Asia-Pacific
Economic Cooperation

APEC ENERGY OVERVIEW 2008

MARCH 2009

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

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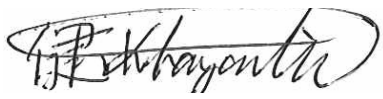
FOREWORD

In 2008, oil prices set a new record of 147 USD per barrel in July and then plummeted dramatically to 30 USD per barrel by the end of the year. The year also saw the onset of a severe global financial crisis triggered by the bursting of the U.S. housing bubble. These events not only impact global energy demand, supply and prices, but also greatly increase the uncertainty in the future outlook. At the same time, the move toward a sustainable energy future seems to be gathering momentum, taking advantage of these unprecedented events. The year 2008 may be remembered as a turning point in the history of energy and environmental development.

In many parts of the world, energy efficiency has moved to the forefront of energy policy. The progress that was once achieved over the course of decades may now occur within a year. Worldwide wind power generation capacity reached 121GW at the end of 2008, with accelerated growth expected to continue into the foreseeable future. Nuclear power generation capacity worldwide is projected to increase from 370 GW in 2007 to 690 GW in 2030, with a growing number of economies expressing interest in introducing nuclear power programs as a means to addressing climate change and energy security concerns. In the meantime, unconventional oil and gas (including oil sands, tight gas sands, and coal bed methane) are supplementing the declining supplies of conventional oil and gas in North America.

The key to achieving sustainable energy development lies in highly effective government policies as well as broader energy cooperation between economies through bilateral, regional and multilateral schemes. In this context, sharing information on our common energy challenges is essential. The *APEC Energy Overview* is an annual publication intended to promote information sharing. It contains updated energy demand and supply data as well as descriptions of energy policy. It also reports on notable energy developments, including energy efficiency improvements, infrastructure development, energy supply diversification, upstream development, regulatory reform, and environmental protection.

We extend our special thanks to APEC member economies for their efforts to improve the accuracy and currency of the information provided. We also acknowledge the expert contributions of APERC researchers and EDMC staff. Finally, we wish to offer a special note of appreciation to EGEDA members for their guidance and provision of basic data. 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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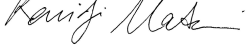

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March 2009

CONTENTS

Foreword ..... *III*
List of Abbreviations ..... *V*

Australia 6
Brunei Darussalam 20
Canada 26
Chile 36
China 47
Hong Kong, China 58
Indonesia 65
Japan 81
Korea 89
Malaysia 96
Mexico 103
New Zealand 112
Papua New Guinea 119
Peru 123
The Philippines 131
Russia 141
Singapore 152
Chinese Taipei 160
Thailand 167
United States 176
Viet Nam 188

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 4.3 percent over the period 2000 to 2006. In 2006, GDP reached US$632.51 billion (2000 US$ at PPP) from US$617.08 billion in 2005, 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 (2006)

Key data		Energy reserves*	
Area (sq. km)	7,600,000	Oil (MCM)	668
Population (million)	20.70	Gas (BCM)	2,490
GDP Billion US$ (2000 US$ at PPP)	632.51	Coal (Mt)	76,600
GDP per capita (2000 US$ at PPP)	30,554		

Source: Energy Data and Modelling Centre, IEEJ. * Proved reserves at the end of 2007 from BP Statistical Review of World Energy 2008.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2006, the total primary energy supply reached 122,582 ktoe. Coal contributed the largest share of about 44 percent, followed by oil at 32 percent, and natural gas at 19 percent. Since 1980, supply from gas exhibited the greatest growth at 4.3 percent, followed by coal at 2.8 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 1.3 percent over the period from 1980 to 2006.

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 2006, total coal production reached 201,335 ktoe, 75 percent (or 150,035 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 decade, Australia's production and exports of coal have steadily grown, however, both production of them in 2006 fell slightly below the previous year levels.

In 2007, Australia's natural gas reserves reached 2,490 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 2006 reached 36,933 ktoe. About 64 percent of this, or 23,526 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 23,080 ktoe crude oil and condensate production in 2006, total demand exceeded domestic supply. In 2006, import dependency for crude oil and petroleum products was around 25 percent. Oil reserves in 2007 stood at 668 million cubic metres (MCM), up from 557 MCM in 1990. The reserve to production ratio is around 20 years.

About 251,659 GWh of electricity was generated in 2006, mostly from thermal sources (92 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 3.8 percent per year for the past 25 years.

Table 2 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	267,918	Industry Sector	26,180	Total	251,659
Net Imports & Other	145,795	Transport Sector	29,697	Thermal	231,872
Total PES	122,582	Other Sectors	22,009	Hydro	16,028
Coal	53,718	Total FEC	77,885	Nuclear	0
Oil	38,787	Coal	3,494	Others	3,759
Gas	23,526	Oil	39,240		
Others	6,551	Gas	13,253		
		Electricity & Others	21,898		

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 2006, the total energy consumption in Australia reached 77,885 ktoe. Total energy consumption was divided between the industry (34 percent), transport (38 percent) and the other sectors (28 percent, which include residential and commercial). By fuel source, petroleum products accounted for 50 percent of consumption, natural gas for 17 percent, and coal 4 percent. Electricity accounted for 28 percent of consumption.

Impediments to the widespread use of gas domestically are the large distances between main sources of supply in the far west part of the continent and the centres of demand on the eastern seaboard, and the very competitive price of steam coal for power generation. Despite these impediments, it is expected that extensions of the natural gas pipeline network will be built in response to strong demand, particularly from the mining, manufacturing and electricity generation sectors. Since 1980, consumption of natural gas has grown at an annual rate of 3.2 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]

National Energy Security Assessment is currently being prepared by the Kevin Rudd administration, which took office in December 2007, and the scope of a new White Paper on energy issues is expected to be announced soon. A White Paper, which sets out Australian Government's policy to tackle global warming was released in December 2008.

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

[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

- Energy resource development should be required to comply with standards of environmental performance which are commensurate with those imposed on other sectors of the economy
- Commercial decisions should determine the nature and timing of energy resource development, with government interventions being transparent and allowing commercial interests to seek least-cost solutions to government objectives (e.g. environment, safety or good resource management objectives)
- Government objectives should generally be driven by sector-wide policy mechanisms rather than impose inconsistent requirements on individual projects/private investors

In November 2005, the Australian Petroleum Production and Exploration Association (APPEA) started a strategy to promote growth in the upstream petroleum sector. The aim of this strategy is to outline a sustainable upstream petroleum industry in Australia by identifying the impediments to the opportunities for realising Australia's potential and setting out the necessary actions for securing a long-term sustainable future. The areas of focus will be declining domestic oil production, skills shortages, increased costs, domestic gas supply, streamlining regulation, the need for pre-competitive data and competition for exploration investment. In 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

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].

Design of the expanded national Renewable Energy Target is now well under way, and draft legislation is planned to be released for public comment in December 2008. Legislative and regulatory amendments to implement the design of the Renewable Energy Target are expected to be in place by mid- 2009, with the revised targets commencing from 2010.

NOTABLE ENERGY DEVELOPMENTS

ENERGY EFFICIENCY OPPORTUNITIES (EEO)

The Australian Government's Energy Efficiency Opportunities program commenced in July 2006, which is subject to the Energy Efficiency Opportunities Act 2006 and Regulations 2006. The aim of the programme is to encourage large energy users to take a more rigorous approach to energy management and ensure company executives to place a high priority on reducing energy costs and improving energy management practices. Participants in the program will be required to complete assessments of their energy efficiency opportunities and report publicly on the outcomes. Decisions on investments in energy efficiency opportunities will then be at the discretion of the business.

Energy Efficiency Opportunities is expected to lead to: identification and uptake of cost-effective energy efficiency opportunities, improved productivity and reduced greenhouse gas emissions.

Companies which used greater than 0.5 PJ of energy in the 2005-2006 trigger year are required to register for the program by 31 March 2007. This is expected to affect more than 250 businesses (60% of Australian business energy use, and 40% of Australia's total energy use) in the transport, manufacturing, mining, refining and commercial sectors.

Companies that have been trialling the Energy Efficiency Opportunities assessment process have been able to identify between 30 and 50 energy saving opportunities per site. One company has

[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.

identified opportunities which could save up to 1.2 million and reduce greenhouse gas emissions by 30,000 tonnes per year. Another company plans to implement opportunities at one site that will save it an estimated $300,000 a year, and is considering opportunities to save an additional $ 300,000 annually.

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 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]

In 2008, the Australian Government announced the establishment of National Low Emissions Coal Council to speed up the development of carbon capture and storage (CCS) technology. The establishment of a "Global Institute" was also announced to accelerate CCS technology in international efforts.

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 projects demonstrate the strength of Australia's renewable energy industry across a range of technologies including: photovoltaic cells; transport fuels; geothermal power; wind turbines; biomass technologies and biofuels; cloud seeding; and other enabling technologies.

The advanced Electricity Storage Technologies (AEST) program is a five-year, $ 20.4 million, programme to support advanced storage technologies to increase the ability of renewable energy-based electricity generation to contribute to Australia's electricity supply system. AEST will complement other measures to support the development of the renewable energy industry by focusing on overcoming the difficulties posed by the intermittency of many renewable energy systems. Electricity storage solutions sought under the program may involve a range of technologies including battery, electro-mechanical, chemical and thermal storage solutions in either on-grid or off-grid situations. Expressions of Interests closed in April 2006, with successful projects expected to be announced in 2007.

ENERGY EFFICIENCY POLICY

Australia has taken significant steps to coordinate development in energy efficiency policy and programmes through formation of the National Framework for Energy Efficiency (NFEE) in 2004

NFEE Stage One consists of nine integrated and inter-linked policy packages which extend, or further develop, a range of cost effective energy efficiency measures that are currently being implemented at a national or jurisdictional level.

The energy efficiency policy packages included in NFEE Stage One cover:

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

1. Residential buildings
2. Commercial buildings
3. Commercial/industrial energy efficiency
4. Government energy efficiency
5. Appliance & equipment energy efficiency
6. Trade and professional training & accreditation
7. Commercial/industrial sector capacity building
8. General consumer awareness
9. Finance sector awareness

In December 2007, the following five new energy efficiency measures were added under NFEE Stage Two:

- Expending and enhancing the Minimum Energy Performance Standards (MEPS) program;
- Heating, ventilation and air conditioning (HVAC) high efficiency systems strategy;
- Phase-out of inefficient incandescent lighting;
- Government leadership though green leases;
- Development of measures for a national hot water strategy, for later consideration.

Implementation of new energy efficiency measures will be subject to full stakeholder consultation and, where appropriate, Regulatory Impact Statements. NFEE Stage Two will also include an energy efficiency data gathering and analysis project, to support policy development.

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 Energy (MCE). The key objective of the MCE is to develop a 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 2008.
- 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. The Australian Energy Market Commission Establishment (Consumer

Advocacy Panel) Amendment Act 2007 gives effect to the new consumer advocacy arrangements and is anticipated to commence in July 2008.

- Amedments to the National Electricity Law and Rules came into effect in January 2008. These transfer price and revenue regulation of electricity distribution networks from the regulators of States and Territories participating in the National Electricity Market, to the Australian Energy Regulator. Additionally, the amendments introduce new merits review provisions that allow the review of Australian Energy Regulator decisions and provisions that aim to remove impediments to the efficient uptake of distributed generation and demand management, including a demand management incentive scheme.
- In January, the national regime for electricity distribution commenced. The national regime transfers economic regulation of the electricity distribution networks in the National Electricity Market from stated based regulation to a single economic regulator – the Australian Energy Regulator. This together with earlier reforms to transmission network regulation provides the electricity market a single national regulatory framework for electricity networks. The economic regulatory framework established sets out principles upon which the regulator is to regulate networks, focusing on regulatory certainty and economic efficiency; outlines the regulator's information gathering framework with appropriate checks and balances on this power; establishes an access dispute framework between the network provider and access seekers; and a merits review framework for the regulator's network regulatory decisions.

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. The legislative package to give effect to this transfer will be introduced to the South Australian Parliament by September 2009, with application Acts being introduced by other State and Territory Governments thereafter.
- Improving the planning and development of electricity transmission networks to create a stable framework for efficient investment in new generation and transmission.
- Improving the markets capacity to integrate growing intermittent generation (such as wind energy), including the development of a national wind forecasting system, technical standards and new dispatch arrangements.
- 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
    - the national roll out of electricity smart meters to areas where benefits outweigh costs, as indicated by the results of the cost-benefit analysis, taking into account the different market circumstances in each state and territory and the circumstances of different groups of consumers[6].

[6] 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. The regular release of offshore acreage is a key part of the Australian Government's strategy to encourage investment in petroleum exploration. 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.

The 2008 Offshore Petroleum Exploration Acreage release comprises 35 release areas, located across five basins. The release areas range from frontier to mature status and offer opportunities for exploration companies of all sizes[7]

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[8].

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

[7] Further information is available at http://www.ret.gov.au/resources/upstream_petroleum/offshore_petroleum_exploration_in_australia/annual_release_of_offshore_petroleum_exploration_areas_australia

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

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.

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 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. [9] 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.

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

EMISSIONS TRADING

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. The following month, 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.

In March 2008, the Australian Government's detailed timetable for introduction of emissions trading was announced. The timetable includes four phases of consultation on key design and implementation issues, with commencement set in 2010.

NUCLEAR POWER

In December 2006 the Prime Minister released the final report of the Uranium Mining, Processing and Nuclear Energy Review Task Force.[10] 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.

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

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

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 2006, the population of Brunei Darussalam was about 0.383 million.

The real gross domestic product (GDP) at current price in 2006 was recorded at US$6,990 million and the GDP per capita was at US$18,305, almost the same level as the previous year[11].

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 98 percent of Brunei Darussalam's exports and about 69 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 2006 averaged 219 thousand barrels per day. Similarly, gas production for 2006 was about 36 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 (2006)

Key data		Energy reserves*	
Area (sq. km)	5,765	Oil (MCM)	191
Population (million)	0.38	Gas (BCM)	340
GDP Billion US$ (2000 US$ at PPP)	6.99	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)*	18,305		

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

* Proved reserves at the end of 2007 from BP Statistical Review of World Energy 2008.

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 2006, the total primary energy supply of Brunei Darussalam reached 4243 ktoe. Brunei's oil and gas production was 24179 ktoe, increasing 11.8 percent over production levels in 2005 of 21,630 ktoe, of which 83 percent was exported in 2006. Natural gas represents 82 percent of the total energy supply while oil represents 18 percent.

[11] According to the Brunei Key Indicators published by Department of Economic Planning & Development (DEPD), Prime Minister's Office, GDP at current price in 2006 was US$11,468 million and the GDP per capita was US$29,937, an increase of about 16% from the previous year. (http://www.depd.gov.bn/download/BDKI%202008.pdf)

Total proven crude oil reserves are 191 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 2002, 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 690.5 MW. DES and BPC each have an installed capacity of 424.5 MW and 266 MW respectively. Almost all, or 99.7 percent of the total electricity generated was supplied by natural gas. Total generation for 2006 was 3,298 GWh, almost same level as in 2005.

FINAL ENERGY CONSUMPTION

In 2006, total final energy consumption was 785 ktoe, up by 1.2 percent over 2005. The shares of the three main sectors remain unchanged. The transportation sector consumed 55 percent of the total amount, followed by the residential and commercial combined on 30 percent and the industrial sector on 15 percent. By source, petroleum products contributed the largest share, amounting to 65 percent of consumption, followed by electricity at 33 percent and gas at 2 percent.

Table 4 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	23,038	Industry Sector	117	Total	3,298
Net Imports & Other	-19,060	Transport Sector	430	Thermal	3,298
Total PES	4,039	Other Sectorsl	238	Hydro	-
Coal	-	Total FEC	785	Nuclear	-
Oil	770	Coal	-	Others	-
Gas	3,269	Oil	514		
Others	0	Gas	13		
		Electricity & Others	258		

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 eight National Development Plans (NDPs). [12] The long-term objectives outlined in these NDPs, particularly the current 9th NDP, place specific emphasis on programmes to strengthen and expand the oil and gas industry, economic

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

diversification through non-oil industries, maximum economic utilisation of national resources, improvements in the quality of life of the people, and the endorsement of a clean and healthy environment. In pursuing these objectives, the development plans will continue to focus on strategies and programmes that will expedite the process of industrialisation with the goal of achieving more balanced socio-economic development. The government is also working on improving the economy's investment climate to attract and encourage the private sector to play a more active and important role in the development of the economy.

In recognition of the importance of energy for Brunei Darussalam, the post of the Minister of Energy was created on 24th May 2005. At the same time, the Energy Division at the Prime Minister's Office was set up to advice the Minister on policy and regulatory issues.

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 (PetroleumBRUNEI). 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 PetroleumBRUNEI'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 in 2001.

[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%).

In 2002, PetroleumBRUNEI 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.

PetroleumBRUNEI on the 21st November 2005 signed a Joint Venture Agreement with Japanese partners, Mitsubishi Gas Chemical Company Inc. (MGC) and trading house ITOCHU Corporation to establish a joint venture company (Brunei Methanol Company Sdn Bhd) to construct and operate Brunei Darussalam's first methanol plant at the Sungai Liang Industrial Park (SPARK). The planned capacity for the methanol plant is 850,000 tonnes per year producing grade AA methanol.

LNG SIXTH TRAIN EXPANSION OPPORTUNITY

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

PetroleumBRUNEI awarded its designated onshore blocks, Block L and Block M under a Production Sharing Contract on the 6th February 2006 to successful consortiums after a bidding round following the launching of the blocks on the 29th August 2005. Block L was awarded to the consortium consisting of Loon Energy Inc. of Canada and local partner QAF Brunei Sdn Bhd. Block M was awarded to the consortium comprising of ChinaOil USA (Macao) Co. Ltd., Valiant International Petroleum of the United Kingdom and local partner Jana Corporation Sdn Bhd.

POWER SECTOR

There are two major power utilities in Brunei Darussalam, namely the state-owned Department of Electrical Services (DES) and an independent power utility, the Berakas Power Company Private Limited (BPC). The existence of BPC has actually relieved the Department of Electrical Services of the administrative and financial burden of supplying power to several strategic loading (areas). BPC today supplies about 40 percent of the total loads in Brunei Darussalam.

From 2002 to 2005, the total installed capacity of DES and BPC are about 424.5 MW and 266 MW respectively. The total installed capacity is about 690.5 MW. In 2006, the maximum demand recorded by DES and BPC were about 257 MW and 198 MW respectively, a decrease of about 1 percent over the previous year. As of 2006, almost 100 percent of the population is provided with electricity supply from the national grid.

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[14]. In April 2005 a contract has been awarded on for the construction of a 116 MW Combined Cycle Power Plant (Phase I) at Bukit Panggal with construction expected to be completed in July 2007.

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

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

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

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

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

DIRECTIVE ON THE SALE OF PETROLEUM PRODUCTS

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

[14] 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.

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 2006, its GDP amounted to roughly US$ 1,030 billion or US$ 31,556 per capita (in 2000 US$ at PPP). Canada's real GDP increased by 2.8 percent compared with that of 2005. Inflation remained low and stable, with consumer prices at 2.1 percent in 2007. Unemployment averaged 6.0 percent in 2007. 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 final energy consumption per capita in 2006 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 124 GW in 2006. Energy production is very important to the Canadian economy, accounting for 5.6 percent of GDP and 372,200 jobs, representing 2.2 percent of the Canadian labour force in 2007.

Table 5 Key data and economic profile (2006)

Key data		Energy Reserves**	
Area (square km)*	9,984,670	Oil (billion bbl)	27.7
Population (million)	32.65	Gas (TCM)	1.62
GDP Billion US$ (2000 US$ at PPP)	1,030.27	Coal (Mt)	6,578
GDP per capita (2000 US$ at PPP)	31,556	Oil Sands (MCM)***	27,528

Source: Energy Data and Modelling Center, IEEJ. * Statistics Canada. ** BP World Energy Statistics.

*** Established reserves of oil sands at 31 December 2006, by National Energy Board.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2006, Canada's primary energy production exceeded 412 Mtoe. Oil and natural gas accounted for most of the supply at 38 percent, respectively, followed by coal (8 percent), hydropower (7 percent), nuclear power (6 percent) and other sources (3 percent). Domestic primary energy supply totalled 270 Mtoe in 2006. Oil accounted for 36 percent, gas 30 percent, hydropower 11 percent, coal 10 percent, and nuclear power 10 percent, respectively.

Despite an 11% drop in drilling, western Canadian natural gas production actually increased slightly, by 53 Bcf (1%) in 2006. Drilling levels only began to decline in mid-2006 on account of falling natural gas prices and rising capital and labour costs. Production levels remained steady for about a year after drilling slowed, including most of 2006 and 2007.

Net natural gas exports totalled approximately 84 Mtoe in 2006, a decrease from 87 Mtoe in 2005 when U.S. demand for Canadian natural gas inflated due to hurricane damage to production facilities in the Gulf of Mexico. Overall natural gas pipeline capacity is adequate while applications for new pipeline facilities are continuously considered. However, there may be limitations at some

point depending on markets, storage and seasonal shifts. The flow of natural gas through Canadian pipelines varies with the demand for natural gas, which changes seasonally.

In 2006, crude oil production slightly increased to 108 Mtoe from 107 Mtoe in 2005. While 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 offset the decrease. In fact, Canada's East Coast offshore crude oil productive capacity increased by 30 percent and oil sands production increased by 15 percent in 2006. Alberta's oil sand accounted for over 43 percent of total crude oil and equivalent production, which indicates that oil sands are an important source of crude oil production.

In 2006, 95 Mtoe of crude oil was exported, accounting for 61 percent of all Canadian production. However, nearly 43 Mtoe of crude oil was imported into eastern Canada as refineries located in Ontario, Quebec, and Atlantic Canada sourced a portion of their crude oil from abroad. Growing offshore production off the East Coast will see this demand decrease over the coming years. Thus, net oil exports equated to 34 percent of production. The 2006 total crude oil exports consisted of 36 percent light crude oil and equivalent and 64 percent blended heavy crude oil. Canada is also a net exporter of petroleum products, mainly to the U.S. Oil pipeline capacity is tight due to growing oil sands production and continued strong demand in the U.S.

Table 6 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	412,419	Industry Sector	56,951	Total	612,594
Net Imports & Other	-141,980	Transport Sector	56,779	Thermal	147,504
Total PES	270,266	Other Sectors	87,463	Hydro	355,511
Coal	27,533	Total FEC	201,194	Nuclear	97,964
Oil	95,827	Coal	2,951	Others	11,615
Gas	79,492	Oil	93,315		
Others	67,415	Gas	50,682		
		Electricity & Others	54,246		

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

Canada generated about 612 TWh of electricity in 2006, 2.1 percent less than in 2005, mainly because electricity demand was reduced as a result of mild weather conditions in many regions. As Canada is the world's second largest producer of hydroelectricity, hydropower dominated with a 58 percent share, followed by thermal plants with 24 percent and nuclear power at 16 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 active electricity trade, and the electricity networks of the two economies are heavily integrated. In 2006, Canada exported 41.5 TWh of electricity to the United States while importing 23.4 TWh. Net electricity exports to the US in 2006 decreased to roughly 3.0 percent of production from 3.8 percent in 2005.

Canada's coal production in 2006 was 66 million tonnes, a 3.4 percent drop from 2005. In 2006 Canada exported 27.7 million tonnes, of which 26 million tonnes was coking coal. Canada's exports to Asia increased 3 percent to 15.2 million tonnes in 2006 whereas exports to Europe and the Americas declined about 10 percent and 3 percent, respectively. On the other hand, Canada imported 20.8 million tonnes if coal, mostly from the United States, of which 16.5 million tonnes was steam coal 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 with output totalling 9,862 tonnes of uranium metal (tU) in 2006. Canada provides 22 percent of total global production from its Saskatchewan mines, the centre of uranium production, in 2007. Canada's recoverable

uranium resources amounted to 423,200 tU as of January 1, 2007, compared to 431,000 tU for January 1, 2006.

In 2006, alternative and renewable energy production, large hydro excluded, increased by 3.2 percent over 2005 and accounted for 4.3 percent of total energy production in Canada. Rapid growth in the wind industry is observed in electricity markets. Generation capacity more than doubled from 684 megawatts in 2005 to 1,459 megawatts in 2006. Although wind generation currently accounts for less than 1 percent of electricity output in Canada, it is expected to grow continuously.

FINAL ENERGY CONSUMPTION

In 2006, total end use energy consumption in Canada reached approximately 201 Mtoe. Industry accounted for 28 percent of energy use, residential and commercial buildings 30 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 2 percent.

Total final energy consumption decreased by 1.0 percent. Energy consumption in the industrial sector increased by 1.4 percent while energy consumption in the transport sector decreased by 0.4 percent. In 2006 petroleum products dominated the transportation sector, accounting for 99 percent of energy consumption of this sector. Energy consumption in both passenger and freight transportations declined by 0.2 percent and 0.9 percent, respectively. For example, passenger transportation energy intensity excluding non-commercial aviation (MJ/passenger-km) decreased to 2.07 in 2006 from 2.10 in 2005.[15] Similarly, freight transportation energy intensity declined to 1.17 in 2006 from 1.18 in 2005.

In 2006, energy consumption in the residential sector and commercial sector decreased by 4.0 percent and 5.7 percent compared to the 2005 level, respectively. Warmer weather and energy efficiency were the main factors to offset an increase of energy consumption.[16] Growth in consumption in the commercial sector has been slow, averaging 1.6 percent per annum, while average annual growth rate of energy use in the residential sector for the same period was -0.3 percent. In the residential and commercial sectors, space and water heating accounted for about 69 percent of energy use while lighting, space cooling, and electronic equipment occupied 22 percent.

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, Fisheries and Oceans Canada, and Indian and Northern Affairs Canada, and Foreign Affairs and International Trade 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 adequately support these policy objectives: regulation to protect the public interest and promote

[15] In 2006, although passenger vehicle ownership annually increased by 3.4 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 3.8 percent and 2.6 percent, respectively.

[16] Natural Resources Canada's Office of Energy Efficiency applies factor analysis technique to isolate the impact of energy efficiency on changes in energy use.

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 inter-provincial transport networks, as well as exports. Provincial authorities have the main responsibility for regulating local and regional distribution networks. Under the Canada Oil and Gas Operations Act (COGOA), 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 voluntary measures, equipment and product labelling, financial incentives for certain types of investments, research and development, information, and energy efficiency standards for a wide range of energy-using equipment,. The federal, provincial and territorial governments, municipalities, utilities and some non-governmental organisations sponsor and collaborate on programmes aimed at improving energy efficiency.

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, such as dishwashers, water heaters, refrigerators, space heating and cooling equipment, and

industrial motors. The goal of the Act is to eliminate the least energy-efficient products from the market in Canada.

For the transport sector, 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. This indicates an important step toward establishing one national mandatory standard on fuel-efficiency.

ENERGY AND ENVIRONMENT

Energy production and use is responsible for the majority of Canada's greenhouse gas (GHG) and air pollutant emissions. The Government of Canada is pursuing a number of actions to reduce these emissions through its Clean Air Agenda, with a commitment to reduce Canada's total GHG emissions by 20 percent from 2006 levels by 2020.

Canada will work with its North American partners to establish a North American cap-and-trade system for greenhouse gas emissions. In addition, the Government will regulate greenhouse gas (GHG) and air pollutant emissions from other major sources such as transportation and consumer and commercial products.

To address important energy-related sources of emissions that cannot be effectively addressed through regulation, the Government has made investments in a series of complementary programs to help Canadians use energy more efficiently, boost renewable energy supplies, and develop cleaner technologies.

- Energy Efficiency: The Government is delivering a series of ecoENERGY Efficiency measures, with up to $300 million in funding, to promote smarter energy use and provide financial incentives in support of energy-efficiency improvements in homes, and small buildings and industries.
- Renewable Energy: Through the ecoENERGY Renewable Initiative the Government is investing more than $1.5 billion to boost Canada's renewable energy supplies and create up to 4,000 megawatts of renewable energy.
- Science & Technology: The Government is investing $230 million through the ecoENERGY Technology Initiative to fund the research, development and demonstration of clean energy technologies, and an additional $250 million for collaborative work with the provinces in support of Carbon Capture and Storage (CCS) related activities.
- Transportation: A series of ecoTRANSPORT initiatives (more than $463 million) are being implemented 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.
- Biofuels: The Government is also supporting the expansion of Canadian production of renewable fuels through the provision of up to $1.5 billion in operating incentives to producers of renewable alternatives to gasoline and diesel.

In 2008, the Government signaled its intention to ensure that 90 percent of Canada's electricity needs be provided by non-emitting sources such as hydro, nuclear, clean coal or wind power by 2020.

Most recently, in Budget 2009, the Government provided a clear recognition of the role of clean energy technologies to reduce GHG emissions. The Budget provided for a number of actions designed to reduce GHG emissions and further support the development of clean energy technologies:

- Energy Efficiency: The Budget provided for an additional $300 million over two years to the ecoENERGY Retrofit program to fund an estimated 200,000 additional home retrofits, and $1 billion for energy retrofits and other renovations of social housing.

- Science and Technology: The Budget provided $1 billion over five years to a Clean Energy Fund to support clean energy technologies: $150 million for research, and $850 million for the development and demonstration of technologies, including large-scale CCS projects.

- Infrastructure: The Budget provided for $1 billion over five years for a Green Infrastructure Fund to improve the quality of the environment. This will include infrastructure that supports a focus on the creation of sustainable energy, such as modern energy transmission lines, that will contribute to improved air quality and lower carbon emissions.

NUCLEAR ENERGY

The nuclear energy program in Canada is an important component of Canada's energy mix. In 2006, Canada's nuclear plants generated 16 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 51 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.

Also in its Budget 2009, the Government of Canada provided $351 million (for 2009-10) to Atomic Energy of Canada Limited (AECL) for its operations, including the development of the Advanced CANDU reactor, and to maintain safe and reliable operations at the Chalk River Laboratories.

OIL SANDS

Canada is endowed with abundant oil sands reserves (comprising 97% of their 178 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 2006, Canada's crude oil production increased at an annual rate of 3.7 percent. This robust increase – compared with history - is substantially supported by the growth in oil sands production.[17] For example, the share that oil sands production accounted in total crude oil production increased from 33 percent in 2002 to 44 percent in 2006.

The majority of the reserves are located in Alberta, and the economy's oil sands reserves are estimated to reach 174 billion barrels in 2006. 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.

[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.

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 oil sands reservoirs too deep to support economic surface mining, some form of 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).

In November 2006, Shell Canada announced the first commercial application of an innovative high temperature froth treatment processing technology, a recently developed 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.

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 from increased water consumption.

LNG IMPORT PROJECTS PROGRESS

To meet growing natural gas requirements in North America, there are seven LNG receiving (import) terminal construction projects at various stages of development in Canada. There is also one LNG liquefaction (export) facility being proposed in British Columbia. Seven projects – Canaport LNG (Saint John, New Brunswick); Bear Head LNG (Port Hawkesbury, Nova Scotia); Kitimat LNG (Kitimat, British Columbia); Cacouna Energy Project (Gros Cacouna, Quebec); Rabaska (Beaumont, Quebec); Keltic/Maple LNG (Goldboro, Nova Scotia); and, Grassy Point LNG Trans-Shipment and Storage Terminal (Placentia Bay, Newfoundland and Labrador) – have received environment assessment (EA) and construction approval from federal and provincial governments. The Bear Head LNG project was cancelled in February 2007 citing an inability to sign a contract for LNG supply.

The most advanced project is the Canaport LNG terminal, which has secured its LNG supply source and is under construction (87% complete as of October 2008), is expected to begin operations in the second quarter of 2009). The Grassy Point LNG Trans-Shipment and Storage Terminal project (Grassy Point LNG) received Canadian Federal Government approval for its facility on August 12, 2008, and Newfoundland and Labrador Provincial Government approval on November 7, 2007, based upon the successful completion of its risk assessment study and employment equity plan. This terminal is not an LNG import terminal but rather an LNG storage and trans-shipment facility for northeastern US and Canadian LNG importers. Grassy Point LNG expects to be on-stream as early as 2010.

Two LNG import terminal proposals: the Énergie Grande-Anse terminal (Saguenay, Quebec) and the Westpac LNG terminal on Texada Island in British Columbia have been announced but have not filed their projects with federal and provincial regulators.

The four LNG projects in Atlantic Canada are mainly intended to supply the northeast market in the US as demand for natural gas in Atlantic Canada is met by natural gas production from

[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.

offshore Nova Scotia. The three Quebec LNG projects would provide an alternative source of natural gas supply to markets in eastern Canada. Two of the three LNG projects in British Columbia would primarily supply natural gas to Vancouver Island and the Lower Mainland. Reversing its earlier decision to import LNG to North America through a re-gasification terminal at Bish Cove, Kitimat LNG last September 2008, announced plans to instead develop an LNG export terminal on the same Bish Cove site.

Kitimat LNG changed its plans after noting significant changes in market forces. However, rising natural gas demand in Asia and increases in supply throughout North America led to significantly higher natural gas prices in Asia than North America, prompting the company to change its plans as conditions provided a "compelling opportunity" to export LNG from North America to Asia. Kitimat LNG received Canadian Federal Government approval for its liquefaction facility on December 10, 2008, and British Columbia Provincial Government approval on January 9, 2009. Kitimat LNG expects to begin construction in 2009, with commercial operation scheduled to begin by year-end 2013. The Kitimat LNG project will utilize natural gas transported via pipeline from Western Canada to the Kitimat LNG Terminal. At the terminal, the natural gas will be liquefied for export via ship to the growing Asian energy markets. If constructed, the Kitimat LNG terminal will be the only LNG export facility in North America since the Alaskan LNG liquefaction plant began operation in 1969.

Combined, these LNG import facilities would provide a new source of natural gas supply for Canadian consumers, direct economic benefits in the form of employment and taxes, and an opportunity for Canadian pipelines to expand. In addition to the approximately CDN $500-1,000 million each in investment, the development of any Canadian LNG import terminal will require access to pipeline infrastructure to deliver natural gas from the LNG terminal to consuming markets. In some circumstances, this will mean the expansion, extension or reversal of an existing pipeline system, while in other cases, this will require that a new pipeline system be built. Continuous development of LNG import facilities will widen access to LNG supply in the world market.

NOTABLE ENERGY DEVELOPMENTS

NEW CLEAN ENERGY TECHNOLOGY INVESTMENT[19]

The Government is providing direct support for the research, development, demonstration and adoption of new technologies through a number of mechanisms, including:

- **ecoENERGY Technology Initiative (ecoETI):** ecoETI is investing $230 million over 4 years (2007-11) to increase clean energy supplies, reduce energy waste and reduce pollution from conventional energy. The initiative is committing to funding two areas: 1) technology development to reduce the environmental impact of oil sands; and, 2) carbon capture and storage technologies to reduce greenhouse gas emissions from oil sands and coal-fired electricity plants.
- **Carbon Capture and Storage (CCS):** The Government of Canada and the Government of Alberta established the Canada-Alberta ecoENERGY Carbon Capture and Storage Task Force which identified regulatory, economic and technological issues that require resolution in order to accelerate the deployment of CCS technologies. The Government is also providing $240 million to Saskatchewan for one of the world's first and largest full-scale commercial demonstrations of CCS at a coal-fired electricity plant. An additional $10 million has been allocated for CCS-related activities: $5 million to Nova Scotia to examine potential for carbon storage and $5 million to the Institute for Sustainable Energy,

[19] "Minister Lunn Announces New Clean Energy Technology Investments." News Release dated on April 4, 2008, by Natural Resources Canada.

Environment and Economy (University of Calgary) for collaboration with stakeholders on regulatory, economic and technological issues.

- **Clean Energy Research, Development and Demonstration:** In its most recent Budget, the Government of Canada provided $1 billion for a Clean Energy Fund to support the research, development and demonstration of clean energy technologies, including large-scale CCS.
- **Biofuels**: Through its Renewable Fuels Strategy, the Government has committed to accelerate the commercialization of new technologies by providing $500 million to Sustainable Development Technology Canada. The NextGen Biofuels Fund will invest with the private sector in establishing large-scale facilities for the large scale demonstration of next-generation renewable fuels.

ENERGY EFFICIENCY ACT[20]

To increase its scope and effectiveness, amendments of the *Energy Efficiency Act* will be made. One of the important provisions is to provide the authority to regulate standby power consumption in an effective manner. Standby power consumed is estimated to account for as much as 10 percent of household electricity use in Canada. With implementation of the amendments, Canada will become one of the first countries in the world to be able to introduce comprehensive standards to regulate the amount of standby power consumed by many products – such as computers, battery chargers, CD players and televisions – when they are not in use. The Tenth Amendment to the Energy Efficiency Regulations was published in the Canada Gazette on December 24, 2008. This amendment includes standards for general service lighting and furnaces that are among the most stringent in the world. The lighting requirements will come into effect throughout 2012 and will eliminate trade in the standard incandescent light bulbs in use today.

Furthermore, the well-known EnerGuide label will be improved to make it even easier for Canadians to make informed choices when shopping for products that use energy. The amendments will also make it possible to prescribe standards not only for more products that use energy but also products, such as thermostats, that affect energy use. Other provisions of these amendments will also ensure a level playing field for dealers of all products subject to the regulations.

The Minister of Natural Resources will be required to submit an energy-efficiency progress report to Parliament every three years. This report will compare the stringency and comprehensiveness of energy-efficiency standards in Canada with those in other North American jurisdictions.

ECOENERGY RETROFIT INCENTIVES[21]

The ecoENERGY Retrofit Incentive has expanded its target to now include businesses and public institutions that own, manage or lease buildings with up to 20,000 square metres of floor space, as opposed to the original 10,000 square metres, can now join homeowners and industry in applying for federal funding to invest in energy-saving upgrades, such as installing efficient lighting, building automation control systems or upgrading heating, ventilation and cooling systems. The increase in size expands the scope of eligible buildings, which includes hotels, motels, churches, hospitals, recreational complexes, and schools, just to name a few. Multiple buildings, such as those on a university campus, can be included in a single project.

[20] "Using Less, Living Better: Government of Canada Modernizes Energy Efficiency Act." News Release dated on June 3, 2008, by Natural Resources Canada.

[21] "ecoENERGY Retrofit Incentives Expanded to Include Larger Buildings." Natural Elements, Issue 28, August 2008. Natural Resources Canada.

This ecoENERGY Retrofit program will result in substantial energy use reductions. By March 31, 2011, it is estimated to help reduce 12.7 million GJ of energy and 1.0 mega tonne of greenhouse gases across its three targeted areas (homes, buildings, industry).

In Budget 2009, the Government of Canada allocated new funding to the ecoENERGY Retrofit program to support an estimated 200,000 additional home retrofits which will further help reduce energy use.

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CHILE

INTRODUCTION

Chile is one of the two APEC economies in South America. Located in southern South America, it is bordered in the north by Peru, in the west by Bolivia and Argentina, and in the south and west by a coastline of 6,435 km against the southern Pacific Ocean. Its area covers nearly 756,102 square kilometres. Administratively, Chile is divided in fifteen regions, which are subdivided in 53 provinces and 346 communes. Total population in 2007 was 16.59 million people, with 40.2 percent living in the Santiago Metropolitan Area and 13 percent, or2.17 million, living in rural areas. Regions with major population are Maule (33 percent) and La Araucania (32 percent). From 1997 to 2007, Chile's population increase 12.1 percent, and population in Chile for 2050 is expected to be 20.2 million. The population density is 22 people per square kilometre; but 433.2 people per square kilometre in metropolitan areas.

Chile's GDP in 2006 reached US$184.03 billion with GDP per capita of US$11,199, both in terms of purchasing power parity (PPP) in 2000 US$. The economy grew at an average annual rate of 4.96 percent during the period 1980 to 2006, and grew 3.97 percent between 2005 and 2006. Mayor contributions came from the manufacturing industry, with an economy participation of 16.5 percent in 2006. Other economic sectors making important contributions to GDP include financial services and personal services, with 15 percent and 10.9 percent share respectively. Global economic growth has helped boost export demand, particularly for copper. In 2006, the president of Chile established an Economic and Social Stabilization Fund to hold excess copper revenues to maintain social spending during periods of shortfalls in copper revenues. This fund surpassed $20 billion by the end of 2007. Chile continues to attract foreign direct investment, mostly focused in developing gas, water, electricity and mining.

Chile deepened its longstanding commitment to trade liberalization with the signing of a free trade agreement with the US, which took effect on 1 January 2004. Chile claims to have more bilateral or regional trade agreements than any other economy. It has 57 such agreements (not all of them full free trade agreements), including with the European Union, Mercosur, China, India, South Korea, and Mexico.

Chile has very limited indigenous energy resources and has to rely on imports to meet all of its energy needs. At the end of 2007, its energy of proved reserves consisted of 150 million barrels (Mb) of oil, 3.46 trillion cubic feet (tcf) of natural gas and 1,302 million tonnes (Mt) of coal. In 2007, roughly 32 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 (2006)

Key data		**Energy reserves**	
Area (sq. km) *	756,102	Oil (Mb) – Proved **	150.00
Population (million)	16.43	Gas (TCF) – Proved **	3.460
GDP Billion US$ (2000 US$ at PPP)	184.03	Coal (Mt) ***	1,302
GDP per capita (2000 US$ at PPP)	11,199		

Source: Energy Data and Modeling Center, Institute for Energy Economics, Japan (IEEJ).

* Compendio Estadístico del Año 2007, Instituto Nacional de Estadística de Chile (INE).

** Oil & Gas Journal, Vol. 105.48, December 24, 2007.

*** Corresponding data for 2005, Energy Information Administrations (EIA), DoE, US, 2005.

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)[22] grew at an average annual growth rate of 4.08 percent from 1980 to 2006. In 2006, TPES reached 30,436 kilo-tonne oil equivalent (ktoe), of which 41.1 percent comes from crude oil, 23.2 percent from natural gas, 11.3 percent from coal and 24.3 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. However, most primary energy supply comes from imports; at the end of 2007, imports represented 65 percent of total supply while domestic production reached 35 percent or about 9,690 ktoe.

CRUDE OIL AND PRODUCTS

Chile's dependence on imported energy had been increasing for many years. In 2007 crude oil imports was 98.8 percent of the gross consumption or 79.04 Mb, while domestic production reached only 1.2 percent of the total or 0.97 Mb.

Empresa Nacional del Petróleo (ENAP), a state-owned enterprise, is the major oil producer and refiner in Chile. ENAP has played a crucial role in the development of the Chile's Energy Policy by taking the leadership in two ways: covering diesel demand during the shortage of natural gas from Argentina, and leading major investment projects aimed to diversify the Chilean energy matrix. During 2007, ENAP implemented projects in exploration and production, refining and commercialization of fuels, complementary activities such as the Liquefied Natural Gas Projects. On the other hand, ENAP's international arm, Enap Sipetrol S.A., holds equity in production operations in Argentina, Ecuador, Egypt and Iran.

Within the refining sector, there are three refineries in Chile: Bío-Bío refinery (113,400 bpd throughput capacity), Aconcagua refinery (97,650 bpd) and Gregorio Magallanes refinery (15,750 bpd). In 2007, total processing of crude oil was 201,664 bpd; 7 percent less than 2006. The origin of the crude oil used by ENAP's refineries was as follows: South America (59.8 percent), Africa (21.9 percent) Asia (17 percent) and domestic supply (1.3 percent). In the same year, consumption of refined petroleum products in Chile reached 329,200 bpd, showing a high increase of 30.5 percent over the previous year. This increase is explained by greater fuel consumption (particularly of diesel) in replacement of natural gas from Argentina. Diesel consumption increased 51.9 percent, reaching 163,400 bpd, and resulting from its increasing use as fuel for power generation. Another refined product with an important increase was fuel oil, for which consumption reached 46,600 bpd, representing 28.6 percent annual growth. In the case of liquefied gas and kerosene, consumption reached 34,400 bpd and 18,300 bpd respectively; an increase of 14.7 percent for liquefied gas and 11.6 percent for kerosene over 2006. Likewise, gasoline consumption grew 6.5 percent totaling 53,800 bpd.

