APEC ENERGY OVERVIEW 2010

Prepared by

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FOREWORD

The goal of sustainable development and use of energy resources continues to be a key driver of energy policy in APEC. Facilitating economic growth, while also ensuring security of energy supply and reducing greenhouse gas emissions, has resulted in a focus on energy efficiency and low-carbon energy supply.

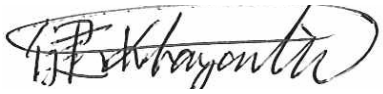
APEC economies continue to develop and implement plans and measures to improve energy efficiency across all sectors of the economy. These may include awareness raising campaigns, promoting good energy management practices and facilitating investment in energy efficient technologies.

In their Fukui Declaration of June 2010, APEC Energy Ministers committed to further strengthen the Energy Security Initiative endorsed by the APEC Leaders in 2001 and to undertake new measures to build upon it. The Ministers understood that the APEC region was facing the difficult challenge of enhancing regional energy security in the midst of emerging concerns about the global environment and the world economy. In their November 2010 Yokohama Declaration, the APEC Leaders called for APEC to assess the potential for reducing the energy intensity of economic output by 2030 further than called for in their Sydney Declaration in 2007. They also called for the deployment of low-emission power sources, including renewables, nuclear, and fossil fuels with carbon capture and storage.

Sustainable energy development can be achieved by employing highly effective government policies and broader energy cooperation between economies through bilateral, regional and multilateral schemes. In this context, sharing information on common energy challenges is essential. The *APEC Energy Overview* is an annual publication intended to promote information sharing. It contains energy demand and supply data as well as energy policy information for each of the 21 APEC economies. It also contains information on notable energy developments, including policy updates, upstream development, energy efficiency, low carbon energy supply, and environmental protection.

To harmonise the APEC energy statistics with other international energy statistics, the Institute of Energy Economics, Japan (IEEJ), the coordinating agency for the APEC Expert Group on Energy Data and Analysis (EGEDA), changed the format of the APEC energy balance table. The change involves the exclusion of international civil aviation from Final Energy Consumption and the transfer of this flow to Primary Energy Supply. With this change, Final Energy Consumption and Primary Energy Supply are decreased by the amount of energy demand from international civil aviation, which is now called "International Aviation Bunkers". To compare the energy demand statistics in this publication with previous years, please see the latest publication "APEC Energy Statistics 2008" (http://www.ieej.or.jp/egeda/general/info/pdf/APEC%20Energy%20Statistics%202008.pdf). The historical statistics for Primary Energy Supply and Final Energy Consumption in that publication have been adjusted to reflect the change mentioned above.

We hope that this report helps to deepen mutual understanding among APEC economies on the energy issues facing the region.



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ABBREVIATIONS AND SYMBOLS

Abbreviation	Term
B/D	barrels per day
Bcf	billion cubic feet
bcm	billion cubic metres
Btu	British thermal units
GW	gigawatt
GWh	gigawatt-hour
kL	kilolitre
km	kilometre
km/L	kilometres per litre
ktoe	kilotonne of oil equivalent
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
Mbbl/D	thousand barrels per day
ML	million litres (megalitre)
MMbbl	million barrels
MMbbl/D	million barrels per day
MMBFOE	million barrels of fuel oil equivalent
MMBtu	million British thermal units
MMcf/D	million cubic feet per day
MMscf/D	million standard cubic feet per day
mpg	miles per gallon
Mt	million tonnes
Mtce	million tonnes of coal equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
PJ	petajoules
Tbbl/D	trillion barrels per day
tce	tonnes of coal equivalent
Tcf	trillion cubic feet
toe	tonnes of oil equivalent
tU	tonnes of uranium metal
TWh	terawatt-hours
W	watt

ACRONYMS

APEC	Asia–Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
APP	Asia–Pacific Partnership on Clean Development and Climate
ASEAN	Association of Southeast Asian Nations
CBM	coal-bed methane

CCS	carbon capture and storage
CCT	clean coal technology
CDM	clean development mechanism
CFL	compact fluorescent lamp
CME	coconut methyl ester
COP 15	15th Conference of the Parties to the United Nations Framework Convention on Climate Change
CSM	coal-seam methane
DUHF	depleted uranium hexafluoride
EAS	East Asia Summit
EDMC	Energy Data and Modelling Center, Institute of Energy Economics, Japan
EEZ	exclusive economic zone
FEC	final energy consumption
GDP	gross domestic product
GHG	greenhouse gas
HEU	highly enriched uranium
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IEEJ	Institute of Energy Economics, Japan
IPP	independent power producer
JOA	joint operating agreement
JOB	joint operating body
LCD	liquid crystal display
LED	light-emitting diode
LEU	low-enriched uranium
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MDKB	measured depth below kelly
MOPS	Mean of Platts Singapore
NGL	natural gas liquids
NGO	non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
PES	primary energy supply
PPP	purchasing power parity
PSA	production sharing agreement
PSC	production sharing contract
PV	photovoltaic
RE	renewable energy
TFEC	total final energy consumption
TPES	total primary energy supply
TVDKB	true vertical depth below kelly
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
VAT	value added tax

CURRENCY CODES

Code	Currency	Economy
AUD	Australian dollar	Australia
BND	Brunei dollar	Brunei Darussalam
CAD	Canadian dollar	Canada
CLP	Chilean peso	Chile
CNY	yuan renminbi	China
TWD	New Taiwan dollar	Chinese Taipei
HKD	Hong Kong dollar	Hong Kong, China
IDR	rupiah	Indonesia
JPY	yen	Japan
KRW	won	Korea
MYR	Malaysian ringgit	Malaysia
MXN	Mexican peso	Mexico
NZD	New Zealand dollar	New Zealand
PGK	kina	Papua New Guinea
PEN	nuevo sol	Peru
PHP	Philippine peso	Philippines
RUB	Russian ruble	Russia
SGD	Singapore dollar	Singapore
THB	baht	Thailand
USD	US dollar	United States
VND	dong	Viet Nam

AUSTRALIA

INTRODUCTION

Australia is the world's largest island economy and the world's sixth largest economy (in land area). It lies in the southern hemisphere, between the Indian and Pacific oceans. Its total land area of nearly 7.7 million square kilometres is divided into six states and two territories. The population of around 21 million lives mostly in major cities or regional centres along the eastern and south-eastern seaboards.

Australia has maintained robust economic growth, averaging 3.2% over the period 2000 to 2008. In 2008, GDP reached USD 676.42 billion (USD (2000) at PPP), up 3.7% from USD 652.41 billion in 2007. Australia's economic growth has been underpinned by accommodative monetary and fiscal policy settings, and its mineral resource exports supported by strong import demand from the Asian region.

The energy sector is important to the Australian economy. Australia has abundant, high-quality energy resources that are expected to last for many decades at current rates of production. The coal, petroleum, gas and electricity industries contributed AUD 58 billion, or 5% of the total, to industry gross value added in the 2009–10 financial year (July–June) (ABARES 2010a). The minerals sector is the largest export earner, accounting for 54% of Australia's export earnings in 2009–10 (ABARE-BRS2010a). Australia is the world's ninth-largest energy producer, the largest exporter of coal and a major exporter of uranium and liquefied natural gas (LNG). Given Australia's large energy resources and geographical proximity to burgeoning markets in the Asia–Pacific region, Australia is well positioned to meet a significant proportion of the world's growing energy demand, as well as its own domestic needs.

Table 1 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (sq. km)	7 692 024	Oil (billion barrels)	1.52
Population (million)	21.43	Gas (billion cubic metres)	4678.29
GDP (USD (2000) billion at PPP)	676.42	Coal (million tonnes)—recoverable	39.20
GDP (USD (2000) per capita at PPP)	31 562	Uranium (million tonnes of uranium metal)	1.16

a Economic Demonstrated Resources under the McKelvey System.

Sources: EDMC (2010); Geoscience Australia (2009a, 2009b).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, Australia's total primary energy supply was 126 129 kilotonnes of oil equivalent (ktoe). Around 43% of its primary energy supply came from coal, 31% from oil, 21% from gas and the remainder from other sources. Between 2000 and 2008, gas was by far the fastest growing fuel supply, increasing at an average annual rate of 3.8%, followed by oil (1.8%), coal (1.4%) and others (0.9%).

Table 2 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	289 137	Industry sector	26 601	Total	257 247
Net imports and other	–158 252	Transport sector	27 610	Thermal	238 885
Total PES	126 129	Other sectors	22 220	Hydro	12 057
Coal	53 771	Total FEC	76 431	Nuclear	–
Oil	39 450	Coal	3 749	Geothermal	–
Gas	25 883	Oil	37 517	Others	6 305
Others	7 024	Gas	12 649		
		Electricity and others	22 516		

Source: EDMC (2010).

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

Australia accounts for around 6% of the world's black coal production and is the fourth largest producer after China, the United States and India. Total coal production in 2008 was 218 816 ktoe. Australian coal production increased at an average annual rate of 3.6% between 2000 and 2008, underpinned by a strong growth in demand and the addition of new production capacity. Australia's coal production is likely to continue to increase significantly over the medium term as a result of the investment in new mining capacity. Coal is Australia's largest commodity export, earning AUD 36 413 billion in 2009–10 (ABARE-BRS 2010a). It is also an important component of domestic energy supplies, accounting for around 76% of the fuel used in electricity generation. More than three-quarters of Australia's total coal production is exported. Its coking and steaming coals are high in energy content and are low in sulphur, ash and other contaminants. Australia accounts for around one-third of the world's coal trade—54% of the world's coking coal trade and 18% of the world's steaming coal trade. Australia's coal exports are destined for markets in Japan, Korea, China, Chinese Taipei and India (ABARES 2010a).

Gas has become increasingly important to the Australian economy both as a source of export income and as a contributor to domestic energy needs. Almost all Australian gas is sourced from three basins: the Carnarvon Basin in Western Australia, the Gippsland Basin in Victoria and the Cooper–Eromanga Basin that straddles South Australia and Queensland. The production of coal-seam methane (CSM), which is produced only in New South Wales and Queensland, has been expanding rapidly since 2000. CSM production is expected to continue to grow, and a number of production projects are under development (ABARES 2010a). In 2008, Australia's production of gas was 39 391 ktoe. Around 45% of this was exported as liquefied natural gas (LNG) to consumers in Japan, Chinese Taipei, Korea and China.

Australia is a net importer of crude oil and petroleum products, but a net exporter of liquefied petroleum gas (LPG). More than 60% of its crude oil production is exported, while around 70% of its refinery feedstock is imported. This is because a large proportion of Australia's oil production is based off the north-west coast, which is closer to refineries in Asia than to domestic refineries on the east coast (ABARES 2010a). In 2008, Australia's crude oil, LNG and condensate production was 23 859 ktoe. Since the mid-1990s, Australia's imports from the Middle East have been declining, while its imports from South-East Asia have been increasing. Australia currently sources the majority of its crude oil and condensate from Viet Nam, which accounts for around 22% of refinery feedstock imports, followed by Malaysia (18%) and Indonesia (15%) (ABARES 2010a).

In 2008, 257 247 GWh of electricity was generated, mostly from thermal sources (93%). Coal is the major energy source, reflecting its wide availability and relatively low cost. Coal is expected to remain the most commonly used fuel in electricity generation. However, given the large number of gas-fired, CSM-fired and wind-powered projects under development, those energy sources are expected to account for an increasing proportion of total electricity generation.

