	296.41	Gas (BCM) – Proven*	5,451
GDP Billion US$ (2000 US$ at PPP)	11,046	Coal (Mt) –Recoverable**	246.6
GDP per capita (2000 US$ at PPP)	37,267		

Source: Energy Data and Modelling Center, IEEJ.

* Oil and Gas Journal, 2006 ** BP Energy Statistical Review, 2006

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2005, total primary energy supply in the US was about 2,356 Mtoe. By fuel type, 41 percent of supply came from crude oil and petroleum products, 24 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 2005.

In 2005, oil was responsible for approximately 962 Mtoe of the US primary energy supply. Petroleum product supply grew 1.5 percent per annum during the 1990s, but domestic crude oil production levels declined by 2.5 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 60 percent by 2005. About 44 percent of net imported petroleum in 2005 comes from OPEC economies. Neighbouring Canada and Mexico are the largest non-

OPEC net suppliers. Growth in the transportation and industrial sectors has been driving demand for petroleum products. Four-fifths of the economy's oil reserves (including federal offshore 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 3.1 percent of the world's natural gas reserves. Primary natural gas supply totalled 508 Mtoe in 2005, of which 16.2 percent was met by net imports. Almost all of the production shortfall was met by imports from Canada through an extensive network of pipelines. Industry is the largest user of gas in the US, though growth is fastest among power generators as 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 1999, the annual growth rate of natural gas supply was about 2.0 percent. However supply of natural gas has since stagnated due to high gas prices, exhibiting a negative annual growth rate of about 0.5 percent between 1999 and 2005. Wellhead prices in 2005 were over 60 percent higher than their previous peak in 1983 in real terms following several years of rapid price growth.

The US transports gas through an extensive network with more than 200 systems, 478,000 km of pipeline, and 5.0 Bcm/d of gas transportation capacity. In recent years, growth in network capacity has outpaced growth in network length. Underground gas storage capacity in the US has grown only slightly since the mid 1970s, and total end-of-year storage volume stood at approximately 30 percent of annual consumption in 2005, down from a peak of 40 percent in 1986. Interest in liquefied natural gas (LNG) is growing in the US as a means to diversify overall energy supplies while fuelling relatively clean power generation, though early proposals for LNG receiving terminals to be constructed on the east and west US coasts have encountered local public and regulatory opposition. Nevertheless, EIA expects that LNG imports to the US will grow to 71 Bcm in 2010 and 180 Bcm in 2025, up from 18.5 Bcm in 2004.

Table 40 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation GWh)	
Indigenous Production	1,646,095	Industry Sector	444,466	Total	4,167,735
Net Imports & Other	709,496	Transport Sector	653,810	Thermal	2,961,136
Total PES	2,355,591	Other Sectors	502,914	Hydro	290,423
Coal	555,515	Total FEC	1,601,190	Nuclear	810,726
Oil	961,864	Coal	28,199	Others	105,450
Gas	507,773	Oil	881,045		
Others	330,439	Gas	322,435		
		Electricity & Others	369,511		

Source: Energy Data and Modelling Center, IEEJ

Primary energy supply of coal in the US totalled 556 Mtoe in 2005. 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 35.9 million metric

tonnes 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. By 2005, however, coal export increased to 45.3 million metric tonnes, with Canada receiving the largest share.

The US produced 4.17 million GWh of electricity in 2005 with 71 percent coming from thermal plants, 19 percent from nuclear power, 7 percent from hydropower, and 3 percent from other sources.

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. Average utilisation rate of the 104 commercial nuclear plants has risen steadily to over 90 percent in 2002. In 2003, the utilisation rate dropped to 87.9 percent and recovered slightly to 89.3 percent in 2005. 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.

Total renewable energy production in the US for 2005 was approximately 161 Mtoe, or 7 percent of total primary energy supply according the US EIA, representing 2.3 growth rate from the previous year. By consumption of renewable energy type, biomass as a whole represented 49 percent of the total, hydroelectric power 42 percent, geothermal 5.4 percent, wind 2.8 percent, and solar/PV 1.0 percent. Of these, biomass used for biofuels (approximately 15.0 Mtoe consumption, 16 percent annual growth for ethanol and biodiesel combined) and wind power (approximately 4.9 Mtoe, 25 percent annual growth) experienced particularly rapid expansion, driven in part by government subsidies.

FINAL ENERGY CONSUMPTION

In 2005, end use energy consumption in the US totalled 1,601 Mtoe. Broken down by sector, transport consumed 41 percent, industry accounted for 28 percent, and the rest 31 percent. By fuel, petroleum accounted for 55 percent of consumption, natural gas 20 percent, coal 2 percent, and electricity and other fuels 23 percent.