During 2007, exportation of crude oil products by ENAP was 1.8 million cubic metres (mcm), representing 13.6 percent of the total production of refineries and a decrease of 33.5 percent from the year before. Central America was the main destination, accounting 41.2 percent of total exportations. The most important products were gasoline and fuel oil, with 95.5 percent and 2.7

[22] The Energy Balance 2007 is available for updated data (year 2007) at Comision Nacional de Energia (CNE). However, data (year 2006) was used to keep consistency among economies.

percent respectively. Peru was the second destination for ENAP's exports, with 22.5 of the total, and gasoline account for 27.8 percent and diesel for 72.2 percent. The third destination was United States, with a total exportation of 387,100 cubic metres, followed by Ecuador and Argentina with 175,000 and 81,000 cubic metres respectively.

Table 8 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	9,691	Industry Sector	8,442	Total	55,320
Net Imports & Other	22,368	Transport Sector	8,152	Thermal	23860
Total PES	30,436	Other Sectors	6,126	Hydro	28,779
Coal	3,441	Total FEC	22,720	Nuclear	0
Oil	12,522	Coal	865	Others	2,680
Gas	7,071	Oil	11,952		
Others	7,402	Gas	1,321		
		Electricity & Others	8,582		

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

NATURAL GAS

Chile's natural gas production comes from onshore and offshore facilities of the XII Region de Magallanes. Natural gas proved reserves are estimated at 3,460 billion cubic feet at the end of 2007. Chile has a high demand of natural gas and its domestic production does not satisfy internal consumption. Imports of natural gas come totally from Argentina, but Chile has confronted important restrictions of natural gas supplies from Argentina starting in 2004, with supplies declining during 2007 to almost 50 percent of the total volume previously supplied and decreasing diring 2008 down to only 5%.

In 2007, natural gas in Chile represented 21 percent of the total domestic primary energy production at 2,313 mcm. ENAP's natural gas production was 2,094 mcm, representing a decrease of 21.7 percent compared with production achieved in 2006. This drop was mainly explained by schedule production stoppage for preventive purposes in the Magallanes Area, in Argentina, and lower production in the mainland of Magallanes, Chile. Lattes production, however, increased 8.5 percent over the previous year. The drop in Chile's Magallanes basin was due to lower production volume in Daniel, Dungeness and Posesion fields in the mainland.

In terms of overall natural gas supply, Chile is a net import of natural gas. In 2007, imports of natural gas reached 3,120 mcm or 57.4 percent of the economy's total natural gas supply. From 2006 to 2007, however, total consumption of natural gas showed an important drop of 41 percent. This drop was mainly a result of dramatic restrictions imposed by Argentina on natural gas imports to Chile. These restrictions had a major impact on several productive sectors, affecting operational and financing costs for power, mining and manufacturing companies, including ENAP's refineries which were forced to replace natural gas with other fuels in their processes.

COAL

In Chile, four regions have the most important production of coal: Bio-Bio region, La Araucania region, Magallanes y Artartica region, and the last one Isla Riesco project. Coal reserves are estimated about 1,300 million short tonnes. At the end of 2007, coal production was 243 thousand tonnes and accounted for around 54 percent of the total domestic primary energy supply in Chile, an increase of 18.7 percent from 2006. Chile is a net import of coal with imports totalling about 5,859 thousand tonnes in 2007. These imports are supplied by Canada, Indonesia, Australia,

Colombia, New Zealand, Argentian and USA. Coal is mostly used for transformation, specifically for electricity generation, accounting for 89.2 percent of total consumption.

ELECTRICITY

In 2007, Chile's electricity installed capacity was 13,911 MW, which is divided into two types: public service and self-suppliers. Public service represents the 92.4 percent and self-suppliers 7.6 percent. On the side of public service, electricity is provided by four separate power grids: Sistema Interconectado Central (SIC), Sistema Interconectado del Norte Grande (SING), Sistema Aysén and Sistema Magallanes. SIC is the most important and it has over 65 percent of the total installed capacity in Chile with about 9,118 MW. SING is the second larger installed capacity, with 3,602 MW (about 26 percent). Sistema Aysén and Sistema Magallanes, the other two grids, represent only a small portion of the overall installed capacity.

Over the last two decades, hydropower has accounted for the bulk of electricity installed capacity. At the end of 2007, hydropower represented 36 percent of the total capacity. Thermal power, however, is becoming more significant, and it has shown an increase of more that 344 percent from 2,004 MW in 1990 to 8,898 MW in 2007.

The total power generation for 2007 was 60,138 GWh, of which 62.1 percent came from thermal power generation and 37.9 percent from hydropower. Most of the power was generated by public service, with 93.7 percent of the total generation. SIC generated the most electricity at 42,035 GWh, or around 70 percent of the economy's total generation. SING came in second with 13,928 GWh. The other two public services (Sistema Magallanes and Sistema Aysén) accounted with 0.4 and 0.2 percent of the total respectively. In the case of self-suppliers, for 2007 their total generation reached 3,785 GWh or 6.3 percent of the total, and thermal power made a major contribution with around 87.4 percent.

Chile has a very small portion of electricity generation by renewable energy. Within Sistema Aysen, an installed capacity of 20 MW from wind power was considered. During 2007, this installed capacity could generate 11.2 GWh of electricity. Late in 2007, the first wind power plant was commissioned in the SIC system, with an installed capacity of 18.15 MW

On the side of exports and imports, Chile does not present electricity exports; however the economy has grid connections with Argentina. In 2007, electricity imports from Argentina reached aout 1,627 GWh.

RENEWABLES

Renewable energy makes a large contribution to domestic energy production in Chile; it reached 75 percent of the total domestic production in 2007, an increase of 5.4 percent from 2006. Renewable energy resources come from hydro and wood. In comparison with crude oil, total production of wood equated to 35.9 million barrel crude oil equivalent (Mbcoe), while crude oil production was only 0.97 million barrels in the same year. On the other hand, wood accounted for about 19 percent of the Chile's total energy supply (including imports of crude oil and others); however it still represents a considerable energy resource within its energy mix. About 90 percent (12,756 thousand tonnes) of the total wood supply was for final consumption; commercial and residential sector and industrial and mining sector had a consumption of 8,388 and 4,368 thousand tonnes respectively. Chile does not have nuclear and geothermal power generation; however studies have been implemented by the Chilean government in order to examine potential for both these resources.

FINAL ENERGY CONSUMPTION

Chile's total final energy consumption (TFEC) grew at an average annual rate of 3.96 percent from 1980 to 2006 and reached 22,720 ktoe in 2006. The TFEC increased by 4.23 percent between 2005 and 2006. The main energy consuming sectors were industry and mining (37.1 percent) and transport (35.8 percent), with residential, commercial and public sectors consuming 26.9 percent.

By energy source, oil products accounted for 52.6 percent of final consumption, and electricity and "other" sources, natural gas, and coal at 37.5 percent, 5.8 percent, and 3.8 percent, respectively.

The transportation sector has recently been the fastest growing end-use sector, with an average increase of about 4.9 percent per year from 1980 to 2006.

The industry sector, on the other hand, grew by an average annual rate of 4.4 percent from 1980 to 2006 which was driven by both energy-intensive and non-energy-intensive industries. Booming prices for Chile's mineral exports, especially copper, became 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 resulting in higher energy consumption from these sectors.

In the residential, commercial and public sectors, growth in energy consumption averaged about 2.5 percent per year from 1980 to 2006. The residential, commercial and public sectors accounted for almost 26.9 percent (6,126 ktoe) of the total energy consumption in 2006.

POLICY OVERVIEW[23]

NATIONAL ENERGY POLICY FRAMEWORK

In Chile, private investment and sector's initiatives are the current energy policy, and the State has the role for the encouragement of free competition as well as to play an essential subsidiary in order to achieve the economic and social development of the country.

The Chilean 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. This dependency to put the country at risk not only on the supply side, but as well to the impact of international prices by volatilities and increases, as well as by the exclusivity of natural gas suppliers.

In this context, the Chilean government has been development several energy policy initiatives through coherent and systematic actions to achieve the higher objectives which correspond to an integrated vision: self-supply, efficiency, security, sustainability and equity. This framework leaves a series of immediate challenges for the long-term energy policy as:

1. To cover oneself energy requirements in a growing country
2. To restrict energy demand to cover strictly the needs
3. To diversify the energy matrix to eliminate supply and prices risks
4. To support competitiveness by the energy reduction
5. To link the energy development with local development and environmental protection
6. To minimize risks and impact of climate change
7. To take advantage of international opportunities (technology advances, public policies, integration, etc.)
8. To guarantee the equitable supply to all population
9. To be ready to confront critical situations of supply and prices

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

10. To have a required normative framework and institutionalism to respond to new challenges

The regulatory framework for Chile's electricity sector (General Electric Service Law of 1982, amended principally by the Short Law I of 2004, Short Law II of 2005 and the Law of Renewable Energy Use of 2008) provides adequate incentives for private sector investments in electricity projects.

The General Electric Service Law regulates the markets for generation, transmission and distribution of electricity. The dealership system is regulated for this law as well.

The Short Law I modified transmission, creating incentives for investments in this segment of the industry. The Short Law II, on the other hand, creates 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[24].

Creation of the Ministry of Energy in Chile

The energy policy requires the reorganization of the sector, establishing an adequate separation of functions among policy developments, the technical-economy regulation and the finances, as well as the coordination of formal mechanisms with the environmental policy and the regional articulation. For this reason, in the future, centralization of development functions, proposals and evaluation of energy public policy are proposed (implementing plans, programmes, technical regulation) in the CNE and the CCHEN (by its acronym in Spanish: Comisión Chilena de Energía Nuclear) as well as the overseeing by the SEC (by its acronym in Spanish: Superintendence of Electricity and Fuels). Additionally, the Chilean Energy Efficiency Agency will begin operations in 2009 (as a public-private organization), which will be focused for the implementation projects and advisory of the design of energy policies by means the practice experience. Another organization is the Renewable Energy Centre (CER by its acronym in Spanish) which principal objective will be to share information within the country by the identification of clean technologies developments and the best practices for the use of renewable energy around the world, achieving its development and promotion in the country.

The Mining and Energy Commission of the Chile's Deputies Chamber approved in 2008 the creation of the Ministry of Energy.

The new Interministerial Biofuels Comission

Biofuels are receiving special attention in Chile, driven primarily by the desire to reduce dependence on imported fossil fuels. 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. Finally, in 2008, the Chilean government has created the Inter-ministerial Biofuels Commission[25] (it will be presided by the new Ministry of Energy) and its mission will be to bring concrete actions, plans, policies and development of the value chain as well as other activities, to all ministries of state and public institutions.

Law of Renewable Energy Use

In 2007, the Government submitted a modification of the Electric Law to Congress, with the objective of accelerating the development of non-conventional renewable energies. This initiative has been a priority in the government's energy policy as a complementary measure to address

[24] 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.

[25] Biofuels Commission will be integrated by the Ministry of the Interior, Ministry of Finance, President General Secretary, Ministry of Education, Ministry of Agriculture, Ministry of Environment, Ministry of National Goods, Ministry of Economy, Ministry of Transport and Communications.

energy security. Finally, Chile's Congress voted in March 2008 to require electric utilities to invest in and supply non-conventional energy sources (NCES) as part of the government's drive to diversify current tight energy supplies. The vote in favor of the project, which mandates that NCES account for at least 5 percent by 2010 and 10 percent of the energy supplied by Chile's electric utilities by 2024, was unanimous.

ENEGY EFFICIENCY PROGRAMME

The Energy-Efficiency Programme (PPEE, by its acronym in Spanish: Programa Pais de Eficiencia Energetica) 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. Twenty-seven different institutions from the public and private sectors are currently collaborating in a coordinating committee under the auspices of the PPEE.

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 "decouple" energy consumption from economic growth. Developed countries have been successful in reducing the growth in energy consumption to rates that are considerably lower than the expansion of their economies.[26] The Chilean government by means CNE, examined different initiatives they could implemented and, on the basis of this information, estimated that an active energy efficiency policy could mean around 1.5 percent annual reduction in the total energy consumption. The most important measures envisaged under the PPEE include:

- An active media campaign managed by the National Consumer Service, the Ministry of Economy and the CNE
- Preparation and launch of a manuals on Efficient Use of Energy (Industrial, Procurement, Construction,etc.)
- Compulsory labeling of refrigeration, light bulbs and other artifacts with information about their energy consumption
- Incorporation of energy efficiency parametres in public procurement decisions
- A manual for the introduction of efficient street lighting (prepared by the CNE, SEC, the UN Development Programme (UNDP) and the Chilean Association of Municipalities
- Incorporation of energy efficiency considerations in the design and construction of public buildings and works
- New insulation standards for housing
- Audit and certification of public buildings
- Energy efficiency incentives for companies; and
- Incorporation of energy efficiency into Clean Production Agreements.

NATIONAL ENERGY BUDGET

The Chilean government announced the major budget assigned to the Comisión Nacional de Energía (CNE) for 2009 will be 30,348 million Chilean pesos (around US$ 60 million at 2007 exchange rate). This budget has been assigned to strengthen Chile's energy policy for energy efficiency, institutional strengthen, and the development of non-conventional renewable energies.

[26] 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.

Most of the budget is assigned to the PPEE, with 19,414 million Chilean pesos (around US$ 31 million) or 64 percent of the total budget.

With this budget, PPEE has established new programmes in Chile's energy policy. The first one is the Thermal Reconditioning of Existent Households Programme, which it will improve the energy efficiency of 10 thousand households; during 2009, this programme will have a budget of 5,622 million Chilean pesos (around US$ 11.1 million). The second programme is the Trucks Changing Programme with 4,248 million Chilean pesos (US$ 8.4 million) budget and taking the initiative to change all trucks that are more than 25 years old. The third is the Motors Changing Programme, announced by a presidential message on May 21, 2008, to create a subside programme for buying electric-efficient motors by PYMES. A fourth one is a CFL programme with an attached CDM programme for the voluntary market, and finally, a budged of US$ 3.2 million to improve the energy efficiency of the municipal streetlight programmes.

On the other hand, another programme, the Development of Non-Conventional Renewable Energies Support Programme, is also funded by the national budget. The programme was created in 2008 and has a budget for 2009 about 4,148 million Chilean pesos (around US$ 8.2 million). Likewise, within this programme a new Non-Conventional Renewable Energy Studies Centre is being designed, to improve the information available on renewable resources in Chile, creating new support instruments, encouraging the development of non-conventional renewable energy projects associated to irrigation infrastructure, on government land and in the rural areas including schools and health centres.

In addition, the government will assign US$ 400 million during 2009 which will be available in a national fund (CORFO) for the promotion of New Renewable Energies, with which a guarantee fund for investments in non-conventional renewable energies and support instruments for the development of transmission infrastructure for non-conventional renewable energy projects and to reduce the risk associated with geothermal exploration.

Furthermore, at the end of 2008, the Government sent Congress a Hill to support the development of solar water heaters, which would permit the creation of tax incentives for construction companies that include this technology in new households.

With the purpose to strengthen the CNE's institutional performance, a budget of 6,786 million Chilean pesos (US$ 13.4 million) was assigned for the creation of the Chile's Ministry of Energy, which will has the objective to develop energy policy studies at middle term and long term.

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 more costly diesel for electricity generation. In addition, plans for an LNG import depot have been decided to help stabilize the supply of natural gas in the near future. One of them is Quintero Plant which will start operations in the second half of 2009 with LNG supplied by BG Group, and the another one is Mejillones Plant which will start operations in January 2010 with Suez International as LNG supplier.

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, Chile with a capacity of 810 million standard cubic feet per day (mmsfd). 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.

CRUDE OIL PROJECTS

Investments made in 2007 by ENAP and its subsidiaries exceeded US$ 400 million, an increase of 45 percent over 2006. From the total investment, US$ 236 million was used for Exploration & Production (E&P) and US$ 164.4 million for Refining & Logistics (R&L). Investments made abroad through the subsidiary Enap Sipetrol S.A. reached US$ 140 million. Investments made in Chile amounted to US$ 96 million, comprising of projects undertaken in Magallanes and for the geothermal companies in which ENAP has a stake.

During 2007, R&L line concluded important projects. One of them was the "Low sulfur diesel production" in Bio Bio refinery, involving an investment of US$ 60 million, with the purpose of increasing diesel production capacity and improving its quality. On the other hand, in the same refinery, the FCC Naphta Desulphurization Unit project was scheduled for the first quarter of 2008 with the purpose to reduce the sulfur content in gasoline. Also, there is a study under way concerning the "Expansion of the Refining Capacity", which includes a technical and economic pre-feasibility study to expand oil secondary processing capacity. In the same year, the "Front-End Engineering and Design" project at the Aconcagua Refinery was concluded in order to estimate the economy profile for the installation of a new alquilation unit. Another important project at the same refinery was the study of the expansion of the low sulfur diesel production capacity from 3,500 cubic metres per day to 7,000 cubic metres per day.

LNG TERMINAL FOR PACIFIC LNG GAS

From 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 and 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. However, at the end of 2008 the new plant cost was revised at around US$950 million. In March 2007, BG Group and partners incorporated GNL Quintero S.A. and executed the shareholders' agreement. GNL Quintero S.A. is under construction and will own and operate a 2.5 mtpa LNG import terminal to be located in Quintero Bay, 110 kilometres from Santiago. The regasification plant will include two 160,000 cubic metre LNG storage tanks and will have an initial send-out capacity of 340 mmscfd on a sustainable basis and 510 mmscfd on a peaking basis, the equivalent of approximately 40% of the economy's demand for natural gas. GNL Quintero S.A. is progressing with the construction of the terminal, which is scheduled to be completed during the third quarter 2010, with early operations scheduled for the end second quarter 2009

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. In October 2007 contracts were signed with CODELCO and Suez Energy as partners in the regasification terminal and with Suez International as the LNG supplier. Investment in the terminal is up to US$500 million for a designed capacity of 194.2 mmscfd output (jetty, onshore regasification battery and permanent ship used as FSU). The terminal is under construction and it is scheduled to be completed at the beginning 2010. Partners are analyzing the feasibility of construction of a 5.6 mmscf LNG onshore storage tank to extend the operation of the terminal beyond 2012 (final year of operations scheduled in the current contracts). Decision for construction depends on the possibility of committing long-term contracts with final clients, mainly mining companies in the north of Chile, which are the major consumers of the electricity generated with LNG in combined cycle power plants.

ELECTRICITY

A number of important developments in the electricity sector in Chile were made in 2007. In the SIC grid alone, around of 735 MW of installed capacity were developed during the same year. The most important projects (considering its installed capacity) were the Central Térmica San Isidro II (with 248.3 MW of installed capacity in poen cycle), the Central Térmica Los Vientos (with 125 MW of installed capacity) and the Central Térmica Campanario (with 118 MW of installed capacity), among others. In the case of hydropower plants, the Central Hidraulica Palmucho began operations in November 2007 with an installed capacity of 32 MW, while the Central Hidráulica Chiburgo with 19.4 MW of installed capacity began operations in July. Also, a small wind power plant (Central Eolica Canela) with 18.2 MW of installed capacity began operations in December 2007.

On the other hand, in October 2007, the Regional Commission for the Environment (COREMA) of Valparaiso, approved the project involving the construction of the combined cycle power plant (CC) which will provide electrical autonomy and steam to the Aconcagua refinery, as well as electricity to the Central Interconnected System (CIS). This project is sponsored by ENAP and Empresas COPEC.

RENEWABLE ENERGY

A strong boost to renewable energy for electricity generation came with modification in 2004 of the law for the electricity sector which removed barriers for the incorporation of small plants (9 MW and below) into the generation mix through simplified commercial and operation regulations in the electricity markets and distribution systems. The streamlining of the law has been a key issue in the policy of the CNE to allow generation projects using non-conventional renewable energy to be competitive, given that many of these projects are below 9 MW, mainly hydraulic and biomass/biogas, and some wind.

Between 2004 and 2008, environmental impact studies have been submitted for 19 ARE projects, representing a total capacity of 1,542 MW (29 small-scale hydro plants, 6 biomass projects and 18 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.

In the case of geothermal projects, important projects in exploratory activities are developing in Chile. ENAP is participating, through Empresa Nacional de Geotermia S.A. (ENG) and Geotérmica del Norte S.A. (GDN) and others, in order to confirm the presence of potential reservoirs for power generation within the Chillan and Calabozo projects (in the XII region of the economy), and in Apacheta and El Tatio-La Torta projects (in the north).

For biofuels, Chilean government has increased their attention for its development and they seem determined to develop a biofuels industry. Currently, there is no production or consumption of biofuels in Chile. According to preliminary estimates, there are 170,000 hectares (ha) in Chile that could be farmed to produce the traditional raw materials for biodiesel and ethanol. An introduction of E10 (a mix of 10 percent ethanol and 90 percent gasoline) in Chile would require 360,000 ha of arable land (corn) and 404,000 ha (raps) for B10 (10 percent biodiesel and 90 percent petroleum diesel). In the period 2008-2009, the government destined US$ 12 million fro innovation and development of second generation biofuels.

The government plans to introduce voluntary E5 (5 percent ethanol and 95 percent gasoline) and B5 (5 percent biodiesel and 95 percent petroleum diesel) production in 2008 as part of a trial programme. The blending could occur at refineries, such as ENAP or at point of distribution, such as Copec, which holds 50 percent of the market.

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 Clean

Development Mechanism (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 in joint coordination with Environmental National Comission (CONAMA) and the German Technical Cooperation (GTZ), in the document "Guía del mecanismo de desarrollo limpio para proyectos del sector energía", as a way of providing local and foreign investors 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.

As of September 2007, there were eight energy-related CDM projects in Chile, according to the UNFCC database, with expected total emissions reductions of about 1.5 million tonnes of CO_2 per year. The breakdown of the projects is as follows: (i) 3 projects on electricity production from biomass (333,392 tCO_2/year); (ii) 3 hydropower projects (578,456 tCO_2/year); (iii) 1 landfill gas project (582,425 tCO_2/year); and, (iv) 1 cogeneration project (2,226 tCO_2/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 Northeast Asia, and is 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 far lower than many developed economies and below the world's average.

China has sustained high rates of economic growth, around 10 percent, for more than 20 years. In the late 1990s, however, 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, industrialisation, urbanisation and motorisation, energy consumption has grown rapidly. In 2006, the energy consumption growth rate amounted to 7 percent. GDP per capita in 2006, however, was still quite low at US$ 3,992 (in 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 182.54 billion tonnes (Bt), proven oil reserves of 2,200 million tonnes (Mt) and proven natural gas reserves of 2,450 billion cubic metres (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 (2006)

Key data		Energy reserves*	
Area (sq. km)	9,600,000	Oil (Million tonnes) – Proven	2,200
Population (million)	1,311.80	Gas (BCM) – Proven	2,450
GDP, Billion US$ (2000 US$ at PPP)	5236.21	Coal (Bt) – Recoverable	182.5
GDP per capita (2000 US$ at PPP)	3,992	Hydro ((GW) - Potential)**	400

Sources: Energy Data and Modelling Center, IEEJ.

*Proved reserves, *BP Statistical Review of World Energy 2008*; Ministry of Land and Resources P.R.C

** Source: Embassy of the People's Republic of China in the United States of America[27]

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

China's primary energy supply has expanded sharply since 2001, driven mainly by rapid growth, especially by the energy consumption of heavy industry. In 2006, the total primary energy supply

[27] Embassy of People's Republic of China website. http://www.china-embassy.org/eng/xw/t168257, retrieved on 28 October 2008.

(TPES) reached 1,681 Mtoe. Of this total, coal accounted for 74.5 percent, oil for 13.2 percent, and natural gas for 3.9 percent, while hydropower, nuclear power and other sources accounted for the remaining 8.4 percent.[28]

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), introducing energy efficiency initiatives (to reduce pollution and emissions from energy use) and optimising existing energy structure. The use of 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 2006, coal production reached 1,222 Mtoe and climbed to 1,768 Mtoe[29] in 2007, reaching a new historic high.

The supply of petroleum products in 2006 grew by about 1.5 percent compared with the preceding year while domestic oil output also increased slightly to 263 million tonnes; China imported approximately 144 Mtoe of oil.[30] Import dependence on oil reached about 46 percent of total oil consumption in 2006. Primary natural gas supply totalled 52 Mtoe in 2006 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 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	1,536,025	Industry Sector	577,087	Total	2,865,726
Net Imports & Other	145,401	Transport Sector	116,023	Thermal	2,369,603
Total PES	1,681,044	Other Sectors	283,158	Hydro	435,786
Coal	1,222,426	Total FEC	976,268	Nuclear	54,843
Oil	349,864	Coal	375,586	Others	5,494
Gas	51,903	Oil	308,054		
Others	56,851	Gas	45,062		
		Electricity & Others	247,565		

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 623.7GW[31] at the end of 2006 with a corresponding growth in power generation to 2,834 TWh. By fuel type, 77 percent of the total installed capacity was from thermal plants, 21 percent hydro, 1

[28] The Industrial Map of China Energy 2007-2008.

[29] China Statistical Yearbook, 2008

[30] China Statistical Yearbook, 2008

[31] China Electric Power Yearbook, 2007

percent nuclear, and 1 percent other[32]. The corresponding shares of power generation were 83 percent for thermal power, 14.8 percent for hydropower, 1.98 percent for nuclear power and 0.22 percent for other.

FINAL ENERGY CONSUMPTION

Final energy consumption in China reached 976 Mtoe in 2006, or 10 percent higher than the previous year. Industry was the largest consumer accounting for 59 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 – at 29 percent. In terms of energy sources, coal (68 percent) remained the most important fuel in 2006, followed by oil (21 percent), electricity, heat and other fuel (8 percent), and natural gas (3 percent).[33]

Coal consumption in 2006 reached 375 Mtoe from 367 Mtoe in 2005. According to consumption by usage, the China's electricity and metallurgical industry sectors were the biggest coal consumers. In 2006, around 54 percent of coal consumption came from the power sector, followed by metallurgical industry sector (16 percent), building materials sector (13 percent), chemical sector (6 percent) and others (11 percent).[34]

Electricity demand increased by 14 percent from the previous year and reached 2,824 TWh in 2006. The high demand growth resulted mainly from the increase in consumption in commercial and residential, industrial and transport sectors at 15 percent, 14 percent and 12 percent respectively. The highest consumption for electricity was from the industrial sector at 75 percent, followed by the residential (12 percent), commercial (10 percent), and agriculture (3 percent) sectors.[35]

China consumed 308 million tonnes of oil in 2006, the second-biggest oil consumer behind the US. The industrial sector was the largest oil-consuming sector, accounting for 43 percent of total final oil consumption. The transport sector, the second largest oil consumer and the fastest-growing oil consuming sub-sector, accounted for 30 percent of total oil consumption, an increase of 10 percent over the previous year.

The market for gas is resides mainly in Southeast China, which accounts for a third of total natural gas consumption. The market is moving, however, to North China and East China 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 35 percent of the total, followed by industrial feedstock (34 percent), city gas (23 percent) and power generation (5 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 industrialisation process. Energy has become an important strategic issue concerning China's economic growth, social stability and national security. According to the 11th Five-Year Plan, the government has set the target of decreasing energy consumption per unit GDP by 20 percent from the 2005 level through 2010; and reducing emissions of major pollutants by 10 percent through 2010. Energy consumption per unit of GDP in 2007, however, dropped by only 3.66 percent, a little behind the expected reduction at the beginning of the year. The failure could be explained by the slow industrial restructuring and overheated growth of heavy industry, in particular of energy-intensive industries.

[32] China Electric Power Yearbook, 2007

[33] The Industrial Map of China Energy 2007-2008

[34] The Industrial Map of China Energy 2007-2008

[35] The Industrial Map of China Energy 2007-2008

The energy consumption structure has been optimised; the proportion of high-quality clean energy consumption continues to increase, the proportion of oil and natural gas consumption rose from 19 percent in 1990 to 24 percent in 2006, and that of hydropower and nuclear power rose from 5 percent to 7 percent. Fast progress has also been made in energy-related technologies. Oil exploitation and development technologies, hydropower construction technologies, and overall mechanised coal exploitation technologies have reached the levels seen in many of the world's advanced economies. Progress has also been made in economising the use of energy resources and protecting the environment. The economy has intensified control of pollution avoidance in the energy sector.

Reforms of the energy sector have been pushed steadily. Positive achievements have been made in the management of energy and energy saving-related legislations have been noticeably intensified. To strengthen the coordination and decision-making, the new Chinese Government, elected out by the 11th National People's Congress, has established a high-level coordinating body - the National Energy Committee - which is in charge of drawing up the national energy strategy, and deliberating major important issues on energy security. At the same time, the National Energy Administration (hereinafter referred to as the NEA) was formed; the organisation is responsible for the development and implementation of energy industry planning, industrial policies and standards, and to assume the Office of the National Energy Committee. According to the State Council's approval, the NEA has been composed of a total of 9 divisions with 112 employees. The 9 divisions include: (1) comprehensive, (2) policies and regulations, (3) development and planning, (4) energy-saving technology and equipment, (5) electricity, (6) coal, (7) oil, (8) natural gas, and (9) new and renewable sources of energy. The role of NEA is to adjust the energy development strategy and planning, to develop energy policies and regulations, to promote the rational distribution of energy major projects, to strengthen the international energy cooperation, and to boost stable and healthy operation of the economy.

In January of 2008, China suffered from a most serious case of cold rain and snow disaster. In some areas there was large-scale power grids collapse, electricity supply break off, and oil products shortage brought by some other incidents such as railway transport artery blockage. Power and transportation disruptions exacerbated the shortage of coal and electricity and created tensions contradictory to national economic development and improving people's livelihoods. On 12 May 2008, China also suffered from an 8.0-graded earthquake in Wenchuan county, Sichuan province. In these two natural disasters, the Chinese energy industry withstood a severe test, which exposed its energy supply structure as irrational, with relatively low anti-risk ability.

Facing growing energy demand and rocketing international energy price (e.g. crude oil and coal), it is impossible for China to continue to follow the old path of extensive development at the expense of resources and the environment through increasing coal production to guarantee energy supply. The optimisation of energy structure, the development of wind power, hydropower and other high-quality energy has become imminent for the Chinese government. To optimise the energy structure, the fundamental way is to carry out the scientific concept of development focused on energy-saving. In order to build up an energy efficient society, the Chinese government will adopt four energy policies of "the adjustment of the industrial structure", "the improvement of the pricing and taxation system", "the upgrading of science and technology level" and "the strengthening of management".

Because of the world financial crisis, China economy has suffered a setback, which to some extent will limit the economy's fast growing need for energy. Chinese government will also consider the right time to make further adjusts to the energy industry, such as changes in the fuel taxation mechanism (see Notable Energy Development below for further details about the above-mentioned regulations).

COAL

The latest draft of the Law of Coal has been submitted to the State Council after three years' revision, and will be brought into effect after the adoption by the NPC Standing Committee. Compared with the current coal law, the revised version focuses on increasing the qualification

requirements needed for coal development and raising the ratio of industrial concentration, as well as proposes to establish a coal strategic resources reserve system. In addition, the amendments also classified the relative provisions on the utilisation of resources, environmental protection, protection of the rights and interests of employees, and industrial management. The draft clarified that National Energy Board and NDRC will serve as the main agencies of law enforcement.

In order to further improve the legislation for coal industry, *China Coal Legal System Framework Program* (hereinafter referred to as "the draft"), is going to be approved after collecting comments from the public. The draft puts forward a coal legal system framework program for the last three years of the 11th Five-Year Plan and also for the 12th Five-Year period; China's recent focus on the coal legislation is to establish a complete legal system for coal, which will fully protect the development of the Chinese coal industry and help it progress in a healthy and sustainable direction.

Mineral Resources of the National Planning has been proposed by experts and submitted to the State Council pending approval. It is reported that this Plan will inform China's strategic reserves of mineral resources planning, including efforts to conduct a comprehensive survey and to operate accompanied by observations on the ground. In addition to oil and other mineral resources reserves, special coal (such as coking coal) will be the forerunner of the strategic reserve.

OIL

National Standardisation Technical Committee for the Oil and Natural Gas Industry was set up on 9 May 2008, and indicates that China's oil and natural gas industry standardisation has entered a new stage of development. The Committee is mainly responsible for petroleum geology, oil exploration, oil drilling, logging, oil and gas field development, gas production, storage and transportation of oil and gas, oil and gas measurement and analysis, oil pipe, offshore oil engineering, production safety and environmental protection.

Beginning 20 June 2008, the benchmark gasoline and diesel oil retail price was marked up by CNY 1,000 (US$ 147) per tonne, with the price of aviation kerosene up by CNY1,500 per tonne. The prices of natural gas and liquefied petroleum gas, however, would be left unchanged. The benchmark retail prices of gasoline and diesel was lifted to CNY 6,980 and CNY 6,520 per tonne, up more than 16 percent and 18 percent respectively. The price rises translated to mark-ups of CNY 0.8 and CNY 0.92 per litre for gasoline and diesel respectively. The oil price adjustment was made to ensure adequate supplies in the economy, by diminishing the gap between rising international crude prices and state set domestic oil prices.

On 5 December 2008, based on the *People's Republic of China Highway Law* and other relevant regulations, the NDRC, Ministry of Finance, Ministry of Transport and the State Administration of Taxation drafted a proposal on a fuel tax reform program. According to the proposal, the main intention for the reform is to standardise government fees and charges, such as: the abolition of highway road maintenance fees; not increasing the current oil price on the premise of increasing the current refined oil consumption tax allowance units; raise the funds for the conservation and the construction of transport infrastructure according to the law; and to improve the oil pricing mechanism so as to smooth out oil prices.

Fuel tax reform includes two aspects. Firstly, the reforms will abolish all fees related to road maintenance, waterway conservation, road transport management, road passenger and freight surcharges, water management and water transport passenger and freight surcharges, as well as orderly and gradually cancel government approval of road charges on secondary loans. Secondly, the reforms will raise the gasoline consumption tax allowance from CNY 0.2 to CNY 1 per litre for gasoline and CNY 0.1 to 0.8 for diesel; the unit tax on other oil products will also increases similarly. For gasoline and diesel oil, such a consumption tax aims to implement a fixed amount of taxation rather than valorem taxation. After the increase of the oil tax, existing gasoline and diesel prices will not be increased.

NATURAL GAS

Since Shanghai raised the sales price of natural gas on 11 November 2008, more Chinese cities like Zhengzhou, Guangzhou may follow the example of Shanghai by raising the price of natural gas. The raising of price shows the Chinese government has been accelerating the establishment of a market-based pricing mechanism for natural gas products.

ELECTRIC POWER

The State Electricity Regulatory Commission (SERC) regulates electricity trading and ensures markets play a greater role in resources allocation. The concrete endeavours are: (1) continue the construction of regional electricity market platform and complete the regional electricity market model; (2) deepen cross-provincial power transactions standardisation; (3) promote direct transactions between power generating companies and large users and independent power T&D companies, thus creating bilateral trading markets; (4) build up the joint factory system for information sharing; and (5) improve the early warning system for the demand and supply of power and thermal coal.

To support the development of nuclear power, the Ministry of Finance and State Administration of Taxation jointly issued in April 2008 a notice about taxation policy for the nuclear power industry. According to the notice, sale of electric power generation products, from the next month that commercial nuclear power generating units are put into operation, will follow a unified policy of "reimburse after levying value-added tax". The returned proportion should be de-escalated according to the three-phase level category. Within the first 5 years, the ratio of return is 75 percent of the total tax.

DEVELOPMENT AND UTILISATION OF RENEWABLE ENERGY

China has decided to invest US$ 125 billion by 2020 to further explore its rich hydropower resources. As a clean and renewable energy resource, hydropower has become an important energy alternative, which is the second largest energy resource next to coal. The economy is to build more than 30 big hydropower stations in resource-rich regions, including eight on the central Jinshan River, and five on the western Lancang River. Chinese government will put the whole economy's hydropower exploitation under a unified program, and encourage social and individual investment in small hydroelectric projects.

In 2007, China's renewable energy projects reached a total investment of US$ 120 billion, ranking second in the world. With the added installed capacity of approximately 3,400,000 kilowatts, total wind power installed capacity has reached 6,000,000 kilowatts. Meanwhile, there was a total of 2,000,000 kilowatts of biomass power generation, methane-generating pits in rural China for 80,000,000 farmers, 1500 large-scale methane-generating pits, with an annual output of gas reaching more than 10 billion cubic metres. In addition, China has been speeding up the progress of solar photovoltaic power generation; in 2006, production capacity reached 2,000 megawatts.

ENERGY CONSERVATION AND EMISSIONS REDUCTIONS

The Year of 2008 can be called "Energy Saving Year", because the State Council issued several important laws and regulations on energy saving issues this year. Besides the *Energy Conservation law* (issued on 28 October 2007) taking effect on 1 April 2008, the State Council issued the *Public Sector Energy Saving Regulation* on 2 August 2008, which was then put into practice October 2008. On the same day, the General Office of Chinese State Council distributed the notice of *In-depth Development of Energy Saving Action to All Chinese People*. On 7 August 2008, the *Civil Energy Bill* was publicised. Besides, Chinese government also published a *Notification about Further Strengthening Fuel-Efficiency and Power-Saving*. (See notable energy development for further details about the above-mentioned new regulations)

Public Sector Energy Saving Regulation

Regulation requires public agencies to strengthen energy management, to take technically feasible and economically reasonable measures to reduce energy consumption, to stop the waste of energy and use energy more effectively and rationally. Measures include: (1) a person in a public body should be designated to be responsible for energy consumption statistics, recording accurately the energy consumption with raw data and statistical standing book; (2) every year before March 31, the public body should submit its previous year's report on the situation of energy consumption to the agencies who are in charge of the public body's administration; (3) a system of "target responsibility" and "evaluation" will be set up for the persons who are in charge of the public body and the completion of energy saving goal will be inclusive in the evaluation of the person in charge; (4) the public body should implement the system of energy consumption measurement, which can be used to distinguish between the types of energy consumption and the types of energy consumption system, using sub-metreing and real-time monitoring to identify and correct the waste of energy; (5) any unit or individual has the right to report the waste of energy to the relevant departments and the relevant departments should deal with it in a timely manner, the unit and individual will be praised by the government for their remarkable achievements in energy saving; and (6) the public body will face administration sanctions if they violate the above requirements.

In-depth Development of Energy Saving Action to All Chinese People

In order to ease the tension in energy supply, protect the environment, further enhance the people's sense of energy and energy-saving awareness, and build a resource-conserving and environment-friendly society, the State Council agreed to carry out energy-saving action, including the following: (1) directors in duty of energy-saving at all levels will experience lacking energy during the economy's annual energy-saving publicity week; (2) reduce a day of car driving every week; (3) strictly control the indoor air temperature to be no higher than 20 degree Celsius in winter and no lower than 26 degree Celsius in summer; (4) reduce the use of elevators; (5) control the use of street lighting and landscaping; (6) promote the use of energy-saving products by encouraging and guiding consumers to buy air-conditioner, refrigerator with the energy-efficient logo; (7) use the energy saving and environmental protection shopping bag; (8) reduce the use of one-time goods such as disposable chopsticks, paper cups, pens and so on.

Civil Energy Bill

The *Civil Energy Bill* encourages the use of solar, geothermal, and other renewable energy sources in new building construction, and includes: (1) the adoption of regional energy-saving standards for civil construction that exceed the national standards; (2) the requirement that governments at or above the county-level make special financial arrangement for energy saving technology research in civil construction and development of standards for both building envelope and heating system, as well as energy-saving demonstration project in civil construction; (3) the government improve the energy pricing mechanism, gradually implement the method in accordance with the heat charging system; (4) guidelines for the technology, technique, material and equipments requirements for new buildings; as well as (5) detailed legal liabilities for the violation of the Bill.

Notification about Further Strengthening Fuel-Efficiency and Power-Saving

The Notification is divided into four parts. The first part talks about the importance and urgency of fuel-efficiency and power-saving. The second part is about the main measures for fuel-efficiency and power-savings, which include regulations for vehicles, boilers, electrical system, air-conditioning and lighting power. The third deliberates the management of some high oil and power-consumption units. The final part exemplifies the role of organisation and leadership, namely the NDRC, the Ministry of Information Industry, the Ministry of Finance, the Ministry of Construction of Urban and Rural Housing, the Ministry of Transportation, the Ministry of Commerce, Administration of Taxation, General Administration of Quality Supervision

ENVIRONMENTAL PROTECTION

Department of Environmental Protection and the State General Administration of Quality Supervision, Inspection and Quarantine jointly issued the *Coal-bed methane (gas) emissions standard* (provisional), *Solid waste landfill pollution control standard*, *Heterocyclic water pollutant emission of industrial*

chemicals Standard and *Heavy-duty motor and gasoline engine vehicle exhaust emission limits and methods of measurement (China III, IV stage)*. These are the first national standards for environmental protection issued after the establishment of the Department of Environmental Protection this year.

In order to ensure the realisation of the 11th Five-Year Plan's environmental objectives, the Department of Environmental Protection prepared the *11th Five-Year Plan of National Environmental Monitoring Capacity-Building*. The Plan will have a total investment of CNY 14.959 billion for 50 key projects, of which the central government will invest CNY 7.847 billion. The 13-building tasks determined in the Plan include: (1) improving the quality of the environment monitoring network; (2) strengthening the supervision's ability to monitor and improve emergency response capacity; (3) upgrading the ability to monitor nuclear radiation; (4) improving the ability to manage and protect nature reserves; and (5) integrating the platform for building major research.

NOTABLE ENERGY DEVELOPMENTS

ENERGY DEVELOPMENT

The National Bureau of Statistics of China released a report on 30 October 2008, showing that since the reform and opening up, there was a significant development in China's energy industry. From 1979 to 2007, China's investment in the energy industry totalled CNY 8340.2 billion, with an average annual growth of 17.6 percent; the investment in the power sector has seen about an average annual growth of 19.3 percent. Through large-scale investment, China's energy supply has rapidly increased. In 2007, China's total energy production amounted to 2.35 billion tonnes of standard coal, which has enhanced its security role for national economic development. At the same time, China has progressed in terms of oil exploration and development, hydropower, and coal mining technologies. China also has progressed in terms of energy saving and environmental protection. In 2007, with State approval, there were 23,360,000 kilowatts of small thermal power that have been closed down. Compared with 2006, the coal consumption of coal-fired power plants with installation capacity of 6000 KW and above was reduced by 11g/kWh, and the loss of power grid transmission line was cut by 0.07 percent.

ENERGY STATISTICS SERVICE

In order to meet the need of energy statistics, from August 2008, a new division of energy statistics will be established under the National Bureau of Statistics. The duties of the Energy Statistics Division include collecting energy statistics (both national and regional), monitoring energy saving statistics of the main energy-consuming industries and enterprises, collating and providing information on survey statistics, and detecting the on-going situation of the economy.

ENERGY LAW

On 29 August 2008, the fourth meeting of the 11th National People's Congress Standing Committee voted to adopt the *Law to Promote Circular Economy*, which will come into effect on 1 January 2009. The law stipulates that the Chinese economic cycle should focused on "reduction", "recycling" and "change waste into resource", through lowering economic growth in the process of raising the utilisation rate of resources. The objective of *Law to Promote Circular Economy* is to promote a circular economy and enhance the efficiency of resource use, protect and improve the environment and achieve sustainable development.