FINAL ENERGY CONSUMPTION

Australia's final energy consumption in 2008 was 76 431 ktoe. The transport sector accounted for 36% of the total energy consumed, industry 35% and the other sectors, which include residential and commercial, 29%. By energy source, petroleum products accounted for 49% of total consumption, electricity 29%, natural gas 17% and coal 5%.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

JURISDICTION AND POLICY

Australia's system of government has three tiers—the Australian Government (federal); the six state governments and two territory governments; and local governments. Australian energy resources are owned either by the Australian Government or the state/territory governments rather than private individuals. None of the tiers of government is engaged in commercial exploration or development. The Australian Government has title and power over energy resources located outside the first three nautical miles of the territorial sea ('offshore'). The state governments and the Northern Territory have jurisdiction over resources on their lands or inside the first three nautical miles of the territorial sea ('onshore').

In 2001, the Council of Australian Governments (COAG) established the Ministerial Council on Energy (MCE) to provide policy leadership and oversight to ensure the Australian energy sector could take advantage of opportunities and address emerging challenges. The council comprises the ministers with responsibility for energy from all the Australian states and territories. It is responsible for delivering economic and environmental benefits within the COAG energy policy framework and it is the policy and governance body for the Australian Energy Market.

In March 2010, the government created the Department of Climate Change and Energy Efficiency, to be its lead agency in Australia's response to climate change. The department is responsible for overseeing the programs and regulatory measures that promote energy efficiency; the Renewable Energy Target scheme; the design and implementation of an emissions trading scheme; and greenhouse gas emissions and energy consumption reporting.

The Australian Government is developing an Energy White Paper to ensure the provision of clean, adequate, reliable and affordable energy supplies to meet Australia's growing energy needs. The Energy White Paper will be integral to Australia's continued economic prosperity and to ensuring Australia reduces its fossil fuel related greenhouse gas emissions.

Four major analytical inputs into the policy development process were released in 2010:

- The Australian Energy Resource Assessment, released on 1 March 2010, provided a comprehensive economic and geological understanding of Australia's conventional and renewable energy resources potential
- The Prime Minister's Task Group on Energy Efficiency report, released on 8 October 2010, provided advice on the development of policy to increase energy efficiency outcomes
- The Australian Electricity Generation Technology Costs—Reference Case 2010, released on 25 November 2010, examined the cost and performance in Australia of globally-available electricity generation technologies to 2030
- The National Energy Scenarios Modelling exercise, released on 15 December 2010, examined the sensitivity of electricity generation technologies in Australia to long-term changes in key factors such as economic growth, population growth, global fuel prices, and climate change policies.

ENERGY SECURITY

In 2009, the Australian Government released the National Energy Security Assessment (NESA), which assessed the challenges that could affect Australia's current and future energy security. Energy security was defined to be the adequate, reliable and affordable provision of energy to support the functioning of the economy and social development, where 'adequate' is the provision of enough energy to support economic and social activity, 'reliable' is the provision of energy with minimal supply disruptions, and 'affordable' is the provision of energy at a price that does not affect the competitiveness of the economy and encourages investment in the energy sector (Australian Government 2009).

The NESA determined that Australia's energy security has declined compared with the assessment conducted as part of the 2004 Energy White Paper process because of the need to address new challenges (mainly reducing carbon emissions). The challenges the NESA identified that governments need to address to maintain or improve Australia's energy security include the need for further market reforms and greater infrastructure resilience, the rising cost of investment capital globally and the transition to a lower-carbon economy.

ENERGY MARKETS

The MCE has responsibility for ensuring Australian energy markets are operating efficiently. In 2003, the MCE agreed to a package of market reforms that included governance and institutions, economic regulation, electricity transmission, user participation, gas market development and reducing greenhouse gas emissions. MCE-led reforms have included:

- the creation of the National Electricity Market (NEM)
- consistent economy-wide regulation of natural gas and electricity transmission and distribution infrastructure through:
  - the National Electricity Law (governance and enforcement, key obligations and access regulation)
  - National Electricity Rules (electricity market operation and network regulation)
  - National Gas Law (governance and enforcement, key obligations for pipeline access and the establishment of the Gas Market Bulletin Board)
  - National Gas Rules (details of the access regime and the Gas Market Bulletin Board)
  - Australian Energy Market Commission Establishment Act 2004 and Part IIIAA of the Trade Practices Act 1974 (establishes the Australian Energy Regulator)
  - Australian Energy Market Act 2004 (applies the National Electricity Law and the National Gas Law to offshore areas and Commonwealth involvement in energy regimes)
- the establishment of the Australian Energy Market Operator (AEMO)
- the introduction of a NEM transmission planning function (which sits in the AEMO) that produces a National Transmission Network Development Plan each year
- the introduction of a consumer advocacy panel to allow greater stakeholder participation in the Australian energy markets (MCE 2003).

Activity streams include:

- the development of a short-term wholesale gas trading market which started operating in Adelaide and Sydney on 1 September 2010 (other hubs may be included at a later date)
- the development of a National Energy Customer Framework to streamline the regulation of energy distribution and retail functions and to include consumer protection in an efficient retail energy market

- the development of a framework for the rollout of smart meters
- improving the market's capacity to integrate growing intermittent generation (such as wind energy), including the development of a wind forecasting system, technical standards and new dispatch arrangements
- further market developments to improve transparency, competition and trading opportunities.

In the transition to a lower carbon economy, the MCE tasked the Australian Energy Market Commission to assess energy market frameworks in the light of climate change policies. The recommendations in the commission's report, released in September 2009, will form a significant input into the MCE's energy market reform agenda.

UPSTREAM DEVELOPMENT

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

- Private decision-makers should be allowed to manage risk in a regulatory framework that is predictable, transparent, equitable and timely.
- Energy resource development should be required to comply with standards of environmental performance that are commensurate with those imposed on other sectors of the economy.
- Commercial decisions should determine the nature and timing of energy resource development; government interventions should be transparent and allow commercial interests to seek least-cost solutions to government objectives (for example, environment, safety or good resource management objectives).
- Government objectives should generally be driven by sector-wide policy mechanisms, rather than by inconsistent requirements imposed on individual projects or private investors.

The Australian Government does not undertake or finance energy resource exploration or development. In the petroleum sector, the government relies on an annual acreage release to create opportunities for investment. A comprehensive package, including details of the acreage release, bidding requirements and permit conditions, is distributed worldwide.

ELECTRICITY AND GAS MARKETS

The NEM was established in 1998 to allow the interjurisdictional flow of electricity between the Australian Capital Territory, New South Wales, Queensland, South Australia and Victoria (Tasmania joined the NEM in 2005). Western Australia and the Northern Territory are not connected to the NEM because of their distance from the rest of the market. The NEM comprises both a wholesale sector and a competitive retail sector. All electricity dispatched must be traded through the central pool, where output from generators is aggregated and scheduled to meet demand.

The Australian Gas Market can also be separated into three distinct regional markets defined by the pipeline transmission infrastructure—the Eastern Gas Market (including the Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania and Victoria), the Northern Gas Market and the Western Gas Market.

A key component of ongoing energy market reforms was the 1 July 2009 establishment of the Australian Energy Market Operator (AEMO). The AEMO is the amalgamation of six electricity and gas market bodies: the National Electricity Market Management Company (NEMMCO), Victorian Energy Networks Corporation (VENCorp), the Electricity Supply Industry Planning Council, the Retail Energy Market Company (REMCO), the Gas Market Company and the Gas Retail Market Operator.

The AEMO's functions include managing the NEM and the retail and wholesale gas markets in eastern and southern Australia; overseeing the system security of the NEM electricity grid and the Victorian gas transmission network; economy-wide transmission planning; and operating a short-term trading market for gas which started in Adelaide and Sydney on 1 September 2010 (AEMO 2009).

The AEMO is also responsible for improving the operation of Australian energy markets. It regularly publishes a 20-year National Transmission Network Development Plan (to provide more information to market participants and potential investors), as well as the annual electricity Statement of Opportunities and Gas Market Statement of Opportunities (to forecast long-term supply and demand). It also maintains the Gas Market Bulletin Board.

The AEMO oversees Australian energy market governance in cooperation with the Australian Energy Market Commission, the rule-making and market development body, and the Australian Energy Regulator, the regulating body.

RESEARCH AND DEVELOPMENT

In the Australian science system, the bulk of the basic research is conducted in the university sector. Funding delivery occurs through organisations such as the Australian Research Council, which has established a range of competitive grants schemes. The Commonwealth Scientific and Industrial Research Organisation's National Research Flagships: Energy Transformed program is the focus for energy research and development in Australia, and the Australian Solar Institute supports research and development into both solar thermal and photovoltaic technologies.

FISCAL REGIME AND INVESTMENT

The taxation treatment of corporations operating in the energy sector is generally the same as the treatment of all other industries. Corporations earning an income in Australia are taxed at a flat rate of 30%. Corporations are also required to pay other indirect taxes, such as payroll tax, fringe benefits tax, fuel excise and land taxes. Some capital expenditure incurred by energy companies, such as exploration expenditure and royalty payments, is tax deductible. In addition, the Research and Development Tax Concession is a broad-based, market-driven tax concession which allows companies to deduct up to 125% of qualifying expenditure incurred on R&D activities when lodging their corporate tax return. A 175% Incremental (Premium) Tax Concession and R&D Tax Offset are also available in certain circumstances. In May 2009, the Australian Government announced it would replace the existing R&D Tax Concession with a new R&D Tax Credit. Bills to establish the R&D Tax Credit were introduced to Parliament in September 2010. The two core components of the package are:

- a 45% refundable tax credit (the equivalent to a 150% concession) for companies with a turnover of less than AUD 20 million a year
- a 40% standard tax credit (the equivalent of a 133% deduction).

The Tax Credit is decoupled from the corporate tax rate and thereby creates certainty in the level of assistance to be provided. It is proposed the Tax Credit will apply to income years starting on or after 1 July 2010.

Corporations involved in energy extraction activities are also required to pay royalties to the governments for the use of the community's natural resources. Royalties on onshore production (excluding petroleum) are collected by the state and Northern Territory governments. Royalty rates vary across states and commodities and are either specific, ad valorem, profit based or a hybrid (flat ad valorem with a profit component). For offshore production (excluding petroleum), 60% of the royalties are directed to the state/territory government and the remaining 40% to the Australian Government (DRET 2010a, 2010b).

Different royalty rates apply to petroleum. Royalties for onshore production are collected by the state and Northern Territory governments. The rate is generally 10% of the net wellhead value of production. A Commonwealth excise applies to crude oil and condensate production,

with the first 30 million barrels being excise exempt and the rate varying with production. The Petroleum Resource Rent Tax (PRRT) applies to offshore petroleum projects except for the North West Shelf production area and the Joint Petroleum Development Area in the waters between Australia and East Timor, which have their own separate arrangements. The PRRT is levied at a rate of 40% of the net project income after accumulated general project and exploration expenditures have been deducted. Project expenditures are classified as either Class 1 or Class 2 expenditures, the former being expenditure incurred before 1 July 1990 and the latter on or after 1 July 1990. Under Class 1, both exploration expenditure and general project expenditure incurred no more than five years before a production license is in force are accumulated at the long-term bond rate (LTBR) plus 15 percentage points; and all expenditure incurred more than five years after a production license is in force is accumulated at the Gross Domestic Product (GDP) factor. Under Class 2, exploration expenditure incurred no more than five years before a production license is in force is accumulated at the LTBR plus 15 percentage points; general project expenditure incurred no more than five years before a production license is in force is accumulated at the LTBR plus 5 percentage points; and all expenditure incurred more than five years after a production license is in force is accumulated at the GDP factor (DRET 2010a).

The Australian Government comprehensively reviewed the taxation system through the Australia's Future Tax System Review. The review made recommendations on the structure of the future tax system to accommodate demographic, social, economic and environmental changes.