POLICY OVERVIEW

NATIONAL ENERGY POLICY

The present National Energy Policy (NEP) was released in May 2001 by the George Walker Bush Administration, which 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 motivated 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.

ENERGY POLICY ACT OF 2005

In the summer of 2005, the Energy Policy Act of 2005 (EPAct) was passed by the US Congress and signed into law as a comprehensive piece of energy legislation after four years of debate. The 2005 EPAct is the successor to the 1992 EPAct. Main focus areas of the 2005 EPAct include addressing the impact of high energy prices on consumers, ensuring protection of human health and the environment, improving energy conservation and efficiency, increasing domestic energy supplies, increasing the use of new and renewable energy, improving energy infrastructure, and

strengthening international alliances to improve energy security and relationships. Contents include:

Energy Efficiency (34 sections)

Energy management and performance standards in federal infrastructure, procurement, and lands; daylight savings time adjustments; voluntary commitments to reduce industrial energy intensity; funding for state energy programs; financial assistance and rebates for weatherization and energy efficient appliances; Energy Star program, energy labelling requirements, and other energy conservation standards for products; public education programs; public housing provisions.

Renewable Energy (36 sections)

Assessment of resources; renewable energy production incentives; geothermal-specific incentives; hydroelectric production incentives and small hydro incentives.

Oil and Gas (61 sections)

National Petroleum Reserve operational authority; natural gas import/export, storage facilities, market manipulation and transparency, and LNG Federal-State forums; incentives for deep well natural gas production in the Gulf of Mexico, royalty relief for deep water production, gas hydrate production incentives, enhanced oil recovery incentives; management of oil and gas leasing and infrastructure on federal lands; Great Lakes oil and gas drilling ban; coalbed methane regulation; refinery revitalization.

Coal (20 sections)

Loans for clean coal technology facilities; coal and coke gasification demonstration projects; Illinois basin coal-to-liquids funding; amendments to existing federal coal leasing regulations, repeal of ~65 hectare limit for coal leases.

Indian Energy (6 sections)

Consultation with Indian tribes; rural electrification; energy efficiency in federally assisted housing programs.

Nuclear Matters (41 sections)

Extension to 2025 of and amendments to Price-Anderson Act (limiting liability of nuclear operators); nuclear licensing and decommissioning; antitrust review; demonstration of hydrogen production at existing nuclear facilities; project establishment, management, and organization for the Next Generation Nuclear Plant Project; nuclear facility and materials security, secure transfer of nuclear materials.

Vehicles and Fuels (39 sections)

Use of alternative fuels for dual-fuel federal vehicles; flex-fuel and hybrid vehicle commercialization initiative; hybrid and advanced diesel vehicles; appropriations for advanced vehicle pilot program; fuel cell bus programs and clean school bus programs; railroad and aviation fuel efficiency; engine idling reduction programs; fuel economy incentive requirements; funding for and update of testing procedures for automobile fuel economy labelling; federal and state procurement of hydrogen fuel cell vehicles.

Hydrogen (16 sections)

Hydrogen fuel cell program and related matters; incorporation of solar and wind technologies; technology transfer.

Research and Development (81 sections)

Energy efficiency R&D including the Next Generation Lighting Initiative, National Building Performance Initiative, Energy Efficiency Science Initiative, and Advanced Energy Efficiency Technology Transfer Centers; distributed energy and electric energy systems R&D including micro-cogeneration energy technology, distributed energy technology demonstration programs, and electric transmission and distribution programs.

Renewable energy R&D programs including bioenergy, renewable hydrogen production and infrastructure for vehicle propulsion, concentrating solar power; agricultural biomass development R&D including production incentives for cellulosic biofuels, small business bioproduct marketing and certification grants, regional bioeconomy development grants, preprocessing and harvesting demonstration grants, and public outreach.

Nuclear R&D including the advanced fuel cycle initiative, security of nuclear facilities, university nuclear science engineering support.

Fossil energy R&D including carbon capture and sequestration, coal mining technologies, low volume oil and gas reservoirs, complex well technology, methane hydrates.

Science R&D including fusion energy, catalysis, hydrogen, solid state lighting, energy and water supplies, advanced scientific computing, rare isotope accelerators, systems biology, Spallation Neutron Source, energy research fellowships and scholarships.

Department of Energy Management (11 sections)

Improved technology transfer; Technology Infrastructure Program; improved coordination or civilian research programs, prizes for achievement in grand challenges of science and technology, and University collaboration.

Personnel and Training (6 sections)

Educational programs in science and math; National Center for Energy Management and Building Technologies; National Power Plant Operations Technology and Educational Center.