Based on the law, the economic cycle is the collective call for quantity reduction, recycling and all activities of changing waste into resources in the process of production, circulation and consumption. Quantity reduction refers to reducing resource consumption and waste production during the process of production, circulation and consumption. Recycling means to re-use a waste directly as a product or through repair and renovation, and then be used for manufacturing products or as a part of the components. The Integrated Management Organisation of Circular Economy Development of the State Council will be responsible for the coordination, supervision

and management of the national circular economy development. The Ministry of Environmental Protection and other relevant authorities, in accordance with their respective responsibilities, will be in charge of the supervision and management of the promotional work. The law emphasises that the working-out of the national industrial policy should be in line with the development of circular economy. Enterprises and institutions should establish and improve the management system and take measures to reduce consumption of resources, reduce waste generation and emissions to increase the level of resource use.

COAL INDUSTRY DEVELOPMENT

China plans to close 4,000 small coal-mines before 2010; the total number of small coal-mines will then be below 10,000. Currently there are 16,000 coal-mines in China, and small coal-mines accounted for 90 percent. According to statistics, the death rate per million tonnes of small coal-mines was 8 times that of state-owned coal-mines.

By June 2008, the economy has closed down small thermal power units totalling 25,870 MW since the beginning of the 11th Year-Plan (51.74 percent of the planned total target of 50,000 MW). Closing these units achieved an annual savings of 32.6 million tonnes of coal and more than 55 million tonnes of sulphur dioxide emissions. Of the closed units, there were 722 coal-fired units totalling 20,520 MW with an average capacity of 28,000 kilowatts per unit, 1,097 fuel units totalling 5,360 MW with an average capacity of a 4,900 kilowatts.

NATURAL GAS INFRASTRUCTURE DEVELOPMENT

On 22 February 2008, the second line of the West-East Gas Pipeline began construction. This gas line is a main energy artery totalling 9139 km, and passes through 14 provinces and municipalities in China. Its west point starts from Horgos in Xinjiang and goes southeast to Guangzhou and east to Shanghai; it connects to the Central Asia Gas Pipeline, which stretches across three other countries. The amount of natural gas to be supplies will total 30 billion cubic metres over more than 30 years. After the West-East Gas Pipeline began operation on 30 December 2004, the pipeline network covered more than 70 cities and 3,000 large and medium-sized enterprises, with a total of 42 billion cubic metres of natural gas sold and nearly 2 billion people benefiting from its use. The pipeline has also become the main gas sources for China's Bohai Sea and Yangtze River Delta economic circle. When the second line of West-East Gas Pipeline is finished, China will have one of the largest natural gas pipeline networks. Its completion will greatly optimise the energy consumption structure of China.

A large gas field with reserves of over 100 billion cubic metres was discovered in Yichuan County. Yichuan County is located in the eastern part of Shaanxi Province around a hilly and gully region of Weibei plateau. In the southern city of Yi Chuan-Yi Shou Feng town and surrounding rural areas, Carboniferous-Permian coal found during pre-inspection work, puts the initial estimate of proved reserves at a total of 2,390 million tonnes of coal and 10 billion cubic metres coal-bed methane.

ELECTRIC POWER

In 2007, total generated electricity in China reached its new record of 3,255.9 TWh, a 14.44 percent increase compared to last year. Power infrastructure investment totalled CNY 549.290 billion and helped add 100.090 GW of new installed capacity. National installed power capacity reached 713.290 GW, up 14.36 percent on the year. The pace of grid construction was also sped up; new 220kv transmission line circuit totalled 41,500 km, an increase of 14.20 percent, while new 220kv substations totalled 188.480 million kv, an increase of 18.71 percent. Last year, the economy closed down 553 small thermal power units, with a total installed capacity of 14.380 GW. The standard coal consumption of power generation in 2007 was 334 grams per kWh, a decline of 9 grams per kWh from 2006. The economy has installed thermal power plant flue gas desulphurisation on units larger than 100 MW, totalling about 110 GW capacity.

To appease pressures from the shortage of electricity coal, the NDRC announced a freeze on domestic thermal coal prices from 19 June 2008 to 31 December 2008. The control is implemented

by setting the contract price of 19 June as the maximum price. The NDRC also announced electricity tariffs to be lifted by CNY 25 (US$ 3.62) per MWh from 1 July 2008. And on 20 August 2008, the on-grid thermal electricity price was raised by CNY 2 per MWh.

ENERGY CONSERVATION AND EMISSION REDUCTION

At the end of 2007, NDRC, the Ministry of Environment Protection and the National Bureau of Statistics together issued 6 proposals on energy conservation and emission reduction including: (1) *Implement Program of Unit GDP Energy Consumption Statistics Index System*, (2) *Implement Program of Unit GDP Energy Consumption Testing System* and (3) *Implement Program of Unit GDP Consumption Evaluation System*. The latter is based on a 100 mark system; if the marks are under 60, those evaluated did not reached the target of energy saving and emission reduction. According to the test result of a thousand enterprises last year, 92.2 percent or 953 of 998 enterprises that signed the "responsibility for energy-saving goal" completed the annual energy-saving goals; 7.8 percent did not completed the goal.

In 2008, Ministry of Finance (MOF) will fund a total of CNY 27 billion (US$ 4 billion) for energy-savings, and MOF will set up a special fund for renewable energy. MOF will play a much more important role in energy conservation promotion, using various fiscal policy tools combined with investment, taxation, government procurement, the mechanism of resources and environment prices and other policy instruments. Different energy policies measures are being considered including efforts to: (1) set up a special fund to increase energy-conservation investment; (2) adjust the tax system to encourage energy conservation and promote the rational development and utilisation of energy; (3) improve government procurement policies to encourage government agencies to take the lead in energy saving; (4) improve the compensation for the use of resources and environment so that prices reflect the real cost; (5) grant subsidies to some special industries and grain farmers in order to create a better environment for the further reforming of oil products and finalise the pricing system to favour of oil saving; and (6) establish a renewable energy fund to support renewable energy and new energy development and utilisation to gradually reduce dependence on conventional sources of energy.

In coordination with the implementation of the Conservation Law, the Standardisation Administration of the People's Republic of China set 46 national standards including 22 energy standards for high energy consumption production units, 5 transport fuel economy standards, 11 energy efficiency standards for energy end-use products, 8 basic standards on energy saving inclusive of energy metreing, energy consumption calculation and economy running. The 22 energy standards for high energy consumption production units related to the power generation, steel, nonferrous metal, construction materials and petrochemical industries. The 5 transport fuel economy standards were for light commercial vehicles involving passenger car, truck, three-wheeled car and low-speed freight car, and provided fuel consumption limits and test methods. The 11 energy efficiency standards for end-use products covered gas water heaters, home storage type water heaters, home induction cookers, frequency conversion air conditioners, multiple air-conditioning systems, computer displays, electrostatic copiers, small and medium-sized three-phase asynchronous motors, exchange contacts, external power supplies, water pumps, and other products. These product standards include limits to energy efficiency and the level of energy-saving evaluation value. The 8 basic energy-saving standards were for energy measurement apparatus, equipment management and energy consumption calculation.

China will increase financial subsidies to promote efficient use of lighting products (subsidising 50 million units). In 2008, the economy began to popularise the use of high-efficient lighting products to ensure that during the 11th Five-Year Plan period there will be a total of 0.15 billion of the same sort of lighting products used by the Chinese people. According to the notice, *State Council on further strengthening the work of fuel-efficient and power-saving,* China will introduce more energy-saving lighting measures in the near future. The first step for the Chinese government is to phase-out the use of inefficient lighting products. By the end of 2008, all administration departments in the eastern and central regions, and in the large and medium-sized cities of the western region, will eliminate all inefficient lighting products, and, by the end of 2009, all city roads and public places in the eastern and central regions and large and medium-sized cities of the western regions will

eliminate inefficient lighting products. The Chinese government will utilise a financial budget to support the development of efficient lighting sources and lamp manufacturers and encourage them to upgrade their technology. Chinese government will also use tax policy to curb the production and consumption of inefficient incandescent lighting products.

By October 2008, China's energy saving service industry reached a value of CNY 7 billion. From 2004 to 2006, the energy saving service industry maintained a growth rate of 40 percent per year with capital formation growing from CNY 1 billion to CNY 2 billion; the growth rate in 2007 reached 250 percent. Because Chinese government has been encouraging energy saving and emission reduction, the potential size of energy saving service industry is estimated to be CNY 450 billion, thus ensuring promising growth in the future.

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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 2006, the GDP per capita of Hong Kong, China was US$ 33,574, one of the highest GDP per capita in APEC region. The GDP of Hong Kong, China expanded by a robust 6 percent in real terms in 2006, down from the 2005 rate of 7 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 3.5 percent in the third quarter of 2008, 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 all CEPA rules of origin being agreed and met. On trade in services, Hong Kong service suppliers enjoy preferential treatment in 38 service areas in 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: (1) speeding up structural transformation to a high-value, knowledge-based, and skill-intensive economy; (2) pursuing reforms in education and population policy to achieve the talent pool required; as well as (3) 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 created.

Table 11 Key data and economic profile (2006)

Key data		Energy reserves	
Area (sq. km)	1,104	Oil (MCM)	-
Population (million)	6.86	Gas (BCM)	-
GDP Billion US$ (2000 US$ at PPP)	230.22	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	33,574		

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 17.4 Mtoe in 2006, decreasing 2 percent from 2005. Oil maintained the highest share in the total primary energy supply at 44 percent, followed by coal (39 percent) and gas (12 percent). Electricity imports from China accounted for the remaining 22 percent in 2007.[36]

In 2008 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 Hong Kong 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 the first gas combined-cycle generator and the unit started commercial operation 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. Being a pilot project for the company, the rated capacity of the wind turbine is 800kW.

FINAL ENERGY CONSUMPTION

Table 12 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)*	
Indigenous Production	93	Industry Sector	546	Total*	44,257
Net Imports & Other	25,164	Transport Sector	6,174	Thermal	44,257
Total PES	17,388	Other Sectors	3,880	Hydro	-
Coal	6,851	Total FEC	10,600	Nuclear	-
Oil	7,731	Coal	0	Others	-
Gas	2,164	Oil	6,550		
Others	641	Gas	581		
		Electricity & Others	3,469		

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.

[36] The data is from the EMSD.

Towngas and liquefied petroleum gas (LPG) are the two main types of fuel gas used throughout Hong Kong, China. Towngas is distributed by the Hong Kong and China Gas Company Limited. It is manufactured at plants in Tai Po and Ma Tau Kok, using both naphtha and natural gas (starting from October 2006) as 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 2006, the total final energy consumption in Hong Kong, China reached 10.6 Mtoe, 2.28 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 62 percent of energy use. Electricity and others made up 33 percent of end-use consumption, while gas accounted for only 5 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) has pursued 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.[37]

The Electricity Ordinance and the Gas Safety Ordinance regulate the safe supply of electricity and gas. Among other things, these ordinances cover the registration of generating facilities, workers and contractors for electrical and gas installations, wiring and gas installation standards and safe distribution and use of electricity and gas. Most provisions of the Electrical Product (Safety) Regulation, which regulates the safety of household electrical products, came into effect in May 1998. To regulate the import, supply and installation of domestic gas appliances for use in Hong Kong, China, the Gas Safety (Installation and Use) Regulation and the Gas Safety (Miscellaneous) Regulation were amended in 2002.

In the latest 2008-09 Policy Address, the Government will continue to support environmental protection and promote sustainable development by taking vigorous measures for air quality improvement. For example, the Government has reached a consensus with the Guangdong Provincial Government on jointly transforming the PRD region into a green and quality living area under the principle of promoting environmental protection and sustainable development. To achieve this goal, Hong Kong and Guangdong will work together on post-2010 emission reduction arrangements, the optimisation of the fuel mix for power generation, the development and wider

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

use of renewable energy, vehicle emissions reductions, enhanced conservation and greening, scientific research, as well as publicity and education.

On 28 August 2008, the Memorandum of Understanding signed between the HKSAR Government and National Energy Bureau ensures a long-term and stable supply of nuclear electricity, and the supply of natural gas from three different sources, namely, offshore gas, piped gas, and liquefied natural gas (LNG) to be supplied through an LNG terminal to be built, as a joint venture, on a neighbouring Mainland site. At present, 28 percent of electricity generated by power plants in Hong Kong is gas fired. To improve air quality and address the challenges posed by global warming, the Government of Hong Kong, China will actively explore ways to gradually increase the use of clean energy by, for example, increasing the proportion of natural gas for local electricity generation to 50 percent.

To further promote energy efficiency and conservation, and to reduce carbon dioxide emissions substantially, Hong Kong, China's Government plans to implement a district cooling system at the Kai Tak Development to supply chilled water to buildings in the new development area for centralised air-conditioning. The Government enacted the legislation on the Mandatory Energy Efficiency Labelling Scheme in May of 2008 and will propose amendments to the Energy Efficiency (Labelling of Products) Ordinance in 2009 for the second phase of the Scheme.

In response to public concerns about fuel prices, Hong Kong, China Government has asked the oil companies to promptly adjust prices in tandem with international oil price movements and be more transparent in price settings so the public can monitor their retail prices.

NOTABLE ENERGY DEVELOPMENTS

ENERGY EFFICIENCY PROMOTION

The voluntary Energy Efficiency Labelling Scheme (EELS) has now covered 17 types of household and office appliances including refrigerators, room coolers, washing machines, electric clothes dryers, compact fluorescent lamps, electric storage water heaters, electric rice-cookers, dehumidifiers, televisions, multifunction office devices, photocopiers, laser printers, LCD monitors, electronic ballasts, computers, domestic gas instantaneous water heaters, fax machines and bottled cold/hot water dispensers. As of the end December 2008, more than 3,700 models have been registered under the voluntary EELS managed by the Government.

The voluntary Energy Efficiency Labelling Scheme was also extended to cover Petrol Passenger Cars in February 2002, to raise the level of public awareness on energy efficiency of vehicles. To further encourage the use of energy-efficient products, the Government introduced a mandatory EELS through the Energy Efficiency (Labelling of Products) Ordinance, covering room air conditioners, refrigerating appliances and compact fluorescent lamps in the initial phase. The relevant legislation was enacted in May 2008 with an 18-month transitional period.

The Hong Kong Government has been promulgating voluntary Building Energy Codes (BECs) since 1998 through its Hong Kong Energy Efficiency Registration Scheme for Buildings. The scheme covers lighting, air-conditioning, electrical and lift & escalator installations. As of December 2007, 807 building venues have been registered under the Scheme. To further enhance energy efficiency in buildings, the Government launched a public consultation on the proposed mandatory implementation of the BECs by way of legislation in December 2007. The consultation ended on 31 March 2008. The vast majority of the returns received in the consultation were in support of the proposal. The Government is now preparing the detailed legislative scheme for submission to the Legislative Council. It is estimated that for new buildings, the proposal will result in an energy saving of 2.8 billion kWh in the first decade of implementation, which contributes to a reduction in carbon dioxide emission of 1.96 million tonnes. As commercial buildings accounted for 37 percent of Hong Kong city's total energy end-use in 2005, to enhance sustainability of building development, the Government has developed a software tool for assessing the energy use, environmental and cost impact of commercial building development in 2006. The Government has been using the software tool in several selected Government building projects for trial application

and would review the outcome at a later stage. The software tool is available free of charge to the local industry.

Another competition entitled the "Eco-drivers" was launched in September 2008. The fuel economy run aims to raise the awareness of drivers on energy and fuel conservation. By highlighting the important role of energy conservation in sustainable development, the event also called for actions of the public to realize this principle in daily life in particular through driving. The competition has received over 500 entries, and the run completed in December 2008.

ENERGY END-USE DATABASE

The Government has continuously maintained and updated the energy end-use database. The database provides a useful insight into energy consumption patterns of different sectors, sub-sectors and the end uses in Hong Kong. A basic data set (Year 2006 basic data) from the database was published in September 2008 and is available for public access at the Electrical and Mechanical Services Department website (http://www.emsd.gov.hk). The handbook would be published annually.

ENERGY CONSUMPTION INDICATORS AND BENCHMARKS

The energy consumption indicators and benchmarks were developed for hospitals, clinics, universities, schools, hotels and boarding houses, offices and commercial outlets in the commercial sector, as well as private cars, light, medium and heavy good vehicles, private light buses and non-franchised buses in the transport sector. The indicators and benchmarks enabled users in the targeted group to compare their energy efficiency performance with other similar users, identify and implement improvement measures. The indicators as well as on-line benchmarking tools are available at the Electrical and Mechanical Services Department website and updated as appropriate.

RENEWABLE AND CLEAN ENERGY

The Government commissioned a study to investigate the viability of using renewable energy technologies in Hong Kong and the finding s of the study suggested that the eastern side of Hong Kong may have sufficient wind resources for commercial wind farms. Five wind monitoring stations were erected at Government Logistic Centre, Pottinger Peak, Town Island, Tung Lung Chau and Miu Tsai Tun to gather wind resource data in the region. The year round wind data collection at these five stations was completed in mid-2006. All the wind data collected from the five wind monitoring stations have been analysed. The analysed wind data together with data collected from the Hong Kong Observatory were used to produce a detailed wind resource map to cover all parts of the Hong Kong territories, completed in 2007. This wind resources map and an on-line wind resources calculator have been uploaded for public access through the Internet Platform-the "HK Sustainable Technology Net" (http:// sustech.emsd.gov.hk) or the Electrical and Mechanical Services Department website (www.emsd.gov.hk).

To assist the public in better understanding the technical issues and the application procedures relating to grid connection of renewable energy installations, a Working Group was formed in 2005 to develop a set of technical guidelines. Members of the Working Group included representatives from power companies, professional institutions, consultants and contractors, property developers, renewable energy interest group etc. The "Technical Guidelines on Grid Connection of Small-scale Renewable Energy Power Systems" was published in 2005.

In December 2007, a revised edition of the technical guidelines, titled the "Technical Guidelines on Grid Connection of Renewable Energy Power System (2007 Edition)" was made available to the public at the website of the Electrical and Mechanical Services Department (www.emsd.gov.hk), which extends the applicable capacity limit of the original guidelines from 200KW to 1 MW.

To facilitate the wider adoption of renewable energy technologies in Hong Kong, China, a website namely the "Hong Kong Renewable Energy Net (HK RE Net) (http://re.emsd.gov.hk) was developed with an aim to provide comprehensive information on renewable energy technologies with emphasis on those technologies suitable for applications in Hong Kong, China.

In Hong Kong, China, almost all the diesel taxis had been replaced by liquefied petroleum gas (LPG) models. In August 2002, the Government launched a voluntary incentive scheme to encourage owners of existing diesel public and private light buses to replace their vehicles with LPG or electricity models. Up to end December 2007, there are over 2,700 LPG light buses in operation, representing more than 40 percent of all public/private light buses in Hong Kong. Taking the leading role in the use of green vehicle, the Government introduced, in 2005, petrol-electric hybrid vehicles in the vehicle fleet. In addition, the Government is continuously identifying possible ways to encourage vehicle owners to use cleaner alternative fuels.

ENERGY SAVING PROGRAMMES IN THE PUBLIC AND PRIVATE SECTORS

The Government has completed three studies on the energy saving potential of Water-cooled Air Conditioning System (WACS). One was on the territory-wide implementation of WACS and the other two were on the implementation of district cooling system in a new development area and an existing developed area. The Government is materializing some recommendations put forward in the studies. Since 2000, the Government has launched a pilot scheme for the wider 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 85 by December 2008, covering about 78 percent of the non-domestic floor area of the economy. As at December 2008, 135 installations of fresh water-cooling towers have been completed and put into operation. It is estimated that these completed installations could save 108 million kWh of electricity consumption and reduce carbon dioxide emission by 76,400 tonnes per annum. In view of the support from the property owners and the environmental benefits, the scheme has operated on a standing status from June 2008.

ENVIROMENT PROTECTION

To demonstrate its commitment to protect the environment, the Government set targets in 2003 to cut down the annual electricity consumption of government departments. Since then, the Government has provided technical support and expert advice to these departments by publishing energy saving tips and guidelines, organizing 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 about 7 percent between 2003 and 2007.

To assist the users and managers of buildings in enhancing their awareness of greenhouse gas (GHG) emissions, measuring GHG emission performance of their buildings and voluntarily participating in reduction and / or offset GHG emissions to combat against climate change, the Government has published the *Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings of Commercial, Residential or Institutional Purposes in Hong Kong* (i.e. the carbon audit guidelines) in July 2008. The guidelines have been designed for voluntary and self-reporting by the reporting entities, and provide a systematic and scientific approach to account for and report on the GHG emissions and removals from buildings. The guidelines could be downloaded from the Environmental Protection Department website for reference (http://www.epd.gov.hk/epd/english/climate_change/files/CAGuidelines_Eng.pdf).

The Hong Kong 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 at the juncture between mainland Southeast Asia, the continent of Australia, and the Pacific Ocean and Indian Ocean. Indonesia had a population of 223.04 million in 2006. Indonesia's territory encompasses 17,508 large and small islands and large bodies of water at the equator over an area of 7.89 million square kilometres (including the Exclusive Economic Zone). Total land area of Indonesia is about 1.826 million square kilometres which constitute 24.4 percent of its territory.

Indonesia had a gross domestic product (GDP) of US$ 662.25 billion, and a per capita GDP of US$ 2,969 in 2006 (in 2000 Price and 2000 PPP). Manufacturing accounted for the largest component in GDP at 27.8 percent; finance, leasing and other services made up 18.4 percent; retail, hotel and restaurant 16.9 percent; agriculture, livestock, forestry and fishery 14.1 percent; mining and quarrying 9.1 percent; transport and communications 6.7 percent; construction 6.1 percent; and electricity, gas and water supply contributed the remaining 0.7 percent.

Indonesia's economic growth was 6.1 percent in 2006, higher than that of 2005 at 5.7 percent. Fossil reserves of oil, gas and coal played an important role in Indonesia's economy, as source of energy, industrial raw material and foreign exchange earner. In 2006, oil and gas export was US$ 21.209 billion or 21.0 percent of total exports. Oil and gas exports increased in 2007 to US$ 22.055 billion constituting 19.3 percent of total exports. Overall tax and non-tax revenue from natural resources account for about 23.0 percent of the government budget in 2006.

Indonesia had fossil energy reserves of 699.5 million cubic metres of proven oil reserves at end of 2007, oil reserves maintained year end 2006 level; proven natural gas reserves of 3.00 trillion cubic metres at year end of 2007, an increase from 2.63 trillion cubic metres at year end 2006; and proven coal reserves of 12.984 billion tonnes at end of 2007, coal reserves declined from 14.904 billion tonnes in 2006.

Table 13 Key data and economic profile (2006)

Key data		**Energy reserves***	
Area (sq. km)	7,893,250	Oil (MCM)	699.5
Population (million)	221.96	Gas (BCM)	3,000
GDP Billion US$ (2006 US$ at PPP)	920.85	Coal (Mt)	14,904
GDP per capita (2006 US$ at PPP)	4,148		

*Source: BP Statistical Review of World Energy, 2007 and 2008

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply (TPES) of Indonesia in 2006 was 130,520 ktoe, which was composed of oil at 44,7 percent, natural gas 29,4 percent, coal 20.9 percent, and other energy 5.0 percent. Indonesia is a net exporter of energy; combined energy exports of crude oil, condensates, natural gas, liquefied natural gas, petroleum products and coal was 131,531 ktoe in 2006.

Indonesia produced 42,956 ktoe of crude oil and 3,376 ktoe of condensates in 2006; of the production of crude oil, 15,428 ktoe was exported. Oil exports had declined by 4.96 percent from the previous year in 2005 and by 22.21 percent in comparison to crude oil exports in 2004. To meet

domestic oil requirements in 2006, Indonesia required imports of crude oil and petroleum products of 15,768 ktoe and 17,462 ktoe respectively, to a total of 33,230 ktoe.

Most of Indonesia's crude oil is produced on-shore from two of Indonesia's largest oil fields, the Minas and Duri oil fields in the province of Riau in the eastern coast of central Sumatra. The Minas and Duri oil fields are mature fields, however. The Duri field is noted as the site of one of the world's largest enhanced oil recovery (EOR) efforts.

Total production from oil fields on-shore Riau was 23,080 ktoe in 2006. Other principal oil producing regions are: South Sumatra, on and off-shore East Kalimantan, off-shore northeast of Java, Jambi in the east coast of central Sumatra and the Natuna Sea. Over the past decade, Indonesia's oil production has declined significantly; in this regard, BP Migas, the regulatory body for the downstream oil and gas industry set a target in 2005 to increase oil production to 1.3 million barrel by 2009[38].

Indonesia produced 67,942 ktoe of natural gas in 2006. Production of natural gas declined by 1.05 percent from the previous year in 2005, and in comparison to gas production of 2004 declined 2.51 percent. About 54.6 percent of Indonesia's natural gas production was converted to LNG for exports; production of LNG was 25,875 ktoe in 2006. Destinations of Indonesia's LNG exports were Japan with 62.9 percent, Korea 22.7 percent, and Chinese Taipei 14.4 percent. In addition, in 2006, Indonesia exported 3,716 ktoe, or 5.47 percent of total natural gas production, by pipeline to Singapore and Malaysia. Overall, 60.0 percent of Indonesia's natural gas production is dedicated to export; the balance is made available for domestic requirements.

Indonesia's large natural gas reserves are located near Arun in Aceh, around Badak in East Kalimantan, off-shore the Natuna islands including the Natuna D-Alpha field (considered one of the largest gas reserve in the region) and the gas fields in Papua, some smaller fields found off-shore north of Java, and off-shore east of Java including the Kangean gas field. The most recent LNG project is in Tangguh, Papua, and the project is expected to start commercial production in 2009; gas supply will come from reserves on-shore and off-shore in the Wiriagar and Berau Blocks, estimated to have reserves of at least 14 trillion cubic feet (Tcf).

In 2006, Indonesia produced 105,348 ktoe of coal, an increase of 27.3 percent from production in 2005. Domestic consumption of coal was 27,315 ktoe in 2006. Coal was utilised in power plants at 56.7 percent; in cement and ceramic industry 10.8 percent; pulp and paper industry 2.5 percent; and other use 30.0 percent. Most of the coal produced, 78,093 ktoe or 74.1 percent, was exported in 2006. Indonesia's coal export destinations in 2006 were: Japan with 22.8 percent, Chinese Taipei 13.7 percent, others Asian economies 38.9 percent, Europe 14.9 percent, the Pacific area 2.8 percent and other destinations 6.9 percent.

About 57 percent of Indonesia's total recoverable coal reserves are lignite, while 27 percent is sub-bituminous coal, 14 percent bituminous coal, and less than 0.5 percent 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 to 7,000 kcal per kg and is distinctive for their low ash and sulphur content; sulphur content is typically less than 1 percent.

Indonesia's state owned power company PLN has a total generating capacity of 30,958 MW in 2006. Total power production to the grid was 133,108 GWh, of which 21.5 percent was supplied by independent power producers (IPP) and captive power. Energy mix structure in production of electricity in 2006 was coal with 44.25 percent, oil 25.53 percent, geothermal 16.79 percent, natural gas 11.00 percent, hydroelectric 2.41 percent, biomass 0.03 percent.

[38] 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.

Table 14 Energy Supply & Consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	228,760	Industry Sector	30,079	Total	133,108
Net Imports & Other	-98,240	Transport Sector	25,512	Thermal	116,795
Total PES	130,520	Other Sectors	19,315	Hydro	9,623
Coal	27,315	Total FEC	74,906	Nuclear	-
Oil	58,305	Coal	11,543	Others	6,690
Gas	38,352	Oil	43,021		
Others	6,548	Gas	10,657		
		Electricity	9,684		

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

FINAL ENERGY CONSUMPTION

Final energy consumption of Indonesia was 74,906 ktoe in 2006, an increase of 0.21 percent from 74,750 ktoe in 2005. Final energy consumption by sector in 2006 is 40.1 percent for industry, 34.1 percent for transport, and 25.8 percent for other sectors.

The fuel mix composition of commercial energy in the final energy consumption, excluding biomass, consists of oil 57,4 percent, coal 15.4 percent, natural gas 14.2 percent and electricity 12.9 percent. Notably, oil is the most important source of commercial final energy in Indonesia's economy; consumption of oil had declined by 6.38 percent to 43.021 ktoe in 2006 from 45,952 ktoe in 2005.

POLICY OVERVIEW

THE ENERGY LAW

On August 10, 2007, Indonesia enacted Law No. 30/2007 regarding Energy. Designated as the Energy Law, it is Indonesia's first legislature on energy. The Energy Law elucidates principles with regard to utilisation of energy resources and final energy use, security of supply, energy conservation, protection of the environment with regard to energy use, pricing of energy, and international cooperation.

Furthermore, the Energy Law elucidates the content of the National Energy Policy, the role and responsibility of government and regional governments in planning, policy and regulation, setting of development priorities on energy, research and development, and the role of enterprise.

The scope of the national energy policy includes:

- Availability of energy for national requirements
- Priority of energy development
- Utilisation of national energy resources
- National energy supply reserves

Moreover, the Energy Policy mandates the government to create the National Energy Council, whose task is to:

- Draft and establish national energy policy, to be issued by the Government, with due consent of parliament (the DPR);
- Establish the national general energy plan;

- Declare measures to revolve conditions of an energy crisis and energy emergency; and
- Provide oversight on implementation of policies on energy that are cross sector by nature.

The National Energy Council or DEN *(Dewan Energi Nasional)* is chaired by the President; vice chaired by the Vice President; and in daily duties, is chaired by the Minister responsible for energy affairs. DEN consists of 15 members specifically, seven Ministers and other government officials that are responsible for supply, transportation, distribution and use of energy; and eight stakeholder members from industry, academia, technology expertise, environmental concerns and consumers.

Notably, at the time of enactment of the Energy Law, Indonesia had Law No. 22/2001 regarding Oil and Gas, and Law No. 27/2003 regarding Geothermal; and Law No. 20/2002 regarding Electricity (for two years, until the law was annulled by the Constitutional Court in December 2004). These laws apply within boundaries of specific energy and are, for the most part, established to promote greater role of enterprise, the possibility of specialised businesses within the energy supply chain, and an equal playing field (as an alternative to a monopolistic industry). The laws established the institutional and regulatory framework for oversight of the industry; and required state owned enterprise in oil and gas to relinquish the roles of government.

ENERGY POLICY

Historically, before the Energy Law, energy policy was drafted by government and involved public consultation prior to legal enactment and promulgation. Until the time DEN establishes a new energy policy, the current National Energy Policy by Presidential Regulation No. 5/2006 of 25 January 2006 applies. The aim of the national energy policy is to:

- Achieve energy elasticity to GDP of less than unity by year 2025.
- Realise optimal primary energy mix in 2025; specifically, a national energy consumption mix as follows:
    1. oil, to become less than 20 percent
    2. natural gas, to become more than 30 percent
    3. coal, to become more than 33 percent
    4. biofuel, to become more than 5 percent
    5. renewable energy and other energy including nuclear, to become more than 5 percent
    6. liquefied coal, to become more than 2 percent

Policy measures to achieve the energy policy aim include:

- Supply of energy by:
    1. increasing availability of supply in the domestic market
    2. optimising energy production
    3. implementing energy conservation
- Efficient utilisation of energy and diversification of energy
- Price energy at economic levels with due regard for providing assistance to the needy members of society.
- Protection of the environment.[39]

The details of the energy programs and targets of the National Energy Policy are elaborated in the *Blue Print National Energy Management 2005 to 2025*, issued in July 2005.

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

REGULATIONS

Regulations on energy issued since enactment of the Energy Law, include the following.

Ministerial Regulation No. 32/2008 regarding Regulation on Supply, Use and Commerce of Biofuel as Other Fuel.

Matters regulated include: (1) priority in utilisation of biofuels, (2) category of biofuels, standards and specification of quality, (3) setting of price, (4) activity in commerce of biofuels as other fuel, (5) directives and oversight, and (6) sanctions.

The regulation stated mandatory targets of greater use of biofuels in the future; share of biofuels in the total fuel consumption in 2025, is expected to be at least as follows:

	Biodiesel (B 100)	Bio ethanol (E 100)
Transport, public service	20 percent	15 percent
Transport, private	20 percent	15 percent
Industry & commerce	20 percent	15 percent
Power plant	20 percent	-

Ministerial Regulation No. 36/2008 regarding Business in Coal Methane Gas.

Matters regulated include: (1) exclusive rights and business of coal methane gas, (2) method of determining and offer of coal gas methane work area, (3) use of data and information, equipment and facilities, (4) research, assessment and development of coal gas methane, (5) dispute resolution, (6) ruling on coal methane gas as associated natural resource, and (7) utilisation of coal bed methane for domestic needs.

The businesses of coal methane gas comply with laws and regulations that govern business activities in oil and gas. Directives and oversight as well as administration of business activities in coal methane gas are by the Directorate General of Oil and Gas. The Minister of Energy and Mineral Resources determine regulations, establish and offer coal methane gas Work Area.

Establishment and actual offer of coal methane Work Area is by the Directorate General of Oil and Gas, with due consideration to opinion of the Regulatory Body of the Up Stream of Oil and Gas Industry.

Other Regulations

Other regulations in relation to the above include: (1) *Presidential Instruction No. 1/2006 regarding Supply and Utilisation of Biofuel as Fuel Substitute*; (2) *Presidential Instruction No. 2/2006 regarding Supply and Utilisation of Coal as a Fuel Substitute*, (3) *Ministerial Decree No. 1128/2004 regarding National Coal Policy*, (4) *Ministerial Regulation No. 0007/2005 regarding Requisite and Implementation Guidelines of Business License in Business Activity in Oil and Gas*, and (5) *Ministerial Decree No. 1321/2005 regarding National Transmission and Distribution Network Master Plan.*

Moreover, regulations on renewable energy include the following: (1) Presidential Decree No. 76/2000 on *Utilisation of Geothermal Resources for Electricity Generation*, (2) Government Regulation No. 59/2007 on *Geothermal Business Activity*, (3) Ministerial Decree No. 1122/2002 on *Business in Small Scale and Scattered Electricity Generation,* and (4) the *Policy on Development of Renewable Energy and Energy Conservation, 2003*.

DIVERSIFICATION OF ENERGY

Indonesia's policy to diversify primary energy resources is aimed at reducing reliance on oil in the economy's total energy mix by utilising other energy including gas, coal, geothermal and renewable energy. The policy initiated large scale development of those resources.

The National Gas Transmission and Distribution Network Master Plan expect to bring gas over long distances to demand centres, in particularly to the economy's largest energy demand centre, the island of Java. The master plan, when completed in the future, will layout a total of 8206 kilometres of gas transmission pipeline for domestic supply and exports. Indonesia's initial pipeline

natural gas exports began in 2001, to Singapore. The master plan's gas pipelines for exports to Singapore and Malaysia has been completed. In addition, Indonesia is considering building LNG receiving terminals in demand centres in Java and Sumatera, and mini-LNG receiving terminals for the island of Bali and South Sulawesi.

Indonesia began to develop large coal reserves in the early 1980's to supply the economy's first series of large coal power generation plants. Coal production has since increased to 195 million tonnes in 2006; most of the production is for export.

Indonesia's geothermal potential is estimated at 27,000 MW; currently, 4.1 percent or 1117 MW of this potential is generating power. In this effect, the government is carrying out exploration and assessment of Indonesia's geothermal potential, to reduce some of the risks associated with its exploration and to promote the commercial development of geothermal for power generation. In 2008, Indonesia announced the *10,000 MW Crash Program Phase II*; generating capacity this time around is being based exclusively on renewable energy, particularly geothermal and hydropower.

Indonesia expects to increase biodiesel and bio-ethanol production which 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 bio ethanol.

DEVELOPMENT FOR NEW ENERGY RESOURCES

The policy measure to intensify search of new energy reserves aims to increase Indonesia's energy resource base, particularly to transform indicated, inferred and hypothetical hydrocarbon reserves into proven and productive reserves. Indonesia's proven and indicated hydrocarbon reserves are estimated at 185.8 TCF of natural gas, 8.71 billion barrels of oil, and 23.0 billion tonnes of coal. If hypothetical and inferred coal reserves are considered, potential coal reserves is 60.4 billion tonnes.

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 in exploration of 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 an increased share for companies from 15 percent to 25 percent for oil, and from 30 percent to between 35 percent and 40 percent for gas. In addition, current policy 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 regarding Energy Conservation* led to the enactment of the National Master Plan for Energy Conservation in 1995. The plan includes programmes for training, efficiency award, energy management, and industrial energy audits; the program also outlined incentives 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.

The energy conservation partnership program promotes energy conservation by providing government funding in energy audits to eligible industry and commercial buildings, which then, voluntary implement measures identified for potential energy savings. The implementation of potential energy savings may involve investments provided by commercial financial institutions. Participating parties are required to report their energy use to the Ministry over a period of 3 years.

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 an estimated energy savings of 20 percent over the long-term. Indonesia is an active participant in the ASEAN Energy Award program– Best Practice Competition for Energy Efficient Buildings.

In 2000, Indonesia disseminated mandatory standards for compact fluorescent lamps (CFLs). Moreover, refrigerators are subject to mandatory standards from 2005, to achieve target maximum energy 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 various types of Demand Side Management (DSM) programs since 1992, to reduce peak electricity demand.

OIL AND GAS

Law No. 22/2001 regarding Oil and Gas is the legislation that governs the oil and gas sector. The law states that the government holds exclusive rights of oil and gas mining; however, certain rights can be awarded to the oil and gas industry in areas of businesses of exploration and exploitation, and in processing, transportation, storage and trade of oil and gas. Fair and competitive processes apply in awarding of oil and gas business activity.

In 2004, Indonesia's Constitutional Court rejected the provision of market based pricing and mandated that retail price of petroleum products be set by the government. In this case, the government sets price of non-subsidised petroleum products based on a formula which takes into account the average petroleum product price issued by Mid Oil Platts Singapore (MOPS).

Enactment of *Law No. 22/2001 regarding Oil and Gas* 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.

TENDER REGULATION REVISIONS

In June 2006, the Minister of Energy and Mineral Resources issued *Ministerial Regulation No. 40/2006 regarding Procedures for Oil and Gas Blocks Allocation and Offering.*[40] 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.

ELECTRICITY LAW AND MARKET

In 2004, the Constitutional Court of Indonesia annulled *Law No. 20/2002 regarding Electricity*, and thereafter, reinstated the electricity law that it had replaced, specifically *Law No. 15/1985*

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

regarding Electricity; this law will govern Indonesia's power industry until a new electricity law is promulgated.

Under *Law No. 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, but 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 where PLN cannot provide the necessary services, consumers could develop their own electricity generation for their own use, and excess production may be sold to PLN.

Since reinstatement of Law No.15/1985, the government issued a number of regulations on the power sector to be more relevant to changes in the structure of government, including, the role of autonomous provincial governments and the private sector. Regulations include, *Government Regulation No. 3/2005 and 26/2006 regarding Supply and Utilisation 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 and 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, and 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 was 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 decentralisation of PLN's assets. Under the annulled *Law No. 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)[41].

COAL

A new legislature with regard to mining and coal passed parliament in December 2008, and will soon be enacted by the government.

For purpose of reference, business in general mining, including coal was previously governed by *Law No. 11/1967 regarding Principle Regulation on Mining*; and *Government Regulation No. 25/2000 regarding Role of Government and Role of Province as an Autonomous Region. Government Regulation No. 32/1969 and 75/2001* governs the implementation of *Law No. 11/1967*.

The Ministry of Energy and Mineral Resources was previously 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.

41 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.

Following the enactment of the regional autonomy law, a Coal Contract of Work (CCoW) establishes a royalty scheme to include the regional government. The CCoW terms require that Indonesian companies eventually have the majority ownership of the mining projects. 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 No. 27/2003 regarding 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 holds exclusive rights 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 bids.

Successful bidders are awarded a maximum work 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 rights (which is extendable). Working areas are subject to tax, land rent, and royalties determined by the government. The utilisation of geothermal energy for electricity generation is subject to regulation and policy on electricity.

NOTABLE ENERGY DEVELOPMENTS

MINING AND COAL BILL PASSED

On 16 December 2008, parliament (the DPR) passed a new law regarding mining and coal to replace *Law No. 11/1967 regarding Mining* that had been in place for the past 41 years. The new law basically ended the concession of work area by contract of work (CoW) and by work agreement of coal mining enterprise (PKP2B). Concessions are now based on issue of permit by the government and regional governments. Prior to the new mining and coal law, the government arguably had less regulatory control over its concessions. For example, such was the case that any changes to the concession terms need to be agreed by consent of both the government and the investor. On the other hand, by licensing, the government expects to gain better position in promoting investments and in regulating mining.

The law does, however, allow for a transition period of current CoW and PKP2B holders, some of them large mining concessions in minerals and coal that will expire between 2021 and 2041. The article on transition basically states that existing contracts will be up held, but the transition of specific existing concessions still needs to be formulated.

Key points of the mineral and coal law include ruling on:

- Concession area and concession period, with regard to exploration permit, and on production limits with regard to production permit, in cases for mining of metals, non-metals and specific non-metals;
- Prerequisite to submit post mining and reclamation plans, prior to application of permit;
- Obligation of permit holders to build smelters;
- Obligation of foreign companies to divest shares to the government, state owned enterprise and national private companies;

- Taxes, fees, and allocation of profit; and
- Reclamation and post mining costs

The law gives greater opportunity to less sizable investment in mining, and greater role of regional governments to regulate and to receive revenue from mining.

SUSPENSION OF MEMBERSHIP IN OPEC

At the 149th OPEC conference in Vienna, Austria in September 2008, in view of Indonesia's position as a net-oil importer; the conference and Indonesia have agreed on suspension of Indonesia's membership in OPEC. The conference expressed hopes that Indonesia may re-establish full membership in OPEC, when conditions allow.

OIL & GAS ACERAGE AWARD

In November 2008, the Government signed twenty-nine oil and gas cooperation contracts, winners of the first-round 2008 direct-offer tender of 25 new oil and gas exploration work areas, and winners of the 2007/2008 tender of 21 new oil and gas exploration work areas, announced in October 2008. The new oil and gas work areas have greater emphasis on exploration of deep sea and frontier regions.

The twenty companies and consortia[42], winners of the first-round 2008 direct-offer tender, committed to invest in exploration activities worth US$ 316.8 million over the first 3 years, to include geological and geophysical study, three-dimensional seismic survey of 3,000 square kilometres, two-dimensional seismic survey of 21,740 kilometres and drilling of 24 exploration wells. The contract includes a signature bonus of US$ 40.5 million to the government.

Nine companies and consortia[43], winners of the 2007/2008 round tender, committed to invest in exploration activities worth US$ 465.1 million over the first 3 years, to include geological and geophysical study, three-dimensional seismic survey of 2,740 square kilometres, two-dimensional seismic survey of 7,300 kilometres, processing of two-dimensional seismic survey of 1,785 km, and drilling of 24 exploration wells. The contract includes a signature bonus of US$ 69.5 million to the government.

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[42] The work areas and contractors/consortia are: 1) East Seruway, Serica East Seruway BV; 2) South CPP, Ranhill Pamai Taluk Energy Pte Ltd; 3) South West Bukit Barisan, consortium PT Radiant Nusa Investama – PC (SKR) International Ltd; 4) Lirik II, PT Karya Inti Petroleum; 5) West Tungkal, Three Golden Energy West Tungkal; 6) South East Tungkal, consortium Gujarat State Petroleum Corp. Ltd – Essar E&P Ltd; 7) East Muriah, consortium Pearl Oil (East Muriah) Ltd - AWE (East Muriah) NZ Limited; 8) Madura, SPE Petroleum Ltd; 9) North Sumbawa II, Husky Oil North Sumbawa Ltd; 10) West Sageri, consortium Kaizan West Sageri LLC – Niko Resources (Overseas II) Ltd; 11) South East Ganal I, consortium Kaizan South East Ganal I LLC – Niko Resources (Overseas III) Ltd; 12) South East Sangatta, consortium PT Kutai Timur Resources – Salamander Energy (SE Sangatta) Ltd;13) South Bengara II ACG (South Bengara II) Pte Ltd; 14) South Matindok, consortium Kaizan South Matindok LLC – Niko Resources (Overseas IV) Ltd; 15) Bone Bay, consortium Black Gold Ventures LLC – Marathon Indonesia (Bone Bay) Ltd; 16) Buton I, PT Putindo, Bintech; 17) Arafura Sea, ConocoPhillips (Arafura Sea Block Indonesia) Ltd; 18) Seram, consortium Black Gold Indonesia LLC – Niko Resources (Overseas VI) Ltd; 19) West Papua I, Chevron West Papua I Ltd; 20. West Papua II, Chevron West Papua II Ltd.