Australian Government policy encourages foreign investment that is consistent with the needs of the Australian community. This policy, together with the Foreign Acquisitions and Takeovers Act 1975, provides the framework for assessing foreign investment proposals. Foreign corporations proposing to establish a business with an investment of more than AUD 10 million are required to inform the Foreign Investment Review Board (FIRB) to get approval. Such proposals are generally approved unless they are deemed to be contrary to Australia's interest. Foreign investors wishing to obtain a substantial interest (more than 15%) in an Australian corporation with assets greater than AUD 100 million, or where consideration for the shares is more than AUD 100 million, must notify the FIRB. Approval is also required for all direct investment by foreign governments or their agencies, regardless of the size of the investment (DRET 2008).

ENERGY EFFICIENCY

Australia has a number of programs and regulatory measures that promote energy efficiency. The National Strategy for Energy Efficiency (NSEE), released in July 2009, is the overarching program of work for promoting energy efficiency in Australia.

The NSEE incorporates and builds on measures already agreed by COAG and the MCE through the National Framework for Energy Efficiency (NFEE). All NFEE projects and activities form part of the NSEE. The NSEE is a 10-year strategy containing measures across all sectors—commercial and residential buildings, appliances and equipment, industry and business, government, transport, skills, innovation, advice and education. The NSEE addresses barriers that prevent the optimal uptake of energy efficient opportunities, such as information failures.

The Energy Efficiency Opportunities (EEO) program is designed to address the organisational barriers to efficient energy use by building the energy management capacity of companies. The program mandates firms using more than 0.5 petajoules (PJ) of energy a year (equivalent to the energy used by about 10 000 Australian households) to undertake rigorous assessments to identify and evaluate cost effective energy savings opportunities. Firms are not required to implement savings measures, but requirements for public reporting on the business response approved by the firms' boards encourages senior managers to carefully consider energy use in a strategic business context. Approximately 280 businesses are currently registered with the program. These businesses account for more than 60% of the total energy used by business and around 45% of all the energy used in Australia. Results from reporting to date indicate that

corporations plan to implement energy savings equivalent to about 1% of Australia's total emissions in 2007–08. The report, Continuing Opportunities—A Look at Results for the Energy Efficiency Opportunities Program 2006–2009, is available at www.energyefficiencyopportunities.gov.au.

In the residential and commercial sectors, the Australian Government is increasing the energy efficiency requirements in building codes, ensuring environmental information is available on the property market and setting out a pathway for improving the energy performance of buildings. In addition, the government also regularly introduces, reviews and increases product energy efficiency standards. The program of compulsory minimum energy performance standards and energy labelling now covers more than 10 product groups and includes more than 30 000 registered models. More products are being considered for the program on a regular basis (DCC&EE 2010a).

RENEWABLE ENERGY

The Renewable Energy (Electricity) Amendment Act 2009 and the Renewable Energy (Electricity) (Charge) Amendment Act 2009 were passed in August 2009. The Renewable Energy (Electricity) Amendment Act modified the Renewable Energy (Electricity) Act 2000 to allow the government to replace the Mandatory Renewable Energy Target (MRET) with the expanded Renewable Energy Target (RET) from 1 January 2010.

The RET aims for at least 20% (or around 60 000 GWh) of electricity supply to be provided by renewable energy sources by 2020. This includes the new target of 45 000 GWh of new renewable electricity generation, on top of the 15 000 GWh of existing renewable electricity generation. Under the old MRET, the target was 9 500 GWh of renewable electricity generation by 2010. The RET also brings existing state-based targets, such as the Victorian Renewable Energy Target and proposed New South Wales Renewable Energy Target, into a single Australia-wide scheme. The RET is scheduled to end in 2030, when the proposed CPRS is expected to be the primary driver of investment in renewable energy (DCC&EE 2009). From January 2011, the existing RET scheme will be separated into two parts—the Small-scale Renewable Energy Scheme (SRES) and the Large-scale Renewable Energy Target (LRET). The SRES will help small-scale businesses, households and community groups install eligible renewable energy systems (DCC&EE 2010b).

The Australian Government offers a number of programs to encourage the development, commercialisation and deployment of renewable energy technologies. In October 2009, it launched the Australian Centre for Renewable Energy (ACRE) to promote the development, commercialisation and deployment of renewable energy and enabling technologies. Details of some of the current programs are outlined in the 'Climate Change' section. There is no Australia-wide feed-in tariff scheme to support small-scale renewable technologies. However, most state and territory governments have implemented, or are planning to implement, feed-in tariffs (Clean Energy Council 2009).

The Australian Government Department of Climate Change and Energy Efficiency has developed two programs to support householders, industry and the community to use renewable energy options:

- *National Solar Schools*. Grants of up to AUD 50 000 (or up to AUD 100 000 for schools with multiple campuses) are offered to eligible primary and secondary schools to install solar and other renewable power systems, solar hot water systems, rainwater tanks and a range of energy efficiency measures.
- *Solar Cities*. This program is designed to trial new models for sustainable electricity supply use. There are currently seven areas involved in the program—Adelaide, Blacktown, Townsville, Alice Springs, Central Victoria, Moreland and Perth. The two major aims of the program are to:

- demonstrate the environmental and economic effects of combining cost reflective pricing with the widespread use of solar technology, energy efficiency and smart meters
- determine the barriers to energy efficiency, electricity demand management and the use of solar technology around Australia and to test ways to deal with these barriers.

The state and territory governments also have a range of rebates and assistance available to encourage households and the community to install renewable energy options. Details on these programs can be found at www.livinggreener.gov.au/rebates-assistance.

NUCLEAR

Australia does not have any commercial nuclear reactors. It currently has no plans to develop a nuclear energy industry.

CLIMATE CHANGE

EMISSION REDUCTION GOALS

The Australian Government is committed to the long-term goal of reducing Australia's greenhouse gas emissions to 60% below the 2000 level by 2050. The climate change policy is built on three pillars:

- reducing Australia's emissions of greenhouse gases
- adapting to unavoidable climate change
- helping to shape a global solution.

Under the Copenhagen Accord, Australia pledged a short to medium term emissions reduction target range of 5% to 15 or 25% per cent below the 2000 level by 2020. Australia's 5% target is an unconditional target; that is, unconditional on international action. The higher emissions reduction target depends on the global response to the challenge of climate change.

The Carbon Pollution Reduction Scheme (CPRS) was considered the major mechanism to reduce domestic greenhouse gas emissions. However, the government had to delay the introduction of the CPRS due to the lack of bipartisan support of the CPRS at the federal level, combined with the slow progress being made on reaching a credible global agreement to limit carbon emissions.

The government has since re-stated its commitment to addressing climate change through the use of a market-based mechanism. It has established a Multi-Party Climate Change Committee to help build a community consensus on what action Australia should take to tackle climate change. The Committee will start from the position that a carbon price is an economic reform required to reduce carbon pollution. It will explore options for the introduction of a carbon price. The government has also established two roundtables to engage the business community and environmental and non-government organisations on its climate change policies. More information on the Multi-Party Climate Change Committee process is available at www.climatechange.gov.au.

CLEAN ENERGY TECHNOLOGIES

In April 2009, the Australian Government formally launched the Global Carbon Capture and Storage Institute (GCCSI). Funding of AUD 355 million has been allocated to the GCCSI until 30 June 2013. More than 30 governments and more than 230 corporations, non-government bodies and research organisations have joined as members. The GCCSI aims to facilitate the development and deployment of carbon capture and storage (CCS) technologies. It will work in collaboration with governments, non-government organisations and the private sector to share

the know-how and expertise necessary to ensure CCS makes a significant impact on reducing the world's greenhouse gas emissions (GCCSI 2010).

The Australian Government has implemented its AUD 5.1 billion Clean Energy Initiative (CEI) to support the research, development and deployment of low-emissions technologies. The CEI components are:

- *Carbon Capture and Storage (CCS) Flagships Program.* AUD 1.9 billion has been allocated to the CCS Flagships Program from 2009–10 to 2017–18 to fund two to four industrial-scale carbon capture and storage demonstration plants. This is consistent with the G20's goal of launching 20 demonstration plants and achieving broad use of the technology by 2020. Four projects have been shortlisted (Wandoan and ZeroGen in Queensland; Collie South West Hub in Western Australia and CarbonNet in Victoria). A final decision on the successful projects is expected to be made in the first half of 2011. Commissioning is expected to take place from 2015 onwards.
- *National Low Emissions Coal Initiative (NLECI).* The CCS Flagships Program is complemented by the National Low Emissions Coal Initiative (AUD 385 million), which includes:
  - the National Low Emissions Coal Research and Development Program (AUD 75 million)
  - the National Carbon Mapping and Infrastructure Plan (AUD 50 million)
  - medium-scale demonstration projects (AUD 200 million) including the fully-integrated Callide oxy-fuel demonstration project (AUD 50 million) and an integrated post combustion capture and storage exploration project in New South Wales (AUD 50 million)
  - the Australia–China Joint Coordination Group on Clean Coal Technology (AUD 20 million).
- *Solar Flagships Program.* AUD 1.5 billion has been allocated to support the construction and demonstration of up to four large-scale, grid-connected solar generation plants. The program has an overall target capacity of 1000 MW, the equivalent of a coal-fired station. In May 2010, the Australian Government announced the projects shortlisted in the first round of the program. Construction is expected to start from 2012, with commissioning by the end of 2015. A second round of the program is expected to open in 2013. The Solar Flagships Program complements the Australian Solar Institute.
- *Australian Solar Institute (ASI).* The ASI will build research capacity in solar thermal and photovoltaic technologies and foster collaboration between universities, research institutions and industry. AUD 100 million has been allocated to the institute between 2008 and 2012. To date, 27 projects have been funded by the ASI, including three AUD 5 million foundation projects. The total funding commitment for the 27 projects is AUD 66.1 million, with a total leveraged value around AUD 209 million. The government has also committed up to AUD 50 million (funded from the Renewable Energy Future Fund) to support joint solar research projects with the United States. The funding will help to build expertise and cooperation between Australian and US researchers.
- *Australian Centre for Renewable Energy.* The Australian Government launched the Australian Centre for Renewable Energy (ACRE) in October 2009. ACRE's objective is to promote the development, commercialisation and deployment of renewable energy technologies. Over AUD 690 million has been allocated to the development of the centre, which will act as a 'one-stop shop' for renewable energy businesses, consolidating the following programs:
  - Renewable Energy Demonstration Program (competitive grants program to support the development of large-scale renewable energy projects other than

solar) (AUD 235 million in grants for four projects was announced on 6 November 2009)

- ACRE Solar Projects (AUD 92 million in grants for two solar thermal projects was announced on 14 May 2010)
- Second Generation Biofuels Research and Development Program (AUD 15 million)
- Geothermal Drilling Program (AUD 50 million)
- Advanced Electricity Storage Technologies Program (AUD 20 million)
- Wind Energy Forecasting Capability Program (AUD 14 million)
- Renewable Energy Equity Fund (AUD 18 million)
- new initiatives (AUD 150 million including funding from the formerly proposed Clean Energy Program) (DRET 2009).

- *The Renewable Energy Future Fund (REFF).* The AUD 652million fund will support Australia's response to climate change. The fund will provide additional financial support for investments in the development and deployment of large-scale and small-scale renewable energy projects; and will enhance the take-up of industrial, commercial and residential energy efficiency measures, helping Australian businesses and households to reduce their energy consumption.

The Australian Government is also an active participant in many international forums to promote the development of clean energy technologies. These include organisations such as the International Energy Agency, the International Renewable Energy Agency, and partnerships on specific technologies such as geothermal and hydrogen.