Electricity (48 sections)

Transmission infrastructure modernization; transmission operation improvements, including native load service obligations; transmission rate reform and infrastructure upgrade investment; amendments to PURPA including requiring net metering upon customer request, smart metering, cogeneration and small power production purchase and sale requirements; repeal of PUHCA; provisions for electricity market transparency, manipulation, and mergers.

Energy Policy Tax Incentives (43 sections)

Tax credits for investments in electricity infrastructure including extension of renewable electricity production credit, issuance of clean renewable energy bonds, advanced nuclear power production credit, clean coal investment credit, electricity transmission, modification of nuclear decommissioning costs; tax credits for domestic fossil fuel production including non-conventional source production, natural gas gathering and distribution lines, and amortization of geological expenditures; conservation and energy efficiency tax incentives including deductions for energy efficient commercial buildings, tax credits for construction of efficient homes, purchase of efficient appliances; alternative motor vehicles and fuel tax incentives including ownership of alternative motor vehicles, installation of alternative fuel stations, tax credit for biodiesel, small biodiesel and ethanol producer credits; expansion of research tax credits.

Ethanol and Motor Fuels (30 sections)

Requirements for renewable (ethanol) content in gasoline, elimination of oxygenate requirement for reformulated gasoline, data collection and provisions for public health and environmental impacts of fuels and fuel additives; commercial loan guarantees for advanced biofuel technologies, waste-derived ethanol and biodiesel, and sugar ethanol; inspection and compliance for underground storage tanks including remediation for oxygenated fuel additives; measures to reduce proliferation of boutique fuels.

Climate Change (2 sections)

Greenhouse gas intensity reducing technology strategies and climate change technology deployment in developing countries.

Incentives for Innovative Technologies (4 sections)

Studies (40 sections)

Funding for a wide range of specific energy-related studies, including petroleum inventory storage, telecommuting, energy efficiency standards, gasoline prices, the Alaska natural gas pipeline, coal bed methane, rapid electrical grid restoration, distributed generation, natural gas supply shortage, employment in the hydrogen economy, passive solar technologies, impact of offshore LNG receiving facilities, availability of skilled workers, renewable energy on federal lands, increased hydroelectric generation at existing facilities, federal leasing structures, a national security review of international energy requirements, and a review of the 1992 Energy Policy Act.

ENERGY INDEPENDENCE AND SECURITY ACT OF 2007

Signed into law in December 2007, the Energy Independence and Security Act of 2007 revises the EPAct and includes new provisions hoped "to move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government" among other issues. Details of the Act, including a 40 percent increase in fuel economy standards by 2020, five-fold increases in biofuel production targets, and appliance and lighting efficiency measures, are described below.

NOTABLE ENERGY DEVELOPMENTS

TWENTY IN TEN GOAL AND PURSUANT LEGISLATION

In January 2007, one year after his "addicted to oil" State of the Union speech, President Bush outlined a vision of reducing projected annual gasoline usage in the US by 20% by the year 2018 along with plans to boost domestic oil production and double the capacity of the Strategic Petroleum Reserve. However, as the US executive branch of government, which the President heads, is tasked with enforcing rather than legislating law, many of the measures of the "Twenty in Ten Goal" are essentially proposals unless codified by Congress. The President's proposals cover four areas:

Reducing gasoline consumption through the growth of alternative fuel sources

Under the current Federal Renewable Fuel Standard (RFS) law established by the EPAct in 2005, blenders must use 28.4 billion litres (7.5 billion gallons) of renewable fuels in 2012. This goal was met five years early in 2007 due to rapid growth of corn-based ethanol production facilities. The President proposed increasing the renewable and alternative fuel blending requirement nearly five-fold to ~132.5 billion litres (35 billion gallons) in 2017, including the use of "corn ethanol, cellulosic ethanol, biodiesel, methanol, butanol, hydrogen, and alternative fuels". The Energy Independence and Security Act of 2007 raised the renewable fuel standard to ~136.3 billion litres (36 billion gallons) by 2022, including ~60.6 billion litres (16 billion gallons) from lignocellulosic biomass such as farm and forest residues and grasses. Most of the fuel would be produced domestically, and the target would include a number of safety valves.

Reducing gasoline consumption through increasing vehicle efficiency

The President proposed gradually increasing corporate average fuel economy (CAFE) standards by 4% per year starting in 2010 for cars and 2012 for light trucks in order to offset 5%, or 32.2 billion litres (8.5 billion gallons), of total projected gasoline usage in 2017. The Energy Independence and Security Act of 2007 embodied this idea by requiring a 40% improvement in CAFE from ~10.6 to ~14.9 kilometres per litre (25 to 35 miles per gallon) by 2020. The proposal also called for CAFE credit trading among automobile manufacturers and increased powers for the executive branch in setting such standards. Proposed efficiency measures also included funding to reduce traffic congestion through demonstration of congestion pricing, mass transit services, workplace schedule flexibility, and improved real-time traffic information.