[43] The work areas and contractors and consortias are: 1) Gunting, Exxon Mobile Exploration & Production Indonesia (Gunting) Ltd; 2) East Bawean, CJSC Sintezmorneftegaz; 3) Kerpu, Pear Oil (Tachylyte) Ltd; 4) Mahakam Hilir, SPC E&P Upstream Pte Ltd; 5) Baronang, Ludin Baronang BV.; 6) Cakalang, Ludin Cakalang BV; 7) consortium Murphy Semai Oil Co Ltd – PTTEP Semai II Ltd – Inpex Seram Sea Ltd; 8) Semai III, PT Suma Sarana; 9) Semai V, Hess (Indonesia – Semai V) Ltd.

The Government expects to offer thirty-one work areas in the second-round 2008 oil and gas work area tender. The work areas would consists of sixteen new work areas and fifteen work area of direct offer.

GEOTHERMAL DEVELOPMENT

In December 2008, Magma Nusantara Limited (MNL) began operation of its Wayang Windu Unit II geothermal power plant in Pengalengan, West Java. Installed capacity of Unit II is 117 MW, constructed at a cost of US$ 200 million. Total installed capacity of Wayang Windu Units I and II is now 227 MW. The company is set to carry out its plans to build Wayang Windu Units III and IV at an estimated investment of US$ 450 million to bring total capacity of Wayang Windu geothermal to its design capacity of 500 MW. MNL has a joint operating contract with Pertamina, specifically Pertamina Geothermal Energy (PGE) and energy sales contract (ESC) with Pertamina and PLN to supply electricity for 30 years.

Over the period of 2007 to 2008, Indonesia's geothermal power plant capacity in increased by 317 MW. New geothermal capacities in 2007 include:

- 110 MW Derajat III in West Java, of Chevron Corporation
- 60 MW Komojang IV in West Java, of Pertamina Geothermal Indonesia
- 20 MW Lahendong II in North Sulawesi; of Pertamina Geothermal Indonesia
- Two 5 MW Sibayak I and II in North Sumatera; of Pertamina Geothermal Indonesia

The Geology Agency of the Ministry of Energy and Mineral Resources announced in January 2007 the 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 were: 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; and Jailolo (75 MW) and Songa-Wayaua (140 MW) in North Maluku.

In June 2007, the government offered five work areas of the fourteen 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.

MAKKASSAR STRAIT GAS DEVELOPMENT

On August 2008, the Government approved Chevron Corporation's bid to develop five deep-water gas fields in the Makassar Strait in the eastern part of Indonesia at a cost of US$ 6.97 billion. The Government approved the plan of development (PoD) of the Gandang, Gendalo and Maha gas fields of the Ganal work area of Chevron Ganal Ltd, and PoD of the Ranggas and Gehem gas fields of the Rapak work area of Chevron Rapak Ltd.

Development of the Makassar Strait gas fields will involve ultra-deep water floating production facilities. The project will drill 28 production wells, and the first drilling is planned for 2009. Initial commercial production is to commence in 2012, and full production of 800-900 million cubic feet per day (MMSCFD) by 2016.

MASELA GAS DEVELOPMENT

Inpex Corporation won an open bid for and acquired a 100 percent working interest of the Masela block in the Timor Sea in November 2008. The Abadi gas field was discovered during the drilling of the first exploration well in 2002. Subsequent exploration drillings to 2007 proved the Abadi gas field to contain substantial gas reserves, estimated at least 14 Tcf. In mid 2008, Inpex Masela Ltd submitted a plan of development (PoD) of the Abadi gas field to the up-stream oil and gas regulatory authority.

In December 2008, after initial discussions, the government requested Inpex Masela Ltd to revise its PoD, specifically with regard to reduction of cost of production and the separation of PoD of gas field development and construction of the floating LNG plant. The scheme will establish gas sales prior to intake into the LNG plant. The proposed offer by Inpex Masela Ltd was for a total project cost of US$ 14.5 billion, which consists of development of gas field at US$ 5 billion and construction of floating LNG plant at US$ 9.5 billion. When completed, the floating LNG plant will have a production capacity of 4.5 million tonnes per year, and will be the first of its kind, with regard to its location in deep waters.

The government expects the Inpex Masela Ltd revised PoD to be approved soon and to commence commercial production in 2015 or 2016. Notably, the scheme for the Masela-Abadi LNG project is similar to the Donggi-Senoro LNG project, which allows greater flexibility of gas field development.

LNG PROJECT IN CENTRAL SULAWESI

Indonesia's state-owned oil and gas company Pertamina signed an agreement with Mitsubishi Corporation 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 Corporation 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. All LNG production will be shipped to Japan commencing 2013. 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.

OIL AND GAS PRODUCTION

The Government expects natural gas production increase by 146 percent in 2009 in comparison to production in 2000 through 18 cooperation contract contractors (KKKS). Natural gas production in 2008 is expected to reach 4,967.9 million scfd.

Significant increase of gas production in 2009 is expected from Pertamina (involving 30 various cooperation), BP Indonesia (Tangguh), ConocoPhillips (Condor Block), ConocoPhillips (Block B Natuna), and Total E&P (Sisi and Nubi gas fields). The government expects a production decline in 23 KKKS by 15.6 percent over the period of 2000-2009. Gas supply to the domestic market has increased over the period to reach 37.0 percent of total gas production in 2007.

Production of oil and condensates is expected to be able to meet the target of 1 million barrels per day at the end of 2008. Oil production in May 2008 was 982,550 barrels per day; in addition production of 71,000 barrels per day is expected from execution of 16 plan of developments (PoD) in 2008.

DOMESTIC MARKET OBLIGATION

The Government is considering applying terms of domestic market obligation (DMO) to allocate some of the coming Makassar Strait gas production to supply a large fertilizer plant in East Kalimantan, namely PT Pupuk Kalimantan Timur – PKT [44] commencing in 2013. The consideration is with regard to decline of gas production of the Sebaku gas field currently supplying PKT, and depletion of committed supply of other gas fields in the region.

Moreover, the Government is considering a number of options including terms of DMO to similarly maintain supply of gas at three other fertilizer plants constrained and are likely to be

[44] Production capacity of PT Pupuk Kalimantan Timur is 2.89 million tons per year

constrained by declining supply of gas in the regions of these plants in the near future. The plan proposes foremost to utilise any uncommitted gas reserves and, in addition, to allocate some of BP Tangguh LNG production in Papua and planned Inpex Abadi – Masela LNG production in the Timor Sea under DMO terms. The three fertilizer plants are namely PT Pupuk Sriwijaya in South Sumatera, PT Pupuk Kujang in West Java, and PT Petrokimia Gresik in East Java[45].

Gas supply from regasified LNG to PT Pupuk Kujang is expected to be purchased from point of sale at the West Java LNG receiving terminal. Supply to PT Petrokimia Gresik is to be purchased from the East Java LNG receiving terminal and gas supply to PT Pupuk Sriwijaya is to be purchased from the South Sumatera LNG reviewing terminal. Notably, the proposed LNG terminals are still at the planning stage of development; domestic LNG terminal was planned initially with regard to meeting requirements in power generation.

Fertilizer plant Pupuk Iskandar Muda (PIM)[46] in Aceh, constrained by supply of gas for the past few years, is expecting new supply of gas to meet production capacity of its two plants. The gas supplier, Medco E&P, has committed to deliver 110 million cubic feet per day for six years beginning from the fourth quarter of 2010. Gas supply will originate from the Block A, Arun gas field. In the mean time, PIM is seeking supply from external sources, including from Petronas, the Malaysian national oil and Gas Company, and other world LNG suppliers. PIM is currently supplied by diversion and gas swap originally destined for PT Pupuk Kalimantan Timur (PKT). The arrangement provided supply for half of PIM's capacity, however, is due to terminate at the end of 2008.

COAL METHANE GAS

In June 2008, the government signed two coal methane gas (CMG) work areas, which were direct offer for the specific work areas. The work areas were awarded to the consortia of Samantaka Mineral Prima over an area of 11 mining permit areas, consolidated as a single coal methane gas work area, located in Indragiri Hulu, Riau; and award to the consortia of Ridatama Mining Utama over 4 mining permit areas, consolidated as a single coal methane gas work area, located in Bentian Besar, East Kalimantan.

Production sharing between the Government and contractor is 60:40 in the case of the consortia of Samantaka Mineral Prima; and 55:45 in the case of the consortia of Ridatama Mining Utama. The contracts require the two companies over the first three years to perform geological and geographical survey worth US$ 400 thousand; 20 exploration drillings and coring worth US$ 12.4 million; and a production pilot project phase I worth US$ 200 thousand; to a total investment of US$ 13 million. Moreover, the Government receives a signature bonus of US$ 2 million.

Coal methane gas 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 categorised as highly prospective basins: South Sumatra (183.0 Tcf), Barito (101.6 Tcf), Kutai (80.4 Tcf), Central Sumatra (52.5 Tcf); moderately prospective basins: 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: Sulawesi (2.0 Tcf) and Bengkulu (3.6 Tcf).

In addition, in November 2008, the Government signed four coal methane gas cooperation contracts of winners of the direct-offer tender for coal methane gas work areas. The four winners of the coal methane gas tender have committed to invest US$ 16.31 million in exploration activities to include, geological and geophysical study, drilling of 13 exploration wells and coring, and a pilot project phase I. CMG work areas and committed contractors are: (1) CMG Barito Banjar I, PT Indobarambai Gas Methan; (2) CBM Bariti Banjar II, PT Barito Basin Gas; (3) CMG Kutai,

[45] Production capacites of these plants are, PT Pupuk Sriwijaya 2.87 million tons per year; PT Pupuk Kujang 1.14 million tons per year; and PT Petrokimia Gresik 2.69 million tons per year (fertilizers of various types).

[46] Production capacity of PIM is 1.14 million tons per year.

consortium Kutai West CBM Inc – Newton Energy Capital Limited; and (4) CGM Sangatta I, Consortium PT Pertamina Hulu Energi Metana Kalimantan A – Sangatta West CBM Inc.

As of mid 2008, 54 companies have submitted direct offer requests for coal methane gas work areas in Sumatera and Kalimantan.

PROGRESS OF THE 10,000 MW PROGRAM

The 10,000 MW acceleration program by *Presidential Decree No. 71/2006*, also known as the 10,000 MW crash program, mandated the state owned electricity company PLN to construct 40 large and small coal power plants to be operational by 2009-2010. Progress of the program, as of mid 2008, is as follows:

In Java, for a total capacity of 7430 MW in 10 locations:

- 6,830 MW in 9 location are under construction
- 600 MW in 1 location in the process of tender

Outside of Java, for a total of 2,121 MW in 25 locations:

- 1,441 MW in 11 locations are under construction
- 780 MW in 14 locations in the process of contract

Current plans expect 1,890 MW or 20 percent of the target to be operational in 2009. Moreover, 8,600 MW or 80 percent of the target is to be operational in 2010, and final completion and operation of entire target of 9,551 MW in 2012. Total investment for the project is estimated at IDR 98.1 trillion, which will consist of PLN internal financing 15 percent and from loans 85 percent. As of mid 2008, PLN is still seeking financing of IDR 47.9 trillion. The project will require 32 million tonnes of coal per year; in this regard, PLN has secured 28.5 million tonnes of coal per year as of mid 2008.

GAS DEAL

Six domestic gas supply contracts worth a total of US$ 578 million were signed in May 2008. Three of the contracts are in relation to gas supply for power plants in North and South Sumatera and in Muara Tawar, West Java, while the remaining three are for a methanol industry and oil and gas development activities.

LPG FOR URBAN HOUSEHOLDS

To reduce dependency on fuel oil, especially kerosene, the Government of Indonesia has implemented the *Conversion Program of Kerosene to LPG*. LPG stoves and small LPG cylinders (3 kilograms) were distributed, free of charge, to urban households using kerosene stoves, starting with households living near the Capital and set to expand to other cities. The target is to eliminate the use of kerosene stoves in urban areas by 2009.

BIOFUELS

Indonesia has been eager to promote biofuels in its energy developments. In 2006, *Presidential Decree No. 10/2006 regarding the National Team on Biofuel Development for Acceleration in Reduction of Poverty and Unemployment,* mandated the National Team to formulate a blueprint on biofuel development, and, this year, the economy issued *Ministerial Regulation No. 32/2008 regarding Supply, Utilisation and Commerce of Biofuel as an Alternative Energy* (as described above). Special Biofuel Zones (SBZ), sized at least 10,000 hectares in Java or 100,000 outside Java, have been designated based on an area's biofuel potential and other criteria.

Pertamina began marketing biodiesel in May 2006 in Jakarta, thereafter followed by Surabaya and Den Pasar. Bio Premium[47] was first marketed in August 2006, while Bio Pertamax[48] was first

[47] Bio Premium is a Pertamina brand name for a blend of 82 octane gasoline and ethanol

marketed in December 2006 in Jakarta, followed by Surabaya, Malang and Den Pasar. In Jakarta, biodiesel is available at 202 filling stations, while Bio Pertamax is available at 22 filling stations. Pertamina biofuel sales increased from 2007 to 2008. Biofuel sales in 2007 consisted of biodiesel at 217,048 kilolitres and Bio Pertamax at 1,408 kilolitres. At end of the third quarter of 2008, Pertamina sales of biofuels consists of 555,141 kilolitres of biodiesel, 9,958 kilolitres of Bio Pertamax and 3,776 kilolitres of Bio Premium.

RENEWABLE ENERGY

For 2008, the Government had programmed to install 40,000 photovoltaic solar home system (SHS) units of a total capacity of 2 MW and in addition to construct 8 centralised photovoltaic systems of 120 kW and 30 kW for distribution and installation in remote regions across Indonesia. The photovoltaic program is targeted to provide electricity in regions that has yet to be reached by PLN service.

The number of SHS distributed in 2008 increased from the previous year, when thirty-three thousand photovoltaic solar home system units were distributed to 30 provinces across Indonesia.

ENERGY EFFICIENCY

Presidential Instruction No. 2/2008 regarding *Energy and Water Efficiency* was released in May 2008 to replace Presidential Instruction No. 10/2005 regarding *Energy Saving*. The new instruction expands efforts to implement energy efficiency, as well as water efficiency. The National Committee for Energy and Water Efficiency was established, and its responsibilities include: (1) formulating policy, strategies and programs, (2) evaluating policy implementation, (3) monitoring progress, (4) creating public awareness and (5) overseeing financial support of programs.

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 in 2025. A strong candidate site of these plants is the Muria peninsular in the north coast of Central Java; site studies have been conducted since the early 1980's.

In 2007, the government established the Nuclear Power Development Preparatory Team; 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 No. 17/2007 regarding Long Term Development Year 2005-2015*, and *Government Regulation No. 43/2006 regarding 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 tonnes, 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 tonnes, grade range is 0.30-1.00. The uranium mines are located in West Kalimantan. By IAEA estimates, Indonesia could produce about 770 tonnes of uranium per year.

[48] Bio Pertamax is a Pertamina brand name for a blend of high octane gasoline and ethanol.

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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 2006 was about US$ 3,508 billion (2000 US$ at PPP). With a population of 128 million people, per capita income was US$ 27,459.

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 2.1 percent (2002-2003). In 2005, the economic activity remained resilient, with GDP growing at an annual rate of 2.4 percent. The recovery was driven by exports, mainly to China, and strengthened domestic capital investment. Continued GDP growth was observed in 2006 at an annual rate of 2.3 percent.

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 2006, 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 (2006)

Key data		Energy reserves	
Area (sq. km)	377,800	Oil (MBBL) – Proven	44
Population (million)	127.76	Gas (TCF)	1.4
GDP Billion US$ (2000 US$ at PPP)	3,508.10	Coal (Mt) – Proven	359
GDP per capita (2000 US$ at PPP)	27,459		

Source: Energy Data and Modelling Center, IEEJ. Oil and Gas Journal.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Japan's total primary energy supply (TPES) was 524 Mtoe in 2006, or a 0.7 percent decline from the previous year. By fuel, oil represented the largest share at 46 percent, coal was second at 20 percent, followed by natural gas (14 percent) and others represented the remainder. In 2006, 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 2006, Japan was the world's third largest oil consumer after the US and China[49], and almost all of the oil was imported. The bulk of these imports (80 percent in 2006) came from economies in the Middle East such as the United Arab Emirates (UAE), Saudi Arabia, Iran, Qatar and

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

Kuwait.[50] In 2006, the primary oil supply was 243.2 Mtoe, decline by 3.1 percent from the previous year.[51]

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 2006 primary coal consumption decreased by 4.0 percent from the previous year, reflecting the decline in the use for power generation.

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[52], which come from Indonesia (23 percent of imports in 2005), Australia (20 percent), Malaysia (19 percent), Quatar (12 percent), Brunei Darussalam (10 percent), UAE (8 percent), Oman (5 percent), and others. Natural gas is mainly used for electricity generation, followed by reticulated city gas and industrial fuels. In 2006, primary natural gas supply was 76 Mtoe, or increase by 7.2 percent from the previous year.

Japan has 275 GW of installed generating capacity and generated about 1,164 TWh of electricity in 2006. The generation amount by energy type is broken-down as: thermal (coal, natural gas and oil) at 62 percent, nuclear (26 percent), hydro (8 percent) and geothermal, solar and wind taking up the remainder.

Table 16 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	103.691	Industry Sector	156,001	Total	1,163,577
Net Imports & Other	430.396	Transport Sector	92,728	Thermal	726,388
Total PES	524,745	Other Sectors	112,212	Hydro	97,650
Coal	106,359	Total FEC	360,941	Nuclear	304,291
Oil	243,180	Coal	36,758	Others	35,249
Gas	76,039	Oil	203,736		
Others	99,166	Gas	27,182		
		Electricity & Others	93,266		

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.[53] In early August 2004, an accident occurred in one of the Kansai

[50] 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.

[51] 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.

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

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

Electric Power Company's nuclear reactors caused by a fracture on one of the secondary piping systems at Mihama Unit 3[54]. In July 2007, As a result of these incidents, public opposition against nuclear power generation has increased.

FINAL ENERGY CONSUMPTION

In 2006, Japan's total final energy consumption was 361 Mtoe, or 0.8 percent lower than the previous year. The industrial sector consumed 43 percent of the total, followed by the other sectors mainly residential/commercial at 31 percent and the transportation sector at 26 percent. By energy source, petroleum products accounted for 56 percent of total final energy consumption, followed by electricity and others (26 percent), coal (10 percent) and city gas (8 percent).

Energy consumption for the industrial sector showed a decline at 0.14 percent in 2006. The decline of industrial energy consumption in 2006 reflects the industrial structure shift from energy intensive industry to non-energy intensive one and the overall energy efficiency improvement in this sector. The residential/commercial sector's energy consumption in 2006 decreased at 1.7 percent. Energy consumption of the transport sector declined at 0.3 percent in 2006 from the previous year. The modest decrease in transport's energy consumption in 2006 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 2006. 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 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

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

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.[55]

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 2006, coal accounted for 20 percent of the total primary energy supply. Coal will continue to play an important role in Japan's energy sector mainly for power generation, iron and steel, cement and paper and pulp. Coal mines in Japan have become increasingly deeper and remoter and the cost of domestic mining is approximately three times that of imported coal. The government used to subsidise the domestic coal mining industry, however, through structural adjustments and reduction of subsidies coal production gradually has gradually decreased. The domestic production of commercial coal ended at the end of fiscal year (FY) 2001.

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

ELECTRICITY

Electricity is an important source of energy that took the second largest position in total final energy consumption in 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.

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.

[55] 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.

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.

NOTABLE ENERGY DEVELOPMENTS

AMENDMENT OF ENERGY CONSERVATION LAW

The current energy conservation law mandates those commercial buildings and industrial factories of which annual energy consumption account for 1,500 kl to (1) designate a personnel in charge of energy management, (2) report the energy consumption trends, and (3) set up mid- to long-term energy management plan. This covers only 10 percent of total energy consumption in Japan as the current energy conservation law does not regulate the major part of commercial and residential sectors of which energy consumption is projected to grow rapidly.

To more effectively manage energy consumption and CO2 emissions from those rapidly growing sectors – including the residential and commercial sectors -, the new energy conservation law will be enacted from April, 2009.

The new law will regulate energy consumption by company, in contrast to the current law that regulates energy consumption by building/industrial factory With the enactment of new law, those companies of which yearly total energy consumption – from retail segment, headquarter, to industrial segment, surpass 1,500 kl are required to (1) designate a personnel in charge of energy

management, and (2) report the annual energy consumption trends to the government. With the amendment, such retail stores as convenience stores will have to follow the energy conservation law.

In addition, the new law will require those owners of commercial/residential building of which size surpasses 300 square meters to report the energy consumption trends, in contrast to the current law that regulates the owners of commercial/residential building with 2,000 square meters.

The new law also encourages the joint implementation of energy conservation by company. Through sharing know-how, and trading surplus energy savings amount, it tries to strengthen the companies' efforts towards energy efficiency improvement.

Aside from these, the sectoral benchmark for energy efficiency improvement will be newly established. The benchmark is created to capture both historical energy efficiency trends and current energy efficiency status by sector. The new law will require companies – as a whole – to improve energy efficiency, while the benchmark indicator will allow those companies to understand the energy efficiency trends and status by sector.

COOL EARTH RDD&D[56]

In May, 2007, the Japanese government announced the "Cool Earth 50" initiative– to reduce its GHG emissions by 50 percent by 2050, 1990 as a base year. To realise this target, in March 2008, the Japanese government has formulated the "Cool Earth – Innovative Energy Technology Plan", which consists of "Innovative Energy Technology Program"[57] and "Technology Development Roadmap"[58]. Firstly, this Plan tries to identify innovative energy technologies, and prioritise them by the order of importance in development. Secondly, the technology roadmaps are formulated with specific timelines towards achieving goals on technology deployment, energy efficiency improvement and cost reduction. Thirdly, the Plan also identifies the importance of social infrastructure that assists the wider deployment of innovative technologies by sector. Finally it presents a list of international cooperation framework that can promote information exchange, and sharing know-how.

COOL EARTH PARTNERSHIP

The Japanese government considers that international cooperation is an important means to reduce GHG emissions. Through providing financial assistance to developing economies, Japan aims to reduce GHG emissions without damaging the economic growth. To meet this objective, Japan will establish a new financial mechanism called Cool Earth Partnership on the scale of USD 10 billion. With this mechanism, Japan will cooperate actively with developing economies in their efforts to reduce GHG emissions. Also, Japan will provide support to developing economies that are suffering from severe adverse impacts from climate change. In addition, Japan aims to create a new multilateral fund with the US and UK, and call for participation from other economies. These instruments will be utilised to strengthen solidarity between developed countries and developing countries towards global GHG emissions reduction.

Starting from 2008, Japan will provide funds that amount approximately to USD 10 billion for 5 years. On the basis of policy consultations with the Japanese government, assistance will be provided to developing economies in the following areas.

- Assistance for adaptation to climate change and improved access to clean energy (USD 2 billion)

[56] RDD&D stands for Research, Technological Development, Demonstration and Deployment.

[57] http://www.meti.go.jp/english/newtopics/data/pdf/031320CoolEarth.pdf

[58] http://www.meti.go.jp/english/newtopics/data/pdf/CE_RoadMap.pdf

- To those developing economies that are affected by the adverse impact of climate change, grand aid, technical assistance and aid through international organisations will be provided.
- The aid/assistance will be provided to: (1) forestry protection, (2) technical assistance towards prevention measures for natural disaster, (3) rural electrification with clean sources of energy.

- Assistance for mitigation of climate change (USD 8 billion)
  - Assistance will be provided to those developing economies that are trying to implement GHG emissions mitigation measure – such as energy efficiency improvement – with financial/technical difficulties.
  - Climate Change Japanese ODA Loan (USD 5 billion) will be created to provided with preferential interest rate.
  - To those projects to reduce GHG emissions, up to USD 5 billion will be provided through capital contribution and guarantee by JBIC (BIC Asia and Environment Facility), trade and investment insurance by NEXI, and government support (projects to be implemented through NEDO), together with private funds.

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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 2006, reaching US$956.7 billion (2000 US$ at PPP) in 2006. Per capita income in 2006 reached US$19,759, 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 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 2006, 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 (2006)

Key data		Energy reserves*	
Area (sq. km)	99,538	Oil (MCM)	-
Population (million)	48.42	Gas (BCM) - Recoverable	250
GDP Billion US$ (2000 US$ at PPP)	956.68	Coal (Mt) - Recoverable	80
GDP per capita (2000 US$ at PPP)	19,759		

Source: Energy Data and Modelling Center, IEEJ.

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

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Korea's total primary energy supply increased 5.7 fold from 38 Mtoe in 1980 to 217 Mtoe in 2006. In particular, energy supply from 1990 to 2000 increased by an annual average growth rate of 7.7 percent, far exceeding the economic growth rate of 6.2 percent for the same period. Likewise, per capita primary energy supply grew from 1.0 toe in 1980 to 4.5 toe in 2006. This is a level similar to that of Japan and most European economies.

In 2006, Korea's total primary energy supply was 216.6 Mtoe, 1.8 percent increase from the previous year. By energy source, oil represented the largest share at 43 percent, coal at 24 percent, and gas at 13 percent. The remaining 19 percent of primary energy came from nuclear, hydro and other fuels. Korea imported around 86 percent of its total energy needs in 2006, including all of its oil and gas requirements and 95 percent of its coal supply.

The oil consumption in 2006 was 93.6 Mtoe, a 1.4 percent decline from the previous year. The decline in oil reflects (1) high oil price and resulting demand decline in the transport sector, (2) fuel switching to gas in the industry and residential/commercial sectors. In 2006, the economy imported about 80 percent of its crude oil from the Middle East.

Coal use in 2006 totalled 52.6 Mtoe, 6.4 percent increase from the previous year. The substantial increase in coal results from the increased demand for the power sector due to its cost competitiveness against the other types of fuels. 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 28 Mtoe in 2006, 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 2006 was 404 TWh, 3.8 percent increase from 2005. Thermal – including coal, oil and natural gas accounted for 62 percent of total electricity generation, followed by nuclear at 37 percent, and hydro at 1 percent.

Table 18 Energy supply & consumption for 2006

Primary Energy Supply (Ktoe)		Final Energy Consumption (Ktoe)		Power Generation (GWh)	
Indigenous Production	43,846	Industry Sector	41,764	Total	403,954
Net Imports & Other	185,932	Transport Sector	32,376	Thermal	249,362
Total PES	216,618	Other Sectors	70,469	Hydro	5,219
Coal	52,618	Total FEC	144,609	Nuclear	148,749
Oil	93,614	Coal	8,322	Others	624
Gas	28,694	Oil	81,603		
Others	41,700	Gas	16,300		
		Electricity & Others	38,383		

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 2006 was 144 Mtoe, a 0.9 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 56 percent of total demand, followed by electricity (27 percent), coal (6 percent) and natural gas (11 percent). Because of strong policy measures, natural gas consumption has increased significantly, particularly in the residential/commercial sector, from 3 percent in 1990 to 36 percent of the sector's energy consumption in 2006.

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 Knowledge Economy

(MKE) [59] 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 changing situation has however 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).

Faced with the high energy prices, and rising concerns over climate change, in September 2008, Korea announced a long-term strategy that will determine the direction of its national energy policy until 2030. The plan has set-up its long-term energy goals in the following four areas:

- Improving energy efficiency and reducing energy consumption. By 2030, Korea will reduce its energy intensity by 46 percent, from current 341 toe/Million USD to 185 toe/Million USD. This would save energy consumption by 42 million toe;
- Increasing the supply of clean energy and reducing the use of fossil fuels. By 2030, the share of renewable energy in total primary energy will reach 11 percent from 2.4 percent in 2007;
- Boosting the green energy industry. By 2030, Korea's green energy technologies will be comparable to levels of most advanced economies; and
- Ensuring its citizens have access to an affordable energy. The government will ensure that energy sources are accessible and affordable to low-income households.

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, Viet Nam, and Peru. The present long term strategy of overseas oil and gas development includes; (1) to raise the self-sufficiency rate by 2012 to 18.1 % for crude oil and natural gas from 4.2 % level (Year 2007). (2) to increase KNOC daily production from 50,000 barrels per day (Year 2007) to 300,000 barrels per day y 2012.

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 81 percent in 2006. 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.

[59] MKE was established in 2008 by merging Ministry of Commerce, Industry, and Energy (MOCIE) with elements of the Ministry of Information and Communications, the Ministry of Science and Technology, and the Ministry of Finance and Economy, with an aim of creating an enhanced government instrument capable of meeting new challenges of the 21 century.

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 9th Plan of Long Term Natural Gas Demand and Supply,"* which was finalised by MKE in December 2008, it is projected that natural gas demand would grow by 0.2 percent per year from 2007 to 2030. By sector, the city gas sector's natural gas demand is projected to increase by 2.0 percent per year, while the gas demand for power generation is projected to decrease by an annual growth rate of 3.8 percent.

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 4th Basic Plan of Electricity Demand and Supply (2008-2022),"* which was finalised by MKE in December 2008, it is projected that electricity demand would grow by 2.1 percent per annum from 2008 to 2022 and a total of 33.6 GW in additional capacity will be required by 2022. Taking decommissioning into account, this translates to 100.8 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 2006, accounted for about 20 percent of total electricity generation. In the Plan, the gas-fired generation is expected to reduce its share, reaching 6.2 percent of total generation by 2022.

Korea has been building nuclear power plants since the 1970s, which now account for around 39 percent of electricity production. The share of nuclear capacity is projected to increase from 26.3 percent in 2007 to 32.6 percent in 2022, surpassing the largest share traditionally held by coal-fired power plants.

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).

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.

NOTABLE ENERGY DEVELOPMENTS

GREEN GROWTH: SUSTAINABLE DEVELOPMENT IN A LOW CARBON SOCIETY

The Korean government has set up the previously mentioned four targets to achieve its green growth initiative. Specific measures are delineated to meet the target as follows:

Improving Energy Efficiency and Reducing Energy Consumption

The government will allow market mechanisms to determine energy prices, and will promote high energy conservation standards. By 2030, Korea will move toward a service-based economy, as opposed to the energy-intensive manufacturing industry.

By sector, Korea will increase support for R&D to improve the efficiency of industrial equipment and facility upgrades, and will provide financial support for companies to invest in energy efficiency. For the transport sector, Korea will improve the fuel economy of automobiles; establish a low-carbon, high energy-efficient public transport system; and implement a plan which will make Korea as the world's top four producers of green cars. On the residential and commercial sectors, Korea will expand its energy-efficiency labelling programme to cover al buildings. Also Korea will promote the development and construction of zero-energy, carbon-neutral buildings. In the public sector, the government will lead by presenting example of energy conservation, and promote carbon trading schemes.

Improving Energy Efficiency and Reducing Energy Consumption

Under the Committee resolutions, renewable energy sources and nuclear power will account for 11 percent and 27.8 percent of total primary energy consumption by 2030. This represents a sizable increase from the current levels of 2.4 percent of renewable energy and 14.9 percent of nuclear power.

To meet the renewable energy target, the government needs to achieve a 44-fold increase in the use of photovoltaic energy, compared with that of 2007. The use of wind power will increase by 37-fold, bilfuels by 19-fold and geothermal power by 51-fold. The government intents to achieve these targets through (1) stimulating domestic demand for wind power, tidal power and biofuels. Steps will include introduction of the Renewable Portfolio Standards. Also the government will support the development of core technologies in the fields of photovoltaic energy, wind power and hydrogen fuel cells.

To promote the use of nuclear power, the government will facilitate and encourage open discussion to develop new nuclear power plants and the management of spent fuel.

Boosting the Green Energy Industry

To support developing the green energy industry, the government will invest about USD 11 billion up to 2030 in research and development into green technologies. It is estimated that the green energy industry will create about 950,000 new jobs.

Ensuring Citizens Have Access to an Affordable Energy Supply

The government will ensure that all Koreans have an adequate energy supply to maintain an acceptable living standard. The plan aims to help low-income household so they do not spend more than 10 percent of their total income on energy needs. To this end, the government will assist low-income households in obtaining more energy-efficient facilities and appropriate heating and cooling equipment.

ENERGY EFFICIENCY INITIATIVE

The Korean government has allocated about USD 14.2 billion for an energy efficiency initiative which will be effective until 2012. This initiative tries to improve energy efficiency by 11.3 percent by 2012 – compared with 2007 – and save 34.2 million tones of oil equivalent. The initiative was approved at the 17th meeting of the National Energy Conservation Committee, presided over by Primer Minister Han Seung Soo. It is part of Korea's long-term energy plan, announced in August 2008 – which tries to achieve a 4.6 percent annual energy efficiency improvement by 2030.

To meet the target, the government will provide incentives for companies to invest in energy efficiency, begin phasing out incandescent lamps by 2013, and implement a programme modeled after the Japan's Top Runner Program to complement the current Energy Efficiency Label and Standard Program.

Other actions include:

- The government will invest about USD 930 million in seven core technologies-building energy management systems, electric power IT, energy storage, green vehicles, LEDs, technologies to improve the energy efficiency of the most energy-intensive appliances, and green home appliances.
- By 2012, average fuel economy for automobiles will be improved by 16.5 percent. This would mean that the fuel economy for engine size below 1.5 liter – will be improved from current 12.4 km/l (29.2 mpg US) to 14.44 km/l (33.9 mpg US), while that the fuel economy for engine size above 1.5 liter – will be improved from current 9.6 km/l (22.6 mpg US) to 11.18 km/l (26.3 mpg US).
- For buildings with the highest level of energy efficiency (grade 1), the government will increase the maximum floor area ratio by 6 percent.
- When purchasing appliances for use in government buildings, the government will put priority in those models with the grade 1 energy efficiency label and products that deliver less than 1 watt of standby power.
- To encourage business to improve energy efficiency, the government will divide business into four categories depending on how much energy they can consume. Specific measures such as negotiated and voluntary agreements will be introduced for each category.

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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 26.11 million in 2006. The Gross Domestic Product (GDP) grew steadily over the 6 year period (2000-2006) at an average of 6.11 percent per year. Between 2005 and 2006, GDP grew at 5.9 percent to reach US$281.38 billion in terms of purchasing power parity (PPP) in 2000 US$. GDP per capita likewise experienced a 4.03 percent improvement reaching US$10,775 (PPP in 2000 US$) in 2006 compared to US$10,358 in 2005.

Malaysia is well endowed with conventional energy resources such as oil, gas, and coal, as well as renewable such as hydro, biomass and solar energy. As of January 2007, Malaysia's crude oil reserve and natural gas reserve stood at 4.316 billion barrels (Bbl) and 88.93 trillion standard cubic feet (Tscf) respectively. Malaysia is a net energy exporter where crude oil, natural gas and petroleum products contributed 15 percent of the economy's export earnings from January to September 2007.[60]

Table 19 Key data and economic profile (2006)

Key data		Energy reserves*	
Area (sq. km)	330,242	Oil (Bbl) - Proven	4.316
Population (million)	26.11	Gas (Tscf) - Proven	88.93
GDP Billion US$ (2000 US$ at PPP)	281.38	Coal (Mt) -Recoverable	1,843.0
GDP per capita (2000 US$ at PPP)	10,775		

Source: Energy Data and Modelling Centre, IEEJ. *National Energy Balance Malaysia, 2007

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary supply in 2006 was 59,318 ktoe. Oil accounted for 44 percent of total primary supply, while gas, coal and others accounted for 44 percent, 10 percent and 2 percent respectively. The recorded primary supply in 2006 was lower by about 4 percent compared to 2005. The decrement was caused by drop in oil production.

In 2006, Malaysia produced about 683 thousands barrels per day of crude oil.[61] The daily oil production declined about 1.3 percent compared to the 2005 production level. The reduction was caused by reserve depletion and production unit shut-downs for maintenance works. In view of the declining domestic reserves, Petronas, Malaysia's national oil and gas company, has been investing in exploration and production projects outside of Malaysia. As of 1 January 2008, the company had a total international reserve about 6.25 billion barrel of oil equivalent (boe), representing almost 23.7 percent of its total reserves.[62]

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

[61] National Energy Balance Malaysia 2007, Ministry of Energy, Water and Communications, Malaysia

[62] Petronas Group Results for the Financial Year Ended 31 March 2008, PETRONAS

Gas production in Malaysia reached about 6,746 million standard cubic feet per day in 2006. A total of 23,777 ktoe of gas was exported in the form of liquefied natural gas (LNG), to Japan, South Korea and Chinese Taipei, while a small percentage, 1295 ktoe, was exported by piped gas to Singapore. For domestic consumption, gas was supplied through the Peninsular Gas Utilisation pipeline system for electricity generation and for industries (a total of 23,908 ktoe).

In 2006, total gross electricity generation was 89,762 GWh. Thermal generation, mostly from natural gas and coal, accounted for 93 percent of production and hydropower for the remaining.

Table 20 Energy supply & consumption (2006)

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	87,561	Industry Sector	15,911	Total	89,782
Net Imports & Other	(28,376)	Transport Sector	14,799	Thermal	83,343
Total PES	59,318	Other Sectors	8,202	Hydro	6,439
Coal	6,020	Total FEC	38,912	Nuclear	-
Oil	26,358	Coal	1,141	Others	-
Gas	26,386	Oil	22,361		
Others	554	Gas	8,142		
		Electricity & Others	7,268		

Source: Energy Data and Modelling Centre, IEEJ (see http://www.ieej.or.jp/egeda/database/database-top.html)[63]

FINAL ENERGY CONSUMPTION

In 2006, total final energy consumption in Malaysia was 38,912 Mtoe. The biggest energy consumer was the industrial sector which consumed 41 percent of this total, followed by the transport sector at 38 percent and other sectors (agriculture, residential/commercial and non-energy) at 21 percent. By fuel source, petroleum products contributed the largest share with 57 percent of consumption followed by gas (21 percent), electricity (19 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:

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

[63] The National Energy Balance 2007 is available for updated data (year 2007). However, data (year 2006) was used to keep consistency among economies.

To support the policy, the National Depletion Policy was formulated with the intention to prolong and 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 2000 million standard cubic feet per day (mmscfd) or 56.6 million standard cubic metres per day (MCM per day). To diversify the fuel mix in power generation, the economy introduced the Four-Fuel Policy in 1981. The policy focuses on reducing the economy's over-dependence on oil as the principal energy source and aims for the optimum mix of oil, gas, hydro and coal in the supply of electricity. As a result, oil's domination in the power generation fuel mix has been reduced significantly and replaced with gas and coal. 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

NATIONAL ENERGY PLAN

Malaysia is very much aware that her oil and gas reserves will be depleted soon. In order to mitigate the side effects of over dependence on fossil resources, the economy needs long-term solutions for its energy security. To address this issue, a comprehensive National Energy Plan is being formulated. The plan will focus on her strategies to intensify energy efficiency initiatives for more productive and prudent use of remaining reserves, enhance efforts on developing viable alternative energy sources, such as solar, wind, and biofuels and explore nuclear energy potential. The plan is scheduled to be ready by the middle of 2009.

RENEWABLE ENERGY

Malaysia has been encouraging the development of renewable energy (RE) through policy and various strategies. The Five Fuel Policy has placed renewable energy as one of the component in the fuel mix for the power generation after oil, coal, gas and hydro while the Ninth Malaysia Plan (2006-2010) has specified a target for electricity grid-connected RE generation: 300MW in Peninsular Malaysia and 50 MW in Sabah.

In order to fast track renewable energy power generation development in Malaysia, a few programmes have been introduced. One of the programmes is the Small Renewable Energy Power Program (SREP), which was launched in 2001. Under the SREP, power generated from renewable resources is allowed for sale through national grid system. SREP developers can sell power to power utilities through the Renewable Energy Power Purchase Agreement (REPPA). The REPPA allows renewable energy power sales up to 21-years with the maximum allowed capacity for export up to 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.

Currently, the government is formulating various strategies to promote successful renewable energy development. In doing so, an action plan is being drafted for a systematic and holistic approach in assisting renewable energy project developers, especially the SREP projects. Among others, the Plan will include:

- In short term (up to 2010), review the obstacles faced by prospective RE developers. Measures to remove the identified obstacles and to stimulate and re-energize the RE program – particularly the SREP program -- will be proposed.
- 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), establish new targets for RE utilisation by type of RE sources and by region; and

- Provide economic support through fiscal and financial incentives improvement.

ENERGY EFFICIENCY

Energy Efficiency Legal Framework

Currently, the government is drafting a regulation called Efficient Management of Electrical Energy Regulations, under the Electricity Supply Act. The regulation is focused on those electricity users who consume 3 GWh or more electricity over a period of six months. Under the proposed regulation, such users will be required to engage a registered electrical energy manager who shall, among others, be responsible for analysing the total consumption of electrical energy, advising on the development and implementation of measures to ensure efficient management of electrical energy, as well as monitoring the effectiveness of the measures taken.

In order to ensure efficient energy use in commercial buildings, the government has been taking action to amend the Uniform Building By-Laws (UBBL) by incorporating the MS 1525, which is the Code of Practice on the Use of Renewable Energy and Energy Efficiency in Non-Residential Buildings. Once the amended UBBL is enforced, commercial buildings are bound to implement energy efficiency requirements as specified in the MS 1525.

Energy Efficiency Action Plan

In order to drive well managed strategy and programs for energy efficiency development, the government is in the midst of formulating an Energy Efficiency Action Plan. The action plan shall be able to put in place a strategic direction for energy efficiency development in the country in the support of sustainable energy development. These energy efficiency strategies will be focused on the industrial sector and commercial and residential buildings. The plan is expected to be ready by the end of 2009.

Energy Efficiency Initiative for the Industrial Sector

The industrial sector is the largest energy consumer in the economy. The energy-intensive industries in the economy are glass, cement, rubber, pulp and paper, iron and steel, ceramic, oleo-chemical, plastic, wood/timber, food, and textiles. To encourage these energy guzzling industries to improve their energy utilization trend and to save energy, the government has developed the Energy Efficiency and Conservation Guidelines Part 1: Electrical Energy-Use Equipment. The guideline, which was launched in July 2007, will encourage the industries to adopt energy efficiency practices and to manage and improve their energy utilization and environmental management. It covers a number of commonly-used equipment such as fans, motors, pumps, chillers, transformers, air-compressors. The guideline also highlights the best practices in selection and design (with standard efficiency values), as well as best practices in operation, monitoring and maintenance of the equipment.

Energy Efficiency in the Commercial and Residential Sectors

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, energy-reducing features. The LEO is used as a showcase and demonstration building for energy efficiency application. The targeted Energy Index (EI) of the LEO Building is 100kWh/m² per year compared to the EI in conventional office buildings in the economy which is around 200-300kWh/m² per year.

Apart from the LEO building, the Zero Energy Office (ZEO) Building, office building for the Malaysia Energy Centre, is also one of Malaysia's showcases for energy efficiency in building designed with zero net energy concepts. The ZEO building incorporates both renewable energy and energy efficiency features for its energy needs and improves energy utilisation. The building is targeted to achieve an EI of 50 kWh/m². These two buildings are expected to provide information

and disseminate knowledge about smart and highly energy efficient buildings to the public in the economy. Information and knowledge from these buildings could provide assistance for commercial building developers and owners in the economy to opt for energy efficient and smart buildings.