NOTABLE ENERGY DEVELOPMENTS

AUSTRALIAN ENERGY RESOURCE ASSESSMENT

In March 2010, Geoscience Australia and the Australian Bureau of Agricultural and Resource Economics (ABARE) released the Australian Energy Resource Assessment (AERA). The AERA examined Australia's identified and potential resources for a number of energy sources—oil, gas, coal, uranium and thorium, geothermal, hydro, wind, solar, ocean and bioenergy. The AERA also reviewed the factors likely to influence the use of these resources to 2030, including the technologies being developed. The full report is available on the Geoscience Australia website at https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=70142.

PRIME MINISTER'S TASK GROUP ON ENERGY EFFICIENCY

In October 2010, the Australian Government released the Report of the Prime Minister's Task Group on Energy Efficiency. This report considers the case for a step-change in Australia's energy efficiency performance and provides a rationale for that effort; reviews the barriers that must be addressed; and proposes mechanisms for achieving a step-change improvement in energy efficiency by 2020. The Task Group proposed five foundation measures that together would provide the basis for a step-change improvement and canvassed a suite of sector-based proposals that would provide benefits in particular areas. The government is considering the report's recommendations. The report is available at www.climatechange.gov.au/publications/energy-efficiency/report-prime-ministers-taskforce-energy-efficiency.aspx).

NEW ENERGY PROJECTS

Australia's production and infrastructure capacity was expanded in 2010 following the completion of:

- the Blackwater Creek Diversion
- the Carborough Downs Longwall expansion which will increase the capacity of the coal mine by 4.2 million tonnes a year
- New Acland (stage 3)
- the Henry gasfield off the coast of Victoria with a capacity of 11 petajoules a year
- the Longtom gas project off the coast of Victoria with a capacity of 25 petajoules a year
- the Pyrenees project off the coast of Western Australia with a capacity of 96 000 barrels of oil a day
- the Van Gogh project off the coast of Western Australia with a production capacity of 38 000 barrels of oil a day
- the South Gippsland natural gas pipeline which will connect around 10 000 properties in Victoria to reticulated gas and involved laying around 250 kilometres of gas pipelines (ABARE 2010b)
- the Clermont open cut thermal coal project (which will ultimately replace the existing Blair Athol mine) with an annual capacity of 12.2 million tonnes
- the Blakefield South thermal coal mine (to replace the existing Beltana mine) in New South Wales
- the Narrabri coal project (1.5 million tonnes a year capacity) in New South Wales
- the Cameby Downs thermal coal mine (1.4 million tonnes a year capacity) in Queensland
- the Talinga Stage Two project (coal seam gas) with a capacity of around 33 petajoules of gas a year
- the Newcastle Coal Infrastructure Groups export terminal in Newcastle with a capacity of 30 million tonnes a year, with a further expansion to 53 million tonnes a year already underway
- the 3Exp expansion at Kooragang Island Coal Terminal will increase capacity by 11 million tonnes a year
- the Brisbane Coal Terminal expansion will increase capacity by 1 million tonnes a year
- the Minimbah Bank Third Rail line in New South Wales
- the Coppabella to Ingsdon rail duplication in Queensland
- the Dampier–Bunbury gas pipeline extension (stage 5B) which will increase the capacity of the pipeline by 40 petajoules a year
- the Eastern Gas Pipeline, with a capacity of 20 petajoules a year, will transport gas from Longford in Victoria to Wollongong in New South Wales
- the Queensland Pipeline with a capacity of 25 petajoules a year (ABARE–BRS 2010b).

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USEFUL LINKS

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Australian Bureau of Statistics—www.abs.gov.au

Australian Energy Market Commission—www.aemc.gov.au

Australian Energy Market Operator—www.aemo.com.au

Australian Energy Regulator—www.aer.gov.au

Australian Government—www.australia.gov.au

Australian Government Department of Climate Change and Energy Efficiency—www.climatechange.gov.au

Australian Government Department of Resources, Energy and Tourism—www.ret.gov.au

Commonwealth Law—www.comlaw.gov.au

Ministerial Council on Energy—www.mce.gov.au

BRUNEI DARUSSALAM

INTRODUCTION

Brunei Darussalam (the Abode of Peace) is located on the north-west coast of the island of Borneo. It has a total land area of around 5765 square kilometres and a 161 kilometre coastline along the South China Sea. It is bordered on the north by the South China Sea and on 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 the Brunei-Muara, Tutong and Belait districts. The small economy is a mixture of foreign and domestic entrepreneurship, government regulation, welfare measures, and village tradition. In 2008, the population of Brunei Darussalam was around 406,200.

In 2008, Brunei Darussalam's GDP was USD 22.59 billion (USD (2005) at PPP). GDP per capita was USD 55 604 (USD (2005) at PPP). Brunei Darussalam's economy has relied heavily on oil and gas since they were first discovered in 1929. The oil and gas sector is the main source of revenue and constitutes around 96% of Brunei Darussalam's export earnings and around 67% of its GDP. To further sustain and strengthen the oil and gas industry, the government of Brunei Darussalam is actively pursuing the development of new upstream and downstream activities.

Brunei Darussalam's existing and potential oil and gas reserves lie within the economy's northern landmass and extend offshore to the outer limits of its exclusive economic zone (EEZ). In 2008, crude oil and condensate production averaged 174 thousand barrels per day (Mbbl/D). Gas production was around 34 million cubic metres a day, most of which was exported as liquefied natural gas (LNG) to the major markets of Japan and South Korea.

Table 1 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (sq. km)	5 765	Oil (billion barrels)	1.1
Population (million)	0.406	Gas (trillion cubic metres)	0.34
GDP (USD (2005) billion at PPP)[b]	22.59	Coal (million tonnes)	–
GDP (USD (2005) per capita at PPP)	55 604		

a Proven reserves at the end of 2007, from BP (2010).

b USD 1 (USD (2005) at PPP) is equal to BND 0.9031, from 2008 World Development Indicators by World Bank.

Sources: EDMC (2010); IMF (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, Brunei Darussalam's total primary energy supply was 3864 kilotonnes of oil equivalent (ktoe). Natural gas represented 79.5% of the total primary energy supply, and oil 21.1%. Oil and gas production was 22 384 ktoe in 2008, a decline of 4.94% from 2007 (23 547 ktoe). Brunei Darussalam exported 82.3% of its oil and gas production in 2008.

At the end of 2007, Brunei Darussalam's proven crude oil reserve was 1.1 billion barrels, and its natural gas reserve was 0.34 trillion cubic metres (BP 2010). Most of the economy's oil and gas fields are considered mature. Intensive exploitation of oil resources for about 80 years and of natural gas resources for over 35 years has required the industry to change its recovery techniques. At current production rates, the 2007 proven oil and gas reserves are expected to be depleted within 20 and 30 years, respectively.

Most of Brunei Darussalam's oil exports go to Indonesia, Australia, Thailand, South Korea, Japan, China, India and New Zealand. Most of its natural gas is exported, in the form of LNG, to Japan and South Korea.

In 2008, the economy generated 3423 gigawatt-hours (GWh) of electricity, entirely from thermal sources. Almost all of the electricity generated was supplied by natural gas fuelled power plants.

Table 2 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	22 384	Industry sector	121	Total	3 423
Net imports and other	–18 335	Transport sector	382	Thermal	3 423
Total PES	3 864	Other sectors	283	Hydro	–
Coal	–	Total FEC	786	Nuclear	–
Oil	793	Coal	–	Geothermal	–
Gas	3 071	Oil	484	Others	
Others	–	Gas	31		
		Electricity and other	270		

Source: Petroleum Unit of the Prime Minister's Office.

FINAL ENERGY CONSUMPTION

In 2008, Brunei Darussalam's total final energy consumption was 786 ktoe, an increase of 2.7% from 2007. The sectoral shares of final energy consumption remained unchanged from 2007. The transportation sector consumed 48.6% of the total, followed by the residential, commercial and non-energy sectors combined (36.1%) and the industrial sector (15.4%). By energy source, oil accounted for the largest share of consumption (61.6%), followed by electricity (34.4%) and gas (4.0%). Natural gas accounted for 99% of the fuel used to generate electricity; the other 1% was generated by diesel fuel.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Brunei Darussalam's energy policy is handled by the Energy Division of the Prime Minister's Office, which is headed by the Minister of Energy. The Energy Division is responsible for overseeing the policy on, the planning for and the regulating of the energy matters and issues affecting Brunei Darussalam. The Petroleum Unit, the oil and gas industry regulator, and the Department of Electrical Services, the state-owned electricity utility supplier, are also under the purview of the Minister of Energy.

Brunei Darussalam implements a five-year economic development plan known as the National Development Plan. Currently, the ninth National Development Plan (2007–12) is in force. Under the plan, energy policy is directed towards strengthening and expanding the oil and gas industry. In line with this plan, the economy has launched a long-term development plan, the Brunei Vision 2035. The vision states the economy's major goals for the next three decades are economic diversification and strengthening the oil and gas sector. The latter is to be achieved by expanding the sector's oil and gas reserves through ongoing exploration, both in existing areas and in new deep-sea locations.

Brunei Darussalam's energy policy is centred on its oil and gas industry. In 1981, the Oil Conservation Policy was introduced when oil production peaked at 239 thousand barrels per day (Mbbl/D) in 1980. The policy aimed to prolong the life of the economy's oil reserves. As a result,

oil production gradually declined to around 150 Mbbl/D in 1989. In November 1990, the government reviewed the policy and removed the production ceiling, resulting in the production of 219 Mbbl/D by 2006. In 2008, oil production averaged 174 Mbbl/D.

In 2000, the Brunei Natural Gas Policy (Production and Utilisation) was introduced. The policy aimed to maintain gas production at 2000 levels, to adequately satisfy export obligations; to open new areas for exploration and development; and to encourage increased exploration by new and existing operators. Under the policy, priority is always given to domestic gas use, especially for electricity generation.

In January 2002, the Brunei National Petroleum Company Order set up the Brunei National Petroleum Company Sdn Bhd (PetroleumBRUNEI) to act as Brunei Darussalam's national oil company.

ENERGY SECURITY

Brunei Darussalam, as a member of the Association of Southeast Asian Nations (ASEAN), has signed the ASEAN Petroleum Security Agreement. Under the agreement, Brunei Darussalam and other ASEAN members have agreed to cooperate closely on energy security relating to oil supply. Furthermore, Brunei Darussalam is working with other ASEAN members on the Trans-ASEAN Gas Pipeline project and the ASEAN Power Grid project to promote and enhance energy security through energy-market integration in the region.

UPSTREAM ENERGY DEVELOPMENT

Brunei Darussalam's existing and potential oil and gas reserves lie within the economy's northern landmass and extend offshore to the outer limits of its EEZ. Most of the existing oil and gas production is located in scattered sites around 70 kilometres offshore. However, new discoveries are being found further out, in water approaching 200 metres deep. There is also potential for more discoveries onshore.

Most of Brunei Darussalam's oil and gas fields are considered mature. Intensive exploitation of oil resources for about 80 years and of natural gas resources for over 35 years has required the industry to move from primary recovery to secondary and tertiary 'enhanced oil' recovery.

Important milestones for Brunei Darussalam were the signing of a new production-sharing agreement for the oil and gas in offshore Block J and the awarding of Block K in 2003, and the signing of production-sharing agreements for onshore Block L and Block M in 2006. These blocks are considered important for the economy to be able to maintain and extend its oil and gas production in the future. The awarding of Block J and Block K by the government has been disputed by Malaysia because of overlapping sovereignty claims for the offshore area included in those two blocks. The two economies have been negotiating to resolve this conflict and a Letter of Exchange was signed on this matter by both economies in early 2009.

Brunei LNG will also refurbish its existing capacity to extend its operating life for 20 years, or up to 2033.