Stepping up domestic oil production in environmentally sensitive ways

The President reiterated his support for oil and gas exploration in the Alaskan Arctic National Wildlife Refuge, construction of an Alaskan Natural Gas Pipeline, and investment to increase domestic refinery capacity.

Doubling the current capacity of the strategic petroleum reserve

The President proposed doubling the capacity of the US Strategic Petroleum Reserve to 1.5 billion barrels by 2027 to provide 97 days of net import protection. The current reserve of 691 million barrels would provide for 55 days of net import protection. Such an increase would return import protection to near 1985 levels.

SUB-NATIONAL ENERGY LEGISLATION AND DEVELOPMENTS

State and City-Level Climate Change Initiatives

In the absence of federal commitments to reduce US GHG emissions, a number of regional, state, and city-level initiatives have been formed and were active as of 2007.

In California, The Global Warming Solutions Act of 2006 was signed into law in September 2006. This law builds upon the 2000 California Climate Action Registry and the 2005 Executive Order S-3-05 in which California Governor Arnold Schwarzenegger noted that the state was particularly vulnerable to the impacts of global warming, citing impacts to, "water supply, public health, agriculture, the coastline, and forestry." The act (also known as AB 32) sets a mandatory statewide GHG emission cap equal to 1990 levels by 2020 with penalties for non-compliance. Currently, a consultation and action plan formation process is underway to determine how targets will be met through regulation, market mechanisms, and other measures, with the option of adopting a cap-and-trade program in the period 2012-2020. California in 2006 also strengthened a statewide renewable portfolio standard requiring that by 2010, 20 percent of electric sales by retail sellers (excluding municipal utilities) come from "eligible renewable energy resources".

Ten states in the northeastern US are members of the Regional Greenhouse Gas Initiative. Similar to the California plan, this initiative sets targets for GHG emissions to be reduced to 2003 levels by 2015, and a further 10 percent reduction by 2020. Related to this initiative is the New England Governors/Eastern Canadian Premiers Climate Change Action Plan, whose seven members (with some overlapping membership) have signed a memorandum of understanding aiming to reduce 2020 GHG emissions to 10 percent below 1990 levels.

The Midwestern Greenhouse Gas Reduction Accord, signed in November 2007, whose members include nine US states and one Canadian province, aims to establish GHG reduction targets and the regulatory or market mechanisms which might be used to achieve them. A host of other regional climate change or clean energy-focused have now formed as well across US and Mexican states and Canadian provinces, including the Western Governor's Association Clean and Diversified Energy Initiative, the Southwest Climate Change Initiative, the West Coast Governors' Global Warming Initiative, and the Western Climate Initiative (six states and two Canadian provinces, 15 percent below 2005 levels by 2020). These regional initiatives, with their overlapping memberships and targets, attempt to actively collaborate on development of methodologies and action plans. Many now rely on the Climate Action Registry, a Washington, D.C.-based NGO with 31 state membership launched in 2007, to coordinate consistent accounting of GHG emissions.

Municipal governments have undertaken other GHG initiatives, notably the US Mayors' Climate Protection Agreement, launched in Seattle in 2005. As of November 2007, there were 710 signatories to the voluntarily agreement, under which US mayors "strive to meet or beat the Kyoto Protocol targets in their own communities" and urge representatives to state or federal government to meet the US Kyoto Protocol GHG emission targets and otherwise act to enact market-based federal legislation for GHG emission reduction.

California Passenger Vehicle Emission Standards

Though regulation of federal air standards falls to the US Environmental Protection Agency, the state of California has been granted waivers by the EPA since passage of the 1990 Clean Air Act to set its own mobile source pollutant emission standards which may then be adopted by other US states. In January 2007, a California executive order enacted the Low-Carbon Fuel Standard, which seeks to regulate the GHG emissions of automobiles-- in effect, demanding that vehicles sold in California improve their present fuel economies by roughly 30 percent by 2016. The California vehicle standard, which is currently not law but which 15 other US states intend to adopt following acceptance by the US EPA, is unique in that it would regulate lifecycle embedded carbon-equivalent of any fuel used by the automotive fleet per distance travelled. This approach is intended to avoid distortions by favouring any one fuel and maximize both flexibility and market efficiency in meeting the emission requirements. An EPA waiver was recently denied, but the states concerned are expected to file legal challenges based on historical precedent.