In order to improve energy efficiency in the government-owned buildings, the economy has directed that their energy consumption should be reduced by 10 percent. As an initial move, the economy has audited seven government-owned buildings to determine the potentials for energy saving. The audited buildings were selected based on their function e.g., hospital, library and etc. The outcomes from these audits could provide a good indication for formulating adequate and effective strategies in realising the 10 percent target.

Fiscal Incentives for Energy Efficiency

To further support the energy efficiency development, the economy has introduced various fiscal incentives in the 2009 Budget.[64] The incentives are:

- Exemption of import duty and sales tax on solar photovoltaic system equipment
- Exemption of import duty and sales tax on intermediate goods such as high efficiency motors and insulation materials
- Exemption of sales tax on locally manufactured solar heating system equipment
- Exemption of sales tax on locally manufactured energy efficient consumers' goods such as refrigerators, air-conditioners, lightings, fans and televisions; and
- Exemption of import duty and excise duty for hybrid cars with the engine capacity below 2000 cc beginning August 2008. The hybrid cars must be certified to have achieved not less than a 50 percent increase in the city-fuel economy or not less than a 25 percent increase in combined city-highway fuel economy relative to a comparable vehicle that is an internal combustion gasoline fuel.

OIL AND GAS SECTOR

As of January 2008, the total domestic reserves for Malaysia were 20.13 billion barrels of oil equivalent; 5.46 billion boe of crude oil and 14.67 billion boe of natural gas. At the current production rate, the reserve life for crude oil and gas are 19 years and 32 years respectively. Reserve Replacement Ratio (RRR) for oil and gas combined is 0.9, 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.

In 2008, three new fields came on stream increasing the total number of producing fields in Malaysia to 88, of which 61 are oil fields and 27 are gas fields. Four new Production Sharing Contracts (PSC) were awarded during 2008, which bringing the total up to 67 PSCs in operation in Malaysia, with 23 in Peninsular Malaysia, 21 in Sarawak and 23 in Sabah.

The three new fields were Kikeh, Abu and Tabu. Kikeh is the first Malaysia's deepwater field came on stream with a peak production rate at 125,000 bpd. The Kikeh field is located about 1120 km from Kota kinabalu, capital city of Sabah, at a water depth of some 1,300 metres and is jointly developed by Murphy Oil Corp and Petronas Cari Gali Sdn Bhd. Other deepwater fields under development are Gumusut-Kakap and Malikai fields. The Gumusut-kakap is expected to come on stream by 2011 with a production capacity around 150,000 bpd. The economy's deepwater projects will assume a prominent role in providing new growth opportunities in Malaysia. As of today, nine deepwater fields have been identified for commercial operations from 2007 to 2013.

[64] Malaysia 2009 Budget Speech delivered by the Prime Minister on 28 August 2008.

Besides that, Petronas is also stepping up efforts to pursue necessary cost-efficient solutions for small field development. Some 90 "hotspots" have been identified as a marginal field potential and are expected to be developed from now and 2010. To increase the national reserve, Petronas has been actively involving in the oil and gas exploration and production internationally. As of January 2008, Petronas's total international reserves amounted to 6.24 billion boe. Petronas was awarded thirteen new PSCs internationally, thus bringing the number of international ventures to 63 in 23 countries.

Natural Gas

In 2008, the Peninsular Gas Utilisation (PGU) system supplied 2170 mmscfd of gas, an increase of 2 percent from 2007 value, for domestic consumption and export to Singapore. The power sector remains as the largest single domestic gas consumer, consuming 60.4 percent of gas transmitted through the system. Industrial, petrochemical and other users accounted for 32.4 percent, significantly increasing from 665 mmscfd in the previous year to 703 mmscfd in 2008. About 7.2 percent was exported to Singapore. PGU gas input was obtained from the offshore Terengganu gas field and, additionally, through imports from the Malaysia-Thailand Joint Development Area (JDA), Indonesia and Vietnam. The gas input from offshore Terengganu increased by 6.6 percent while almost 20 percent of total supply was imported.

Liquefied Natural Gas (LNG)

As of March 2008, Malaysia had produced a total of 22.5 million tonnes of LNG at the Petronas LNG complex in Bintulu. The LNG was exported to Japan (59.6 percent), South Korea (28 percent) and Chinese Taipei (12.4 percent). During the year under review, three new contracts have been signed with Osaka Gas and Shikoku Electric Power from Japan and Shanghai Gas from China. The LNG Complex in Bintulu is expected to receive new gas supply from the offshore gas fields in Sabah through a new 550 km gas pipeline system, connecting Bintulu to a new gas terminal with a storage capacity of 1250 mmscfd at Kimanis in Sabah. The new gas pipeline system will be constructed with a cost of US$ 900 million and is scheduled to be ready by 2013.

ELECTRICITY

Prior to the Asian Financial Crisis, the period between 1990 and early 1997, annual electricity demand growth in Malaysia was growing at an average of 14 percent per annum on the back of 8 to 10 percent GDP growth. Electricity demand growth then fell to 4.5 percent in 1999 on the aftermath of the Asian Financial Crisis. However, the economy's GDP growth rates shot up again in the period between 1999 (6.1 percent) and 2000 (8.9 percent), thus creating an immediate concern on the threat of a possible shortage of generation capacity should the GDP growth rate continues. Electricity demand growth for 2000, for instance, was back at the pre-Asian Financial Crisis rate of 14 percent. The immediate reaction was to accelerate previously deferred new generation capacity projects in order to meet the possibility of a continued high growth. However, the GDP growth rate leveled off and fell back to only 5 percent in 2001, thus creating a persistent excess generation capacity situation in the years ahead due to the overhang of committed generation projects. Therefore, Malaysia is currently working on a gradual reduction of the excess reserve margin, which is now hovering at 43 percent to 25 percent in the long term. Therefore, it is expected that no new plant-up projects will be implemented for the period from 2006 to 2010 except for the already approved 750 MW Combined-Cycle Gas Turbine Tuanku Jaafar phase 2 project and the two coal-fired power plants, the 2100 MW Tanjung Bin and the 1400 MW Jimah.

On the aspect of generation fuel-mix, the role of hydropower will be more prominent after 2010. Though most of the potential sites in Peninsular Malaysia had already been developed, there are still some untapped potentials in the states of Pahang, Kelantan and Perak. The major potential, however, is the Bakun Hydroelectric Project, which is currently being developed. The Bakun project development will see an installation of 2,400 MW generation capacity. Meanwhile, the Peninsular Malaysia-Sarawak interconnection link via sub-marine cable is also being considered to channel the power generated from the Bakun project. The economy is also studying the possibility

of developing more hydropower at the Rejang Basin in Sarawak. Another interesting development in the economy's power generation sector is the possibility of using nuclear power. At the moment, nuclear energy has no share in the generation fuel mix. However, the latest development in the world energy market with the volatility of oil and gas and coal prices, depletion of indigenous oil and gas resources, environmental concern due to the coal-fired power plants and so forth, have made the government consider nuclear as one of the options for future power needs. Currently, the government has initiated a study on nuclear energy potentials for power generation in Malaysia. If the outcomes of the study are positive, the economy may consider nuclear energy in its power generation sector after 2020.

REGIONAL ENERGY COOPERATION

In addressing energy security issue with neighbouring countries, Malaysia and other South East Asia countries under the Association of South East Asia Nations (ASEAN) are taking steps to interconnect their power and gas pipeline systems. To achieve this objective, Malaysia and other ASEAN countries are working on two projects, namely, the Trans-ASEAN Gas Pipeline (TAGP) and the ASEAN Power Grid (APG). The TAGP project, which is currently underway, is expected to provide the region with a secure supply of energy with the realization of gas infrastructures. Among the milestones achieved and planned under the TAGP for Malaysia are pipeline interconnections with South Sumetra, Indonesia; West Natuna, Indonesia; East Natuna, Indonesia; Joint Development Authority (MTJDA), Thailand; and Arun, Indonesia. For the APG, a Memorandum of Understanding between ASEAN member countries was signed in August 2007. The APG, if materialized, will provide the necessary interconnectivity for regional mobilization of electricity sales and optimize the development of energy resources in the ASEAN region.

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PETRONAS Group Results for the financial year ended 31 March 2008

MEXICO

INTRODUCTION

Mexico is located in North America, bordering the United States 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 105.7 million in 2007, and steadily growing at an average annual rate of 1.04 percent over the last 5 years. Due to industrialisation and urbanisation in recent years, around 29.7 percent of the population lives in principal metropolitan areas. The three largest urban metropolitan areas in Mexico are Mexico City, Guadalajara City and Monterrey City. Mexico City is one of the largest urban centres in the world, with around 20.3 million people within the city.[65]

Mexico's economy continued to rebound in 2006 from years of slow economic performance. The economy has been linked to a favourable evolution of external demand and an important increase of the commercial balance of petroleum products, as well as revenues from family remittances. In 2006, the real gross domestic product (GDP) reached US$ 1,090.81 billion in terms of 2000 US$ at purchasing power parity (PPP), an increase of 4.77 percent over 2005. This growth has been higher than the average over the last 6 years, with high increases in the agricultural and fishing sectors. In the same year, the GDP per capita grew at 3.63 percent to settle at US$ 10,466 (2000 US$ at PPP). Mexico's economy depends highly on crude oil production and its exportation, representing about 3 percent of GDP.

Mexico is a major non-OPEC oil producer. Together with other independent producers and OPEC, it has made a major contribution 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 has important crude oil and gas production fields which are developed by offshore and onshore facilities. The four crude oil and gas production regions in Mexico are: Northeaster Marine region, South-western Marine region, Southern region and Northern region. In 2007, proved crude oil reserves (including gas liquids) ranked sixteenth largest in the world, totalling 12,187 million barrels (Mb), and proved natural gas reserves ranked thirty-fifth with 13 trillion cubic feet (TCF). Mexico ranked sixth in oil production with 3,082 thousand barrels per day (bpd), and eleventh in natural gas production with 6,059 million cubic feet per day (mmscfd).

Table 21 Key data and economic profile (2006)

Key data		Energy reserves	
Area (sq. km)*	1,964,375	Oil (Mb) – Proved**	10,501
Population (million)	104.22	Gas (TCF) – Proved**	13.161
GDP Billion US$ (2000 US$ at PPP)	1,090	Coal (Mt) – Recoverable***	1,211
GDP per capita (2000 US$ at PPP)	10,466		

Sources: Energy Data and Modelling Center, IEEJ.

* Instituto Nacional de Estadística, Geografía e Informática (INEGI), Información geográfica

** As of December 2007, Statistical Report 2008, Pemex, Mexico. (Not including gas liquids).

*** At the end 2007, BP Statistical Review 2008.

In 2007, Mexico had 51,028 MW installed capacity for electricity generation, which is provided by two state-owned electric utilities and Independent Power Production (IPPs). Electricity is

[65] Mexico City is conformed by the Capital City (Distrito Federal) and their Metropolitan Areas, as well known as Zona Metropolitana del Valle de Mexico (ZMVM).

provided not only by oil and gas resources; renewable energy as nuclear, hydro, geothermal, wind and biomass energy are also developed. Natural sources as renewable energy are profitable for the electricity generation, and renewable sources represent 26.9 percent of the total installed capacity. Hydroelectric plants have an installed capacity of 11,343 MW, while nuclear plants have 1,364 MW.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Mexico's total primary energy supply (TPES) in 2006 was 177,024 ktoe, a growth of 1.94 percent compared with 2005, which was 176,618 ktoe. Oil and gas (with contributions of 56.4 percent and 27.9 percent respectively) dominate primary energy supply with a combined share of 84.3 percent. Coal's share decreased in 2006 by 1.17 percent from 8,847 ktoe in 2005 to 8,743 ktoe in 2006.

CRUDE OIL AND PRODUCTS

Mexico had 14,717 million barrels of crude oil equivalent (Mbcoe) of proved oil and gas reserves as of December 2007, the 16th largest in the world. Mexico's proved reserves have declined in recent years; in 2007 reserves were 10.5 percent less than the previous year.

The National Oil Company, Pemex, is one of the largest crude oil and natural gas companies in the world. By law, Pemex is the sole producer of crude oil and its derivates in Mexico from upstream exploration to final distribution as well as downstream by means their four integrated companies: Pemex Exploration and Production (PEP), Pemex Refining (PR), Pemex Gas and Basic Petrochemicals (PGPB) and Pemex Petrochemicals (PP). Total production of crude oil in 2007 reached around 3.082 million bpd, or 5.3 percent less than the previous year. Domestic consumption accounted for 44.3 percent of the total volume produced, with 1.36 million bpd; the remaining 55.6 percent or 1.71 million bpd was exported. Of this amount, about 80.1 percent went to the US, followed by 9.6 percent to Europe. In 2007, Mexico was world's sixth-largest crude oil producer and the world's ten-largest crude oil exporter. In the context of refining, Mexico has six major refineries with a total refining capacity of 1.54 million barrels per day. Six refineries shape the National Refining System (NRS). The total volume distributed to refineries in 2007 was 1.27 million bpd, 1.0 percent less than 2006; this decline is primarily due to the acts of sabotage carried out on Pemex's pipelines, as well as to adverse weather conditions. Despite its status as one of the world's largest crude oil exporters, Mexico is a large importer of petroleum products. In 2007, Mexico imported 494.7 thousand bpd of petroleum products (gasoline, diesel, fuel-oil, petrochemicals, natural gas, liquiefied gas, and others), while exporting 179.7 thousand bpd. Of these imports, gasoline represented about 57.1 percent, an increase of 47.2 percent respective to 2006. In order to increase output volume and improve the quality of petroleum products, the government has carried out a long-term upgrading (or reconfiguration) plan for all six refineries. The plan is to increase the total refinery capacity by about 350 thousand bpd and improve the quality of gasoline by reducing the amounts of sulphur and lead. Pemex has recently completed the reconfiguration in four of the refineries (Madero, Salamanca, Tula and Cadereyta). As of December 2007, the reconfiguration of the Manatitlan refinery was 75 percent complete; its total reconfiguration is expected to be concluded in February 2009, which will increase the capacity by about 185,000 bpd to reach a total capacity of 330,000 bpd.

NATURAL GAS

Mexican natural gas proved reserves as of December 2007 were 13,161 million cubic feet (mcf). Most of the proved reserves are associated gas, while the rest comes from non-associated gas reserves. The Southern Region of the country contains the largest share of proven reserves, with 39.4 percent in 2007. On the production side, Burgos project is the main producer of non-associated natural gas and it comprises the development of reserves and the production of natural gas in the Burgos basin, Sabinas and Piedras Negras. Burgos basin is located in the Northern region. During 2007, natural gas production averaged 6,058.5 million standard cubic feet per day (mmscfd);

an increase of 13.1 percent compared to production registered in 2006, mainly as a result of a greater production from the Burgos basin. The Northern region contributed the most with 42.1 percent. Dry gas production averaged 3.54 mmscfd and natural gas liquids production was 405 thousand bpd in 2007. Mexico has 11 natural gas processing centres in 2007 and 4,288 mmscfd of total processing. The Cactus Gas processing centre contributed 32.7 percent of total processing. Domestic consumption in 2007 was 3,076 mmscfd, an increase of 4 percent respective to 2006. The important drivers of consumption are power generation and industrial distribution. In terms of foreign trade, exports of natural gas increased from 33 mmscfd in 2006 to 139 mmscfd in 2007; this represents an increase of 421 percent, mostly due to greater production of associated gas. Natural gas imports decreased 15 percent in 2007 compared to 2006, averaging 368 mmscfd. Natural gas imports decreased of 50 percent between 2004 and 2007.

COAL

Coal is a relatively small component of Mexico's energy primary production and consumption compared to petroleum and natural gas. Mexico has 1,211 million tonnes of recoverable coal reserves. The majority of Mexico's coal reserves are located on the state of Coahuila in the northeastern part of the country; additional resources are located on the state of Sonora (in the northwest) and the state of Oaxaca (in the south). Around 70 percent of recoverable reserves are anthracite and bituminous, while 30 percent are lignite and sub-bituminous. Total coal supply in 2006 was 8.74 Mtoe and accounted for around 2.2 percent of primary energy supply; an increase of 6.8 percent respect 2005. In 2006, final coal consumption was 1.6 Mtoe, an increase of 15 percent relative to 2005. During 2006, exportation of coal decreased 26.1 percent, from 236 ktoe in 2005 to 174 ktoe in 2006, while importations increased 5 percent in the same period, from 4,532 ktoe to 4,757 ktoe respectively. Coal is imported from the US, Canada, and Colombia. It is mostly used for electricity generation and steel production.

ELECTRICITY

The Mexican electricity sector is divided into two main areas: electric power public utilities service and activities in which private participation is allowed. Generation, transmission, distribution and sale of power for public service purposes is reserved to the federal government through two governmental companies: the Comisión Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LyFC). The Mexican electric grid is well developed and it is interconnected in the National Electric System (NES) which is controlled by the CFE through its National Centre for Energy Control (CENACE).

Electricity demand has grown rapidly over the past decade, with an average growth rate of 4.7 percent per year. Electricity consumption reached 150.4 TWh in 2007, an increase of 3.3 percent from 2006. It is expected to increase by an average of 4.9 percent per year over the next ten years. During 2007, electricity installed capacity in Mexico was 51,028 MW, of which 77.5 percent is owned by the two state-owned electric utilities; 75.2 percent by CFE and 2.3 percent by LyFC. The remaining capacity is owned by IPPs (22.4 percent).

The total power generation for 2006 was 239,475 GWh. Most of the power was generated by thermal generation (79 percent). Mexico has interconnections with the US in the north and Belize in the south. In 2007, Mexico exported 1,208 GWh, an increase of 30.4 percent from 2006, and imported 256 GWh, a decrease of 45.8 percent from 2006.

RENEWABLES

Renewable energy in Mexico is provided by hydro, geothermal, wind, nuclear and biomass (sugarcane and wood). Natural resources such as hydro, geothermal, wind and nuclear are installed for electricity generation while biomass is for heating purposes. The total installed capacity for renewable electricity was 13.75 GW in 2007, an increase of 9 percent from 2006. This increase was possible because both Central Hidroeléctrica "El Cajón" and Central Eólica "La Venta II" began operations in 2007, contributing an additional 750 MW and 83.3 MW respectively. Of the total renewable installed capacity, hydro represents 82.4 percent.

In 2006, biomass production was 8,196 ktoe, a decrease of 2 percent from 2005. Sugarcane biomass is the fibre produced from sugar production and is burned for electricity generation; it represents 28 percent of the total energy biomass production. Electricity is generated for plant-use at sugar plants. Wood production was 5,885 ktoe in 2006 and is used for cooking and heating in the residential sector.

Table 22 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	255,778	Industry Sector	27,845	Total	239,475
Net Imports & Other	-76,962	Transport Sector	50,998	Thermal	189,010
Total PES	177,024	Other Sectors	34,593	Hydro	30,394
Coal	8,743	Total FEC	113,436	Nuclear	10,866
Oil	100,325	Coal	1,611	Others	9,205
Gas	48,565	Oil	73,605		
Others	19,390	Gas	14,676		
		Electricity & Others	23,543		

Source: Energy Data and Modelling Center, IEEJ and Secretaría de Energía, Mexico 2007.

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

FINAL ENERGY CONSUMPTION

In 2006 the total final energy consumption in Mexico reached 113,436 ktoe, a large incremental increase of 4.42 percent relative to the previous year. Total energy consumption was divided between the industry, transport and other sectors. Industry consumed 24.3 percent of energy, the transport sector 45.1 percent, and other sectors (including residential, commercial and agriculture) 30.5 percent. By fuel source, petroleum products accounted for 64.9 percent of consumption, natural gas for 12.9 percent, coal for 1.4 percent and electricity and others for 20.7 percent.

POLICY OVERVIEW

NATIONAL ENERGY POLICY FRAMEWORK

Mexico's Ministry of Energy (SENER) is responsible for Mexico's energy policy within the current legal framework. The Energy Sector Programme 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 Programme 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 Mexican Political Constitution. The Constitution, specifically in Article 27, 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 Programme 2007 – 2012" recognised the need to liberalise energy markets to augment investment capacity, foster competition and to enhance energy quality and supply. In this way, an initiative of energy reform was sent to both Senator's Chamber and Dispute's Chamber in order to make changes to the Mexican Political Constitution within the energy issue. As a result of multiple discussions and agreements in both Chambers, the energy reform was approved in October 2008. From this new reform, six new laws were published: 1) Regulation law of the Article 27 Constitutional for the Petroleum Sector; 2) Law of Petróleos Mexicanos; 3) Law for the Sustainable Use of Energy; 4) Law for the Renewable Energy Use and the Financing of the Energy Transition; 5) Law of the Hydrocarbon National Commission; and 6) Law of the Regulatory Energy Commission. With these laws, Mexico's energy economy is expected to strengthen this sector and achieve greater energy security.

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

Law for Renewable Energy Use and Financing of the Energy Transition

In October 2008, the Low Chamber of the Mexican Congress approved the decree project for the expedition of the Law for Renewable Energy Use and Financing of the Energy Transition. This Law establishes regulation for electricity generation from the renewable energy utilization and clean technologies, as well as establish the national strategy and mechanisms for the financing the energy transition. The Law also includes provisions to create a renewable energy fund to make renewable-based generation competitive versus other fossil-fuel based projects. In 2009, the Law will have a fund of 3,000 million pesos (approximately US$ 280 million at 2007 value) in order to strengthen the energy security of the country. Incentives would comprise a set of policies and measures to promote using renewable energies.

Law for the Development and Promotion of Bioenergy

In February 2008, the Mexican Congress published 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, promotes cleaner and environmentally friendly fuels, and develops 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 biofuels, tax exemptions and subsidies to organizations

involved in biofuel production and development, and the establishment of a national biofuels 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 as well as investing to increase its refining capacity.

The Cantarell oil field, located in the Gulf of Campeche, is one of the largest oil fields in the world.[66] Production of Cantarell field has decreased in last nine years by means its natural decline. In 2007, The Cantarell Complex's total production was 1.49 million bpd, 16.9 percent less than the average production recorded in 2006. The Cantarell oil field represents 48.5 percent of Mexico's total crude oil production. According with Pemex, production levels in the Cantarell complex for middle 2008 was 1.07 million bpd, showing a decrease of 16.9 percent lower than the number recorded in 2007. Projections reveal that total production in this project will decrease at a rate of 14.1 percent per annum between 2006 and 2016, averaging a volume of 921 million bpd during the period. Nevertheless, Cantarell is expected to remain the economy's main producing field until 2012, at which point the production decline of the field should be offset by increased production at Ku-Maloob-Zaap, A.J.Bermúdez, Jujo-Tecominoacán, and other fields.

Exploration and Production developments: During 2007, for the Cantarell project, the Nohoch dehydratation plant began operations, incorporating the first production wells with high water content. Additionally, non-conventional wells were drilled in order to increase its productive life and improve the distribution of the drainage flow within the reservoir.

Refining developments: In 2007, Pemex Refining initiated the renewal of its maritime fleet in order to transport petroleum products, primarily from the Pacific coast. During the first stage, five boats will be incorporated and 10 vessels will be renewed. Also, Pemex analyzed the construction of a new crude oil refinery with a total capacity of 330,000 bpd at an approximated investment cost of US$ 8,171 million. With this project, Mexico's refining crude oil capacity is expected to increase by 2,020 thousand bdp by 2016. Construction of this new refinery could start in 2010 to begin its operation in 2015.

Petrochemical developments: In April 2007, the Swing plant at the Morelos petrochemical complex commenced production of linear polyethylene. The plant has the capacity to produce, indistinctively; 300 thousand tonnes of high or low density linear polyethylene per year, which represents a 60 percent increase in the production capacity to 800 thousands tonnes per year. Also, at the same petrochemical complex, Pemex Petrochemicals (PP) began a project aimed at expanding the production capacity of the ethylene oxide plant from 225 thousand to 360 thousand tonnes per year, in order to satisfy the potential demand for this product. In August 2007, Pemex Petrochemicals and the Brazilian group, Unigel, signed a cooperation agreement to reactivate the productive chain of acrylonitrile in Mexico; Unigel will acquire the total acrylonitrile production and byproducts, and build a new plant in Coatzacoalcos, in the state of Veracruz. Additionally, Unigel will transfer to the Morelos petrochemical complex a plant located in the city of Tula, in the state of Hidalgo, which will be operated by Pemex Petrochemicals through a service contract.

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.

[66] Cantarell oil field is conformed by Akal-Nohoch, Chac, Ixtoc, Sihil and Kutz fields.

Under this policy, Mexico's Energy Regulatory Commission has awarded several LNG storage permits.

In September 2006, the Altamira Terminal, located on the north coast of the Gulf of Mexico, began operation; it is expect to have a regasified volume of 500 million cfd in 2009. The terminal, which is a joint venture of Royal Dutch Shell, Total and Mitsui & Co., is the economy's first LNG regasification terminal and required an investment of US$ 440 million. This project plans to increase to a peak capacity of 1.3 billion cfd. On the Pacific coast, the Energia Costa Azul LNG terminal of Sempra Energy started operation in April 2008. The terminal with a capacity of 1.0 billion cfd will supply gas to local power utilities as well as exports to Arizona in the US through a new 72.4 kilometre (45 mile) long pipeline that will interconnect with existing pipelines in the area, specifically with Bajanorte Gas Pipeline. The natural gas will be sourced from Indonesia and, possibly, Sakhalin, Russia. There are two other LNG terminal projects in progress, 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. The Manzanillo terminal will be sourced from Peru LNG.

POWER SECTOR DEVELOPMENTS

Mexico's Ministry of Energy has been formulating plans to meet increasing energy demand in parallel with economic development. The Electricity Market Outlook 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 4.9 percent. During the period between 2007 and 2016, the expansion programme of CFE will require an addition of 21,737 MW of capacity, of which 5,082 MW are in place, under construction or in the bidding phase, and 16,656 MW of additional capacity for which no bidding has taken place yet. In addition, LyFC's programme will lead to the start-up of distributed generation projects in the Central region, adding 416 MW of capacity. Total additional capacity of 22,153 MW will be added during the period on behalf of the public utility.

Regarding the technologies considered for the required additional capacity, combined-cycles represent 51.8 percent of the total capacity to be installed during 2009 – 2016, with 8,385 MW, followed by the assignment of the so-called free capacity, for which technology has not yet been specified. Also, as part of a policy to diversify energy sources, this capacity will be assigned to different technologies allowing for the use of diverse sources, such as coal, natural gas and uranium, among others. This is a way to prevent dependency on a single fuel. The remaining 24.6 percent of uncommitted capacity corresponds to different technologies, mainly coal, hydro, wind and geothermal. To achieve this diversification, construction of 2,100 MW of new coal capacity is under consideration, along with integrated gasification combined cycle (IGCC), 406 MW of wind and 158 MW of geothermal.

The investment needed for the electricity sector for the period 2007 – 2016 is estimated by Mexico's Ministry of Energy to be 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.

On the other hand, a net additional remote self-supply and cogeneration capacity of 2,581 MW is estimated, considering both private and public sector projects, more specifically by Pemex and its cogeneration project at Nuevo Pemex Complex with 304 MW of remote self-supply.

RENEWABLE ENERGIES

Among Latin American nations, Mexico is one of the most promising areas for renewable energy development. International organizations such as the GEF, the United Nations Development Program (UNDP) and the World Bank, among others, are supporting 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, in the 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 wind installed capacity of 87 MW. In 2007, La Venta II, the first large-scale wind power plant in Mexico (83.3 MW), began operations. There is an intention to develop five in-grid, large scale renewable energy projects through a US$ 70 million donation from the GEF. In this way, La Venta III wind electric plant will operate in the Tehuantepec Isthmus, contributing to the diversification of the country's generation fleet with 101 MW; it is the first one of these projects, developed under IPPs scheme, with an estimated investment of US$ 120 million. There are four other projects considered under the same scheme, each at 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 US$ 49.35 million grant from the Global Environment Facility (GEF) for the installation of a new hybrid power plant (combined cycle + thermo-solar). The Agua Prieta II plant will be located in Agua Prieta in the state of 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 tonnes of carbon dioxide over its 25-year lifespan. The plant is expected to start operations in 2011.

Solar Water Heating Programme (Procalsol): Within the renewable energy projects of the Ministry of Energy by means of the National Commission for Energy Conservation (CONAE), and the joint participation of the German Technical Cooperation (GTZ) and the National Association of Solar Energy (ANES), Mexico has been promoting the use of solar water heaters in three final energy-use sectors: residential, agro-industry and commercial, and industry. The goal of this programme is to achieve the installation of 1.8 million square meters of solar water heaters in 2012.

ENERGY EFFICIENCY

Law for the Sustainable Use of Energy

After approbation of energy reform in Mexico, Law for Sustainable Use of Energy has been published for the implementation of new strategies, objectives, actions and targets for the application of technologies, equipments, devices and vehicles through an energy efficiency approach, as well as to establish one normalization programme for energy efficiency and scientific technology research. The government, by means the Ministry of Energy, has proposed to develop the National Programme for the Sustainable Use of Energy in order to achieve the implementation of these new mechanisms.

Green mortgages programme: In January 2007, CONAE and the Mexican National Fund for Workers' Dwelling (Infonavit) launched the Green Mortgages Programme (Hipoteca Verde). The programme 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 US$ 720. This programme is linked with Procalsol, through the promotion of energy efficiency to achieve the installation of solar water heaters and energy savings lamp in the Infonavit's houses.

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NEW ZEALAND

INTRODUCTION

New Zealand is an island nation in the southern Pacific with a population of approximately 4.1 million in 2006. GDP has grown by an average of around 3 percent per annum (2000-2006), reaching about US$ 96.72 billion in 2006 (in 2000 US$ at PPP).

New Zealand is currently self-sufficient in all energy forms apart from oil and has modest energy resources including 23.6 million cubic metres (MCM) of oil, 55.9 billion cubic metre (BCM) of natural gas, and 15 billion tonnes (Bt) of coal. As of 2006, hydro, geothermal and wind resources met around 70 percent of electricity demand.

Table 23 Key data and economic profile (2006)

Key data		Energy reserves*	
Area (sq. km)	268,680	Oil (MCM)**	23.6
Population (million)	4.14	Gas (BCM)	55.9
GDP Billion US$ (2000 US$ at PPP)	96.72	Coal (Bt)	15
GDP per capita (2000 US$ at PPP)	23,362		

Source: Energy Data and Modelling Center, IEEJ and IEA.

* Ministry of Economic Development, the New Zealand Energy Data File, June 2008.

** Oil reserves include crude oil, condensate, naphtha and LPG as at 1 January 2008.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

New Zealand's total primary energy supply in 2006 was 17,541 ktoe. A variety of energy sources are used to meet these needs comprising oil (39 percent), gas (19 percent), coal (12 percent), hydro (12 percent), geothermal (12 percent) with solar, wind, biomass, biogas and waste heat providing the remainder (6 percent). Self-sufficiency in 2006 was 74.4 percent.

Since 1990, New Zealand's primary energy supply has grown by 27 percent, driven by demand growth arising from a population increase of approximately 25 percent and economic growth of over 60 percent during the same period. The majority of New Zealand's energy supply is sourced from indigenous energy resources. Local oil production, however, does not meet demand so New Zealand imports a large amount of crude oil and oil products

In 2006, New Zealand generated 41,503 GWh of electricity. Around 65 percent of generation was from hydro and renewable resources. Hydro, at 56 percent, was the most important source of generation. Thermal generation (coal, oil and gas) showed an increase of 0.3 percent to 15,312 GWh compared with the previous year. Around 68 percent of hydro electricity is generated in the South Island, and all geothermal electricity is generated in the North Island. Almost all of the remaining electricity is generated in the North Island from natural gas, coal, wind, and landfill gas.

Table 24 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	13,053	Industry Sector	3,410	Total	43,519
Net Imports & Other	4,733	Transport Sector	5,755	Thermal	15,308
Total PES	17,541	Other Sectors	3,153	Hydro	23,453
Coal	2,093	Total FEC	13,133	Nuclear	0
Oil	6,910	Coal	528	Others	4,758
Gas	3,278	Oil*	6,816		
Others	5,260	Gas*	1,410		
		Electricity & Others	4,379		

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 increased by 3.1 percent in 2006 to 13,133 ktoe compared with the previous year. The industrial sector consumed 26 percent of energy used, the transportation sector 44 percent and other sectors 30 percent. In 2006 final energy consumption was dominated by oil, comprising 6,816 ktoe (52 percent), followed by gas 1,410 ktoe (11 percent), coal 528 ktoe (4 percent) and 4,379 ktoe (33 percent) for electricity and others (heat etc). Excluding international transportation, domestic transport is the main consumer of petroleum products, accounting for 83.8 percent of the total oil consumption in 2006. Consumption of oil in the other sectors was shared between agriculture (3.3 percent), industrial (10.2 percent), commercial (1.8 percent) and residential (0.9 percent).

The largest electricity consumer sector is the industrial sector which accounted for 38 percent of electricity consumption in 2006. The major industrial consumers are an aluminium smelter, iron and steel works, pulp and paper mills, timber mills and large dairy factories. The residential sector consumed around 32 percent with the commercial sector, agriculture sector and transport sector consuming the balance of 30 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, there have been dramatic changes in the structure of the electricity industry with former government-owned and operated electricity and gas monopolies 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 competitive wholesale electricity market has operated since 1996.

Recently, it has become apparent that New Zealand faces some challenges 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 years or dry years and growth in demand for electricity. In addition to these challenges has been consideration of how to address energy security and climate change issues, including by leveraging energy efficiency and conservation.

In October 2007 the Government launched the New Zealand Energy Strategy (NZES) and the the New Zealand Energy Efficiency and Conservation Strategy (NZEECS). The NZES provides a framework for competitive markets and effective regulation, strategies to create a conducive

environment for capital investment and, at the same time, provide leadership to tackle energy security and climate change issues. The NZEECS is the second five year strategy as required by the Energy Efficiency and Conservation Act 2002. It outlines energy efficiency and conservation strategies with specific energy improvement and saving targets for the transport, industrial, commercial and residential sectors. In late 2008 New Zealand had a change of government; as such the details of these strategies are subject to reconsideration.

OIL

The oil industry was liberalised in 1988, removing price controls, government involvement in refining, licensing requirements for wholesalers and retailers, and restriction on imports of refined products. The industry is subject to general competition regulations through the Commerce Commission, a government body that handles general economic and competition regulations.

New Zealand's downstream oil industry is dominated by four major international oil companies; British Petroleum, Chevron, Mobil and Shell. These four international companies also have stakes in the New Zealand Refining Company Limited (NZRC) which operates the country's only oil refinery at Marsden Point in Northland. The four international oil companies own bulk storage facilities throughout the country, and many retail outlets.

In 2006, two petroleum mining permits (PMPs) and eleven petroleum exploration permits (PEPs) were granted. The two PMPs, for the Turangi field and the Cheal and Cardiff fields, have added to the total PMPs now at twenty one. One PEP was granted over the East Coast basin, two offshore PEPs were awarded over the Northland basin, five PEPs were granted over the Great South basin and three PEPs were awarded over the Taranaki basin.

Thirty wells were drilled in 2006. Wells were drilled in a number of basins including onshore and offshore Taranaki, offshore Canterbury Basin and, in early 2007, the East Coast Basin. Seven wells were drilled offshore in 2006. A total of approximately 112,400 metres (m) oil and gas wells were drilled in 2006. This reflects an increase of 24,900 m on the 2005 figure of approximately 87,500 m, when 34 wells were drilled. Of the 30 wells drilled in 2006, 12 were exploration wells and 18 were appraisal or development wells. Accompanying this rise in drilling activity was a continued increase in the number and size of 2-D seismic acquisition surveys carried out. A total of 22,660 km of 2-D seismic was acquired in 2006. 3-D seismic acquisition was planned for the Northland Basin covering 250 km^2 in early 2007 and about 1,900 km^2 3-D seismic were reprocessed.

In 2006 New Zealand's oil was being produced from 16 onshore and offshore fields in the Taranaki region. Oil production was dominated by the offshore Maui field, which supplied 56 percent of total production in 2006. The Kapuni field provided 9 percent of total oil production, while the McKee field provided 6 percent. The remaining 29 percent is produced at the Tariki/Ahuroa, Waihapa/Ngaere, Mangahewa, Ngatoro, Kaimiro, Moturoa, Rimu, Cheal, Surrey, Turangi and Pohokura fields. In 2006, New Zealand's oil production was 929.1 ktoe, a decrease of 2.4 percent compared with 2005. This was mainly due to the decreasing production at the Maui field (down 19 percent). Crude oil production dropped by 37 percent, from 312.9 ktoe to 198.2 ktoe, and naphtha production dropped by 14 percent, from 176.7 ktoe to 152.8 ktoe, compared with the previous year. However, condensate production increased by 25 percent, from 463.4 ktoe to 580.4 ktoe. The average daily production of crude oil was 3,972 barrels, condensate was about 11,627 barrels, and naphtha was 3,051 barrels.

In 2006, 86 percent of local crude oil, condensate and naphtha were exported. The remaining 14 percent was used for feedstock at Marsden Point refinery to produce refined products. Exports of crude oil, condensate and naphtha in 2006 were 800.1 ktoe, 19 percent higher than the previous year. Most of the local crude oil, condensate and naphtha were exported to Australia, Japan and Korea. Total exports of oil products fell from 179.1 ktoe to 102.7 ktoe in 2006, a decrease of 42 percent from the previous year. LPG exports were 7.2 ktoe, 47 percent less than in 2005 and oil products used for international transport decreased by 6.9 percent to 1,122.5 ktoe. Total crude oil

imported in 2006 was 4,968 ktoe, 2.1 percent higher than in 2005. Crude oil was imported mainly from Australia and the Middle East. Total imports of oil products rose 4.3 percent from 2,144.8 ktoe to 2,235.6 ktoe in 2006. LPG imports were 45.4 ktoe, 233 percent higher than the 2005 level of 14.3 ktoe.

New Zealand's oil self-sufficiency had declined over time from over 50 percent in 1986, to 15% by 2006, largely due to decreasing production from Maui, NZ's largest oil field. However since production from the Tui field came onstream in 2007, self sufficiency has increased to 59% for 1Q-3Q2008.

NATURAL GAS

In 2006, total New Zealand gas production increased by 2 percent to 3893.2 ktoe, compared with 3797.6 ktoe in the previous year. Gas is produced entirely in the Taranaki region. Fifteen fields produce gas, with production dominated by the Maui field. Fields in production in 2006 were Maui (57.1 percent), Kapuni (17.3 percent), Pohokura (8.6 percent), McKee (4.6 percent), Tariki/Ahuroa (3.7 percent) and others (8.7 percent). Gas is piped through the 3,400 km of high pressure gas transmission pipelines and distributed through 2,800 km of intermediate, medium and low pressure gas distribution pipeline networks.

About 58 percent of New Zealand's natural gas produced during 2006 was used for electricity generation (including cogeneration and other transformation). Of the gas used for generation, 72 percent was used for electricity generation, 25 percent for cogeneration and 3 percent for other transformation. Gas consumption for electricity generation increased by 12 percent to 1457.0 ktoe and cogeneration decreased by 11 percent to 501.6 ktoe compared with 2005. The industrial sector used around 18 percent of New Zealand's natural gas in 2006, compared with 17 percent in the previous year. The residential sector accounted for around 5 percent of total gas consumption and 3 percent of gas consumption was used by the commercial sector. The final 15% of New Zealand's natural gas was consumed by the petrochemical industry for non-energy purposes. The majority of this provided feed-stock at Methanex's methanol plants at Motunui and Waitara Valley, and at Ballance Agri-Nutrients' ammonia-urea plant at Kapuni.

ELECTRICITY

The government outlined its objectives for the electricity sector in its Government Policy Statement on Electricity Governance (GPS), published in 2004. A limited revision of the GPS was made in October 2006, designed to improve the quality and timeliness of decision-making on transmission. In September 2003, the government established the Electricity Commission to govern the electricity industry in accordance to the GPS. This was triggered by the industry's failure to establish a self-governance regime as previously envisaged. There were also concerns that existing market arrangements did not ensure security of supply in dry years. The Commission is responsible for managing the electricity sector so that electricity demand can be met even in a 1 in 60 dry year[67].

There are five main generating companies plus a number of small, independent generators and on-site co-generators. In 2006, the five major generating companies provided 91 percent of New Zealand's electricity generation. They were: Meridian Energy (29 percent), Contact Energy (27 percent), Genesis Power (19 percent), Mighty River Power (12 percent), and TrustPower (4 percent). The remaining 9 percent of generation was split between on-site cogeneration and other independent generators. On transmission, Transpower operates the national grid, which connects most of the major power stations around the country to local distribution lines. It also conveys electricity directly to major users. Power transmission between the North and South Islands is via a high-voltage direct current (HVDC) link from Benmore power station in the South Island to

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

Hayward substation in the North Island. Part of this link is a submarine cable running under Cook Strait. The link allows surplus power generated in the South Island to be transmitted to the North Island, where demand is greatest, but also allows transmission from north to south if required.

On the retail market side the buying and selling of wholesale electricity is done via a "pool", where electricity generators offer electricity to the market and retailers bid to buy the electricity at prices set half-hourly. The market is operated under the Electricity Governance Regulations 2003 and Electricity Governance Rules 2003. Electricity generators and buyers enter into hedge contracts to manage the financial risks of trading electricity at spot prices. The previous government recently reviewed the operation of the electricity market and concluded that the current arrangements were fundamentally sound, although there is room for improvement.

RENEWABLE ENERGY AND ENERGY EFFICIENCY

New Zealand has significant renewable energy resources. In 2006, the share of renewable energy in the electricity generation fuel mix was 65 percent. Hydro generation contributed nearly 54 percent to this figure, followed by geothermal with 7.6 percent, wind with 1.5 percent and others with 1.9 percent. In addition, renewable energy resources such as geothermal, biomass and biogas are being used directly for heating and as biofuel in commercial and industrial sectors. Total renewable consumer energy, excluding electricity generation, was 1074.8 ktoe in 2006. The NZES, released in October 2007, included a target of having 90 percent of electricity generated from renewable sources by 2025.

In terms of energy efficiency, the NZEECS, represents a step change in funding and delivery for energy efficiency and conservation. The strategies under the NZEECS are developed based on cost-benefit analysis and use a programme driven approach to setting targets and forecasting outcomes. The NZEECS also makes clear, on a programme by programme basis, who is responsible for delivering results; progress will be tracked and reported on annually. The new NZEECS incorporates lessons learned from the earlier version. The NZEECS has specified the following energy saving targets: (1) 30 PJ of savings in non-transport energy per year by 2025; (2) 9.5 PJ of additional direct use of renewable energy per year by 2025; and (3) 20 PJ of energy savings in the transport sector by 2015. The energy saving targets have also been coupled with CO_2 emissions reduction targets. The NZECS estimates that its strategies will be able to reduce 5-6 Mt of carbon per year compared to the business-as-usual scenario.

NOTABLE ENERGY DEVELOPMENTS

This section outlines the key achievements to June 2008

ENERGY EFFICIENCY

- 11,047 homes were insulated through EECA programmes and 3,040 Housing NZ Corporation homes were retrofitted with insulation or heating improvements;
- 2.2 million energy efficient light bulbs subsidised by the Electricity Commission were sold in the year through June 2008, resulting in an estimated annual energy savings in 2007 of 173 GWh;
- The Efficient Lighting Strategy and the voluntary Home Energy Ratings Scheme was launched, minimum energy performance standards for an additional 13 product classes are being developed, and new Energy Star labels were launched for computers, monitors and fridges;
- 3,455 old fridges were retired and recycled in a pilot programme;
- Building code changes were introduced requiring higher insulation levels for homes and more energy efficient lighting in commercial buildings, and providing a solar water heating standard;

- The Energy Efficiency and Conservation Authority (EECA) reported energy savings of 1.8 PJ p.a. from its 'better products' programmes and savings of 1.3 PJ p.a. from its programmes with industry; and
- The Electricity Commission reported energy savings of 0.71 PJ p.a. as a result of its efficiency programmes with industry delivered in the year through 30 June 2008.