ENERGY MARKETS

The energy market in Brunei Darussalam is regulated by the government. Energy prices are subsidised. However, in the wake of an increase in the smuggling of fuels to neighbouring economies, the government has considerably raised the prices of motor gasoline (Premium 97) and diesel for vehicles and vessels not registered in Brunei Darussalam. The government is also concerned about the increasing cost of maintaining fuel subsidies, and in 2008 began a Subsidy Awareness Campaign to expose the public to the scale of energy subsidies in the economy.

ELECTRICITY MARKET

Brunei Darussalam's electricity generation is almost entirely natural gas fired. The electricity system's three main grids are operated by two utilities, the Department of Electrical Services and the Berakas Power Company Private Limited (BPC). BPC supplies around 40% of the total

power generated in Brunei Darussalam. The National Development Plan for 2007–12 proposes to interconnect the three power grids by 2012. In the long term, the economy also expects to harness the hydroelectric potential of the Temburong River. This project has a potential capacity of around 80 MW and could produce an estimated 300 GWh a year.

FISCAL REGIME AND INVESTMENT

ENERGY EFFICIENCY

Brunei Darussalam is actively promoting energy efficiency and conservation in various sectors in the economy. The government's economy-wide target is to reduce its domestic energy intensity by 25% by 2030, with 2005 as the base year. This is in line with the goal set by the Asia–Pacific Economic Cooperation (APEC) leaders in the Sydney Declaration 2007.

Activities to achieve the target include economy-wide public education awareness campaigns, talks, publications on energy efficiency and conservation issues, and a voluntary energy labelling scheme for air-conditioners. The economy is also enhancing its human capacity building through seminar-workshops on energy management and energy audit, and through energy education in schools. The energy management and energy audit seminar-workshops are being conducted by local higher educational institutions and international partners to train estate managers and officers from government agencies and the private sector. The Energy Management Guide and the Basic Energy Audit Guide are available to give practical help to those carrying out energy efficiency and conservation measures in the government and private sectors.

To build energy efficiency and conservation culture at the grass-root level, the Ministry of Education and the Energy Division collaborated to introduce into the school curriculum the importance of using energy wisely and responsibly. Energy saving tips were printed and distributed to all Brunei Darussalam schools. In 2009, the Energy Clubs in Schools program was launched, where school students are encouraged to act as energy ambassadors to promote energy efficiency and conservation measures in their schools and at home.

To further promote energy efficiency and conservation initiatives and measures economy-wide, the government has declared 24 May as Energy Day in Brunei Darussalam. National Energy Efficiency and Conservation Initiative Awards are given to recognise those who have achieved a 10% or more energy saving.

The government has also commissioned an economy-wide study on the direction energy efficiency and conservation should take in the future.

RENEWABLE ENERGY

The economy is assessing the viability of large-scale photovoltaic electricity generation. To promote this effort, the government started the construction of a solar-energy demonstration project known as Tenaga Suria Brunei in August 2008. The project, located at the Seria power station in the Belait District, is an on-grid photovoltaic system with a nominal capacity of 1.2 MW. The project was commissioned in August 2010.

Research on clean and renewable energies is being conducted in Universiti Brunei Darussalam with funding from the government. It also promotes collaborations with international institutions to facilitate information sharing, capacity building and technology transfer.

On 23 June 2009, the economy became a signatory state to the International Renewable Energy Agency (IRENA).

In 2010, the government, through the Centre for Strategic and Policy Studies, commissioned an international consultant to do a feasibility study to identify the potential of alternative energies in Brunei Darussalam. The project is to be completed in 2011.

NUCLEAR

Brunei Darussalam does not have a nuclear energy industry.

CLIMATE CHANGE

Brunei Darussalam recognises the importance to its economic growth of energy security and environmental sustainability. Environmental policy directions are embedded in the 2035 long-term development plan. These include:

- Implementing the highest environmental standards for existing and new industries in accordance with established international standard and practices.
- Strictly enforcing appropriate regulations on the maintenance of environments that affect public health and safety.
- Supporting global and regional efforts to address trans-border and regional environmental concerns.

In 2007, Brunei Darussalam acceded to the United Nations Framework Convention on Climate Change and subsequently to its Kyoto Protocol in 2009. Brunei Darussalam also associated itself with the Copenhagen Accord in 2009.

Brunei Darussalam's major greenhouse gas emissions are from the oil and gas production industry, power generation and transportation. As part of the economy's environmental initiatives, actions have been taken by the major oil and gas producers to reduce greenhouse gas emissions through field rationalisation projects and improvements in operational efficiencies. Efforts are also focused on energy efficiency and conservation measures in power plant facilities. In 2008, a more efficient combined cycle 116 MW power plant was commissioned.

To further identify more accurately the sources of greenhouse gas emissions from the different sectors in Brunei Darussalam, the government has commissioned a consultant to conduct a study. The project is expected to have been completed by the end of 2010.

NOTABLE ENERGY DEVELOPMENTS

ENERGY PROJECTS

The Brunei Darussalam Government seeks to maximise the economy's oil and gas resource potential, and to take advantage of its strategic location for trading. Plans are underway to develop export-oriented petroleum industries, including oil refining, petrochemicals, and associated downstream industries. A world-class industrial site, the Sungai Liang Industrial Site (SPARK) in the Belait District, will be the location for the development of petrochemical industries. The first petrochemical plant to be constructed at the site, a methanol production plant, was successfully commissioned with its first methanol product in April 2010. The methanol plant, owned by the Brunei Methanol Company, has an annual production of 850 000 tonnes. Methanol will initially be produced for export. Natural gas is the primary feedstock for the methanol plant.

The government wants experienced investors to set up an export-oriented oil refinery. The new refinery will be expected to also cater for the growing domestic requirements for petroleum products, as the existing refinery is not able to meet increased demands. The Brunei Economic Development Board (BEBD) plans to base the refinery on the island of Pulau Muara Besar, in the Brunei-Muara District.

Brunei Darussalam is also developing a fully-fledged Brunei National Institute for Energy Research and Innovation (BNIERI). The research institute will focus on developing innovative solutions for using fossil fuels, for energy efficiency, conservation, and for energy renewables, by January 2011.

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USEFUL LINKS

Brunei Economic Development Board—www.bedb.com.bn

Brunei LNG Sdn Bhd—www.blng.com.bn

Brunei Shell Petroleum Company Sdn Bhd—www.bsp.com.bn

Energy Division, Prime Minister's Office—www.energy.gov.bn

Petroleum Unit of the Prime Minister's Office—www.petroleum-unit.gov.bn

CANADA

INTRODUCTION

Canada occupies the northern part of North America and is second only to Russia in geographic size. The population of Canada is around 33.3 million, of which approximately 39% is concentrated in the province of Ontario (EDMC 2010, Statcan 2010). Canada is known for its wealth of energy and other natural resources. In 2008, its GDP amounted to roughly USD 1052 billion, a 0.4% increase over 2007, and USD 31 591 per capita (both in USD (2000) at PPP) (EDMC 2010). Inflation remained low and stable, with consumer price inflation of 2.3% in 2008 (Statcan 2010). Unemployment averaged 6.2% in 2008 (Statcan 2010). While GDP declined in 2009 following the global recession, the damage to the Canadian economy was limited as a result of the inherent strength of the economy and the timely injection of economic stimulus.

Canadians are large energy consumers because of the economy's high standard of living, cold climate, long distances between major cities, and presence of many energy-intensive and bulk-goods industries. Canada's final energy consumption per capita in 2008 was 6.7 tonnes of oil equivalent (EDMC 2010).

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 (US EIA 2009). 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. At 174.7 billion barrels, Canada's proven oil reserves are the second largest in the world. The reserves are largely concentrated in oil sands; there are also significant offshore oil and gas deposits near Nova Scotia and Newfoundland. Energy production is very important to the Canadian economy, accounting for approximately 7% of GDP and 363 000 jobs, representing 2% of the Canadian labour force in 2008 (NEB 2009a).

Table 3 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	9 984 670	Oil (billion barrels)	174 713
Population (million)	33.3	Gas (billion cubic metres)	1 754
GDP (USD (2000) billion at PPP)	1 052	Coal (million tonnes)	8 723
GDP (USD (2000) per capita at PPP)	31 591	Uranium (tonnes)	427 000

Source: EDMC (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, Canada's domestic energy production reached 408 million tonnes of oil equivalent (Mtoe). Oil and natural gas accounted for most of the supply, at 39% and 35% respectively, followed by coal (8%), hydropower (8%), nuclear energy (6%) and other sources (3%). After imports and exports, Canada's primary energy supply totalled 268 Mtoe in 2008. Oil accounted for 36%, gas 29%, coal 10%, and others (including hydro and nuclear) 25% (EDMC 2010).

Canadian natural gas production has been in decline since 2006. Gross production in 2008 was 209 billion cubic metres (bcm); it fell to 196 bcm in 2009 (Statcan 2010). Drilling levels began to decline in mid-2006 as increasing capital and labour costs, combined with declining productivity in new gas wells, reduced profitability. In 2009, drilling levels were at their lowest in

a decade. The success in developing the US shale gas resource has led producers to take an interest in shale gas plays in British Columbia. In 2009, shale gas production still represented a relatively small part of Canadian production and it did not offset a decline in conventional production (NEB 2010). Additional pipeline capacity is likely to be necessary in order to support growing production from this region (NEB 2009a). According to the National Energy Board Reference Scenario (July 2009), Canada's natural gas production is expected to fall from 461 million cubic metres per day (16.2 billion cubic feet per day) in 2008 to 447 million cubic metres per day (15.8 billion cubic feet per day) by 2020. An expected decline in conventional production will be mostly offset by an increase in unconventional natural gas production (NEB 2009b). More recent industry forecasts suggest shale gas could more than offset declines in conventional gas production.

Net natural gas exports totalled approximately 85 Mtoe in 2008, a decline from 88 Mtoe in 2007 – this is due to growing US shale gas production and increased LNG imports (EDMC 2010, NEB 2010). Canada's import capacity was expanded in 2009, with the opening of Canada's first liquefied natural gas (LNG) terminal in New Brunswick. The Canaport LNG import facility has a maximum send-out capacity of 28 million cubic metres per day or 1.2 billion cubic feet (Canaport LNG 2009).

In 2008, production of crude oil, natural gas liquids and condensate declined to 161 Mtoe from 163 Mtoe in 2007 (EDMC 2010). The decline in conventional oil production in the Western Canada Sedimentary Basin (WCSB) and maintenance and natural field decline in the east coast offset increased oil sand production (NEB 2010).

Canada is endowed with large oil sands reserves. While some deposits of oil sands extend into Saskatchewan, at present the only recoverable resources are located in north-eastern Alberta. At the end of 2008, proven oil sands reserves stood at 169.9 billion barrels. According to Alberta's Energy Resources Conservation Board (ERCB), bitumen production averaged 1.49 million barrels per day in 2009, up from 1.31 million barrels in 2008. Of this total, 61% is upgraded to synthetic crude oil and distillates and the rest is sold as bitumen.

Depending on the geology, generally two different production methods are used. For oil sands near the surface, extraction of bitumen from the sand, clays and water that make up the oil sands involves surface mining operations. However, most oil sands reserves must be recovered in situ by drilling into the oil sands, and heating the bitumen to allow it to flow. About 20% or 34.2 billion barrels of these reserves are accessible through mining operations with the remaining 80% or 135.5 billion barrels requiring some form of in-situ production. In 2009, about 44% of bitumen was produced in situ (242 million barrels) and 56% by mining operations (302 million barrels) (ERCB 2008, ERCB 2009).