EFFICIENCY AND CONSERVATION

Adjustments to US EPA Fuel Economy Vehicle Ratings

In 2006 the US EPA announced updated fuel economy testing methodology meant to better replicate real-world driving conditions by incorporating air conditioner use, higher average driving speeds with faster acceleration, and cold weather driving. Replacing the previous ratings, which consumers often found to be optimistic, the new ratings generally lower vehicle fuel efficiency estimates by 12 to 30 percent for city driving and 8 to 25 percent for highway driving. New testing procedures will officially begin with vehicle model year 2011, but updated estimates approximating the new testing procedures have already begun with model year 2008. Along with the updated fuel economy guides, the EPA has created redesigned window-stickers for new cars on the dealer's lot, more prominently showing estimates for vehicle-specific yearly expenditures on gasoline and also showing how the vehicle's fuel efficiency compares to others in its class.

It is important to note that these new testing procedures are meant only to give vehicle buyers a more accurate depiction of a new car's fuel economy, helping them to make the most efficient purchase decision. They do not affect the testing procedures for regulated CAFE standards (which, vehicle-by-vehicle, are more optimistic than real-world conditions), and as such do not affect requirements on vehicle manufacturers.

More Efficient Appliances and Lighting

The Energy Independence and Security Act of 2007 requires new light bulbs to use 25-30 percent less power by 2012-14 and 60 percent less by 2020, while requiring DOE to establish strengthened energy efficiency standards for a wide range of appliances.

INTERNATIONAL COOPERATION

Major Economies Meeting on Energy Security and Climate Change

In September 2007 the President convened the first "Major Economies Meeting on Energy Security and Climate Change", hosting representatives from 17 developed and developing economies to "set a long-term global goal for reducing greenhouse gases" and "establish midterm national targets and programs that reflect their own mix of energy sources and future energy needs" by the end of 2008. International discussion concerning reduction of greenhouse gases through this initiative is characterized by the perspective that, "While all countries must do their part to reduce emissions, we should not seek to impose on any countries measures or frameworks that thwart their efforts to meet the legitimate aspirations of their people for better and more prosperous lives."

The series of talks are intended to "reinforce and accelerate discussions under the UN Framework Convention on Climate Change", with particular regard to addressing the period after 2012 when Kyoto Protocol emission targets will expire. As of December 2007, the US remained the only major developed economy to not undertake such targets.

Global Nuclear Energy Partnership (GNEP)

GNEP was formally established in 2007 and had 19 member countries by the end of the year. GNEP aims to increase access to clean, non GHG emitting nuclear energy throughout the world, to increase the amount of energy generated by nuclear fuel while decreasing the amount of material that must be disposed of in waste repositories, and to 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 sevenAsia Pacific nations – namely, the US, Australia, Canada, China, India, Japan and Korea. Ministers from the six Partner countries held an inaugural meeting in January 2006 in Sydney, Australia and a second ministerial in October 2007 in New Delhi, India. 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. Eight public-private sector task forces cover: 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, China, France, Japan, Korea, Russia, South Africa, Switzerland, the United Kingdom, and Euratom.

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VIET NAM

INTRODUCTION

Vietnam is located in South East Asia; the economy share common border with Cambodia and Laos to the west, and China to the north; to the east and south, the economy borders the Gulf of Tonkin, the South China Sea and the Gulf of Thailand. Vietnam has an area of 331,111 square kilometres, and marine exclusive economic zone of 200 nautical miles from its 3,260 km coastline. In 2005, Vietnam has a population of 84.403 million. Market-oriented reforms since 1986 and rapid economic development has transformed the economy of Vietnam; GDP grew at an average annual rate of 7.9 per cent over the period of 1991 to 2005.

In 2005, Vietnam had a GDP of US$253.2 billion, and an income per capita of US$3,000 at 2000 US$ PPP. The government targets GDP growth at 7.5 - 8.0 per cent per year to 2010, with high expectations of annual GDP growth above 8 percent per year. The government also expects export growth to increase by 16 percent per year; total annual capital investment to the economy to reach around 40 percent of GDP; and lower population growth to be under 1.14 percent, over the period to 2010.

Energy contributed greatly to Vietnam's economic development, energy supports industrial growth and generates foreign revenue from its exports. 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. Proven energy reserves of Vietnam in 2005, consists of oil at 615 million tons, gas at 600 million cubic meters, coal at 3,880 million tons, and hydropower potential 20,000 MW. Natural gas and crude oil are found mainly offshore the southern region, while coal reserves are located in the northern region, Vietnam's coal reserves are mostly anthracite. Since 1990, Vietnam has become a net energy exporter, its main energy exports are crude oil and coal.

Table 41 Key data and economic profile (2005)

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

Total primary energy supply (TPES) of Vietnam in 2005, was 43,465 ktoe, an increase of 15.1 per cent from 2004 at 37,755 ktoe. By source of energy, 29.3 percent of supply came from oil, 21.3 percent from coal, 11.8 percent from natural gas and 34.2 percent from other resources.