SECURITY OF SUPPLY:

- New investment in the transmission grid needed to support new renewable generation in remote locations has been identified;
- Ways to integrate wind generation into the electricity system have been identified;
- Improvements to the design of the electricity market – to ensure fair prices for consumers – were released for comment following a major review;
- Guidelines for smart meters have been issued, so that the new technology can benefit consumers and aid the efficient operation of the electricity system;
- A better accounting system for electricity flows has improved incentives to minimise electrical losses in the electricity system; and
- Government policy statements governing the electricity and gas sectors have been updated to align to the goals outlined in the Strategy.

LOW EMISSIONS POWER AND HEAT:

- An Emissions Trading Scheme has been designed and legislation was passed in September 2008;. The newly elected Government has established a special select committee to review the Emissions Trading Scheme and related climate change matters in order to build a broader consensus on how to make more effective progress on climate change issues.
- Guidance for councils on the importance of renewable electricity has been developed, to help resource consent decision-making. A draft National Policy Statement for Renewable Electricity Generation is was released in August 2008;
- The Minister for the Environment has 'called in' four resource consent applications for nationally significant renewable electricity developments and referred them to a one-step process to reduce decision-making timeframes; and
- Legislation to facilitate investment by lines companies in renewable generation was passed in September 2008.

TRANSPORT:

- The domestic sea freight strategy, *Sea Change,* was launched and the Seafreight Development Unit established to revitalise the domestic sea freight industry;
- A work programme has been scoped to encourage early deployment of electric vehicles in New Zealand and an expert advisory group established (Vehicle Energy and Renewables Group); and
- The New Zealand Transport Strategy was updated and a Government Policy Statement to guide funding allocations for transport was developed.

FOSTERING TECHNOLOGY AND INNOVATION:

- The Marine Energy Deployment Fund and Low Carbon Energy Technologies Fund were established and the first rounds allocated;
- Energy research funding was boosted further by US$ 32.5 million over four years in the May 2008 Budget;
- The EnergyScape project completed an assessment of New Zealand's natural energy resources and developed a model for evaluating new technologies; and

- The National Energy Research Institute improved links between energy researchers by holding conferences and creating a new web-based database.

AFFORDABILITY AND WELLBEING:

- More South Island electricity customers will have lower fixed daily charges once regulation changes, now developed, come into effect (proposed date is 1 April 2009).

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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.

In 2006, real GDP at 2000 US$ at PPP was estimated at US$9.69 billion, which increased by 2.6 percent compared to the previous year which was at US$9.44.

PNG's primary energy use per capita at 0.2 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 in the oil and gas industry.

Table 25 - Key data and economic profile (2006)

Key data		Energy reserves*	
Area (sq. km)	462,840	Oil (MCM) - Proven	63.6
Population (million)	6.20	Gas (BCM)	440
GDP Billion US$ (2000 US$ at PPP)	9.69	Coal (Mt)	-
GDP per capita (2000 US$ at PPP)	1,562		

Source: Energy Data and Modelling Centre, IEEJ and BP 2008 Statistical Review of World Energy.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2006, PNG's net primary energy supply was 1,638 ktoe, an increase of 2.4 percent compared with 2005. Light crude oil and petroleum products accounted for 80 percent, gas 16 percent while hydro and other fuels, the remaining 4 percent. Around 86 percent or 2,480 ktoe of indigenous crude oil and NGL 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 2007 is 38,000 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 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. Hides gas field 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.

Table 26 - Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	3,201	Industry Sector	553	Total	3,012
Net Imports & Other	-1268	Transport Sector	344	Thermal	2,149
Total PES	1,638	Other Sectors	131	Hydro	863
Coal	-	Total FEC	1,028	Nuclear	-
Oil	1,305	Coal	-	Others	-
Gas	259	Oil	787		
Others	74	Gas	-		
		Electricity & Others	241		

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 2006, PNG had generated 3,012 GWh of electricity (a 10 percent increase from 2004). The sources of generation were hydro at 29 percent and thermal at 71 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 2006, the total final energy consumption in PNG was 1,028 ktoe (an increase of 2.6 percent from 2003). The industrial sector, accounted for 54 percent (an increase of 6 percent over 2003) and was the largest end user, followed by transport (33 percent), and other sectors including agriculture and residential/commercial (13 percent). Petroleum products accounted for 77 percent of total consumption (a. decrease of 0.5 percent over 2003), electricity and others accounted for 23 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 revised Oil and Gas Act of 2002 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

In March 2008, a Joint Operating Agreement (JOA) for PNG LNG Project was signed among the project participants, who are ExxonMobil (41.6%), Oil Search (34.1%), Santos (17.7%) AGL, Nippon Oil and local landowner interests. The Project plans 6.3 million tonnes of production per annum, and feed gas is to be sourced from Kutubu/Gobe/Moran oil fields as well as Hide/Juha/Angore gas fields. In May 2008, a Gas Agreement was signed between joint project participants and the State of Papua New Guinea. A front end engineering design study is projected to start early 2009, with a target to start production in 2013.

Liquid Niuguni Gas Co, which was formed by InterOil, Merrill Lynch Commodities, Inc and Pacific LNG Operations Ltd in 2007 has been evaluating reserves of Elk/Antelope gas fields, which supply feed gas to the possible LNG plant of 4-9 million tonnes annual production capacity. InterOil is an operator of these gas fields and also operates an oil refinery (capacity 32,000 barrel per day) 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 area covers nearly 1.28 million square kilometres. At the end of 2007, Peru had a total population of 28.22 million people, growing an average of 1.6 percent annually from 1993 to 2007. Peru has three main regions: Selva, Sierra, and Costa. Most of its population lives in the Costa region, with 54.6 percent of the total, while Sierra region and Selva region represents 32 percent and 13.4 percent respectively. Also, Peru is divided into twenty-five departments; the major population centre is located in the Lima department with 8.44 million people. Peru's urbanisation rate is 75.9 percent.

The large metal deposits in the Andean mountains make Peru a major metal exporter; it is the world's second largest silver exporter and third largest copper exporter (after Mexico and Chile). It is also among the top five exporting economies for gold, zinc, tin and lead.

Peru's gross domestic product (GDP) in 2006 was US$168.17 billion while GDP per capita was US$6,096 (both in 2000 US$ at PPP). In the same year, real GDP grew 7.74 percent, up from 6.5 percent in 2005. This rate is higher than the average over the past 10 years despite robust economic growth in the last 8 years. Peru's economic growth was possible thanks to developments in the construction sector and agro-industrial sector, which grew 14.7 percent and 7.2 percent, respectively. Overall, real GDP growth is projected to remain favourable in 2007, at more than 8.0 percent, driven by the agro-industry, construction, manufacturing and the long-expected Camisea energy project.

Peru is currently a net importer of energy. Between 2005 and 2006, Peru increased its primary energy imports by 22.6 percent. Crude oil comprised the largest share of the total energy imported, at 88 percent, because domestic crude is not of adequate quality to use as refinery feedstock. The remainder of Peru's energy imports consist of coal. Its proven energy reserves at the end of 2007 were 447.4 million barrels (Mb) of crude oil, 334.73 billion cubic meters (BCM) of natural gas and 45.9 million tonnes (Mt) of coal. Furthermore, in 2006, Peru had proven uranium reserves around 1,800 tonnes located in the northwest of the country in the Puno region. The largest share of Peru's energy reserves comes from natural gas at around 45 percent of the total. Peru's primary energy supply also includes a considerable rate of non-conventional energy including wood, biogas, solar and others.

Table 27 Key data and economic profile (2006)

Key data		Energy reserves	
Area (million sq. km)	1.28	Oil (Mb) – Proved **	447.4
Population (million) *	28.22	Gas (BCM) – Proved **	334.73
GDP Billion US$ (2000 US$ at PPP)	168.17	Coal (Mt) – Proved ***	45.9
GDP per capita (2000 US$ at PPP)	6,096		

Source: Energy Data and Modelling Center, Institute of Energy Economics, Japan (IEEJ).

* Instituto Nacional de Estadística e Informática (INEI), Perú.

** As of December 2007, Libro Anual de Reservas, Ministerio de Energía y Minas, Perú, 2008.

*** Balance Nacional de Energía 2006, Ministerio de Energía y Minas, Perú, 2007.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Peru's total primary energy supply (TPES) in 2006 was 11,499 ktoe, growing slightly from 11,127 ktoe in 2005. Oil retained the largest share of TPES (60.7 percent), while the share of natural gas was 16.21 percent. Coal's share in 2006 was 6.8 percent at 784 ktoe, a decrease of 18.3 percent compared to last year. Non-conventional energy supply reached 21 percent of the total primary energy supply, or 2,414 ktoe.

Peru increased its energy imports by 22.6 percent, from 2,838 ktoe in 2005 to 3,481 ktoe in 2006. These imports contributed 30.2 percent of Peru's energy requirements and comprised of mostly oil from Colombia, Ecuador, Venezuela and Nigeria. In the same way, energy exports increased 43 percent compared to last year, where crude oil was the major energy commodity; the increase was made possible by both increases in production and exploitation of new wells. Total energy exportation reached 1,206 ktoe in 2006.

CRUDE OIL AND PRODUCTS

Peru's crude oil production is concentrated in the northern part of the country. Several oil blocks are exploited for crude oil production; however, the largest oil blocks are Block 1-AB along the border with Ecuador, Block 8 in the north-eastern Amazon region, Block X in the northwest, and Block Z-2B off the northwest coast. Block 1-AB and Block 8 account for almost two-thirds of Peru's total crude oil production. The largest oil producer in Peru is Argentina-based Pluspetrol, which controls over one-half of the country's entire crude oil production. Peru mostly privatized the former state-owned oil company, Petroperu, in 1993. Still, Petroperu continues to play an important role in the oil sector, including operation of oil crude production and most of the refineries.

Peru had 1,121 Mb of proven oil reserves (including gas liquids) in 2007, which represents an increase of 7.6 percent compared to 2006. Successful results from drilling activities in La Selva, Costa Norte and El Zocalo, as well as reserves reclassification and new reconditioning procedures contributed to this increase. The economy produced 113,869 barrels per day (bpd) of total oil liquids in 2007, a decrease of 1.4 percent compared to last year. From the total production, 68 percent was crude oil, with 77,113 bpd, and the other 32 percent was natural gas liquids (NGL) with 36,755 bpd. Increasing NGL production represents the bulk of the increased oil production in last three years, including a significant increase between 2004 and 2005 of 150 percent, from 14,260 bpd to 35,840 bpd respectively.

Table 28 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	9,268	Industry Sector	3,829	Total	27,370
Net Imports & Other	3,481	Transport Sector	3,956	Thermal	7,723
Total PES	11,499	Other Sectors	1,719	Hydro	19,594
Coal	784	Total FEC	9,494	Nuclear	0
Oil	6,979	Coal	397	Others	53
Gas	1,859	Oil	6,724		
Others	1,878	Gas	334		
		Electricity & Others	2,039		

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

Peru has seven major refineries with a total capacity of 197,000 bpd. All refineries are privately-operated, where Repsol-YPF controls the largest facility in the country, La Pampilla refinery, with 102,000 bpd of installed capacity. Another privately-operated refinery is Purcallpa refinery with 3,300 bpd operated by Maple Gas. Petroperu operates four refineries: Talara refinery (62,000 bpd), Conchon refinery (15,500 bpd), Iquitos refinery (10,500 bpd), and El Milagro refinery (1,700 bpd). The other refinery is Shiviyacu refinery, which is operated by Pluspetrol Norte with 2,000 bpd of installed capacity. During 2007, total crude oil processed in refineries was 158,919 bpd; 31.1 percent came from national production and 68.8 percent from imports. The La Pampilla refinery was a major player processing 84,181 bpd of crude oil, 94 percent of which came from imports from Ecuador, Angola, Nigeria, Brazil, Colombia, Venezuela and Iran.

In 2007, production of petroleum products was around 172,595 bpd. The major products were Diesel 2 and liquefied petroleum gas (LPG) with 45,857 bpd and 25,425 bpd respectively.

NATURAL GAS

Peru had proven natural gas reserves of 334.73 BCM in 2007, ranking fifth in South America. During 2007, the country produced around 644.6 million standard cubic feet per day (mmscfd), an increase of 1.2 percent compared to last year. The start of production at the Camisea project in August 2004 has been the principal force behind the large increase from 2003 (180.1 mmscfd) to 2004 (320.7 mmscfd).

The Camisea project consists of several natural gas fields located in the Ucayali basin of southeastern Peru, principally in Block 88 along the Camisea River. This project provides natural gas for domestic consumption, although, the ultimate goal of the project is to develop an export market. The initial production capacity at Camisea was 450 mmscfd of natural gas and 34,000 bpd of NGL. However output capacity is expected to increase steadily as drilling continues on Camisea's Block 56, adjacent to Block 88. Besides Camisea, large concentration of Peru's natural gas lie in the Aguayita gas field in central Peru, Block X in the northwest region , and Block Z-2B located off the northwest coast.

In 2007, Peru consumed around 111 billion cubic feet (bcf) of natural gas, where power generation sector was the principal consumer with 66.8 bcf. Other larger consumers include the industrial and transportation sector with 20.87 bcf and petroleum operations with 18.61 bcf. Peru has the potential to produce much more gas than it does currently as domestic gas demand and gas export markets grow. Specifically, power generation and industrial sectors are expected to be major gas consumers in the future.

ELECTRICITY

The installed electricity capacity in Peru increased 5.5 percent from 6,658 MW in December 2006 to 7,027 MW in December 2007. Installed capacity was almost equally divided between hydropower (46 percent) and thermal power (54 percent). The largest hydroelectricity facility is the Mantaro Complex, which contains two hydroelectric plants, together generating over one-third of Peru's total electricity supply from 900 MW of installed capacity each.

On the side of electricity generation, Peru's total electricity generation was 27,370 GWh in 2006, while increasing 9.9 percent to around 29,943 GWh in 2007 For this last year, 65 percent of generation came from hydropower plants, and 35 percent from thermal power plants. On the other hand, total sales of electricity in 2007 totaled 24,722 GWh, where 54 percent was trade in the regulated market and 46 percent through open markets.

Peru has two main power transmission grids: the North Central Interconnected System (SICN) and the Southern Interconnected System (SIS); together they form the National Interconnected Electrical System (SEIN). In 2007, of the 29,943 GWh of electricity generated in the economy, 98 percent was delivered through the SEIN and the remaining 2 percent was delivered through Isolated Systems (SA).

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 Transmisión Centro Norte (Etecen) and Empresa de Transmisión 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 Inversión en Energía).

COAL

At the end of 2006, Peru had proven coal reserves of around 45.9 Mt. The majority of these reserves comes from anthracite coal with 97 percent share of total reserves. The Libertad region contains 88 percent of the total coal reserves; other regions, namely Ancash and Lima, contain 9 percent and 3 percent of the total respectively. Coal consumption in Peru reached 107.09 thousand tonnes.

Importation of coal in 2006 was 695.3 thousand tonnes, showing a decline of 20.3 percent from 2005. This decrease was a result of reductions in coal imports from some enterprises, namely Corporación Aceros Arequipa, Corporación Cementos Lima y Enersur which contributed 78.8 percent, 75.5 percent, and 14.4 percent to the decrease respectively. Coal is imported from Colombia (83.6 percent) and Venezuela (16.4 percent).

FINAL ENERGY CONSUMPTION

In 2006, final energy consumption in Peru amounted to 9,494 ktoe, of which, the transport sector consumed 41.5 percent, industry sector 40.3 percent and other sectors 18.1 percent. Petroleum products dominated end use consumption, accounting for 70.8 percent of demand in 2006, an increase of 6.74 percent from 2005. The share of electricity in final energy consumption was 21.4 percent, coal 4.1 percent and gas 3.5 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 and responsible for promoting investment in hydrocarbon exploration and exploitation activities. Several laws have affirmed 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 privatisation of the electricity sector with regards to 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. The Peruvian government acknowledges, however, that there are barriers that impede the market from running efficiently. As such, in July 2006, the government elaborated on the rules established in the Law of Electrical Concessions with the purpose of:

- Ensuring the supply of "sufficient efficient generation" so as to reduce the economy's exposure to price volatility and help insure the final consumer receives a more competitive electricity tariff;
- Reducing administrative intervention in determining prices for generation by means of market solutions;
- Taking the necessary measures to create effective competition in the generation market; and
- Introducing a mechanism of compensation between the SEIN and the Isolated Systems so that prices incorporate the benefits of natural gas production while reducing their exposure to the volatility of fuel markets.

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 Comité de Operación Económica 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.

EXPLORATION AND EXPLOITATION ACTIVITIES

The participation by exploration and exploitation contractors in exploration activities has been encouraged recently. In 2007, 24 new contracts for exploration and exploitation of hydrocarbons were subscribed, reachinhg a total of 84 contracts (19 contracts for exploration and 65 contracts for exploitation). As a result, investments for both activities reached about US$ 1,447 million, representing an increase of 110 percent over 2006. Investment for exploitation activities was US$ 1,134 million, while investment for exploration activities was US$ 313 million.

On the side of exploration, in 2006, Barret Resources announced that it would spend US$ 1 billion to develop Block 67, located in Peru's Amazon region. The project could begin production by 2010, eventually reaching 100,000 bpd of crude oil. In early 2008, Barret Resources was purchased by Perenco, which has continued to develop the project. At the time, Parenco was awarded a contract for a feasibility study of a pipeline between Block 67 and the existing Norperuano pipeline system.

On the other hand, in 2008, the company Petro-Tech announced that it had made a major discovery in the offshore Z-6 Block. The company stated that production there could begin as early as 2010. Also, the company BPZ discovered crude oil in the Z-1 Block, specifically in the oil well Corvina, at 4.5 Mbpd of crude oil production and 40 mpcd proven reserves.

ENERGY SECURITY

Increasing energy imports combined with depleting domestic resources have stemmed rising 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. A new fuel mix that includes natural gas as an integral element is being undertaken in accordance with the *Plan Nacional de Transformación de la Matriz Energética.*

Peru is also interested in adding ethanol and biodiesel to its energy matrix, driven by the desire to create jobs, attract new investments, increase exports, and mitigate climate change. Some of the challenges facing the biofuels industry in Peru include lack of strong policy and incentives for promoting the sector's development as well as need for substantial research and development (R&D) investments. In addition, the Government has begun the promotion of biofuels production. 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 needed to produce both anhydrous ethanol and biodiesel. To support the development of biofuel in Peru, the government adopted Law 28054: *Ley de Promoción del Mercado de Biocombustibles* in 2003. The goal of this law is to diversify the fuel market, stimulate farming and agribusiness, promote sustainable development, and stimulate the creation of new jobs. The Peruvian government plans to introduce a B2 (2 percent

biodiesel with 98 percent petroleum diesel) mandate in January 2009, and then extending it to B5 (5 percent biodiesel with 95 percent petroleum diesel) in 2011 and E7.8 (7.8 percent ethanol with 92.2 percent gasoline) in 2010.

NOTABLE ENERGY DEVELOPMENTS

ADVANCES OF THE CAMISEA GAS PROJECT

The huge reserves of natural gas discovered in Camisea and the reserves discovered at less than 20 kilometres in the Pagoreni Field together make up an estimated 11 trillion cubic feet of proven and probable reserves. The Camisea gas project alone is expected to deliver between 250-729 mmscfd of natural gas and 70,000 bpd 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 USA. This potential drew the PERU LNG Consortium to implement the project. In 2006, the Engineering, Procurement & Construction (EPC) contract for the project was awarded to the 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 an operating capacity of 4.2 million tonnes per year. The initial investment to build the plant was between US$ 1,600 and US$ 2,000 million. Repsol-YPF, which joined 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 so that they could 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 CNG in vehicles, 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.

EXPANSION OF THE POWER GRID

Peru has several expansion projects for the North Central Interconnected System (SEIN) and the Isolated System (SA) under consideration, including new power generation expansion projects and transmission expansion projects. Candidate projects for the expansion of power generation are for hydropower and thermal generation with a planned expansion of 1,909 MW and 1,205 MW, respectively. The projects under evaluation correspond to long-term expansion development plans. On the side of transmission expansion, the long-term vision is to take on progressive step-wise developments, including the reinforcement of grids linked among SEIN regions. Several projects under consideration include : Proyecto de Reforzamiento Centro – Norte Medio (Línea Chimbote y Línea Longitudinal de la Sierra), Proyecto de Transmisión Chilca – Lima, Proyecto de Reforzamiento de la Transmisión Centro – Sur (Línea Cotaruse – MachuPichu and Estación convertidota CA/CC/CA "Back to Back").

According with the *Plan Referencial de Electricidad* (PRE) 2006-2015, investments needed for the expansion of both generation and transmission could be around US$ 2,571 million (in the medium scenario), US$ 3,065 million (the optimist scenario), or US$ 1,999 million (the base scenario); all of them without utilising natural gas in the southern part of the country. In the medium scenario case with natural gas expansion, total investments are estimated around US$ 2,601 million. Other investments in the period 2006-2015 are estimated at US$ 71 million (for the Sistemas Aislados Mayores) in the medium scenario projection.

RURAL ELECTRIFICATION

Within the framework of the National Rural Electrification Programme (PNER, by its acronym

in Spanish) of Peru, coordinated by the Ministry of Energy and Mining, the government aims to reach a goal of 91 percent electrification of rural household's by 2012, and improve the electric generation systems for isolated rural communities. The goals of the plan include encouraging sustainable socioeconomic development, improving the quality of life, and deterring the migration of people from rural regions to cities. The government has assumed a subsidiary role in the execution of the Rural Electrical Systems, and participation by regional and local governments is expected in carrying out the project through direct consultation or coordination with the Ministry of Energy and Mining. In 2003, the Peruvian government, by mean the Ministry of Energy and Mining, proposed the platform and action plan for rural electrification in the way of the Alianza Global Village Energy Parthership International (GVEP). In April 2007, the Ministry of Energy and Mining organized diverse working meetings with GVEP International, municipal entities, and representatives of public and private institutions, in order to achieve the Millennium goals on gender equality and poverty eradication.

In order to ensure the program's effectiveness, projects under 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 coordinates and offers technical expertise to the regional and local governments, and other organizations. Short-term plans will be drafted which will include projects that can be developed, within corresponding budgetary limits, by the national, regional, and local governments and the private sector.

LIQUIFIED NATURAL GAS PROJECT

The Peru LNG Project, amassing US$ 1 billion in loans and guarantees as the largest foreign investment in Peru's history, has been finalised. The Peru LNG Project consists of the construction of a liquefied natural gas plant, a marine loading terminal and a 408 kilometres (252 miles) pipeline. The project will connect to the natural gas pipeline the runs from Peru's Camisea gas fields. The project sponsors are Hunt Oil Company (United Kingdom), SK Corporation (South Korea) and Repsol YPF S.A. (Spain). Hunt Oil Company leads the Peru LNG consortium, which broke ground in January 2006 on a LNG export terminal at Pampa Melchorita. The Peru LNG facility will have an operating capacity of 4.2 million tonnes per year, and the first exports are expected in 2010. For the construction of natural gas pipeline, Peru LNG project awarded a contract to Techint for its construction in October 2007. In late 2007, the Inter-American Development Bank (IADB) approved a US$ 400 million loan package for the pipeline project. At the same time, Repsol YPF has already purchased rights to the entire output of the facility. In late 2007, the company concluded a contract with Comisión Federal de Electricidad (CFE), the Mexico's state-owned electricity company, to supply LNG at the Manzanillo LNG regasification terminal, in the state of Colima, along Mexico's Pacific coast. According to industrial accounts, contract volumes start at 700,000 tonnes per year in 2011, rising to 3.8 million tonnes per year in 2015. The remaining output from Peru LNG Project would be available for spot sales or additional term contracts.

ENERGY EFFICIENCY

In 1994, after an energy shortage situation in Peru, the Ministry of Energy and Mines created the Project *Proyecto Ahorro de Energía (*PAE), which started a strong energy savings campaign that lasted through 2000. After reeping positive result from PAE, the Ministry of Energy and Mines signed a technical cooperation agreement with the Inter-American Development Bank (IADB) called *Convenio de Cooperación Técnica No Reembolsable* ATN/JF-7040-PE. This technical cooperation was then nominated as the Regulatory and Institutional Marc Consolidation for Efficient-Energy Use and Sustainable Services; it has two components. The first component has allowed the development of five diagnostic and evaluation studies in order to understand the principal barriers in achieving energy efficiency and to give recommendations and solutions. The second component includes the current *Sistema de Monitoreo y Evaluación del Mercado de Servicios Energéticos* (Monitoring and Evaluation System of the Energy Service Market) and the *Sistema de Acopio y Difusión de Información* (Stock-up and Information Diffusion System), which are responsible for compiling and diffusing all available information and monitoring the progress and development of energy efficiency in Peru.

RENEWABLES

Biofuels are not used currently in Peru, but adding ethanol and biodiesel to the energy matrix has been one of Peru's energy goals. New biofuel projects are under development in Peru. As of March 2008, two ethanol plants were under construction both in Sullana, Piura, each with 100 million litres per year of total capacity. Two more plants, also in the northern region, are planned with a total capacity of 200 million litres per year. The primary feedstock for ethanol production in Peru is sugarcane. Sugar mills are located along the coast and have a total milling capacity of 37,000 tonnes of cane per day and sugarcane is produced year-round.

In terms of biodiesel, there is one operating biodiesel plant in Callao, Lima. The plant is operated by Pure Biofuels Corporation with a capacity of 127 million litres per year, and is currently under expansion. Pure Biofuels acquired Interpacific Oil SAC's biodiesel production business in 2007, Peru's largest and longest-running biodiesel processor. Interpacific currently produces 27 million litres per year of biodiesel and has been producing commercial quantities since 2002. Likewise, two plants are under construction: Industrias del Espino (42.5 million litres per year of total capacity) near Tocache, San Martín, and Herco (85 million litres per year of total capacity) near Lurin, Lima. The main feedstock for biodiesel production is palm oil and it production is concentrated in the provinces of Ucayali, San Martín, and Loreto. Peru is also considering jatropha as feedstock with several plantations in different locations in San Martín and Amazonas.

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THE PHILIPPINES

INTRODUCTION

The Philippines is located along the western rim of the Pacific Ocean and covers 300,000 square kilometers of land, which is spread out over an archipelago of 7,107 islands and islets. The total population in 2006 was 86.26 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 2006, the economy's Gross Domestic Product (GDP) grew by an average annual rate of 4.36 percent to reach US$ 237.77 billion (in 2000 US$ at PPP) in 2006. GDP per capita likewise experienced an improvement reaching US$ 2,710 (2000 US$ at PPP) in 2006 compared with US$2,622 (2000 US$ at PPP) in 2005.

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 tonnes (Mt) of coal, mainly lignite. However, the Philippines have extensive geothermal resources 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 (2006)

Key data		Energy reserves*	
Area (sq. km)	300,000	Oil (MCM) – Proven	24
Population (million)	86.26	Gas (BCM) – Proven	107
GDP Billion US$ (2000 US$ at PPP)	233.77	Coal (MMt) –Recoverable	399
GDP per capita (2000 US$ at PPP)	2,710		

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

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2006, the total primary energy supply (TPES), excluding traditional biomass fuels, amounted to 31,126 ktoe. The economy imports 17,019 ktoe (or 54.7 percent) of the total energy supply; the remainder was supplied through domestic production of indigenous resources, at 14,334 ktoe. The main energy sources were oil (68.1 percent), others (23.6 percent), coal (8 percent), and gas (0.3 percent). Gas production decreased from 2,701 ktoe in 2005 to 2,531 ktoe in 2006. Oil production also decreased from 14,203 ktoe in 2005 to 13,420 ktoe in 2006. As for coal, most of the economy's total coal requirements are supplied through imports; coal production increased, however, from 5,230 ktoe in 2005 to 5,316 ktoe in 2006.

In 2006, electricity generation reached 56,786 GWh. Thermal generation, mostly from natural gas, fuel oil and coal, accounted for 64 percent of total electricity production, followed by hydropower (18 percent) and others (18 percent).

FINAL ENERGY CONSUMPTION

In 2006, total final energy consumption in the Philippines was 16,600 ktoe, a decline of 3.0 percent from the level of 17,200 ktoe. The transport sector consumed 48.3 percent of this total, followed by the industry sector at 25.7 percent, and other sectors accounted for 26 percent By

energy source, petroleum products contributed the largest share with 68 percent of consumption followed by electricity (24 percent), and coal (8 percent).

The 2006 Philippine Energy Plan indicates that between 2007 and 2014, the economy's final energy demand will grow at 3.3 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.[68]

Table 30 Energy supply and consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	14,334	Industry Sector	4,279	Total	56,784
Net Imports & Other	17,019	Transport Sector	8,039	Thermal	36,625
Total PES	31,126	Other Sectors	4,328	Hydro	9,939
Coal	5,316	Total FEC	16,646	Nuclear	-
Oil	13,420	Coal	1,324	Others	10,520
Gas	2,530	Oil	11,341		
Others	9,860	Gas	53		
		Electricity & Others	3,928		

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 realising 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 it following.

Energy self-sufficiency

The government is targeting a 60 percent energy self-sufficiency level by 2010 and to maintain this level through 2014 (In 2006, it was 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 renewable energy (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. Most of the gas is produced from Malampaya gas field, which also produces condensate with output reaching 5.1 million barrels per 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

[68] The Philippine Energy Plan 2005-2014

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 is responsible for issuing exploration and production licenses and ensuring compliance with relevant regulations.[69]

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 tonnes. In 2006, the economy's in-situ reserves stood at 323.3 Mt, registering a 3.0 percent increase from its 2006 target of 313.2 Mt. 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 with about 9,000 ktoe in 2006. Harnessing geothermal energy remains a primary objective 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 optimisation 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; they 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: (1) greater private sector participation in the development of hydropower; (2) steps to allow PNOC to take up to a 20 percent stake in all its proposed hydropower projects to attract private investors to participate in those project; (3) the passage of the RE bill that will provide incentives to developers of hydropower; and (4) steps to administer R.A. 7156[70].

To promote the wide scale use of other RE sources, about 707 MW of generating capacities from biomass, wind and solar energy sources were 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 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 percent mandated blend would correspond to a total of 78.8 million litres of diesel fuel displacement in 2008, while the 2.0 percent biodiesel blend is expected to displace a total of 163.9 million litres of diesel fuel and reach 198.4 million litres by 2014[71]. 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 percent mandatory blend of bioethanol in 2009 would displace a total of 222.9 million litres of gasoline fuel,

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

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

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

while the 10 percent blend would result in the displacement of a total of 482.3 million litres in 2011 and reach 537.2 million litres by 2014[72].

Meanwhile, in April 2006, the DOE issued a policy directive that 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[73] 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[74].

Efficient and globally competitive energy sector

The energy conservation efforts of the government generated energy savings of about 880 ktoe with equivalent carbon dioxide (CO_2) emission avoidance of 2.1 Mt in 2006. This includes savings accounted from the energy management activities conducted by DOE such as the *spot check* program of government agencies nationwide, the continuing energy standards and labelling 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 labelling 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 and to reach 8.1 MMBFOE (1.17 ktoe) in 2014. To realize this target, the government will:

1. 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);
2. 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;
3. Promote a market-based application under the *Demand Reduction Program* in the absence of utility-based demand-side management (DSM);
4. 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;

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

[73] 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

[74] PEP 2006 Update.

5. 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; and
6. 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 privatisation 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 privatisation effort thus far.

To counter the impact of increases in the price of electricity, some measures will be enhanced including: (1) energy conservation and demand side management, (2) the National Power Corporation's (NPC's) internal efficiency measures, (3) economic dispatch, (4) time-of-use pricing, and (5) implementation of the wholesale electricity spot market (WESM), and (6) 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: (1) commercial operation of the WESM, (2) privatization of NPC generating assets, (3) privatization of the TransCo transmission assets and its concession, (4) implementation of retail competition and open access, (5) administration of universal charge for missionary electrification and environmental charge for the preservation of the environment, and (6) 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: (1) creating an environment that will promote competition in the downstream oil industry; (2) creating a level playing field among industry stakeholders; and, (3) 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

ENERGY SELF SUFFICIENCY

Oil and Gas

With the launching of the Philippine Energy Contracting Round (PECR), there was 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 were approved under PECR 2005 and three negotiated SCs were 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 :

7. *Singapore-based Premiere Oil* to drill one exploration well in Ragay Gulf under SC No. 43;
8. *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;
9. *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 metres, 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.[75]

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 Mt or about 1.0 Mt less than the targeted 3.33 Mt. 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 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 2,677.4 MW.

Potential capacity addition of 699.4 MW from geothermal resource could be developed through 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.

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

Biomass, Wind and Solar

A total of 183.9 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

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, 23 wind sites in different regions are promoted during the year with a total potential capacity of556.5 MW.

In August 2008, the NorthWind completed the commissioning of Phase 2 of the Bangui Bay Wind Power project, consisting of 5x1.65MW wind turbine generators, which will increase Philippine's wind power capacity to 33MW.

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 [76] was signed on 12 January 2007, which provides the impetus for the full development and utilisation 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[77], 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 (Coconut Methyl Ester) production reached 111.9 million litres while sales of manufacturers/retailers reached 655,401 litres of pure CME and 32.3 million litres 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. Currently, ethanol-blended (E10) is available in 105 Seaoil stations, 55 Shell stations, and 14 Petron stations.

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.

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

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

To date there are two existing bioethanol plants in Philippines. Leyete Agri has been in operation since July 2008 and San Carlos Bioenergy, Inc will start operations commercially in early 2009. As of September 2008, eight bioethanol projects were endorsed by the DOE to the Board of Investments for incentives under the existing Investments Priorities Plan (IPP), while one project was endorsed to Philippine Economic Zone Authority (PEZA). Total annual capacity of the above projects is about 505 million liters and investments will reach 28 billion pesos.

To regulate the fast-growing auto-LPG industry in the economy and protect the consuming public, the DOE issued D.C. No. 2007-02-0002[78] in February 2007. There is a growing demand for LPG use in the transport sector in view of the cheaper auto-LPG 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 privatisation 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. To date, the Power Sector Assets and Liabilities Management Corp. (PSALM) has successfully bid out fourteen (14) generating plants, twelve (12) of which are in Luzon/Visayas grids, with a total capacity of 2,598 MW, equivalent to 68.8% of total capacity in Luzon/Visayas . This brings the government closer to its 70% target by the end of 2008.

On the other hand, the Wholesale Electricity Spot Market (WESM) was commercially operated in Luzon in June 2006 signalling an important phase in promoting open access in accordance with the EPIRA. As of latest billing date for 2006 (25 December), There are 14 power generators and 23 customers who have applied as participants to WESM as of November 2007.

In power generation, the economy's self-sufficiency level increase to 66.0 percent in 2006 from 65.0 percent in 2005. Natural gas provided the largest contribution of 16,366 gigawatt-hours (GWh) or 29 percent of the total power generation while coal accounted for 27 percent.

The DOE continued to ensure the reliability of energy supply through the installation of new power plants and upgrading of existing power projects. In the 3rd quarter 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.

ENERGY EFFICIENCY

The DOE recently launched the Philippine Energy Efficiency Project (PEEP) as part of the SWITCH Movement79, which was launched by President Arroyo in July 2008. The project aims to provide direct economic benefits to the economy by reducing energy peak demand and the needed imported oil for power generation. The project's first phase – The Energy Efficient Lighting System (EELs) – will feature, among others, the replacement of 13 million incandescent bulbs with CFLs. With this, the government is expected to reap the following benefits.

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

[79] SWITCH is a movement of switching from a lifestyle of expenditure and waste to a lifestyle of conservation and efficiency. SWITCh also aims to promote a shift from petroleum-based fuels to alternative fuels such as biodiesel and bioethanol.

10. Reduce peak demand by 450MW
11. Reduce oil imports by 120 million USD each year
12. Defer power generation by 1,300MW or 0.3 billion USD
13. Clean development mechanism (CDM) revenues of about 10 million USD for 2010-2012
14. Create an energy efficient market

Other than energy bulbs, the following components form part of the project: government retrofit, public lighting retrofit, expansion of energy efficiency labelling, lamp waste facility, super ESCO, green building initiatives and communication, and social mobilization. To ensure largest possible reach and an effective distribution of the CFLs, the government plans to establish three to five distribution channels involving the academe, the civil society, non-government organizations (NGOs), government agencies, and the private sector.

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[80]. As of 1st half of 2007, there were 627 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. The investment increased to PhP 31.69 billion in the first half of 2007.

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.

NATURAL GAS VEHICLE PROGRAM FOR PUBLIC TRANSPORT (NGVPPT)

After the inauguration of the Philippines' first compressed natural gas (CNG) daughter stations in October 2007, the "Libreng Sakay" Program was launched in March – April 2008. This is to provide awareness to the public commuters on the use of CNG in transport. Around 7,000 commuters from Batangas – Cubao and Sta. Cruz, Laguna-Cubao and vice versa have benefited from this public awareness program. Commercial operation of NGVPPT Pilot Phase ensued in April 2008 after the successful promotional runs of the "Libreng Sakay". To date seventeen (19) of the twenty-two (22) CNG buses are commercially operating along Laguana/Batangas-Cubao route. The retail price of CNG during the 7-year NGVPPT Pilot Phase is Php 14.52/diesel liter equivalent (DLE).

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

[80] 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.

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. As a net energy importer, the Philippines is looking into the prospects of developing a nuclear power program to support its own development needs and has considered it as a long-term energy option.

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RUSSIA

INTRODUCTION

Russia is the largest economy in the world in terms of land area (more than 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. Its terrain is characterised by broad plains west of Urals, vast coniferous forests in Siberia and tundra along the Arctic seaboard, uplands and mountains on the southern regions. 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 147.7 million to 142.2 million as of January 2007.

After a decade of economic contraction, of about 40 percent compared to the 1990 GDP level, the Russian economy began to grow again since 1999. The recovery was triggered by the rouble devaluation in the aftermath of the 1998 financial crisis and its positive impact on the economy's competitiveness. In parallel, soaring world prices of oil and natural gas increasingly drove the recovery. The Russian Oil Stabilisation Fund (OSF) was established in January 2004 with the purpose of (1) reducing the vulnerability of the state budget to the volatility of world oil prices (stabilisation function), and (2) decreasing the impact of oil-related foreign exchange inflows on the money supply and inflation (sterilisation function). Since 2008, the OSF had been split into the Reserve Fund and the National Wealth Fund, with total assets more than RUR 3.8 trillion (or US$ 149 billion), which consisted of 10 percent of Russia's 2007 GDP. Russia's economy is continuing to develop strongly and achieved 7.7 percent growth in 2006, reaching an average growth rate of 7.1 percent since 1999. GDP in 2006 was estimated at US$ 1,606 billion (at 2000 US dollars PPP). The unemployment rate in 2006 was 6.7 percent, while inflation was 9.0 percent.

Table 31 Key data and economic profile (2006)[81]

Key data		Energy reserves*	
Area (sq. km)	17,075,200	Oil (MCM) - Proven	12,607
Population (million)	142.5	Gas (TCM) - Proven	44.6
GDP Billion $ (2000 US$ at PPP)	1606.4	Coal (Mt) - Proven	157,010
GDP per capita (2000 US$ at PPP)	11,273		

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

In terms of proven reserves, Russia holds a quarter of the world's gas, 7 percent of oil reserves and 17 percent of coal reserves. 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

[81] Area:17,098,242 based on the data of Federal Agency "Rosnedvizhimost" as of January 2007, GDP Billion $: 1697.5 according to PPP and Real Expenditures, 2005 benchmark year. OECD. Eurostat.Paris.2007

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 63.3 percent of the total economy's exports and approximately 9 percent of GDP.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Russia's total primary energy supply in 2006 was 666.2 Mtoe. 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, export of energy reach 532 Mtoe (which consisted of 30 percent of coal, 28 percent of natural gas, and 50 percent of oil extracted in 2006), making Russia the top energy exporter in the world. Regionally export is overwhelmingly concentrated in 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 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, as well as NAFTA region in the North America.

In terms of oil, in 2006, Russia produced 480.5 million tonnes of crude oil and gas condensate (NGL), where West Siberia, the oil heartland province, accounted for approximately 67 percent of total crude oil and NGL production. Refiners consumed 220 million tonnes of crude oil as feedstock, producing 34.4 million tonnes of gasoline, 64.2 million tonnes of diesel oil, and 59.3 million tonnes of fuels oil. The exports of crude oil reach 227 million tonnes and, additionally, 102 million tonnes of petroleum products, or 47 percent and 65 percent of total production respectively. 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 2006 reached 656 billion cubic metres (BCM). Net exports accounted for 195 BCM or 30 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 undeveloped resources of natural gas are located in remote regions where lack of infrastructure prevents the start-up of upstream operations.

Table 32 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	1 ,214,823	Industry Sector	155,102	Total	995,794
Net Imports & Other	-544,896	Transport Sector	98,176	Thermal	660,868
Total PES	659,327	Other Sectors	183,820	Hydro	175,282
Coal	99,807	Total FEC	437,099	Nuclear	156,436
Oil	138,508	Coal	19,863	Others	3,208
Gas	358,625	Oil	102,881		
Others	62,387	Gas	130,665		
		Electricity & Others	183,690		

Source: Energy Data and Modelling Center, IEEJ.

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

Russia produced 310 million tonnes of coal in 2006. Coal exports reached 91.5 million tonnes, or 30 percent of production, despite the fact that the main coal producing areas (Kuznetsky and Kansko-Achinsky basins) 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 991 TWh of electricity in 2006, of which 67 percent was from thermal power plants, 17 percent from hydro and 16 percent from nuclear energy.

FINAL ENERGY CONSUMPTION

In 2006, total final energy consumption in Russia was 437 Mtoe, an increase of 4.1 percent compared with the previous year. By sector, industry accounted for 36 percent share, transport for 23 percent and other sectors for 41 percent. By energy source, coal accounted for 5 percent, petroleum products 24 percent, natural gas 30 percent and electricity, heat and others 41 percent. Russia has the highest final energy intensity among APEC economies. 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 the share of less energy intensive services and high technology industries are considered 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 included energy pricing based on market approach and 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; and
- Provision for the financial stability and improving the investment attractiveness of energy businesses.

Another key factor in Russia's energy policy, as the world's largest supplier of energy resources, is cooperation towards improvements in 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 in remote areas and offshore; and
- Accelerating energy exports to the Asia-Pacific regional international market.

The revised version of the *Energy Strategy of the Russian Federation* with extended time frame to 2030 is to be adopted by the Federal Government in fall of 2009.

In October 2006, the government approved the *Federal Programme for development of the nuclear industry until the year 2015*. The programme includes reorganisation of the industry and 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 of 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.

The *General Scheme for the development of Power Industry up to year 2020* was approved by Federal Government in February 2008. The basic assumptions for the document are consistent with the *Energy Strategy of Russia to 2020*.

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.

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

The oil market in Russia has been deregulated since the 1990s. Currently, the oil industry consists of 9 large companies that produce about 90 percent of the crude oil in Russia, some 300 small-scale enterprises extracting the remaining 10 percent, and operators of three Production Sharing Agreements making less than 0.5 percent. There is no state control of petroleum products prices except under the Federal Antimonopoly Supervision Agency. The refining sector consists of 27 large and more than 50 small refineries and is mostly controlled by 8 vertically integrated oil companies, with the remaining 20 percent share of this market controlled by 8 large and some 40 small independent refineries. Major international oil companies like ConocoPhillips, ExxonMobile,

Royal Dutch Shell, BP, Total, and others, 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 billion cumulative investments into the Russian energy sector in 2003-2006.