New technologies and extraction methods are being developed to improve recovery and reduce costs, including vapour recovery extraction, toe-to-heel air injection, and froth treatment (Government of Alberta 2009). There are a number of environmental impacts associated with oil sands development. Heavier forms of crude oil, such as oil sands, require more energy and resources to produce and refine compared to lighter crude oil, resulting in higher air pollutant and greenhouse gas (GHG) emissions. In addition, the unique nature of oil sands extraction technologies has other environmental challenges associated with production, such as water and land use. The federal and provincial governments are making investments (e.g. in carbon capture and storage technology) to bring on this strategic resource in an environmentally responsible way.

The rise in oil prices and accompanying technological improvements dramatically improved the economics of oil sands production in recent years, creating a boom just before the onset of the 2009 recession. While the economic downturn contributed to delays of several oil sands projects, Canada's National Energy Board (NEB) forecasts oil sands crude production to rise to 2.8 million barrels per day by 2020 (while the ERCB in Alberta has estimated 2019 production of 3.2 million barrels per day). The NEB overall forecast for Canada's crude oil production, including oil sands, is a rise to 3.8 million barrels per day by 2020, despite declining conventional production (NEB 2009b).

The 2009 total crude oil exports consisted of 43% light crude oil (including synthetic crude) and 57% heavy crude oil (NEB 2010). Canada is a net exporter of petroleum products, mainly to the US, where Canadian crude oil accounts for 21% of the total US imports. Construction of two export pipelines began in 2008 to allow for further oil sands production to meet continued demand in the US (NEB 2009a).

Canada generated about 618 terawatt-hours (TWh) of electricity in 2008. Canada is the world's second largest producer of hydroelectricity, and hydropower dominates the generation mix with a 60% share. Thermal plants contribute 25% to the generation mix and nuclear energy contributes 14%. Canada and the US have an active electricity trade, and the electricity networks of the two economies are heavily integrated (EDMC 2010).

The global economic crisis affected Canada's coal production and exports. Canada's coal production in 2009 was 62.6 million tonnes (Mt), a decline of 7.6% from 67.8 Mt in 2008. In the same year Canada's coal exports declined 16% to 27 Mt from 32 Mt in 2008. Coking coal exports declined 20% or 5.4 Mt from 2008, due largely to weaker global demand. Canada imported 12.7 Mt of coal in 2009, 7.7 Mt from the US. Of its total imports, 10.5 Mt was steam coal to be used in coal-fired power generation and 2.2 Mt was coking coal to be used in coke manufacturing.

Table 4 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	407 997	Industry sector	73 251	Total	644 500
Net imports and other	–144 232	Transport sector	57 344	Thermal	155 788
Total PES	268 393	Other sectors	71 627	Hydro	382 580
Coal	26 268	Total FEC	202 222	Nuclear	93 951
Oil	97 553	Coal	3 718	Geothermal	–
Gas	77 071	Oil	90 753	Other[a]	12 181
Other	67 501	Gas	52 943		
		Electricity and other	54 807		

a Wind energy, tidal, biomass, waste and solar photovoltaic.

Source: EDMC (2010). For full detail of the energy balance table see: www.ieej.or.jp/egeda/database/database-top.html

In 2009, Canada was the world's second largest producer of uranium, with output totalling 10 174 tonnes of uranium metal (tU), equivalent to 20.1% of total global production. All of Canada's operating uranium mines are located in northern Saskatchewan. Canada's uranium resources that area recoverable at a cost of less than USD 150/kgU, amounted to 427 000 tU at 1 January 2009, compared with 485 000 tU at 1 January 2008. This decrease is primarily due to resources being reclassified into the higher cost category of USD 150–300/kgU as estimated development and operating costs increase (NRCan 2009a). Canada's only uranium refinery, located at Blind River, Ontario, is the world's largest with a capacity of 18 000 tonnes per year (NRCan 2009b, Cameco Corp. 2010). One of the largest uranium hexafluoride (UF_6) conversion facilities is located in Port Hope, Ontario. This facility also provides the world's only commercial supply of fuel-grade natural uranium dioxide (UO_2), which is used to fuel CANDU reactors.

FINAL ENERGY CONSUMPTION

In 2008, total end-use energy consumption in Canada reached approximately 202 Mtoe. Industry accounted for 36% of energy use, transport for 28%, and other sectors for 36%. By energy source, petroleum products accounted for 45%, natural gas 26%, electricity 22%, and coal 2%, and others 5% (EDMC 2010).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

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 control of international and interprovincial trade is a federal responsibility. Through Natural Resources Canada (NRCan), the National Energy Board (NEB), and other government departments—including Environment Canada, Fisheries and Oceans Canada, Indian and Northern Affairs Canada, and Foreign Affairs and International Trade Canada—the federal government works with provincial governments to implement economy-wide 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 health and safety; and policies and programs that encourage scientific and technological research, promote energy efficiency, and assist the development of renewable and alternative energy sources.

ENERGY MARKETS

OIL AND GAS MARKETS

Wellhead oil and natural gas prices in Canada have been fully deregulated since the Western Accord and the Agreement on Natural Gas Markets and Prices between the federal government and energy-producing provinces were agreed to in 1985. The agreements 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 (NRCan 2009c NEB 1996).

The NEB, a federal regulatory body reporting to Parliament through the Minister of Natural Resources, has the main responsibility for regulating international and interprovincial transport networks, as well as exports (Minister of Justice 2009a). 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 (Minister of Justice 2009b).

ELECTRICITY MARKETS

In most provinces, the electricity industry is highly integrated with the bulk of generation, transmission and distribution services provided by one or two dominant utilities. Although some of these utilities are privately owned, many are Crown corporations owned by the provincial governments. Independent power producers also exist, but rarely in direct competition with a Crown corporation. Exceptions include Alberta, which has moved to full wholesale and retail competition and Ontario, which has established a hybrid system with competitive and regulated elements. Retail electricity prices vary across the provinces, in terms of both their level and the mechanism by which they are set. In 2007, residential prices per kilowatt-hour ranged from USD 0.06 to USD 0.14. Provinces with an abundant supply of hydroelectricity have the lowest prices. In most provinces, prices are set by the regulator according to a cost of generation plus reasonable rate of return formula. Retail electricity prices in Alberta are more market-based than

in other provinces and territories, and the remaining regulated price plan is gradually being phased out. In Ontario, both regulated and deregulated price plans are offered (NEB 2009a).

Institutional arrangements have been made to improve the reliability of the electricity power system. The US Energy Policy Act of 2005 called for the creation of an Electric Reliability Organization (ERO) to address reliability concerns of the North American grid that were prompted by the 2003 blackout. In July 2006, the Federal Energy Regulatory Commission (FERC) certified the North American Electric Reliability Corporation (NERC) as the ERO, authorising NERC to enforce reliability standards on the owners, operators and users of the bulk power system (FERC 2006). The governments of Canada and the US 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 (FERC 2005).

FISCAL REGIME AND INVESTMENT

FEDERAL CORPORATE INCOME TAX FOR ENERGY

Canada's federal corporate income taxes are determined by applying the applicable tax rate to taxable income calculated according to the Income Tax Act. Income tax rules broadly follow generally accepted accounting principles. Assets are placed in specific capital cost allowance (CCA) classes. These classes specify the rate at which the asset may be deducted. In general, CCA rates reflect the economic life of the assets in that CCA class.

Some features of the tax system promote certain types of activity. The Scientific Research and Experimental Development Tax Incentive Program provides a tax credit for qualifying research and development (R&D) spending, and a number of energy industries are important users of this program. The Atlantic investment tax credit promotes investment in Atlantic Canada. Several energy production activities qualify for this credit, although oil-and-gas exploration and development and pipeline expenses do not.

The oil and gas sector has specific income tax provisions (reflecting the special characteristics of the industry). It can deduct exploration, development and oil-and-gas property expenses. Oil and gas exploration and development expenses are also eligible for flow-through share treatment, whereby a corporation can flow out the eligible deductions to an investor. This tax treatment is designed to help small exploration companies raise capital.

In recent years, the tax treatment of the oil and gas sector has been undergoing fundamental reforms. Royalties are now fully deductible, and the resource allowance, a special deduction permitted in lieu of royalty deductibility, has been phased out. As well, corporate tax rates for the oil and gas sector, which had been higher than those for other industries, have been brought into line with the general corporate rate. Finally, the accelerated CCA for oil sands mining and in situ projects, which permitted companies a fast write-off of certain kinds of assets, will be phased out, as announced in Budget 2007.

The tax treatment of electricity generating equipment has also undergone important changes. CCA rates have been increased to better reflect the economic life of the different assets. Also, a range of renewable energy and energy conservation equipment has been given an accelerated deduction – to encourage clean energy production and to contribute to the government's economic and environmental objectives.

Moreover, a new category of expense was introduced in the 1996 budget to make the tax treatment of certain types of renewable and conservation expenses more consistent with oil and gas exploration expenses. Included in this category are intangible expenses associated with developing such projects as wind farms, small-scale hydroelectric installations and cogeneration systems (e.g. for process engineering, right of access to the project site, and test wind turbines). These expenses are immediately deductible and are also eligible for flow-through shares.

In the renewable energy sector the federal government provides tax support under Classes 43.1 and 43.2 of the federal Income Tax Act, Annex II, in the form of an accelerated capital cost

allowance (ACCA) at 50%, on a declining basis, for equipment that is designed to produce energy from renewable sources. The ACCA under Class 43.2 increases returns on investment in renewable energy projects. The federal budgets 2007, 2008 and 2010 successively extended the ACCA under Class 43.2 to eligible equipment acquired before 2020 and expanded eligibility to a broader range of applications involving renewable energy power and thermal technologies.

For projects using these technologies, many intangible start-up expenses qualify as Canadian Renewable and Conservation Expenses (CRCE). CRCE may be deducted in full in the year incurred, carried forward indefinitely or transferred to investors using flow-through shares.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

Federal-level energy research, development and demonstration (RD&D) is undertaken by many agencies working in close coordination with NRCan. The main focus of Canada's energy RD&D activities is the sustainable production, use and export of Canada's energy resources. This is achieved through the use of technologies and systems for the efficient production and use of energy that respect the environment and are sustainable for future generations. These technologies facilitate cleaner air and water, improved land use and the reduction of GHG emissions, within the scope of a market-driven economy accompanied by intervention in areas of strategic interest.

Public funds are provided through federal programs, as well as from other private and public partners. Because of the federal government's interest in practical solutions and economic applications, privately initiated RD&D activities are encouraged, and those that complement the government's goals are funded primarily through private–public partnerships, i.e. the government working with private-sector firms and consortia. The federal government also acts as a leader, coordinator and facilitator of RD&D with all stakeholders. The general thrust of the federal effort has been towards greater integration of science and policy, with greater concentration on applied research and technology development in cooperation with private and public sector partners. (See also section on renewable energy.)

ENERGY EFFICIENCY

ENERGY EFFICIENCY ACT

The Energy Efficiency Act of 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 (Minister of Justice 2009c). The goal of the Act is to transform the market by eliminating the least efficient products and promoting the development and deployment of new, high-efficiency products.

To increase its scope and effectiveness, the Energy Efficiency Act was amended in 2009. One of the important provisions was to provide the authority to regulate standby power consumption in an effective manner. Standby power consumption is estimated to account for as much as 10% of household electricity use in Canada. The amendments would also make it possible to prescribe standards not only for products that use energy but also for products, such as thermostats, that affect energy use. Other provisions of the amendments would ensure a level playing field for dealers of affected products and will improve the well-known EnerGuide label to make it even easier for Canadians to make informed choices when shopping for energy-using products (NRCan 2009d.

The proposed eleventh and twelfth amendments to the Energy Efficiency Regulations include minimum energy performance standards for many appliances, and equipment types, including standards for standby power consumption for three consumer electronic products, and more stringent standards for electric motors and domestic water heaters (NRCan 2010a).