Vietnam proven oil reserves of 615 million tonnes in 2005 are likely to increase as exploration continues. Crude oil production has grown rapidly from only 2,750 ktoe in 1990 to 18,961 ktoe in 2005. Over the past 10 years, oil production and exports grew an average annual rate of 8.4 percent. Vietnam has eight oil producing oil fields, namely, Bach Ho, Rong, Dai Hung, Rang Dong, Ruby, Emerald, Su Tu Den, and Bunga Kekwa fields.

Most oil exploration and production activities occur offshore in the Cuu Long and Nam Con Son Basins. Since Vietnam does not yet have its own refinery in 2005, all crude oil production is exported. On the other hand, the economy requires imports of petroleum products.

The value of crude oil exports had increased from $3.47 billion in 2000 to $7.40 billion in 2005. On the other hand, oil product imports also increased from 5,101 ktoe in 1995 to 12,110 ktoe in 2005 at an average annual growth rate of 8.2 percent; the import value of oil products was about $4.1 billion in 2005. Oil product demand has increased from 6,759 ktoe in 2000 to 11,553 ktoe in 2005; the average growth rate was 9.3 per cent per year.

In the case other energy specifically biomass are excluded, oil is still the most important energy source in Vietnam, accounting for 44.5 percent of the economy's TPES in 2005, however, the share of oil in the TPES has decreased significantly from 52.0 percent in 1995.

Vietnam's gas reserves are more promising than oil reserves, in 2005, proven gas reserves is estimated at 600 BCM; this figure is likely to increase as oil and gas discoveries are coming on stream. Gas resources are found in may parts of Vietnam, however, large gas reserves are found at offshore basins. Besides several large gas fields that have been discovered such as in the Cuu Long and Nam Con Son basins offshore the South East region, there are the Malay-Tho Chu basin offshore the South West region, and the Song Hong Basin in the North region. Cuu Long basin is one of the developed natural gas production areas and mostly produces associated gas in crude oil production.

A 160 km pipeline from the Bach Ho field has been operating since 1995; associated gas is gathered and transported to shore, to fuel power plants. The gathering, transportation and processing of the associated gas from the Bach Ho and Rang Dong oil fields has a capacity of 2 BCM per year and is 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, total gas supply of Vietnam is 2.7 bcm per year, capable of supplying enough gas to the Phu My power generation complex that has a generating capacity of 4000 MW. Natural gas demand of Vietnam has increased rapidly from 200 ktoe in 1995 to 5,109 ktoe in 2005, the largest increase in gas use has come from power generation. The share of natural gas in TPES has increased from 186 ktoe or 2.0 percent in 1995 to 5,109 ktoe or 17.8 percent in 2005.

Vietnam has two large coalfields. In Quang Ninh Province in northern Vietnam, anthracite coal are found, 3.8 billion tonnes of reserves at the depth of 300ml, and over 10 billion tonnes at the depth of 1000m. In the Red River Delta, brown coal or sub bituminous coal basin with reserves of hundreds of billion of tonnes was discovered. Exploration and survey work have already been done for this coal basin. Vietnam is carrying out studies and expects foreign investment so that it will be mined in the next 10 to 15 years. Vietnam's coal production increased steadily from 4.6 million tonnes in 1990 to 30.8 million tonnes in 2005. This increase in coal production has resulted in 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 including China, Japan, Korea, Taiwan, Thailand, and France. Primary coal demand increased by 11.1 percent per year throughout period 2000 to 2005 from 4.37 Mtoe to 19.073 Mtoe respectively. In 2005 coal used for power generation was 2,661 ktoe (accounting for 28.7 percent); for the industrial sector (glazed terra-cotta, porcelain, glass, chemical fertilizer, paper, metallurgy, and other industries) about 6,132 Mtoe (66.2 per cent); other sector (residential, commercial and agriculture), 4.980 Mtoe (14.8 per cent).

The electricity generation of Vietnam has increased from 26.56 TWh in 2000 to 52.05 TWh in 2005 at an annually growth rate of 11.9 per cent. The structure of primary energy use for Vietnam power plants has changed totally within the last decade. Oil product use in generation is however still substantial at 10.7 percent in 2005. The share of gas to electricity generation has increased from 7.6 percent of total generation in 1995 to 48.0 percent in 2005. The share of electricity generation

from coal has declined from 33.0 percent in 1995 to 26.2 percent in 2005. In the meantime, hydropower use has decreased from 42.2 percent of total generation to 14.8 percent in 2005 due to rapid expansion of natural gas use Foreign companies are becoming increasingly involved in the growing power market of Vietnam.