After the merger of crude oil and petroleum products pipelines companies Transneft and Transnefteprodukt, the state control 75 percent of combined company's shares. Private oil pipelines, however, already exist in Russia (Caspian Pipeline Consortium), and some are under construction in the 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 the natural gas and supply some 25 percent of 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 in domestic markets is scheduled to be complete in 2011, uniformly increasing the share of free trading for domestic supplies.

The coal sector has been restructured and fully privatised in the nineties, and foreign participation in the Russian coal sector is practically absent. There are no restrictions for coal export; the geographical size of Russia's vast economy, however, 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 total rail freight. Although price controls have been removed, many coal producers fight to compete with low natural gas prices.

Market liberalisation is almost complete within the power industry. All thermal generation and regional power distribution companies were privatised in July 2008. However, the hydro, nuclear generation facilities and backbone transmission lines remains under the government control. Timetable was scheduled to complete transition to the national-wide electricity wholesale market trading in 2011. Total of 173 generation companies and 150 distribution companies and large consumers have joined the electricity wholesale trading system as of November 2008.

ENERGY PRICES DEREGULATION

One of the main issues in Russia is a gradual move from state-regulated energy pricing to free market regulation for natural gas and electricity, as coal and petroleum prices are already 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 tariffs for natural gas, electricity and centralised heat.

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

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: (1) to organise trade and arrange financial payments in the wholesale electricity and power market; (2) to increase efficiency of power generation and consumption; and (3) 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 (one day forward) was launched in November 2003 within the framework of the Federal Wholesale Electricity Market (FOREM). In September 2006, 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. Under the current pricing methods within the market mechanism 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, the volume of regulated contracts market was limited to 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

After January 2011, regulations will be eliminated (excluding tariffs for direct residential supply) and all electricity will be sold at competitive prices. At the same time, the average tariff growth for 2008 was projected to increase by 17 percent, for 2009 by 26 percent, for 2010 by 22 percent, and finally in 2011 by 18 percent.

In July 2007, new regulation for natural gas sales in Russia was introduced with a schedule for industrial contracted set gas prices to 2011. Upper limits were set for tariff growth at 15 percent in 2007, 25 percent in 2008, 14 percent for each half of the year in 2009 and 2010, and at 40 percent in 2010, in order to reach the European price level under the net-back pricing mechanism. Regulated prices for the residential sector should be eliminated by 2015, as the pace of tariff 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, and enjoy free contract prices.

The first free trades for next month deliveries of natural gas were started in November 2006. The share of natural gas free trading is expected to increase from 2 percent of domestic consumption in 2007 to 8 percent in 2008. Through 2008, average prices exceeded the tariff by 30 percent, and a set range of US$ 73 per thousand cubic metres to 90 USD per thousand cubic metres (approximately US$ 2.1 to 2.5 per MMBTU) for gas delivered to the Moscow region. The sessions are assigned for one month, ten days and one day ahead trading.

POWER INDUSTRY RESTRUCTURING

Russia started restructuring of the power industry in 2000. The very first step was the development of the reform concept. 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 included more than forty documents. From July 2008, binding regulation separated generation and transmission assets in Russia. Federal Antimonopoly Service of the Russian Federation is in charge of monitoring the transportation market, where the threshold is less than 20 percent of transmission lines capacity per actor.

Generation assets are 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, and 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, Hydro WGC has been formed as a Holding company. All TGCs predominantly consist of rather small combined heat and power plants (CHPs) and their shares are also traded.

Backbone transmission lines were pass on to the Federal Grid Company, while distribution grids were transformed into eleven interregional distribution grid companies (IDGCs), and functions and assets of regional dispatch administrations were transferred to the System Operator. Wholesale market infrastructure include the following organisations:

- Non-profit partnership Administrator of Trading System (NP ATS) is a non-profit partnership to manage trading activity on the wholesale power market.
- System Operator Central Dispatch Administration of the Unified Energy System (SO_CDA UES) is the organisation that renders dispatching services to wholesale market participants. State share in the company should be more than 75 percent.
- Federal Grid Company of the Unified Energy System (FGC UES) 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, which specified the procedure for reorganisation of RAO "UES of Russia" during the final phase of the Russian power industry reform. Since 1 July 2008, RAO UES has been disbanded as the final phase of the reorganisation and *pro rata* distribution of assets has been completed.

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 provided a legal framework for the industry restructuring by separating military and civil facilities, and also introduced regulations for nuclear materials management.[82]

In April 2007, a single vertically-integrated state-owned nuclear power company was established. This new corporation - AtomEnergoProm (AEP) - includes 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 will eventually be transformed into public companies. In November 2007, this holding company was set up after acquiring 31 former state enterprises. Currently AEP holds 17 percent of the world's nuclear fuel supply share and 40 percent of the world's enriched uranium supply, 23 GW of existing nuclear Power Plants and 5 reactors under construction in Russia, and additionally 5 reactors under construction in four Asian and European countries.

In November 2007, the bill to create Rosatom corporation was passed. Rosatom will take over the functions of the Rosatom Agency; it will be state holding for AEP, providing 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

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

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 economies interested in nuclear energy development and ready to comply with IAEA non-proliferation regulations.

The existing enrichment plant in Angarsk will be utilised to serve the IUEC. In February 2007, the IUEC was certified by the IAEA for international operations. 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 available under IAEA control and prudence.

NOTABLE ENERGY DEVELOPMENTS

NEW ENERGY MINISTRY ESTABLISHED

In May 2008, the new Ministry of Energy was established, thus taking part of government control from the former Ministry of Industry and Energy. Major objectives for the new Ministry would be development and monitoring national energy policy and regulation for energy supply in the Russian Federation, including control of the state's assets along the supply chain.

The new *Classification of Oil and Gas Fuel Reserves and Resources* was accepted in 2005. In addition to previous categorisation of reserves and resources by the level of geological knowledge, the Classification is based on grouping oil and gas reserves and resources by economic appraisal of their efficiency. The main economic criterion for identifying groups of oil and gas reserves and resources is the Net Present Value (NPV) at the discount of 10 percent, which would result from the exploitation of a field or formation under exploitation. The new classification will come into force in January 2009.

ATLANTIC MARKET INFRASTRUCTURE EXPANSION

At the beginning of 2001, there was not any single Russian oil export terminal on the Baltic Sea. Since that time the Baltic Pipeline System (BTS) and other sophisticated facilities have been developed for overload on sea transport of crude oil and petroleum products delivered to the Vysotsk oil export terminal through pipelines. The general capacity of this system has reached 75 million tonnes in 2006. In November 2007, use of front-end engineering design (FEED for the BTS-2) doubled these capacities. All crude oil and petroleum products pipeline transported to Central and Northern Europe from Russia will be switched to the sea shipping mode after the implementation of these expansion plans.

In September 2008, a new 550 kilometre pipeline was commissioned to link the giant Vankorskoye oilfield in the East Siberia's Arctic to the West Siberian oil pipeline system, which is targeted at the Atlantic oil market.

In May 2008, Transnefteprodukt, an affiliate of the Transneft company, started operations of the 1056 kilometre pipeline system and export terminal in Primorsk. The purpose of the project development was to bring production of the landlocked refineries, located at Volga and Ural regions, to the Atlantic market. Capacity of the first phase is 168,000 barrels per day of petroleum

products deliveries to the Baltic Sea. The major export product is Euro-5 gasoline. The full designed capacity of the system is 500,000 barrels per day.

The first out of two tankers start operations on delivering heavy crude from Timan province on the European North to the oil export terminal in the non-freezing Murmansk harbour on the Barents Sea. Special Arctic design addresses the highest environmental requirements, while the tanker could navigate through of 1.5 metres of sea ice.

EAST SIBERIA – PACIFIC OIL PIPELINE CONSTRUCTION

Construction of the 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 2009, one year later than original scheduled, together with the branch to China and oil export terminal in Nakhodka on the 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.

In October 2008, Transneft and CNPC signed an agreement on the principles to develop 67 kilometres of oil pipeline springing from ESPO phase I with a destination point of Skovorodino to the Chinese border.

In November 2008, the first branch of the trunk pipeline from Ust'-Kut to Verchnechonsk started operations in reverse mode; and 2160 kilometres out of 2700 kilometres for the first phase trunk line was constructed.

The second phase of the ESPO is to extend the route to the Pacific coast and start pipeline operations in 2014. The ultimate capacity of the system will reach 80 million tonnes of crude oil deliveries per year. Due to the high cost for exploration and production in the untapped hydrocarbon province of East Siberia, the break-even point for these projects is considered to be US$ 70 to 100 per barrel of oil equivalent.

The Russian Federal Government, in March 2008, decided on the infrastructure development for the phase II of the ESPO project: the final point of the route will be the oil export terminal in Kozmino bay, which will have a 15 million tonne per year loading capacity and will be capable of simultaneously loading one Panamax and one Suezmax sized tanker. A giant refinery of 20 million tonne per year capacity, next to the oil export terminal, is under construction and is supposed to start operations in 2014.

SAKHALIN ISLAND OIL AND GAS DEVELOPMENT

Russia's first natural gas liquefaction plant is to be commissioned in first quarter of 2009 on Sakhalin Island within the 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 kilometres from the liquefaction plant will start in early 2009.

In December 2008, the facilities to deliver oil year-round from offshore North Sakhalin through the 800 kilometre TransSakhalin pipeline to the Oil Export Terminal at Prigorodnoye start operations under Sakhalin 2 project. In 2007 Sakhalin 1 project start export of Sokol loght crude from the De-Kastri harbour.

Production and export of seasonal oil, through an offshore facility, began in 1999. Production was limited to around six months out of the year during the ice-free season. More than 100 million barrels of Vityaz crude oil has been produced and exported during ten production seasons.

TURBINE INSTALLATION HAS BEING STARTED AT THE BOGUCHANSKAYA HYDRO POWER PLANT

In August 2008, the first hydropower unit was shipped from St. Petersburg for Boguchanskaya Hydro Power Plant in East Siberia. The unit is the largest one among similar equipment

manufactured in Russia for several decades. The weight of the hydro turbine is 156 tonnes, while its diameter is some 8 metres. The Boguchanskaya HPP will consist of nine such units with capacity of 333 MW each, to be delivered in three years. The first unit should bring electricity to the grid in 2010, while the whole HPP commissioning is planned through 2012.

AMENDMENTS OF THE 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.

INCENTIVES FOR OIL INDUSTRY

In July 2008, legislation was amended to provide tax holidays on mineral extraction tax for oil produced from areas located north of Polar Circle, Azov sea, Caspian sea, Nenetsk and Yamal regions, starting 2009.

Since December 2008, new regulation on the custom fees came into force. The major amendment is a shorter monitoring time frame. The measure is supposed to save US$ 5.5 billion in custom fees for petroleum exporters, making crude oil and petroleum products export profitable in a volatile price environment.

NEW COAL WASHING FACTORY IN SIBERIA

New coal washing facility was commissioned in Eastern Siberia, next to the Tugnuisky open coal pit. Under full operational capacity, the factory could produce 4.5 Mt per year of steam coal concentrate, which contains 40 percent less ash, 20 percent less water, and 7 percent more calorific value than raw coal. The facility will significantly affect the economics of electricity and heat production, due to decreasing logistic costs of delivering energy in the region (with average distance exceeding one thousand kilometres). The new coal product also contributes greatly to environmental improvements.

COAL-BED METHANE UTILISED TO POWER CHP IN SIBERIA

The programme to utilise coal-bed methane started in Kuzbass, West Siberia. Three small CHP (1 to 1.5 MW each) are under construction, to prevent methane emissions and provide coal mining industry with power and heat. The project is developing within JI framework of the UNCCC's Kyoto Protocol.

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SINGAPORE

INTRODUCTION

Singapore is situated in Southeast Asia south of the Malay Peninsular, between the Strait of Malacca and the South China Sea. Singapore has a total land area of 704.0 square kilometres and a population of 4.40 million in 2006; notably, 875.5 thousand of its total population are non-residents. Despite its small land area and population, Singapore is one of the more highly industrialised and urbanised economies in the Southeast Asian region.

Highly developed and a successful free market economy, Singapore had experienced gross domestic product (GDP) growth of 8.8 percent over 2005-2006 to reach US$ 143.807 billion in 2006, and a per capita GDP of US$ 32.683 (both in 2006 US$ PPP).

GDP of Singapore in 2006 was for the most part created in the service industry which account for 63.0 percent of GDP, and in the goods producing industry at 31.6 percent of GDP. Major service industries are financial and business services accounting for 35.3 percent of service industry value added, followed by wholesale and retail at 26.1 percent. Manufacturing account for 84.1 percent of the goods producing industry value added in 2006, and is the Singapore's largest economic sub sector in national GDP at 26.6 percent.

Most of Singapore's manufacturing output is for exports. Main exports of Singapore in 2007 include: electronics 41.2 percent; petroleum and petroleum products 17.7 percent; electrical circuits and electrical machinery 13.7 percent; chemicals and chemical products 12.3 percent; manufactured goods including non-ferrous metals, iron and steel, metal products, textile, paper, rubber, 4.8 percent; and other manufactured goods 6.4 percent. Other exports include food, beverage and tobacco, and crude materials.

Strategically located, Singapore has become one of the world's busiest marine cargo port, an important petroleum refining hub in South East Asia, and an emerging leader in the bio-engineering industry.

Table 33 Key data and economic profile (2006)

Key data		Energy reserves	
Area (sq. km)*	704.0	Oil (MCM)	-
Population (million)	4.40	Gas (BCM)	-
GDP Billion US$ (2006 US$ at PPP)	143.807	Coal (Mt)	-
GDP per capita (2006 US$ at PPP)	32.683		

Source: Energy Data and Modelling Centre, IEEJ. * Singapore Department of Statistics.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

To meet most of its domestic energy needs, Singapore relies on imports of energy. In 2006, Singapore imported 52,745 ktoe of crude oil and 54.414 ktoe of petroleum products. Crude oil refined in Singapore's oil refineries produced 47,668 ktoe of petroleum products in 2006, of which 59.8 percent was for exports and international bunkers; the balance was for domestic consumption.

Natural gas supply increased by 7.9 percent in 2006 to 5,649 ktoe, down from a 12.3 percent increase in 2005, while oil supply increased 1.91 percent in 2006 to 17,897 ktoe, down from 10.6 percent increase, the previous year.

Electricity generation in 2006 was 39,442 GWh an increase of 3.2 percent from the previous year in 2005; electricity demand in 2007 was 41,134 GWh an increase of 4.3 percent from 2006. Peak demand of power generation capacity was 5,624 MW in 2006 and 5,946 MW in 2007. Singapore's power generation is based entirely on thermal power plants which consist of combined cycle gas turbine (CCGT) at 52 percent, steam turbine at 42 percent, open cycle gas turbine (OCGT) at 3 percent, and incineration and other types of power plants at 2 percent. Singapore has 4 large incinerators, with total incinerating capacity of 2.5 million tons of solid waste per annum. Notably, the Tuas South Incinerator Plant of 132 MW, which began commercial operation in 2000, is one of the worlds' largest.

Fuel mix of energy consumption in power generation consists of natural gas with 81 percent, orimulsion with 10 percent, fuel oil with 6 percent and municipal wastes with 3 percent. Power generation consumed 5,649 ktoe of natural gas in 2006. Singapore is currently dependent on supply of natural gas by pipeline from Indonesia and Malaysia.

Installed power generation capacity was 10,446 MW in 2007, an increase of 5 percent from the previous year. Power generation reserve margin was 43 percent in 2007, which exceeds Singapore's own minimum reserve margin of 30 percent to maintain system security.

FINAL ENERGY CONSUMPTION

Singapore's final energy consumption had increased from 14,744 ktoe in 2005 to 15,251 ktoe in 2006, an increase of 3.4 percent, and a decline from an 11.6 percent increase the previous year.

In 2006, Singapore consumed 12,085 ktoe of petroleum products which accounted for 86.0 percent of the economy's total energy consumption, natural gas accounted for 13.9 percent, while municipal wastes provided the remainder of energy needs.

In 2006, the industry sector accounted for 53.1 percent of total final energy consumption, the transport sector 33.3 percent, while the residential and commercial sectors accounted for 12.0 percent. Energy consumption growth was most rapid in the transport sector at 7.4 percent, energy consumption of residential and commercial was 6.8 percent, while energy consumption in industry increased by 0.5 percent.

Table 34 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)*		Final Energy Consumption (ktoe)*		Power Generation (GWh)*	
Indigenous Production	295	Industry Sector	8,100	Total	39,442
Net Re-exports & Other	54,552	Transport Sector	5,075	Thermal	37,818
Total PES	23,845	Other Sectors	2,076	Hydro	-
Coal	5	Total FEC	15,251	Nuclear	-
Oil	17,897	Coal	-	Others	1,624
Gas	5,649	Oil	12,084		
Others	295	Gas	108		
		Electricity & Others	3,059		

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

POLICY OVERVIEW

The inter-agency Energy Policy Group (EPG) chaired by the Permanent Secretary of the Ministry of Trade and Industry (MTI) has developed a national energy policy framework which strives to maintain a balance between the policy objectives of economic competitiveness, energy

security and environmental sustainability. To meet the energy policy objectives, Singapore focuses on five key strategies, as follows[83]:

- Strategy 1: Promote Competitive Market

  Promote competitive markets to keep energy affordable and ensure Singapore's economic competitiveness. Correction of any market failures will be made by using market-based instruments or imposing standards and regulations. Moreover, the private sector will be encouraged to innovate and achieve energy security and environmental outcome that Singapore is seeking.

- Strategy 2: Diversify Energy Supplies

  Diversify energy supplies to protect against supply disruptions, price increases and other threats to the reliability of supply. In competitive markets, companies themselves will have the incentives to diversify, and reduce their own commercial risks. The Government's role is to create an open and flexible framework that allows diversification to take place.

- Strategy 3: Improve Energy Efficiency

  Improve energy efficiency to be able to achieve all the objectives of the energy policy, while reducing business costs, pollution and CO_2 emissions. The Government has set up an Energy Efficiency Programme Office (E^2PO) and developed a comprehensive national energy efficiency plan called Energy Efficient Singapore (E^2Singapore).

- Strategy 4: Build Energy Industry and Invest in Energy R&D

  Position Singapore's economy to turn energy challenges into opportunities to meet rising global and regional demand for energy. Singapore will increase its refining capacity consolidating its status as Asia's premier oil hub; and expand the range of energy trading products to include liquefied natural gas (LNG), biofuels, and carbon emissions credits. Furthermore, Singapore will pursue growth opportunities in clean and renewable energy including solar energy, biofuels, and fuel cells.

- Strategy 5: Step-up International Cooperation

  Promote greater regional and international energy cooperation to further the economy's energy interests, particularly to enhance energy security. Singapore continues to be actively involved in various energy-related initiatives in major fora, including the Association of Southeast Asian Nations (ASEAN), the Asia-Pacific Economic Cooperation (APEC), and the East Asia Summit (EAS). Singapore also participates actively in the United Nations Framework Convention on Climate Change (UNFCCC), as well as international discussions on climate change in other forums.

ENERGY MARKET REFORM

Singapore first restructured the energy sector a decade ago with the corporatisation of the electricity and gas industries as vertically integrated companies starting in 1995. Notable milestones since the mid 1995 included corporatization and industry structure reforms, creation of institutional framework, and issue of market rules and regulations of the contestable and monopolistic segments of the market.

In 2000, the natural electricity transmission monopoly, Power Grid, was separated to keep infrastructure open to "free access". By 2001, the electricity market reforms were completed. In

[83] The five strategies herewith is a synopsis of the energy policies stated in: Energy for Growth – National Energy Policy Report, Ministry of Trade and Industry Singapore.

2003, the Natural Electricity Market of Singapore (NEMS) was launched. In addition, liberalisation of the retail market was implemented in three phrases beginning in July 2001. By February 2006, Phase 2 of the electricity market liberalization was completed, bringing 75 percent of Singapore's total electricity demand opened for retail competition. Energy Market Authority of Singapore (EMA), Singapore's energy market regulator, has developed an Electricity Vending System (EVS) to 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.

In January 2002, PowerGas divested its contestable business of gas import, production and retail. The manufactured gas production and gas retail business undertaken by City Gas and natural gas import business undertaken by Gas Supply transferred to Temasek Holdings. With this divestment, PowerGas became a gas transporter. Under the new gas industry framework, transportation of natural gas will be regulated. PowerGas, the gas transport company will be prohibited from gas import, trading and retailing. All other gas industry participants will not be allowed to transport gas.

NATURAL GAS AND LNG IMPORT

Natural Gas has become the major fuel used for electricity generation in Singapore. Three main natural gas pipelines supply Singapore's natural gas system. In view of historical development, the first gas pipeline, located in the northern part of the main island, supplied 150 million standard cubic feet per day (mmscfd) of natural gas from Malaysia. Senoko Power is the importer of Malaysia gas, for use in its own power generation plant. Since January 2001, a pipeline from the West Natuna gas field in Indonesia supplies 325 mmscfd of natural gas to customers which include: Senoko Power for power generation, and large customers in the Jurong and Tuas areas. SembCorp Gas (SembGas) was the importer, transporter and retailer of the West Natuna gas, and large consumers account for about 98 percent of gas served. SembCorp Gas, under the new gas industry framework, was required to transfer its onshore natural gas pipeline assets to PowerGas and exit the gas transportation business. The latest pipeline started gas supply to Singapore in September 2003, this pipeline supplies 350 mmscfd of natural gas from South Sumatra, Indonesia, for power generation and industry. Gas Supply is the importer of the South Sumatera gas, and retailed by Gas Supply and City Gas Both of these retailers engage the services of PowerGas for gas transportation.

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. A disruption in natural gas supply from West Natuna on the morning of 5 August 2002, led to the tripping of seven gas fired generation plants. About a third of Singapore's generating capacity was suddenly lost. Such risk has made the potential cost of previously shelved Liquified Natural Gas (LNG) importation plans more palatable.

With a favourable feasibility study completed in 2005, EMA plans for a LNG receiving terminal to be operational by 2012, depending on market demand. In 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 indicated that pipeline gas contracts will be limited or allowed to expire so as to build up demand for the imported LNG once available.

ENERGY EFFICIENCY

The plans and programs of the Energy Efficiency Programme Office (E^2PO) primarily target five sectors specifically, power generation, industry, transport, buildings and households.

Power generation

Implementation of a competitive electricity market had promoted greater incentives in efficient power generation. Singapore's overall power generation efficiency had improved from 38 to 44 percent between 2000 to 2006. Efficiency improvement was primarily driven by switching out of oil based power plants to combined cycle gas turbines (CCGTs) in the generation mix. The E²PO expects further generating efficiency improvements in the future, and is promoting cogeneration and tri-generation in Singapore.

Industry

Energy efficiency measures in industry include:

- The Energy Efficiency Improvement Assistance Scheme (EASe) is a program to encourage and help companies identify potential energy Under EASe, the National Environmental Agency (NEA) co-funds up to 50 percent of the cost of appraisals for buildings and individual facilities;
- Investment Allowance (IA) Scheme is to encourage companies to invest in energy efficient equipment. The Economic Development Board (EDB) administers the Investment Allowance Scheme which is a capital allowance on qualifying equipment costs that allows a deduction against chargeable income;
- Energy Efficiency by Design is a program to help companies incorporate efficiency considerations during the conceptual design phase of a new facility.

Transport

Singapore land transport policies focuses on encouraging greater use of public transport and more fuel-efficient vehicles, as well as reducing congestion in Singapore's roads.

Buildings

Energy efficiency is one of the main considerations in the assessment of a building's environmental credentials in Singapore. Since the introduction of the Ministry of National Development (MND) Research Fund for the Built Environment in 2006, agencies such as the Building and Construction Authority (BCA) and the NEA have encouraged in development and construction of energy efficient buildings. Energy efficiency initiatives include:

- EASe for Buildings
- EnergySmart Label
- Building Control Regulations
- Green Mark Buildings
- Green Mark Incentive Scheme
- Public Sector taking the lead

Households

Households account for about a fifth of the electricity consumed in Singapore. Energy efficiency improvement in the household sector is promoted by encouraging consumers to purchase energy efficient appliances and adopt energy efficient habits. Incentives to inform households on their consumption habits include:

- Mandatory Energy Labelling Scheme: beginning from 2008, all household refrigerators and air-conditioners that are sold in Singapore must be energy labelled. Furthermore, the E²PO evaluates minimum energy performance standards for other energy-intensive household appliances.
- Reducing Standby Power Consumption: public information and encouragement to households by the NEA to completely switch-off appliances that is not in use. In view that

modern appliance often consume power even when they are supposedly "off", and that appliances on stand-by can account for up to 10 percent of typical household electricity consumption.

ENVIRONMENT AND CLIMATE CHANGE STRATEGY

Primary anthropogenic GHG emission of Singapore is carbon dioxide by the energy sector from burning of fossil fuels in power stations, industries and vehicles. Singapore signed the UN Framework on Convention Climate Change in 1997 and ratified the Kyoto Protocol in April 2006. At this stage, however, Singapore 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 drafted in 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

TEMASEK DIVESTS POWER GENERATION COMPANIES

In June 2007, Temasek Holdings (Temasek) confirmed its plan to divest all three of its wholly-owned Singapore power generation companies, namely PowerSeraya, Senoko Power and Tuas Power (collectively called the gencos) over a period of the next 12-18 months. The sale was reportedly with due consideration to the passage of Amendments to the Gas Act by the Singapore Parliament and completion of regulatory framework governing the competitive wholesale supply of gas and power. Divestment of the three gencos was considered as the next step towards liberalization of Singapore's electricity market. The gencos were independent companies, each with its own board and management.

The sale of Power Seraya in December 2008 concluded Temasek's divestment of its three power generation companies, within the time span as announced in July 2007. The sale also marks completion of transition to a fully competitive power generation market in Singapore, which began by the restructuring of Temasek's generating assets into three independent operating companies in 1995. Notably, Temasek Holdings is an investment company owned by the Government of Singapore that was incorporated in 1974. It is currently an Asia-centric investment firm, headquartered in Singapore and supported by affiliates and offices around the world.

BG ASIA PACIFIC AS LNG AGGREGATOR

The Energy Market Authority (EMA) on 1 April 2008 announced that it has appointed BG Asia Pacific (BG) as the Liquefied Natural Gas (LNG) Aggregator for Singapore. EMA and BG have entered a Memorandum of Agreement (MoA) which is a comprehensive contract detailing BG's responsibilities in the role of the Aggregator. Its role will be to aggregate demand for regasified LNG from all end-users of gas in Singapore, and to procure LNG supply for these end-

users. BG will have an exclusive licence to import LNG and sell regasified LNG in Singapore for a demand of up to three (3) million tonnes per annum (Mtpa) starting in early 2012.

LNG TERMINAL AGREEMENT

The Energy Market Authority (EMA) announced on 28 April 2008 that it has signed a LNG Terminal Agreement (LTA) with PowerGas (a member of the Singapore Power Group), confirming its designation as the developer of Singapore's first LNG import terminal.

Reportedly, the LNG terminal, which will be located on reclaimed land at Jurong Island, will have an initial send-out capacity of 3 million tonnes per annum (Mtpa), with potential for expansion to 6 Mtpa. EMA expects that the terminal to be ready for start up in early 2012 to coincide with the first deliveries of LNG to Singapore.

Moreover, PowerGas has already commenced the design and engineering work to prepare the tender specifications for the construction and commissioning of the LNG terminal. EMA also stated that PowerGas and BG Asia Pacific (BG), which was appointed by EMA as the LNG Aggregator for Singapore, will develop a Terminal Use Agreement (TUA) which will define the technical, operational and commercial arrangements for the use of the LNG terminal.

PowerGas is currently the gas transporter and system operator in Singapore. It owns and operates gas transmission and distribution assets including two onshore receiving facilities for Sumatra gas and Malaysian gas, and 2,800 km of pipelines. It transports natural gas to power generation companies and industrial customer, and town gas to commercial and residential customers.

SINGAPORE GAS MARKET

The EMA announced in 11 September 2008 that Singapore's new restructured gas market would be operational from 15 September 2008. As part of the new gas market, the gas transportation business will be separated from the competitive businesses of gas import and retail. EMA stated that a set of rules called Gas Network Code (GNC) will govern the activities of gas transportation, providing open and non-discriminatory access to the onshore gas pipeline network.

Restructuring of the gas market is reportedly to support liberalization of the electricity industry, by proving a competitive source of natural gas for electricity generation. The EMA reported that over the past few years it had worked closely with industry players to put in place the new gas and electricity market structures. Singapore expects greater competition in the gas and electricity sectors, and furthermore expects that benefits of competition will be passed through to consumers in terms of competitive prices and more choices of electricity and gas retailers.

The GNC issued by the EMA, in consultation with industry players, provides open and non-discriminatory access to Singapore's on-shore pipelines. The GNC outlines the common terms and conditions between the gas transporter (i.e. PowerGas) and industry players who engage the transporter to transport gas though the pipeline network. Under the GNC, suppliers and users of natural gas will have open and non-discriminatory access to the entire on-shore gas pipeline network in Singapore.

To ensure that the gas transporter is not in commercial conflict to common interests, PowerGas is banned from participation in parts of electricity and gas business which are open to competition.

Notably, Sembcorp Gas, which has diversified interests in gas transportation, import and retail businesses, will exit from the gas transportation business and transfer its gas pipelines to PowerGas, via a statutory transfer under Section 98 of the Gas Act. Section 98 of the Gas Act empowers the Minister for Trade and Industry, with the Minister of Finance, to determine the terms of the statutory transfer of pipeline assets from Sembcorp Gas to Power Gas.

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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. It has an area of about 36,188 square kilometres. Only one quarter 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 23.01 million in 2007 and grew at a rate of 0.059 percent between 2006 and 2007, slower in comparison with the 0.43 percent annual growth rate between 2000 and 2006. Driven by rapid economic development in the past decade, the economic structure of Chinese Taipei has substantially changed. The service sector contributed 71.3 percent, the industrial sector 27.1 percent and the agriculture sector 1.7 percent of GDP in 2005. The GDP of Chinese Taipei reached US$ 600.93 billion, and the GDP per capita was US$ 26,368 in 2006 (both in 2000 PPP terms).

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

Table 35 Key data and economic profile (2006)

Key data		Energy reserves**	
Area (sq. km) *	36,188	Oil (MCM) – Proven	-
Population (million)	22.79	Gas (BCM)	7.7
GDP Billion US$ (2000 US$ at PPP)	600.93	Coal (Mt) - Recoverable	-
GDP per capita (2000 US$ at PPP)	26,368		

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 110,100 ktoe in 2006, up 3.24 percent from the previous year. By fuel, oil represented the largest share at 41 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 has had to import around 99 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 81 percent of total imports. West African countries also are important suppliers. In 2006 Chinese Taipei imported 54.5 million tonnes 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 tonne in 2005. To ensure against 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 (bpd), 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 bpd to 510,000 bpd. 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 2007, 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 tonnes 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 tonnes per year. This terminal will start partial operation with a handling capacity of 690 thousand tonnes 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 (36.7 percent), Australia (38.8 percent) and China (19.9 percent). In 2006, primary coal supply was 41.1 million toe or 4.81 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.

Table 36 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	13,389	Industry Sector	37,116	Total	235,372
Net Imports & Other	100,205	Transport Sector	14,768	Thermal	181,448
Total PES	110,091	Other Sectors	13,565	Hydro	7,999
Coal	41,069	Total FEC	65,449	Nuclear	39,870
Oil	45,109	Coal	7,254	Others	6,054
Gas	10,957	Oil	38,798		
Others	12,956	Gas	2,010		
		Electricity & Others	17,388		

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

Chinese Taipei has 45,885 MW of installed generating capacity and generated about 243,100 GWh in 2007. Of the production in 2007, Taipower's thermal power comprised 46.09 percent (coal shared was 29.05 percent oil 5.02 percent, LNG 12.02 percent), cogeneration 18.22 percent, nuclear power 16.68 percent, IPP 15.49 percent, and wind power 0.12 percent. Taipower dominates Chinese Taipei's electric power sector, with Independent Power Producers (IPPs) accounting for only about 19.3 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.

FINAL ENERGY CONSUMPTION

The final energy consumption in Chinese Taipei was 65,400 ktoe in 2006, or 1.86 percent higher than the previous year. Elasticity of total domestic energy consumption was 0.85 in 2006. The industrial sector consumed 57 percent of the total, followed by transportation (23 percent) and the other sectors, mainly residential and services (20 percent). By energy source, petroleum products accounted for 59 percent of total final energy consumption, followed by electricity (27 percent), coal (11 percent) and city gas (3 percent).

The industrial sector has been the primary energy consumer. Due to the rising gasoline price and a more convenient mass transportation system, the energy consumption in the transportation sector has not increased significantly, reaching 14,800 ktoe in 2006 from 14,700 ktoe in 2005, representing a 0.46 percent increase. The consumption in the commercial and residential sectors showed a decrease of 0.82 percent.

By energy source, petroleum accounted for 59 percent of total consumption, electricity and others 27 percent, coal 11 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 16 years at 3.96 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 (NRE). Two National Energy Conferences were convened in Taipei on 26 May 1998 and 20 June 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: (1) stabilising energy supply to increase energy independence, (2) increasing energy efficiency and reinforcing management of energy efficiency, (3) further promoting liberalisation of the energy market, (4) coordinating the development of 3E (energy, environment, economy), (5) reinforcing research and development, (6) promoting education campaigns and expanding public participation. The aims of Chinese Taipei energy policy are to establish a liberalised, 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.

NUCLEAR ENERGY

There are three nuclear power plants with six units and a total installed capacity of 5144 MW in 2008. The first, second and third nuclear power plants having two 636MW, two 985MW and two 951MW units respectively. The fourth nuclear power plant will complete a 1350 MW unit in 2010 and 2011. At that time, there will be 7844 MW installed capacity of nuclear power generation.

NEW AND RENEWABLE ENERGY

In order to promote the use of new and renewable energy, the government has selected some major areas with viable market potentials: solar energy, wind energy, geothermal energy, ocean energy, biomass, and energy from waste. To advance the development of new and renewable In order to establish a legal basis for promoting renewable energy and to foster its sustainable utilisation, the "Renewable Energy Development Bill" has been drafted by the Bureau of Energy and submitted to the Legislative Yuan for approval. The essence of the Bill is based on fixed feed-in tariffs and grid-connecting obligation to secure the market for electricity generated from renewable energy. The subsidisation of photovoltaics, hydrogen energy and fuel cells was also proposed. For the differences between non-renewable electricity generating costs of power utilities and renewable electricity feed-in tariffs, a fund will be established to subsidise utilities when they produce or purchase renewable electricity.

CO2 EMISSIONS VOLUNTARY REDUCTION PROGRAMME AND ENERGY INDUSTRY AUDITING

The 2005 General Energy Conference identified the need for Chinese Taipei to commit itself to 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:

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

DEEPENED LIBERALISATION OF THE PETROLEUM MARKET

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

- 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;
- 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;
- Inclusion of ethanol gasoline and bio-diesel under the petroleum management mechanism; and
- Extension of the scope and utilisation of the Petroleum Fund so as to further enhance security of oil and natural gas supply, promote reasonable and effective energy use, stabilise 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:

- Formulation of guiding principles on energy development, establishment of an evaluation mechanism for energy utilisation, and implementation of preliminary management on energy utilisation for large energy users;
- Formulation of related regulations on energy conservation and energy efficiency aimed at specific energy users; and
- 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 popularising 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 22 February 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) starting 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, The IPP investors did not meet the bidding price which Taiwan Power company offered in this stage. Fortunately, power demand will not increase between 2011 and 2013. The MOEA will release the Fifth Stage of Opening Electricity Market to IPPs if the rate of reserve capacity is below 16 percent in the future.

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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 63.44 million at the end of 2006. In 2006 the Gross Domestic Product (GDP) was US$ 414.36 billion with GDP per capita of US$ 6,531 (both at 2000 US$ at PPP).

Thailand is highly dependent on energy imports, particularly oil. In 2006, net energy imports accounted for 58 percent of energy supply in the economy; down significantly from 96 percent in 1980.

Table 37 Key data and economic profile (2006)

Key data		Energy reserves*	
Area (sq. km)	513,115	Oil (MBBL)	238
Population (million)	63.44	Condensate (MBBL)	289
GDP Billion US$ (2000 US$ at PPP)	414.36	Gas (TCF)	12.51
GDP per capita (2000 US$ at PPP)	6,531	Lignite (Mt) - Recoverable	2,121

Source: Energy Data and Modelling Centre, IEEJ, 2008.

* Proved reserves, Department of Mineral Fuels, Ministry of Energy (2004 data).

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary supply in 2006 was 83,862 ktoe. Oil accounted for 57 percent of total primary supply, while gas, coal and others accounted for 26 percent, 14 percent and 3 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 2006, coal supply was 11,847 ktoe, a 10.9 percent increase from the previous year, mainly due to increasing consumption in the industry sector and other sectors. In terms of oil, total supply was 47,631 ktoe in 2006, a 16.2 percent increased from 43,645 ktoe in 2005.

For natural gas, in 2006, natural gas supply was 22,097 ktoe, a largr decrease from the 2005 value 28,905 ktoe. Natural gas is mainly used for power generation, which accounted for almost 80 percent of consumption.

From statistics of the Department of Mineral Fuels and Ministry of Energy, at the end of 2004, Thailand had proven reserves of petroleum both onshore and offshore as follows: 238 million barrels of crude oil, 289 million barrels of condensate, and 12.51 trillion cubic feet of natural gas. For lignite, total reserves, include the remaining resources from areas currently in production as well as the proven and probable reserves from undeveloped areas, was 2,121 million tonnes.

In 2006, total electricity generation was 138,742 GWh, a 4.9 percent increase from 2005. Thermal generation, mostly from natural gas and coal, accounted for 84 percent of production and hydropower for 4 percent. The generating capacity consisted of domestic electricity production as well as power purchased from Lao PDR and Malaysia. Natural gas accounts for over 70 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 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	33,537	Industry Sector	17,244	Total	138,742
Net Imports & Other	48,399	Transport Sector	22980	Thermal	116,813
Total PES	83,861	Other Sectors	14899	Hydro	8,125
Coal	11,847	Total FEC	55122	Nuclear	-
Oil	47,631	Coal	7,569	Others	13,734
Gas	22,097	Oil	34,451		
Others	2,286	Gas	2,151		
		Electricity & Others	10,951		

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 2006 was 55,122 ktoe, a substantial increase of 11.8 percent over the previous year.

The transportation sector was the largest energy consuming sector and accounted for 42 percent of total final energy consumption at 22,980 ktoe. The second largest consumer of energy was the industry sector, which consumed 17,244 ktoe in 2006, a slight increase of about 1.0 percent over 2005. In terms of fuel types, oil accounted for 62 percent share (34,451 ktoe) of the total energy consumed by Thailand in 2006, followed by electricity and others, coal and gas at 20 percent, 14 percent and 4 percent respectively.

The consumption of oil has decreased in 2006 compared to the previous year. Oil consumption also decreased at 12.9 percent to reach 34,451 ktoe in 2006 compared to 35,580 ktoe in 2005. Natural gas slightly increased by 3.95 percent to reach 2151 ktoe in 2006 compared to 2,069 ktoe in 2005. On the other hand, coal consumption has increase 10.9 percent from 2005 to 2006, to reach 7,569 ktoe in 2006.

As a result of economic expansion, domestic electricity demand increased by 5.0 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 energy policies pointed out by Thailand's energy minister in 2008 include: (1) enhance energy security to ensure sufficient energy supply for the economy's development and to increase energy self-reliance for the people's well-being; (2) monitor energy prices to be appropriate, stable and in line with the economic and investment situations; (3) promote research and development of all forms of alternative energy on a continuous basis; (4) emphasize the creation of energy saving discipline as a national culture and encourage Local Administration Organizations to be focal points for disseminating "Energy Saving Culture"; (5) protect the environment from impact of energy industry, generated by both energy production and consumption processes, as well as promote the tackling of global warming and support the Clean Development Mechanism (CDM).

ENHANCE ENERGY SECURITY

The policy to enhance energy security to ensure sufficient energy supply for the economy's development and to increase energy self-reliance for the people's well being includes the following measures:

- Expedite exploration and production of domestic energy resources, covering oil, natural gas and electricity, to enhance stability. A target was set to increase crude oil and condensate exploration and production to reach 250,000 barrels/day by 2011. Supply of natural gas from JDA and B-17 gas fields will be accelerated to meet the schedule. With regard to electricity, greater domestic generation will be promoted, especially SPPs and VSPPs using renewable energy.
- Enhance interconnection with energy resources in foreign countries. Greater investment will be encouraged in the production of crude oil and natural gas in foreign countries to be procured back to Thailand. Particularly, the signing of natural gas sale agreement (GSA) will proceed for natural gas supply from M9 gas field in Myanmar, for which the Head of Agreement (HOA) has been signed by the former Minister of Energy, Lieutenant General Poonpirom Liptapanlop. As for other petroleum resources in the Middle East region where PTTEP has already invested and began development, the operations will be sped up so that production could commence and supply sent to Thailand. With regard to the purchase of electrical power from neighbouring countries, the power purchase plan will be reviewed to suit the demand requirements under the current economic conditions of the country.
- Manage LPG supply to prevent shortage. A study will be undertaken to determine an appropriate approach and amount of LPG reserve to meet the current demand. The LPG import capacity as well as domestic logistics system will be improved to prevent LPG shortage, along with the formation of appropriate pricing policy to create equity for all stakeholders.
- Revise the *Power Development Plan* (PDP). Since the present reserve margin is more than 20 percent, it is deemed appropriate to expeditiously adjust the reserve margin level to be in line with international standards so as to reduce not only the investment burden of the country but also the impact of F_t burden on the people. In addition, the Electricity Generating Authority of Thailand (EGAT) is to maintain an appropriate share of power generation capacity in order to guarantee the stability and security of the national power system in the long term.
- Carry out a comprehensive study on nuclear energy. In order to provide another option and to increase the power supply stability in the future, it is necessary that a detailed study on nuclear energy be expedited prior to its submission to the government for further consideration and decision-making in the next two years. In particular, clear clarification will be required for the following two major issues: (1) economic and social profits, and (2) public acceptance.
- Distribute Energy Risks. This aims to create a wide diversity of fuel types so as to reduce excessive dependency on any one particular fuel in both transportation and power generation sectors and to provide people with more options in energy consumption as a means to deal with the volatility of many fuel types, in terms of quantity and prices.
- Promote the extension of petrochemical and oleo chemical industry. Preparation will be made for a study on the extension of petrochemical development to be well integrated with biofuel development so as to generate a new industry in the country, such as the oleo chemical industry.