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 energy-efficiency standards and comparative and high-performance efficiency labelling, financial incentives for certain types of investments, RD&D, and education programs. The federal, provincial and territorial governments, municipalities, utilities and some non-governmental organisations sponsor and collaborate on programs aimed at improving energy efficiency.

For the transport sector, the government provides consumers with information about the fuel efficiency of light-duty vehicles, offers training programs for fuel-efficient driving, and encourages manufacturers and importers to meet voluntary company average fuel consumption goals and to voluntarily affix fuel consumption labels on new vehicles. In October 2010, the federal government announced final regulations under the authority of the Canadian Environmental Protection Act to establish progressively more stringent GHG emission standards for new passenger automobiles and light trucks for the 2011–2016 model years. As a result of the regulations, it is projected that the average GHG emission performance of new vehicles for the 2016 model year will be about 25% lower than the vehicles that were sold in Canada in 2008. Programs for the industrial sector aim to encourage and accelerate energy-saving investments and the exchange of best practice information. The Canadian Industry Program for Energy Conservation (CIPEC) is a long-standing voluntary partnership between the federal government and industry to support networking and knowledge transfer and includes more than 50 trade associations representing over 98% of industrial energy end-use in Canada.

The ecoENERGY Retrofit Incentive program offers homeowners, along with smaller businesses and organisations financial support to retrofit their homes, smaller buildings and industrial facilities. In the budget for 2009–10, the government provided additional funding to the initiative (bringing the total program funding to CAD 805 million). The program is expected to achieve substantial energy-use reductions, with close to 500 000 Canadian homes in total receiving retrofits.

The federal, provincial and territorial governments are also collaborating on the development of updated economy-wide energy codes for buildings and for houses. A buildings energy code is expected to be released in 2011 and will increase the stringency of its predecessor by 25%. The housing energy code will require energy performance equivalent to EnerGuide 80 and is expected to be released in early 2012.

RENEWABLE ENERGY

Canada is a global leader in the generation of clean, renewable energy. Hydroelectricity, the largest renewable energy source in Canada, accounts for 60% of Canada's electricity generation, and Canada is the world's second largest producer of hydropower. Other renewable energy sources, such as biomass, wind and solar, contribute to a total share for renewable energy of approximately 62% of the economy's electricity generation.

FEDERAL POLICY AND SUPPORT PROGRAMS

The Government of Canada is committed to reducing Canada's total GHG emissions by 17% from 2005 levels by 2020. The government also intends to implement regulations that will require an amount of renewable fuels equal to 5% of the volume of the gasoline pool by 2010 and 2% renewable content in diesel and heating oil by 2012 upon successful demonstration of renewable diesel fuel use under the range of Canadian conditions.

The drivers for federal support for renewable energy include environmental benefits, diversification of the energy mix, energy security, and industrial and economic development. The Government of Canada provides support to the renewable energy sector through programs, tax

measures and environmental policy. This includes deployment incentive programs and RD&D activities.

In 2007, the federal government announced a number of ecoENERGY Initiatives. These programs provide almost CAD 4 billion in funding to assist the development of a more sustainable energy system. The initiative includes the ecoENERGY for Renewable Power Program, a four-year, roughly CAD 1.5 billion investment to increase the supply of renewable energy from a number of sources.

Budget 2009 announced CAD 2 billion in new measures to support a cleaner and more sustainable environment, and help meet Canada's climate change objectives. (Tax measures for the renewable energy sector are outlined earlier in the 'Fiscal regime and investment' section.)

RD&D activities are geared to increasing the efficiency and reducing the cost of emerging technologies and are supported by funding programs through Sustainable Development Technology Canada (SDTC), as well as NRCan's Program for Energy Research and Development (PERD) – see also the earlier 'Research, Development and Demonstration' section.

To help foster the adoption of renewable energy technologies, Canada is developing and sharing knowledge that allows the global community to make cleaner energy choices – Canada's RETScreen International Clean Energy Project Analysis Software is an analysis tool that allows project planners to evaluate the feasibility of renewable and energy efficiency projects in the early stages. The latest version of includes a full array of financially viable clean power, heating and cooling technologies, and energy efficiency measures, and is freely available for download in 26 languages.

The SDTC, which was established by the government in 2001, is a not-for-profit foundation that operates two funds aimed at the development and demonstration of innovative technological solutions:

- The CAD 550 million SD Tech Fund supports projects that address climate change, air quality, clean water, and clean soil
- The CAD 500 million NextGen Biofuels Fund supports the establishment of first-of-kind large demonstration-scale facilities for the production of next-generation renewable fuels.

PROVINCIAL INITIATIVES

All provinces have been promoting the use of renewable energy through a number of incentives, including voluntary renewable energy targets and legislated renewable portfolio standards, and procurement of renewable energy through requests for proposals, standard offer and feed-in tariff programs.

NUCLEAR

Nuclear energy is an important component of Canada's energy mix. In 2009, Canada's nuclear plants generated 15% of Canada's electricity (NRCan 2010a). The federal government regulates the development and application of nuclear energy and the provinces and the provincial electric power utilities have the authority to plan, build and operate nuclear power plants. Most of the nuclear electricity plants are located in the province of Ontario, where nuclear power accounts for more than half of the generation mix. Nuclear licensing and regulation is exclusively handled at the federal level, through the Canadian Nuclear Safety Commission (CNSC) (NRCan 2009b).

Atomic Energy of Canada Limited (AECL), which is wholly owned by the Government of Canada, is the designer and builder of Canada Deuterium Uranium (CANDU) power reactors. AECL also delivers research and development support and services, such as consulting and maintenance, to nuclear utilities. In 2006, the federal government launched the five-year, CAD 520 million start-up phase of a long-term strategy to safely and cost-effectively deal with

legacy radioactive waste and decommissioning liabilities at AECL sites based on sound waste management and environmental principles (AECL n.d.)

In 2009, the government provided CAD 842 million (for 2009–10) to AECL for its operations, including the development of the Advanced CANDU Reactor, the completion of CANDU reactor refurbishment projects, the repair and return to service of the National Research Universal (NRU) reactor, and to maintain safe and reliable operations at the Chalk River Laboratories. In December 2009, the federal government issued an invitation to potential investors to make proposals that would allow the CANDU reactor business to take advantage of commercial opportunities in Canada and other countries, while reducing the risks carried by taxpayers. The federal government will assess how well the proposals received meet its aims of preserving the Canadian nuclear industry and the employment it provides, and of controlling costs and achieving maximum value for taxpayers, and strengthening Canada's nuclear industry (NRCan 2010b).

CLIMATE CHANGE

Energy production and use is responsible for the majority of Canada's greenhouse gas (GHG) and air pollutant emissions. In early 2010, Canada announced the submission of its 2020 emissions reduction target under the Copenhagen Accord. Canada's 2020 target, an economy-wide 17% emissions reduction below 2005 levels, is aligned with the US target, and will be subject to adjustment to remain consistent with the US target (Government of Canada 2010). Canada will continue to support the G8 partners' goal of reducing global emissions by at least 50% by 2050, as well as the goal of developed economies reducing emissions of greenhouse gases in aggregate by 80% or more by 2050 (NRCan 2010a).

The federal government is pursuing a number of actions to reduce emissions including funding programs to help Canadians use energy more efficiently, boost renewable energy supplies, and develop cleaner technologies (Treasury Board 2008).

- *Energy efficiency.* The government is delivering a series of ecoENERGY Efficiency Initiative measures, with up to CAD 960 million in funding, to promote smarter energy use and provide financial incentives in support of energy-efficiency improvements in homes, small buildings, industry and transportation (Government of Canada 2010).
- *Renewable energy.* Through ecoENERGY for Renewable Power, the government is investing close to CAD 1.5 billion to boost Canada's renewable energy supplies and create up to 14.3 terawatt-hours of additional renewable electricity generation (NRCan 2010a).
- *Science and technology.* The government is investing CAD 230 million through the ecoENERGY Technology Initiative to fund research and development on eight technology priorities relating to clean energy supply, reducing energy waste, and reducing pollution from energy use and in addition 795 million for the Clean Energy Fund on renewable energy and cleaner fossil fuels including CCS (NRCan 2010a).
- *Transportation.* A series of ecoTRANSPORT initiatives (more than CAD 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. One example of this is ecoENERGY for Personal Vehicles Program (CAD 21 million over four years), which provides assistance with buying, driving and maintaining cars to reduce fuel consumption and GHG emissions (Government of Canada 2010).
- *Biofuels.* The government is also supporting the expansion of Canadian production of renewable fuels through the provision of up to CAD 1.5 billion in operating incentives to producers of renewable alternatives to gasoline and diesel (Environment Canada 2007). This complements a regulatory requirement to include 5% renewable fuel in gasoline by 2010 and 2% renewable fuel in diesel and heating

oil by 2011. Further, in 2007, the government committed to accelerating the commercialisation of next-generation biofuel technologies by providing CAD 500 million over eight years to Sustainable Development Technology Canada (SDTC). SDTC will invest with private sector partners to establish large-scale demonstration facilities for the production of next-generation renewable fuels (NRCan 2009e). The federal government has also announced funding of CAD 345 million to bolster the development of biofuels and other bio-products (NRCan 2010a). Finally, the ecoABC Initiative is a CAD 200 million program that is providing repayable contributions over four years for the construction or expansion of transportation biofuel production facilities (Government of Canada 2010).

NOTABLE ENERGY DEVELOPMENTS

- *Clean Energy Fund:* In the budget for 2009–10, CAD 466 million was announced for three large-scale carbon capture and storage (CCS) projects, and a further CAD 146 million for 19 renewable and clean energy demonstration projects across Canada. Research, development and demonstration are being undertaken in the areas of: clean fossil fuels; clean integrated electricity including clean coal, CCS, distributed power generation, and next generation nuclear; bioenergy systems; low-emission industrial systems; clean transportation systems; and the built environment. The Clean Energy Fund is expected to reduce GHG emissions by 6 million tonnes by 2015.
- *Canada–US Clean Energy Dialogue*. In 2009, Prime Minister Stephen Harper and US President Barack Obama established a Clean Energy Dialogue (CED). The main objective of the CED is to enhance bilateral collaboration on the development of clean energy technologies to reduce GHG emissions and address climate change. Joint Canada–US Clean Energy Dialogue working groups have developed an action plan to advance bilateral collaboration in three key areas:
  - Expanding clean energy research and development
  - Advancing the development and deployment of clean energy technologies, with a focus on carbon capture and storage
  - Building a more efficient electricity grid based on clean and renewable generation.
- *Renewable Fuels Regulation*. Canada has finalised a regulation on renewable fuels requiring an average 5% renewable content in the gasoline pool coming into effect 15 December 2010. The government has announced it will also be requiring an average 2% renewable content in the diesel and heating oil pools subject to technical feasibility.
- *The ecoENERGY for Biofuels Program*: This is an investment of up to CAD 1.5 billion over nine years to boost Canada's production of renewable fuels such as ethanol and biodiesel. The program targets are by volume: 2 billion litres of renewable alternatives to gasoline and 500 million litres of renewable alternatives to diesel.
- *Major investment in international climate change*: As part of its commitment to help the poorest and most vulnerable economies in their efforts to fight climate change, under the Copenhagen Accord, Canada will invest CAD 400 million for international climate efforts in the 2009–10 fiscal year. Under the same accord, Canada has set the ambitious yet realistic target of reducing GHG emissions of 17% below 2005 levels by 2020.