In 2005, installed generating capacity of Vietnam was 11,340 MW; of this total, Electricity of Vietnam (EVN) operated 8,822 MW, while IPP operated 2,518 MW. Generating capacity of EVN consists of hydropower plants 4,155 MW (47.1 per cent), coal power plants 1,245 MW (14.1 per cent), gas fired power was 3,224 MW (36.5 per cent) and oil fired power 198 MW (2.2 per cent.). Total electricity production of Vietnam in 2005 was 52.050 TWh, of which 10.867 TWh or 20.9 percent was produced by IPP.

Low income households in rural areas rely primary on biomass which consists of wood and agricultural waste as a source of energy for cooking. In Vietnam, biomass accounted for 34.1 per cent of TPES in 2005; the share of biomass has decreased significantly since 1995, when it was 70 percent of TPES.

Table 42 Energy supply & consumption for 2005

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	61,299	Industry Sector	13,119	Total	52,050
Net Imports & Other	-12,116	Transport Sector	6,814	Thermal	35,920
Total PES	43,465	Other Sectors	17,262	Hydro	16,130
Coal	9,256	Total FEC	37,119	Nuclear	-
Oil	12,753	Coal	6,132	Others	-
Gas	5,109	Oil	11,553		
Others	16,347	Gas	809		
		Electricity	3,922		
		Others	14,778		

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 an average annual growth rate of 20.9 per cent from 2000 to 2005. In 2005, the TFEC was 37,119 ktoe, up 11.1 percent from that of 2004. By fuel source, excluding biomass, oil products represented the largest share with 51.5 percent of consumption, followed by coal at 27.3 percent, electricity at 17.5 percent, and gas at 3.6 percent. Between 2000 and 2004, consumption of electricity grew at the fastest of all final energy at an annual growth rate of 12.6 percent.

Industry is one of biggest energy consumers, accounting for 35.3 percent of final energy consumption in 2005, slightly lower then 39.0 percent in 2000. Steel, construction materials manufacturing, pulp and paper and fertilizer are the industries that consumed the most energy. From 2000 to 2005, annual average growth rate of energy consumption in industry was 18.9 percent.

The share of transport in the TFEC has declined, from 31.5 percent in 2000 to 18.3 percent in 2005, however the annual average growth rate was 10.4 percent over the period. 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 46.4 percent of Vietnam's final energy consumption, the share increased from 28.2 percent in 2000, at average growth rate of

31.3 percent per year over this period. However, in remote and rural areas, non-commercial biomass 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. The 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 Prime Minister for issuance or approval. The MOI is also responsible for directing and supervising development of the energy sector and reporting their findings to the Prime Minister.

Vietnam diversifies its consumption of energy, by developing regional indigenous resources and expanding regional cooperation. Vietnam hopes to minimise its dependence on oil, and place priority to ensure that energy supplies are adequate to meet the needs of a growing population and to support socio-economic development.

ENERGY SECURITY

Beyond the year 2010, Vietnam expects a transformation from being a net energy exporting economy to become a net importing economy. The inevitable change requires special consideration to energy security policies and preparations of long-term policy to assure supply of energy.

There are still many challenges that the economy need to overcome to assure energy security; until Vietnam's first oil refinery is completed, oil products will have to be imported; currently the economy has no strategic oil stockpiling in place; the electricity system is still at its early stages of development, electricity shortages still occur, and power systems operate without adequate reserves. Investment in energy development, especially in electricity generation is insufficient to meet rapid demand growth. In the coal sector there are still many challenges, particularly in the need for greater environmental protection; coal reserves currently being exploited are gradually declining; new coal reserves and supply infrastructure will need to be developed, to meet increasing demand. Although the potential of oil and gas discoveries are high, nonetheless, the size of these reserves are relatively small. Meanwhile, relatively large oil fields that are in production such as Bach Ho, Block 06-1 and other fields are in a declining trend, and is estimated to be depleted within the next ten to fifteen years.

To lessen dependency on oil product imports and to ensure energy security, Vietnam is implementing the following policies:

- Strengthen domestic energy supply capacity, through legislative reforms, and the expansion of infrastructure;
- Apply preferential policies for financing and widen international cooperation to strengthen exploration and development of indigenous resources thereby increasing reserves and exploitability of oil, gas, coal and new and renewable energy (NRE);
- Strengthen exploitation and use of domestic energy resources to reduce dependence on imported energy that is prone to volatility, especially for petroleum.
- Support Viet Nam's national oil company to invest in exploration and development of oil and gas resources overseas;
- Intensify regional and international energy cooperation and diversifying energy import sources; and
- Develop 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 the program is savings of 3 to 5 percent of the total energy consumed nationwide over 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; the company is engaged in the generation, transmission and distribution of electricity for the whole of Viet Nam. EVN is responsible for electricity supply to support economy development and to provide power to meet the consumption needs of the people, on electricity tariffs as approved by the Government. EVN is responsible for investments in power generation and network expansion, to meet power demand of the country.