ENERGY PRICES

The policy for monitoring energy prices to be appropriate, stable and in line with the economic and investment situation includes the following:

- Monitor the oil price policy and oil price structure to be in line with the world market mechanism, reflecting actual costs and ensuring fairness for consumers. Monitoring will focus especially on the marketing margin of oil traders, which is excessively high at present, and the refining margin of oil refineries.
- Determine LPG prices to reflect actual costs and consumption volume, particularly in the industrial and transportation sectors. For household consumption, however, where LPG is used for cooking, the price level will be maintained under the *6-measures 6-months* policy. Relevant guidelines and measures will be presented to the National Energy Policy Council (NEPC) for further consideration.
- Control safety aspects, emphasizing the establishment of safety standards relevant to each stage of the use of LPG and NGV as fuel in the industrial, transportation and household sectors for the safety of the general public.
- Encourage the establishment of Provincial Energy Offices in each and all provinces to act as representatives in monitoring and following up the policy implementation of the Ministry of Energy so that the policy could be materialized in all dimensions.
- Support the work of the Energy Regulatory Commission pursuant to the prescribed role and duties and according to the purposes of the law so as to ensure benefits of the protection and create fairness for energy consumers

ALTERNATIVE ENERGY R&D

To promote research and development of all forms of alternative energy on a continuous basis, Thailand is undertaking the following measures:

- Speed up the preparation of the *15-Year Renewable Energy Development Plan* (REDP), as initiated under Minister Poonpirom's office, as a national agenda by accelerating the organization of public consultations prior to submission to the National Energy Policy Council (NEPC) and the cabinet for consideration and proclamation.
- Proceed full steam ahead with the promotion of ethanol and biodiesel to be the energy for Thais. Biofuels will help Thailand to be more energy self-reliant. In addition, ethanol and biodiesel are renewable energy, which will not be depleted and will help increase the prices of agricultural products while also reducing oil imports and hence save foreign currency. These biofuels are considered clean energy, contributing to reduction of environmental impacts and global warming problems. Moreover, their selling prices are not expensive. Particularly, E85 (gasoline blended with 15 percent ethanol) will be an important energy option for Thai people amidst oil price hikes. The Ministry of Energy will monitor the equilibrium between the use of agricultural products for energy production and that for food production.
- Implementation of Natural gas for vehicles (NGV) will be sped up according to the action plan as devised under Minister Poonpirom's office. The plan covers preparations to accommodate the increase in transportation demand and to reduce the problems of "running out of gas", "long queue" and "scarce service stations" through improvement of the management and administration of NGV service stations. Improvements include acceleration of mother station construction, increase in the number of NGV transportation tank-trucks and investment in the construction of three major pipelines.
- Promote power generation using renewable energy. Consideration will be made to introduce more incentives, besides the existing "Adder" measure, in order to induce investment in power generation using all potential types of renewable energy.
- Promote community-scale alternative energy. The development of prototype energy villages will be encouraged, emphasizing the application of traditional cultures and way of living of the villagers as the basis for energy management within individual villages so that they can become self-reliant. In this regard, the principles of *Sufficiency Economy Philosophy of His Majesty the King* will be applied, concurrently.

ENERGY SAVING

Efforts to emphasise the creation of energy saving discipline as a national culture and encourage the local administrative organisation to be focal points for disseminating "energy saving culture" include:

- Speed up the implementation of energy conservation pursuant to the *Energy Conservation Program*, Phase 3 (2005-2011). The target of energy saving has been adjusted, under Minister Poonpirom's office, from 10.8 percent to 20 percent, and the program will focus mainly on energy saving promotion in the industrial and transportation sectors.
- Accelerating the materialization of the "11 energy-saving measures for the public". A target was set to achieve energy saving, accounting for a value of 100 billion baht (US$ 2.85 billion) per year by 2011. The 11 measures are: (1) household energy credits; (2) energy credits for the industrial sector; (3) mandatory energy labelling; (4) 1-Watt Standby Power; (5) concerted energy saving efforts in temples and mosques; (6) energy saving standards for building designing (Building Energy Code); (7) monitoring energy saving in factories (ISO - energy); (8) energy mobile units; (9) "555" project - price reduction for high-efficiency (No. 5) electrical appliances for the public; (10) "Clean Air-conditioners Increase Savings for Households" project; and (11) "Engine Tune-up to Reduce Oil Consumption" project. In particular, the implementation of Projects number 9, 10 and 11 will be continuously carried out every year, especially during summer. Additional measures will be explored so that greater energy saving can be achieved.

REDUCING ENERGY'S ENVIRONMENTAL IMPACT

To protect the environment from impacts of the energy industry, both from energy prodcurction and consumption, as well as to tackle global warming and support the Clean Development Mechanism (CDM), Thailand plans to implement the following:

- Support CDM projects in the energy sector to bring about reduction of greenhouse gas (GHG) emission at no less than 1 million tonnes per year.
- Reduce environmental impact caused by energy consumption by reducing GHG emission, especially in the transportation sector, by 15 to 20 percent, and preparing for the enforcement of EURO 4 oil standards in 2012, together with the reduction of volatile organic compounds (VOC) from oil business facilities through the installation of vapour recovery units.
- Reduce environmental impacts caused by energy production by undertaking a study to achieve a target of GHG emission reduction by oil refineries and power plants by 15 to 20 percent per each unit of energy produced and promoting the reduction of flare gas emission from petroleum production resources in order to re-use the gas.
- Promote appropriate technology innovations with moderate costs, that are environmentally friendly, easy to use and with easy maintenance.

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"[84].

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 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.

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

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 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$11.3 trillion (in 2000 US$ at PPP) in 2006. The US is located in North America between Canada and Mexico. It has a population of 299 million people (2006), 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 3.9 percent by 2004 before dipping to 2.9 percent in 2006. The unemployment rate of 6.0 percent in 2003 decreased to 4.6 percent in 2006 as economic growth recovered. As of autumn 2008, however, the US was caught at the centre of major global financial crisis with serious impacts on financial markets and consumer spending; the economic outlook was poor.

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 2006, there were 3,459 MCM of proven oil reserves, 5,788 BCM of natural gas reserves and 242.7 billion tonnes of coal reserves. According to the US DOE EIA, total electricity (net summer) generating capacity across all sectors was 986.2 GW in 2006, of which 77 percent was thermal, 10 percent was nuclear, 10 percent was hydro (conventional and pumped storage) and 2.4 percent was other renewable energy (biomass, geothermal, solar and wind etc).[85] Due to a large, wealthy population and broad industrial base, the economy consumed 5.3 toe per capita in 2006, over three times the APEC average and far in excess of production.

Table 39 Key data and economic profile (2006)

Key data		Energy reserves	
Area (sq. km)	9,631,418	Oil (MCM) – Proven*	3,459
Population (million)	299.40	Gas (BCM) – Proven*	5,788
GDP Billion US$ (2000 US$ at PPP)	11,315	Coal (Mt) –Recoverable**	242.7
GDP per capita (2000 US$ at PPP)	37,791		

Source: Energy Data and Modelling Center, IEEJ.

* Oil and Gas Journal, 2006 ** WEC Survey of Energy Resources, 2007 (2005 data)

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

In 2006, total primary energy supply in the US was about 2,330 Mtoe. By fuel type, 40 percent of supply came from crude oil and petroleum products, 24 percent from coal, 22 percent from natural gas and 15 percent from nuclear, hydro, geothermal and other fuels. The US imported about 31 percent of its net energy requirements in 2006.

In 2006, oil was responsible for approximately 937 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 2.3 percent per year as oil exploration and production companies

[85] This data from US EIA rather than the APEC energy database (previous source). APEC energy database installed capacities figures are approximately 10 percent higher than given here by US EIA.

turned their attention to cheaper, less mature basins in Africa, Asia and the Middle East. The US itself, however, remained the third-largest crude oil producer in the world. 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, and remained at that level in 2006. About 44 percent of net imported petroleum in 2006 came 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, Louisiana, Alaska and California, which are the four largest states in terms of current oil production.

The US contained about 3.3 percent of the world's natural gas reserves in 2006. Primary natural gas supply totalled 501 Mtoe, of which 16.0 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. Consumption 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 2000, the annual growth rate of natural gas supply (including net imports) was about 2.2 percent. However supply of natural gas has since stagnated alongside high gas prices, declining at an average annual rate of 1.5 percent between 2000 and 2006[86]. And though real wellhead prices in 2006 fell somewhat from 2005 (when they were over 60 percent higher than their previous peak in 1983 following several years of rapid price growth), they remained at their second-highest level in recent history.

Table 40 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation GWh)	
Indigenous Production	1,672,924	Industry Sector	282,506	Total	4,300,103
Net Imports & Other	730,248	Transport Sector	655,753	Thermal	3,048,259
Total PES	2,329,840	Other Sectors	646,540	Hydro	317,686
Coal	550,962	Total FEC	1,584,799	Nuclear	816,195
Oil	937,117	Coal	26,211	Others	117,963
Gas	501,418	Oil	880,466		
Others	340,344	Gas	299,302		
		Electricity & Others	378,820		

Source: Energy Data and Modelling Center, IEEJ

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 34 percent of annual consumption in 2006, compared to a peak of 40 percent in 1986. Interest in liquefied natural gas (LNG) has grown in the US as a means to diversify overall energy supplies while fuelling relatively clean power generation, though proposals for new LNG receiving terminals to be constructed on the east and west US coasts continue to face local public and regulatory opposition. Nevertheless, EIA forecasts that net LNG imports to the US will grow from about 15 Bcm in 2006 to 43 Bcm in 2018 as pipeline imports from Canada decline. After 2018, the need for imports is forecast to decline due to increasing domestic production – this

[86] EIA data shows that natural gas production has been increasing since 2006, and production in 2008 recorded the highest in history. This may be attributed to the increase in unconventional gas production, which accounted for 47 percent of total natural gas production in the US.

represents an important departure from past EIA forecasts which showed continued import growth to 2030.

Primary energy supply of coal in the US totalled 551 Mtoe in 2006. US coal reserves are concentrated both east of the Mississippi River in Appalachia and in several key western states. Eastern coal, which accounted for 42 percent of production in 2006, 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 the east in 1999, 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 seventh largest coal exporter in the world behind Australia, Indonesia, South Africa, Russia, China, and Columbia. After 1998, US coal exports dropped 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, total US coal exports fell to 35.9 million metric tonnes, their lowest level since 1961, as a strong dollar made US coal more expensive internationally and high spot prices for domestic coal made it attractive for producers to sell at home. By 2006, however, coal exports increased to 45.0 million metric tonnes, with Canada receiving the largest share.

The US produced 4.30 million GWh of electricity in 2006 with 71 percent coming from thermal plants, 19 percent from nuclear power, 7.4 percent from hydropower, and 2.7 percent from other sources.

The US generates more nuclear power than any other economy in the world but has built no new nuclear power plants 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 operable units (down from a peak of 112 units in 1990) rose to over 90 percent in 2002, where it remained through 2006. 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 September 2008, the NRC had approved license extensions for 48 nuclear reactor units and had applications for another 18 extensions under review, while 21 other units had informed the agency of their intent to seek extensions by 2013.

Total renewable energy production in the US for 2006 was approximately 173 Mtoe, or 7 percent of total primary energy supply according to the US EIA, a 6.9 percent growth from the previous year and an annualised 5.3 percent growth over the five years preceding. By consumption of renewable energy type, biomass as a whole represented 49 percent of the total, hydroelectric power 41 percent, geothermal 5.0 percent, wind 3.8 percent and solar/PV 1.0 percent (hydroelectric, wind and solar power converted using fossil-fuelled plants heat rates). Of these, biomass used for biofuels (approximately 20.0 Mtoe consumption, 34 percent annual growth for ethanol and biodiesel combined) and wind power (approximately 6.6 Mtoe, 48 percent annual growth) experienced particularly rapid expansion, driven in part by government subsidies and cost reductions relative to fossil-fuelled alternatives.

FINAL ENERGY CONSUMPTION

In 2006, total final energy consumption in the US totalled 1,585 Mtoe, a decline of 1.3 percent from the previous year. Broken down by sector, transport consumed 41 percent, industry accounted for 18 percent, and the rest 41 percent. By fuel, petroleum accounted for 56 percent of consumption, natural gas 19 percent, coal 2 percent, and electricity and other fuels 24 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 intended "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.

Main provisions of the Act included mandates for:

- A 40 percent increase in combined car and light truck fleet fuel economy standards by 2020, reaching 14.9 kilometres per litre (35 miles per gallon). CAFE credit trading is permitted among vehicle manufacturers and interim standards set beginning with model year 2011.

- A five-fold increase from previous biofuel use targets by 2022, requiring fuel producers to use a minimum of 136 billion litres (36 billion gallons), up from 34 billion litres (9 billion

gallons) in 2008. From 2016, new biofuel productio lower the n towards the mandate (representing 44 percent of the 2022 target) is to be derived from cellulosic or other non-cornstarch feedstocks, and provisions are directed towards biorefineries to lifecycle GHG emission of biofuel production. Most of the new biofuel is to be produced domestically, and the target includes a number of safety valves.

- A 25-30 percent decrease in light bulb power consumption by 2012-14 and 60 percent less by 2020, effectively phasing out most incandescent bulbs.

- New efficiency standards for residential and commercial appliances and buildings. Appliance standards apply to dehumidifiers, dishwashers, electric motors, external power supplies, freezers (including walk-in freezers), refrigerators, residential boilers, and residential clothes washers. Funding is increased for residential building weatherisation programs, and a goal is set for newly-built commercial buildings to achieve zero-net-energy use by 2025 and to retrofit all commercial buildings to that level by 2050.

- Federal government building and other efficiency improvements. Specifically, mandates include a 30 percent reduction in federal government building energy use and an elimination of fossil-fuel use new federal buildings by 2030, with comprehensive audits every four years. Overall, federal government petroleum use is to drop 20 percent and alternative fuel use to rise 10 percent by 2015 from a 2005 baseline.

- New funding for investigating the feasibility of or R&D on a number of new energy systems including biofuels and biofuel infrastructure, energy efficiency in data centres, green building strategies including school design, solar energy, geothermal energy, energy storage, CCS, international energy programs, green jobs, energy transportation and infrastructure, small business energy programs, and the smart grid. It also includes prizes for the development of advanced lighting and hydrogen technologies.

Funding for some provisions of the act, including improving the fuel efficiency of automobiles, is provided by the repeal of certain 2005 EPAct oil and gas tax subsidies.

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. Some but not all elements of this vision were enacted into law as part of the Energy Independence and Security Act of 2007 (described above). The President's proposals covered four areas:

Reducing gasoline consumption through the growth of alternative fuel sources

Under the 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 raises the renewable fuel standard to ~136.3 billion litres (36 billion gallons) by 2022.

Reducing gasoline consumption through increasing vehicle efficiency

The President proposed gradually increasing corporate average fuel economy (CAFE) standards by 4 percent per year starting in 2010 for cars and 2012 for light trucks in order to offset 5 percent, 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 percent improvement in CAFE from ~10.6 to ~14.9 kilometres per litre (25 to 35 miles per gallon) by 2022.

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. These proposals were not directly addressed in the Energy Independence and Security Act of 2007.

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. Such an increase would return import protection to near 1985 levels, and would be a 50 percent increase from the current authorised level of 1 billion barrels set by the 2005 EPAct. The current reserve level (December 2008) of 701.8 million barrels is the equivalent of about 61 days. The Strategic Petroleum Reserve Fill Suspension and Consumer Protection Act of May 2008 suspended inflows as of August 2008 in the face of rapidly rising oil and gasoline prices, but these are scheduled to resume in January 2009.

SUB-ECONOMY-LEVEL 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. The California Air Resources Board in October 2008 released a proposed scoping plan including measures, evaluation, and proposed implementation plans for meeting targets through regulation, market mechanisms, voluntary actions, 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. This initiative has a narrower scope than the California plan and focuses on the reduction of power sector carbon dioxide emissions by 10 percent through 2018. The first permit auction for the cap-and-trade system was conducted in September 2008 and the first three-year compliance period begins in January 2009. 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, with members including six 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 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 December 2008, there were 909 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 18 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. California and 15 other states filed legal challenges based on historical precedent after an EPA waiver was denied in December 2007, and it was expected that the waiver would be granted by the incoming Barack Obama administration in early 2009.

OTHER RECENT DEVELOPMENTS

Offshore Drilling

The 1985 US moratorium on offshore oil and gas drilling was allowed to expire in September 2008 amid intense political debate, allowing new offshore exploration and lease negotiation. However, the immediate effect of the moratorium's expiration was unclear as the US congress appeared likely to reinstate some regulatory limits on offshore drilling under a new administration in early 2009.

NRE Power Incentives

Though all forms of energy production in the US receive government incentives in some form, those for NRE power are noteworthy for their importance to the development of these industries. Apart from research and development, current incentives include both financial incentives (subsidies) and policy support.

The production of wind, geothermal, "closed-loop" bioenergy, and marine power is currently eligible for a Federal Renewable Energy Production Tax Credit (PTC) of USD 0.020 per kilowatt-hour (inflation-adjusted, figure for 2008). This credit is renewed and adjusted by congress every few years and has a history of contributing to boom-bust cycles in NRE investment, particularly in the wind industry, as it has been allowed to expire on a few occasions. Originally set to expire at the end of 2008, the PTC for wind producers was renewed for 1 year in October.

New solar facilities no longer qualify for the PTC as a result of the 2005 EPAct, but they are eligible for the federal Business Energy Tax Credit. Updated and extended in 2008, this gives a 30 percent corporate tax credit to utilities and businesses that investment in solar (thermal and photovoltaic), small wind, and fuel cell systems and a 10 percent credit for geothermal, microturbines, and CHP, valid through 2016. A related individual tax credit of 30 percent is

available for residential solar electric system expenditures without cap, with similar tax credits for residential small wind and geothermal systems as well.

Many state and local governments also have financial measures in place that complement federal financial incentives for NRE investment. And in addition to subsidies, sub-federal legislation has also provided significant indirect incentives for NRE development through the establishment of policy frameworks such as renewable portfolio standards (RPS). In the absence of federal RPS, 36 states had enacted such legislation as of 2008, alongside other supporting measures such as generation disclosure rules, mandatory utility green power options, pubic benefit funds for renewable energy, and net metering.

FutureGen Initiative

FutureGen is a public-private partnership undertaken by the US Department of Energy and the FutureGen Industrial Alliance, with additional international support, that focuses on the sequestration of carbon dioxide from coal-fired power plants. When first announced in 2003, its aim was to build a single smaller-than-commercial scale demonstration of a near-zero emission power plant that could produce electricity and hydrogen from coal and serve as a laboratory for further research and development, with construction scheduled to begin in 2009 on a plant using IGCC combustion technology. The initiative was significantly restructured however in January 2008, with DOE citing rising costs and evolving coal power technologies as the impetus to instead focus FutureGen project activities only on implementations of the carbon sequestration itself (and not hydrogen production) across multiple commercial-scale IGCC power plants. DOE solicited funding opportunity announcements for the restructured initiative in June 2008 in anticipation of selecting projects (that is, existing IGCC power plants) for CCS implementation in December 2008.

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. 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.

Following three meetings in 2007 and 2008, leaders released a statement at the July 2008 G8 summit in Toyako, Japan focusing on "ambitious, realistic, and achievable" steps towards greenhouse gas emission reductions. Near term steps focused on clean energy technology cooperation, including the elimination of trade barriers under WTO along with accelerated technology development, transfer, financing, and capacity building.

Asia Pacific Partnership on Clean Development and Climate (APP)

APP is a voluntary public – private partnership among seven Asia Pacific economies – 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.

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.

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.

NEW AND RENEWABLE ENERGY

Twenty Percent Wind Energy by 2030

In July 2008, the U.S. Department of Energy (DOE) released a report that examines the feasibility of using wind power to provide up to 20 percent of the economy's total electricity needs by 2030. Entitled "20 Percent Wind Energy by 2030", the report identifies requirements to achieve this goal including reducing the cost of wind technologies, citing new transmission infrastructure, and enhancing domestic manufacturing capability. Most notably, the report identifies opportunities for 7.6 cumulative gigatons of CO2 to be avoided by 2030, saving 825 million metric tons in 2030 and every year thereafter if wind energy achieves 20 percent of the nation's electricity mix..

In 2007, U.S cumulative wind energy capacity reached 16,818 megawatts (MW) – with more than 5,000MW of wind installed in 2007. Wind contributed to more than 30 percent of the new U.S. generation capacity in 2007, making wind the second largest source of new power generation --- surpassed only by natural gas. The U.S. wind energy industry invested about $9 billion in new generating capacity in 2007, and has grown 30 percent annually in the last 5 years.

The report can be downloaded from
http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf

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VIET NAM

INTRODUCTION

Viet Nam is located in Southeast Asia; the economy shares a common border with Cambodia and Laos to the west, China to the north and the Gulf of Tonkin, the South China Sea and the Gulf of Thailand to the east and south. Viet Nam has an area of 331,212 square kilometres, and marine exclusive economic zone of 200 nautical miles from its 3,260 km coastline. In 2006, Viet Nam had a population of 84.115 million. Market-oriented reforms since 1986 and rapid economic development has transformed the economy of Viet Nam; GDP grew at an average annual rate of 7.6 percent from 1990 to 2006.

In 2006, Viet Nam had a GDP of US$ 170.84 billion and an income per capita of US$ 2031, (both at 2000 US$ PPP). The government targets GDP growth of 7.5 to 8.0 percent per year to 2010. 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 population growth to lower to be under 1.14 percent, all over the period to 2010.

Energy contributed greatly to Viet Nam's economic development; energy supports industrial growth and generates foreign revenue from its exports. Viet Nam 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 Viet Nam in 2006, consists of oil at 615 million tonnes (Mt), gas at 600 billion cubic metres (BCM), coal at 3,880 million tonnes (Mt), and hydropower potential at 20,000 MW. Natural gas and crude oil are found mainly offshore the southern region, while coal reserves are located in the northern region. Viet Nam's coal reserves are mostly anthracite. Since 1990, Viet Nam has become a net energy exporter, its main energy exports are crude oil and coal.

Table 41 Key data and economic profile (2006)

Key data		**Energy reserves***	
Area (sq. km)	331,212	Oil (Mt) - proven	615
Population (million)	84.115	Gas (BCM) - proven	600
GDP Billion US$ (2000 US$ at PPP)	180.84	Coal (Mt)	5.883
GDP per capita (2000 US$ at PPP)	2,031		

Source: Energy Data and Modelling Center, IEEJ. See http://www.ieej.or.jp/edmc/edmc_db/index-e.html

General Statistic office, Viet Nam. See http://gso.gov.vn

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Total primary energy supply (TPES) of Viet Nam in 2006 was 43,628 ktoe, an increase of 7.05 percent from 2005 at 40,755 ktoe. By source of energy, 29.3 percent of supply came from oil, 20.7 percent from coal, 11.8 percent from natural gas and 34.1 percent from other resources.

Viet Nam proven oil reserves of 615 million tonnes in 2005 are likely to increase as exploration continues. Crude oil production has grown rapidly from only 2,73 ktoe in 1990 to 17,510 ktoe in 2006. Over the past 10 years, oil production and exports grew an average annual rate of 8.4 percent. Viet Nam 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. Viet Nam did not yet have its own refinery in 2006, and all crude oil production is exported. On the other hand, the economy requires imports of petroleum products.

Oil product imports also increased from 4,713 ktoe in 1995 to 12,777 ktoe in 2006 at an average annual growth rate of 6.4 percent. Even considering biomass, oil is still the most important energy source in Viet Nam, accounting for 29.3 percent of the economy's TPES in 2006, though the share of oil in the TPES has decreased significantly from 30.8 percent in 2005.

Viet Nam's gas reserves are more promising than oil reserves. In 2005, proven gas reserves was estimated at 600 BCM; this figure is likely to increase as oil and gas discoveries are coming on stream. Gas resources are found in many parts of Viet Nam, though large gas reserves are almost 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 in the South West region, and the Song Hong Basin in the North region also. Cuu Long basin is one of the developed natural gas production areas and mostly produces associated gas from 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 tonnes of LPG and 130 thousand tonnes 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 Viet Nam was 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. The share of natural gas in TPES has increased from 186 ktoe or 2.0 percent in 1995 to 5,108 ktoe or 11.7 percent in 2006. The largest increase in gas use has come from power generation.

Viet Nam has two large coalfields. In Quang Ninh Province in northern Viet Nam, where anthracite coal is found, there is about 5.833 billion tonnes of reserves at the depth of 300 metres, and over 10 billion tonnes at the depth of 1000 metres. In the Red River Delta, there is a brown coal or sub bituminous coal basin with reserves of hundreds of billion of tonnes. Survey works have been ongoing for this coal basin. Viet Nam is carrying out studies and expecting foreign investment to mine this resource in the next 10 to 15 years. Viet Nam's coal production increased steadily from 4.6 million tonnes in 1990 to 36.9 million tonnes in 2006. This increase in coal production has resulted in growth in exports and domestic demand.

In 2006, Viet Nam exported 18.8 million tonnes, a record amount of coal compared to past years. Exports made up nearly 51 percent of the coal industry's sales for the year 2006. Viet Nam coal was exported to many economies including China, Japan, Korea, Taiwan, Thailand, and France. Primary coal demand increased by 12.9 percent per year throughout period 2000 to 2006 from 4,370 ktoe to 9,045 ktoe respectively. In 2006, coal used for power generation accounted for 10 percent in the total coal consumption. The electricity generation of Viet Nam has increased from 26.56 TWh in 2000 to 61.458 TWh in 2006 at an annually growth rate of 15 percent. The structure of primary energy use for Viet Nam power plants has changed drastically within the last decade. Oil product use in generation has decreased substantially, while the share of gas in electricity generation has increased from 7.6 percent of total generation in 1995 to 44 percent in 2006. The share of electricity generation from coal has declined from 33 percent in 1995 to 23 percent in 2006. In the meantime, hydropower use has decreased from 72 percent of total generation to 33 percent in 2006 due to rapid expansion of natural gas use and foreign companies becoming increasingly involved in the growing power market of Viet Nam.

In 2006, installed generating capacity of Viet Nam was 12,721 MW; of this total, generating capacity consists 4538 MW (36 percent) of hydropower plants, 1.030 MW (15 percent) of coal power plants, 5,758 MW (45 percent) of gas and oil fired power plants, 245 MW (2 percent) of DO fired power plants and 250MW (2 percent) of other small producers.

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 Viet Nam, biomass accounted for 34.1 percent of TPES in 2006; the share of biomass has decreased significantly since 1995, when it was 70 percent of TPES.

Table 42 Energy supply & consumption for 2006

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	63,159	Industry Sector	12,286	Total	61,460
Net Imports & Other	-18,659	Transport Sector	7,560	Thermal	40,026
Total PES	43,628	Other Sectors	17,774	Hydro	20,024
Coal	9,045	Total FEC	37,620	Nuclear	-
Oil	12,777	Coal	5,528	Others	1410
Gas	5,108	Oil	12,294		
Others	14,860	Gas	326		
		Electricity	4,630		
		Others	14,841		

Source: Energy Data and Modelling Center, IEEJ. See http://www.ieej.or.jp/cgi-bin2/J101outbcgi.sh

Institute of Energy, Viet Nam

FINAL ENERGY CONSUMPTION

In 2006, the TFEC was 37,620 ktoe, up 5.4 percent from that of 2006. 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 2006, consumption of electricity grew at the fastest of all final energy at an annual growth rate of 15 percent.

Industry is one of biggest energy consumers, accounting for 32.6 percent of final energy consumption in 2006, slightly lower then 35.3 per cent in 2005. Steel, construction materials, pulp and paper and fertilizer manufacturing industries consumed the most energy. From 2000 to 2006, the annual average growth rate of energy consumption in industry was 11.9 percent.

The share of transport in the TFEC has increased from 18.3 percent in 2005 to 20.1 percent in 2006, and the annual average growth rate was 12.3 percent over the period 2000 - 2006. Oil products (diesel, gasoline and fuel oil) are mainly used in transportation.

Others sectors (residential and commerce sectors) consumed 47.2 percent of Viet Nam's final energy consumption, with the share increased from 28.2 percent in 2000; the average growth rate was 9.58 percent per year over this period. In remote and rural areas, however, non-commercial biomass is still the main source energy for households.

POLICY OVERVIEW

The Ministry of Industry (MOIT) was formed after the merger between Ministry of Industry and Ministry of Trade and is in charge of activities related to the energy sector and other industries in accordance with the decree on 189/2007/ND-CP Issues by the prime minister on 27 December 2007.

Related to the energy sector, the MOIT is responsible for the state management of all energy industries, namely electricity, new and renewable energy, coal, and the oil and gas industries. The MOIT is 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 MOIT is also responsible for directing and supervising development of the energy sector and reporting their findings to the prime minister.

Looking at the energy related government organisation, there are many ministries related to energy under the cabinet. Inside MOIT, the Energy Department carries out responsibility related to the energy field, administering Viet Nam electric power corporation (EVN), Viet Nam coal industrial and mineral group (VINACOMIN) and National Viet Nam Oil & Gas Group (PetroVietnam). Another ministry related to the energy is Ministry of Planning and Investment (MPI). MPI has the authority to set the *Socio-economic Development Strategy and Plan* and, at the same time, to coordinate distribution of national capital investment among projects submitted by ministries and agencies as well as distribution of foreign capitals (FDI).

In addition, Ministry of Finance has jurisdiction over tariff and taxation related to energy activities. At the same time, Ministry of National Resources and Environment (MONRE) plays an important role in the energy field reflecting the rise of concern over environmental protection.

The *National Energy Development Strategy* for the period up to 2020 with outlook to 2050 approved by the Prime Minister on 27 December 2008 (Decision No. 1855/ QD- TTg) set up the targets for energy development as follows:

- Ensuring sufficient supply of energy to meet the demands of socio-economic development, in which primary energy is expected to reach about 47.5 - 47.9 Mtoe in 2010, 100 - 110 Mtoe in 2020 and about 310 - 320 Mtoe in 2050.
- Developing power plants and power networks, ensuring a sufficient supply of electricity for socio-economic development, and ensuring the reliability of electricity supply is 99.7 percent in 2010.
- Developing refineries, step by step, to meet demand of petroleum products in the country, and increasing capacity of refineries to about 25 to 30 million tonnes of crude oil in 2020.
- Ensuring national strategic oil stockpiling at a 45 days level in 2010, 60 days in 2020 and 90 days in 2025.
- Achieving a share of renewable energy of 3 percent in the total commercial primary energy supply in 2010, 5 percent in 2025 and 11 percent in 2050.
- Completing the rural energy program for rural and mountainous areas. Increasing share of rural households using commercial energy to 50 percent in 2010 and 80 percent in 2020. By 2010, 95 percent of rural households will have access to electricity.
- Changing the electricity, coal, oil-gas sectors to operate in competitive market mechanisms with State regulation. Establishing competitive electricity retailing market in the period after 2022; establishing a coal and petroleum product business market by 2015.
- Actively preparing necessary and harmonious conditions for putting the first unit of nuclear power plant into operation in 2020, then growing nuclear power in the national energy structure. By 2050, nuclear electricity will account for about 15 to 20 percent in total commercial energy consumption of the whole country.

Viet Nam is diversifying its consumption of energy by developing regional indigenous resources and expanding regional cooperation. Viet Nam hopes to minimise its dependence on oil, and place priority on ensuring 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, Viet Nam 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 needs to overcome to assure energy security. Until Viet Nam's first oil refinery is completed: (1) oil products will have to be imported; (2) currently the economy has no strategic oil stockpiling in place; (3) the power sector is still at its early stages of reform; (4) electricity shortages still occur; and (5) 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, namely the need for greater environmental protection, declining coal reserves, developing new coal reserves and supply infrastructure and meeting increasing demand. Although the potential of oil and gas discoveries are rather high, the size of these reserves is relatively small nonetheless. 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, Viet Nam 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 petroleum;
- Improve energy efficiency, reduce energy losses and implement extensive measures for conservation of energy;
- 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 energy efficiency programme (hereafter called EE&C program) for the period 2006-2015. The programme 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 in the whole society. The aim of the program is to save 3 to 5 percent of total national energy consumption over the period 2006-2010 and 5 to 8 percent in period 2011-2015. The program includes six components: (1) strengthen state management on energy efficiency and conservation, by developing a management system for energy saving; (2) strengthen education, disseminate information, and enhance public awareness to promote EE&C as well as environmental protection; (3) develop and popularised high energy efficiency equipment, by phasing out low energy efficiency equipments, step by step; (4) promote EE&C in industry; (5) promote EE&C in building; and (6) promote EE&C in transportation activities.

RESTRUCTURING OF THE ENERGY SECTOR

Power Sector

Electricity of Viet Nam (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. EVN also has the key responsibility for ensuring 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, Viet Nam 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, and operation of large-scale hydropower and nuclear power plants in the future.

The Electricity Law, approved by the Viet Nam National Assembly, came into effect in July 2005 and outlines the major principles for the establishment of the power market in Viet Nam. In October 2005, the Decision No. 258/2005/QD-TTg was signed by the Prime Minister, and clearly stipulates the functions, duties, and organisation of the Electricity Regulatory Authority of Viet Nam (ERAV). ERAV's main function is to assist the Minister of the Ministry of Industry and Trade 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 Viet Nam National Coal Corporation (VINACOAL) to the new Viet Nam National Coal and Mineral Industry Group (VINACOMIN), which has operated in the form of a holding company becoming the first state-owned enterprise (SOE) in the country with diversified business interests. VINACOMIN has been formed by restructuring the Viet Nam 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 comprised 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 organisations and ministries. Among them, only the Viet Nam Oil and Gas Group (PetroVietnam), which was transformed from the Viet Nam Oil and Gas corporation established in 1975 and supervised by the Ministry of Industry and trade, is vested with the responsibility of managing all the oil and gas resources in Viet Nam. 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

Viet Nam signed the United Nations Framework Convention on Climate Change (UNFCCC) in November 1994, and ratified the Kyoto Protocol (KP) in August 2002. Viet Nam fulfils all requirements to be a host economy for the development of Clean Development Mechanisms (CDM).

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 Viet Nam being one of the most vulnerable countries. By participating in CDM, Viet Nam showed its willingness to contribute to global environmental protection while seeking additional investment and opportunities 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 or 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 Viet Nam 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.[87] 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 and 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; and
- Actively participate in international co-operative and exchanging activities related to the UNDP framework convention on climate change in 1992.

RENEWABLE ENERGY

In Viet Nam, renewable energy plays an important role in rural development. The government has provided significant support and issued a number of legislation polices to promote rural electrification and renewable energy development such as the *Viet Nam Power Sector Development Strategy* issued in October 2004 (Decision: No.176/2004/QD-TTg); and the *National Energy Strategy Development* issued in 27 December 2007 (Decision No. 1855/ QD- TTg).

The followings are renewable energy issues addressed in the two above-mentioned documents:

1. Viewpoint of Development includes: (1) giving priority to developing new and renewable energy resources such as wind, solar, hydro power; and (2) motivating the power development program for rural areas by researching and developing new forms of new and renewable energy so as to meet the need of power consumption, especially in the islands and remote areas.

2. Development Objectives include: (1) developing new and renewable energy, increasing its proportion from its currently inconsistent level to around 3 percent of the total primary commercial energy, equal to 1.4 Mtoe by 2010, 8 percent equal to 9.02 Mtoe by 2025 and 11 percent equal to 35 Mtoe by 2050; (2) Providing 90 percent of rural households with access to electricity by 2010 and 100 percent by 2020.

3. Development Strategies include: (1) engaging in R&D for the new and renewable power sector, and gradual increasing the proportion of new and renewable power; (2) only investing in power plants with capacity of 100 MW and above in order to create favourable conditions for other enterprises to invest in power plants with smaller capacity; (3) give priority to hydropower development, especially to multi-purpose projects (water supply, flood control, drought control etc.), and encourage several forms of investment in small hydropower plants in order to develop this clean renewable energy resource. It is expected that about 13,000 to 15,000 MW of hydropower will be developed by 2020; (4) promote rural electrification to contribute to industrialisation, modernisation of agriculture and rural areas, by developing management mechanism in order to maintain and develop power resources in these areas, and enhancing control of electricity tariffs in order to ensure application of the ceiling tariffs stipulated by the Government; (5) encourage diversification in investment and management of rural power network on the basis of controlling selling prices in rural areas in order to prevent exceeding ceiling tariffs

[87] Information on this decisions can be found at the following link the Strategic Orientation for Sustainable Development in Vietnam (Vietnam Agenda 21)

set by the Government.

In general, despite the high potential of renewable energy resources, their contribution in electricity production in Viet Nam is still negligible (about 2 percent of total electricity produced by 2006). The Government of Viet Nam, however, recognised the important role of renewable energy in sustainable energy supply, in general, and in electricity for rural off-grid areas, in particular. There are good conditions favourable for encouraging the initial development of renewable energy in Viet Nam in the coming years. The target is to increase the share of renewable electricity production to 5 percent to 8 percent or higher in total electricity production up to 2025.

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 Viet Nam. 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 Viet Nam for the period 2006 to 2025 that was approved by the Prime Minister on 18 July 2007, the electricity sector needs a total investment of around US$ 108.7 billion through 2025; around US$ 72.4 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 Viet Nam (EVN) and other domestic state owned companies, foreign direct investment, 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 electricity sector, the Prime Ministerial Decision 26/2006/QD-TTg was approved in January 2006. With the establishment of this legislation Viet Nam's power market will be established and developed through three levels, of which each will be implemented in 2 steps (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 electricity sector.

In terms of reform within the electricity sector, EVN has been proceeding with plans to equitise member enterprises since the early 2000s, including the settlement of financial issues and reduction in the number of unnecessary employees.[88] By April 2006, EVN had completed the equitisation of 21 subsidiaries and successfully converted five others into one-member limited liability companies. EVN has also begun the process to equatise a further 18 companies and restructure 5 others. EVN expects to complete the restructuring and equatisation process of the generating companies by 2008. Power transmission companies, hydropower plants including Hoa Binh, Tri An and Yaly, as well as the nuclear power plants, however, will remain under the

[88] 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.

management of EVN. Under the 2006-2010 development plan, EVN plans to equatise 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 Viet Nam 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 2025 (MP- VI) was approved by Prime Minister of Viet Nam 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.
- 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 Viet Nam 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 Viet Nam 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.

Viet Nam Ministry of Industry and Trade (MOIT) 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 Viet Nam). A revised version of this pre-feasibility study will be submitted to the Government by EVN by end of year 2008. 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 the Oil & Gas sector: The governments of Viet Nam and Malaysia have authorised PETROVIETNAM and PETRONAS to sign the Commercial Arrangement Agreement (CAA) for Joint Development of Petroleum from overlapping areas between the two economies. Viet Nam 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 in Manila, Japan's Ministry 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 Viet Nam was completed in 2006, the next step of the feasibility study utilising funds from JICA will be completed in 2008.

In the Power sector: The governments of Viet Nam and Laos PDR have signed an Agreement on energy cooperation. Under this accord, Viet Nam will import about 2,000 MW of electricity from Laos. The governments of Viet Nam and Cambodia have also signed an agreement on energy cooperation, through which Viet Nam 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 hydro power plants and starts participating in the regional electricity market, Viet Nam will conversely buy electricity from Cambodia. Viet Nam 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, Viet Nam supplies electricity to Laos and Cambodia by medium voltage lines at some places in bordering provinces and buys electricity from China by 110 kV lines. In 2006, Viet Nam imported nearly 400 GWh from China. Viet Nam 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 (Viet Nam) line and the Van Son (China) to Soc Son (Viet Nam) line; these lines will be completed step by step in 2008. With a total transmission capacity of more than 500 MW, the lines will meet a part of the rising demand for electricity in years 2007 and 2008.

In Coal sector: Viet Nam and Japan have been cooperating to explore deep underground coal deposits in southern Quang Ninh province and investigate in the Red River delta.

OIL AND GAS SECTOR

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 approved the scheme on forming the Viet Nam National Oil and Gas Group in August 2006. The Group shall be a multi-owned group, in which the government holds

the dominant share, formed on the basis of rearranging and reorganising PetroVietnam and its subsidiary units. The aim is to: (1) bring in more modern technology and management personnel; (2) do business in multiple branches, namely exploration, exploitation, production, processing and distribution of oil and gas; (3) closely combine production and business activities with that of science, technology, research and training; (4) act as a core for the Viet Nam oil and gas industry to sustainable develop, effectively compete and integrate into the international economy; and (5) ensure energy security for the development of the economy.

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 Viet Nam 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 Viet Nam National Oil and Gas Group come into operation). PetroVietnam also includes joint stock companies, joint venture enterprises, scientific & technological enterprises, and training organisations.

The Viet Nam 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 in working out mechanisms, policies and solutions to solve difficulties in the construction of national oil and gas projects. The corporation also needs to pay greater attention to training its staff, both professionally and ethically, to further 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 percent, and contribution to the state budget increased 28 percent over 2004. In 2006 the corporation's output was 17,4 million tonnes of oil and 7 billion cubic metres of gas. In the first half of 2007 production of crude oil was 8 million tonnes and gas was 3.69 billion cubic metres.

Regulations on direct investment abroad in the oil and gas sector by Viet Nam-based foreign investors have been stipulated in a recent decree signed by Viet Nam'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.

Viet Nam'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 percent of the economy's entire demand of petroleum products.

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 tonnes 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.

Viet Nam has planned to build a 500-kilometre 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 6.9 BCM in 2005 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 Viet Nam 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, Viet Nam'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 was no refinery in Viet Nam. 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, Viet Nam 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 Viet Nam will be commissioned by the year 2009. Two more refineries each capacity about 7-10 millions tones of crude oil located in north and southern Viet Nam will be put in operation in period 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 tonnes per year is being built in Ca Mau province and will be completed in 2008.

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 Viet Nam using natural gas resources in this area to produce fertilizer and other products from Ammonia.

COAL SECTOR

Viet Nam National Coal and Mineral Industries Group (VINACOMIN) had discovered a major coal deposit in the Red River Delta of northern Viet Nam estimated to contain up to one hundred billion tonnes. The coal bed covers an area of 25 square kilometres situated about one kilometre 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.

Viet Nam produced about 38.9million tonnes of coal in 2006. VINACOMIN plans to exploit more than 40 million tonnes in 2008. 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 $600 million, of which Vinacoal is providing 65 percent of the source fuel. VINACOMIN has focused on thermal power plants to provide a market for lower-quality coal products, which are otherwise difficult to market. The Dac Nong aluminium processing plant with an investment of US$ 544 million and annual capacity of a million tonnes began operation in early 2006.

ENERGY EFFICIENCY

The UNDP and the Viet Nam Ministry of Science and Technology has been implementing a project to raise the effectiveness of energy use at small and medium enterprises (SMEs). It is 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: (1) supporting policy and institution

development; (2) improving communications and awareness; (3) building technical capability; (4) supporting providers of energy saving services; (5) providing financial assistance; and (6) providing 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)

Viet Nam is rather 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 3500 MW (with capacity of less then 30MW per site); total capacity of geothermal is estimated at 200-300 MW; and, wood and agricultural residues and by-products are about 50 million tonnes per year. Wind, solar and biogas is relatively abundant. About 75 percent Viet Nam's 84 million population is living in rural areas and about 7.0 percent of households in these regions having no access to electricity.

Key Organisations related to study and development of renewable energy are Ministry of Industry and Trade (MOIT), Electricity of Viet Nam (EVN) and Institute of Energy (IE). MOIT is responsible for establishment and implementation of energy policies such as National Energy Strategy and Power Development Master Plan, and EVN and IE are responsible for study and implementation of such policies. In particular, IE takes positive actions for renewable energy, such as establishment of Center for Renewable Energy and CDM in 2007 and conducting the Master Plan on Renewable Energy in Viet Nam (to be completed by the end of 2008).

The Electricity of Viet Nam (EVN) will spend VND 3.1 trillion (about US$ 194.7 million) for building 37 small-scale hydroelectric power stations in the Northern provinces bordering China. Of these, 10 to 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, Viet Nam has reviewed the implementation of wind turbines for power generation in islands and remote grid connected areas. Some of the recent wind power developments include the 15 kW solar PV-wind power hybrid systems in one of the smaller village with 40 households; this project was implemented by Institute of Energy (IE) with a grant from Tohoku Electric Company of Japan. Another is the 800 kW wind power generator in Bach Long Island, which was financed completely by the Government of Viet Nam. Future wind energy developments in the economy with a total installed capacity of 120 MW include the Ly Son Island project (2 MW), the Phuong Mai wind farm in Binh Dinh Province (15 MW), the wind power project in Phuong Mai (84 MW) with investor Grabowski Renewable Energy Company, the Phu Quoc Island project (2.5 MW), the wind farm in Phu Yen Province (15 MW); and the Con Dao Island project (2.5 MW).

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