In accordance with the Strategy for Electricity Sector Development approved by the government in October 2004, Vietnam is implementing a policy to gradually establish a competitive power pool, to diversify investment and trading methods, and stimulate the participation of several economic sectors. The State maintains a monopoly in transmission, construction and operation of large-scale hydropower and nuclear power plants in the future.

The Electricity Law 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), which was 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 issues 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.[72] According to this document, the energy industry is 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

[72] Information on this decisions can be found at the following link the Strategic Orientation for Sustainable Development in Vietnam (Vietnam Agenda 21)

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 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 combined cycle technology; 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 privatize member enterprises since the early 2000s, including the settlement of financial issues and reduction in the number of unnecessary employees.[73] 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

[73] 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.

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.

Power Market's Road Map. The Road Map for Electricity Market Establishment and Development in Vietnam approved by the Prime Minister envisages the corporate restructuring of EVN to establish the necessary conditions for initiating the first stage of the power market. The 1st Phase of the proposed Road Map for Electricity Market Establishment and Development is to establish an internal pilot market for EVN-owned power plants and the power plants in which EVN holds a dominant share. The existing Independent Power Producers (IPP) and the three strategic multi-purpose power plants will not take part in the internal market. The IPPs will be dispatched according to the Power purchasing Agreement (PPA) between EVN and the IPPs. During the 1st phase, the market rules as well as the regulatory, technical and commercial institutions and capacity required for operating the 2nd Phase of the proposed power market (i.e. single buyer based competitive generation market with the participation of non-EVN power plants) would be developed and pilot tested.

Pilot Competitive Generation Market. During the 1st and 2nd phases of the proposed power market, the competition would only be among the sellers (i.e. power plants) with the single buyer acting as the sole buyer. The single buyer in turn would sell electricity to distribution companies and large consumers at regulated prices. It is envisaged that the EVN internal power market would be started in 2007 with Competitive Generation Market starting in 2009.

The Master Plan for National Power Development of 2006-2015 with prospects to 2015 (MP- VI) was approved by Prime Minister of Vietnam upon the Decision No. 110/2007/QD-TTg dated 18 July 2007. In the Power Master Plan VI there is a list of power plants to be put into commercial operation (COD) during 2006-2015. Notable plants to be developed and called for investment under BOO and BOT are:

- Son My thermal power plant (TPP) 2,400 MW, in Binh Thuan province, COD 2012 to 2015.
- Nghi Son II TPP 1200 MW, in Thanh Hoa province, COD 2012 to 2013.
- O Mon II combined cycle power plant (CCPP) 1,200 MW, COD 2012 to 2013.
- Kien Giang (1-3) TPP 4,400 MW, COD 2013-2018.
- Southern CCPP 750 MW, COD by 2014

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 (now Chevron) and other companies. 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 fields 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. PetroVietnam 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 to 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.

The Vietnam oil and gas group (Petrovietnam) strives to attract more foreign investments in exploration activities and seek greater opportunities to invest in foreign countries and speed construction of key projects such as the Dung Quat oil refinery, Ca Mau gas-electricity-fertilizer complex and the gas pipeline linking Phu My district in Ba Ria – Vung Tau province with Ho Chi Minh City. The corporation will be more active to work out mechanisms, policies and solutions to solve difficulties in the construction of national oil and gas projects. The corporation also needed to pay greater attention to training its staff, both professionally and ethically the achievements and progress made by PetroVietnam in surpassing its revenue targets for the past five years, helping ensure national energy security and contributing significantly to the state budget. During 2001-2005, the corporation contributed 25 percent of the state's total revenues. In 2005, PetroVietnam's total income increased 34 per cent, and contribution to the state budget increased 28 per cent over 2004. In 2006 the corporation's output were of 17,4 million tones of oil and 7 billion cubic meters of gas. In the first half of 2007 production of crude oil was 8 million tons and gas was 3.69 billion cubic meters.

Regulations on direct investment abroad in the oil and gas sector by Vietnam-based foreign investors have been stipulated in a recent decree signed by Vietnam's Prime Minister on 27 July 2007, providing detailed provisions on investment procedures and state management of direct off-shore investment in oil and gas sector as well as the implementation of oil and gas projects overseas. The new regulation is applicable for limited liability companies, partnership and private companies, state-owned companies, foreign-invested companies, cooperatives, household businesses and individuals.

Vietnam's first oil refinery, the Dung Quat refinery is expected to be operational in 2009, as planned. Construction of the Dung Quat oil refinery began in June 2005. The refinery is designed to have a capacity of 6.5 million tonnes of oil per year, sufficient to produce 33 per cent of the economy's entire demand of petroleum products.

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.

To the year 2020, four petrochemical centres 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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