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Statistics Canada—www.statcan.ca
Transport Canada—www.tc.gc.ca

CHILE

INTRODUCTION

Chile is one of three Asia-Pacific Economic Cooperation (APEC) economies in Latin America. Chile became an APEC member in November 1994. It borders Peru to the north, Bolivia to the north-east and Argentina to the east, and has a coastline of 6435 kilometres along the Pacific Ocean to the west. With a land area of nearly 756 102 square kilometres, it is 4300 kilometres long and averages 175 kilometres wide. Administratively, Chile is divided into 15 regions, which are subdivided into 53 provinces and 346 communes. The economy's own statistics show the population was 16.9 million in 2009, about 86.8% of whom live in urban areas (INE 2010a). The three largest urban regions are the Santiago metropolitan region (44.8% of total population), the Bío Bío region with 11.5%, and the Valparaíso region with 10.8%. From 1980 to 2009, Chile's population increased at an average annual rate of 1.5%, and is expected to reach 20.2 million by 2050 (INE 2010b). The population density is 22 people per square kilometre, but is much higher in metropolitan areas (around 433 people per square kilometre).

Chile's economic growth has been impressive. Since 1990, the Chilean economy has almost doubled its per capita income and it has been one of the fastest growing economies in Latin America. In 2008, Chile's GDP reached USD 198.18 billion and GDP per capita was USD 11 794 (USD (2000) at PPP). The economy grew 3.16% during 2007–08 (EDMC 2010). In 2008, major contributions to GDP came from financial services (17.8%) and the manufacturing industry (16.7%). Other economic sectors that made important contributions to GDP include personal services (11.5%), construction (7.9%), transport (7.7%) and mining (7.1%) (INE 2010c). Chile's economy is dependent on commodity prices, particularly copper prices. Chile continues to attract foreign direct investment, mostly focused on developing gas resources, water, electricity and mining.

The Chilean Government has focused on increasing the openness of its economy through trade liberalisation and the pursuit of bilateral free trade agreements. Chile claims to have more bilateral or regional trade agreements than any other economy. By 2008, it had signed trade agreements (not all of them full free trade agreements) with 58 partners, including the European Union, Mercosur (a regional trade group comprising Argentina, Brazil, Paraguay, Uruguay and Venezuela), India, China, Japan, Korea, Mexico and the United States (IEA 2009).

Table 5 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	756 102	Oil (million barrels)[a]	150
Population (million)[b]	16.9	Gas (trillion cubic metres)	0.097
GDP (USD (2000) billion at PPP)	198.18	Coal (million tonnes)	700
GDP (USD (2000) per capita at PPP)	11 794		

Source: EDMC (2010).

a Proven reserves at the end of 2009 (O&GJ 2009).

b According to Chile's own statistics (INE 2010a).

Chile's energy security is challenged by its limited energy resources, in particular oil and natural gas. The government has introduced new policy in this area, following the reduction in natural gas supply from Argentina in 2004. Chile is a net energy importer, and dependent on crude oil imports. In 2009 Chile imported 59.3% of its internal demand; crude oil was 69.1% of the imported energy.

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Chile's total primary energy supply (TPES) increased by 7.82% between 2007 and 2008. In 2008, TPES reached 32 640 ktoe, of which 55.1% came from crude oil and oil products, 8.3% from natural gas, 14% from coal and 22.6% from other sources, mainly biomass and hydropower. Chile is a net importer of primary energy. In 2008, it imported around 70.6% of its TPES, a decrease of 1.74% compared with 2007. Most primary energy imports are of crude oil. Domestic energy production is limited; however there was robust growth of 13.24% between 2007 (8529 ktoe) and 2008 (9658 ktoe). Chile's domestic energy production is mainly from renewable sources, which account for 75%; the remainder comes from hydrocarbons (crude oil, natural gas and coal). Among the renewable sources, biomass (principally wood) is the largest contributor, with a share of 53% of total domestic production (EDMC 2010).

Chile has limited crude oil reserves of around 150 million barrels (about 20.7 million tonnes of oil equivalent) (O&GJ 2009). All of Chile's crude oil reserves are in the southern Magallanes region in onshore and offshore fields. To meet crude oil demand in 2009, 98.1% of the economy's total crude oil supply was imported (of the total crude oil supply of 10 648 ktoe). In the case of petroleum products, Chile's indigenous production in 2009 totalled 10 549 ktoe, made up mainly of diesel (35%) and gasoline (26%). That was supplemented by 6862 ktoe of imports, which accounted for 39% of the total 2009 petroleum products supply. In the case of natural gas, Chile produced 2523 million cubic metres (mcm) and imported 885 mcm in 2009 (MINERGIA 2010a).

There are three important coal production regions in Chile: the Bío Bío region, the La Araucanía region, and the Magallanes y Antártica region. Coal reserves (proven and probable) are estimated at around 700 million tonnes (CNE 2008). In 2009, domestic coal production increased by around 34.1%, reaching 370.8 ktoe (529 718 tonnes) and accounting for around 3.6% of total domestic primary energy supply.

In 2009, Chile's installed electricity capacity was 16 153 MW, including public service (92.1%) and self-suppliers (7.9%). Thermal power plants have traditionally accounted for the bulk of installed electricity capacity. At the end of 2009, thermal power represented 66% of the total capacity (self-suppliers included). The share of hydropower has declined from 47.7% in 1998 to 34% in 2009, with a total installed capacity of 5486.8 MW at the end of 2009. Chile's electricity generation in 2009 rose 3% from 2008, to a total of 61 038 GWh, of which 58.6% came from thermal power generation and 41.4% from hydropower (MINERGIA 2010a).

Renewable energy (hydro, wind, biomass and biogas) contributed 71.6% of Chile's domestic energy production in 2009 (7370 ktoe). Chile is dependent on wood for domestic energy production (49.8% of the total indigenous production and 69.6% of energy from renewable sources). Production of wood in 2009 totalled 14.65 million tonnes (5128 ktoe). Around 88.5% (12.97 million tonnes) of the total wood supply was for final consumption. The second largest renewable energy contributor is hydro. In 2009 Chile produced 2228 ktoe (25 990 GWh) of hydropower, which was 21.6% of the total indigenous energy production. A small volume of electricity was generated from wind in 2009 (79 GWh); this was a robust increase of 107.3% from 2007. Chile began some production of biogas in 2009, producing a total of 6.9 ktoe (12 million cubic metres) (MINERGIA 2010a).

Table 6 Energy supply & consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	9 658	Industry sector	9 148	Total	60 858
Net imports and other	–23 059	Transport sector	8 988	Thermal	32 085
Total PES	32 640	Other sectors	7 432	Hydro	24 292
Coal	4 578	Total FEC	25 568	Nuclear	–
Oil	17 992	Coal	709	Geothermal	–
Gas	2 698	Oil	13 901	Others	4 481
Others	7 372	Gas	1 784		
		Electricity and other	9 174		

Source: EDMC (2010).

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

FINAL ENERGY CONSUMPTION

Chile's total final energy consumption grew by 3.6% on 2007 levels, reaching 25 568 ktoe in 2008. The two main energy consuming sectors were industry (35.7%) and transport (35.1%). Petroleum products made up 54.3% of final consumption, electricity 35.8%, natural gas 6.9% and coal 2.7%. There was a significant reduction in natural gas consumption between 2007 and 2008, a drop of 23.3%. On the other hand, oil consumption has grown consistently since 2000, with an average annual growth rate of 4.1%; between 2007 and 2008 oil consumption grew by 7.9% (EDMC 2010).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Since the late 1970s, Chile's energy policy has been structured around two central pillars: economic efficiency and the subsidiary role of the state. The state's subsidiary role is established in the Chilean Constitution, which requires a law to create new public entities. Following the publication of the General Electric Services Law in 1982, the state's presence and role in entrepreneurial activities has been limited. This approach has supported continuous Chilean economic growth during the last two decades. However, the energy crisis of 2004 has shown security of supply is a basic requirement of a well-functioning energy market and that the state should play a forward-looking and coordinating role in the design of energy policy (IEA 2009).

The government of Chile developed a new long-term energy policy after the 2004 Argentine gas crisis and the 2007–08 electricity shortage. The government, through the National Energy Commission (CNE by its Spanish acronym), published new energy policy guidelines in 2008 (CNE 2008), which set out six energy priorities:

- strengthening institutions
- promoting energy efficiency
- optimising diversification
- ensuring sustainable development
- supporting equal access
- contingency planning.

The guidelines are the base for the development of general energy policy.

With the aim of strengthening energy organisation in Chile, a bill to create the Ministry of Energy was presented to the Chilean Parliament in 2008, and was approved in November 2009. In February 2010, the new Ministry of Energy started operation. It centralises the functions of

developing, proposing and evaluating public policies in this area, including the definition of objectives, the regulatory framework and strategies to be applied, and the development of public policy instruments.

All energy sector public services are now overseen by the Ministry of Energy, including the National Energy Commission (CNE), the Superintendence of Electricity and Fuel (SEC), and the Chilean Commission on Nuclear Energy (CCHEN). These institutions are charged with applying, clarifying and interpreting macro policies, technical analysis, tariffs, rules and regulation, and enforcement. On the implementation side, the Ministry has created two important institutions: the Renewable Energy Centre (CER) and the Chilean Energy Efficiency Agency (AChEE). The activities of these agencies are integrated with other government agencies, and also involve public–private cooperation.

Other key objectives of the government are to increase electrical coverage in rural areas, benefiting the 15% of the population (about 2.25 million people) who live there, and to use the economy's enormous solar potential to reduce dependence on imported electrical energy from neighbouring economies.

ENERGY MARKETS

Chile has embarked on the development of an economy based on international trade and the rules of the free market. Since 1990, the economy has growth impressively and almost doubled its income per capita and has been a faster-growing economy in Latin America. The Chilean economy is highly integrated, as demonstrated by its participation in free trade agreements and vigorous development of further trade opportunities. Chile has evolved from an economy dependent on the export of copper, to a diversified participant in a free market, trading products of higher added value.

Chile offers a business-friendly environment for foreign investors. According to some of the most recent rankings, Chile is first among Latin American economies in terms of business and private investment attractiveness, market access, and transportation and communication infrastructure. For example, Chile ranked 15th among the most attractive economies in which to do business and invest in over the next five years according to the 'Best Place to do Business 2009–2013' index, published by The Economist Intelligence Unit (CORFO 2009).

The electricity market in Chile encompasses power generation, transmission and distribution. The regulatory framework for Chile's electricity supply industry is based on the principle of competitive markets for generation and supply. This market is wholly dominated by private companies. The state's only roles are as regulator, and as the provider of planning and analysis—such as energy planning to identify required investment to meet projected demand growth. The principal state organisation involved in the regulation of the electricity industry in Chile is the CNE. The main law that governs the operation and regulation of the electricity sector is the Ley General de Servicios Eléctricos (General Electric Services Law) of 1982, which was amended by the Ley Corta I (Short Law I or Law 19.940) of 2004 and the Ley Corta II (Short Law II or Law 20.018) of 2005, to provide adequate incentives for private sector investments in electricity projects and improve the entry conditions for non-conventional renewable energy (NCRE) into the electricity system.

Most of Chile's energy sector is privatised, with Empresa Nacional del Petroleo (ENAP) controlling the bulk of oil production and refining. Chile hopes it can develop its oil industry to a level that will enable it to become self-sufficient and eventually become an oil exporter.

A new Oil Market Policy began implementation through ENAP in December 2009. This policy has two fundamental objectives: to ensure a highly efficient and competitive market for the distribution of petroleum products; and to ensure supply for the whole economy. The new policy sets the basis for parity prices of petroleum product imports, and also sets up incentives for distribution companies. This new price structure establishes a competitive market in Chile because it considers only the variable costs of refineries, based on costs for refineries in the Gulf of Mexico (ENAP 2009).

FISCAL REGIME AND INVESTMENT

Chile's fiscal policy since 2000 has been developed in accordance with a structural surplus rule, which emphasises medium-term fiscal responsibility. The 2006 Fiscal Responsibility Law introduced new rules on the investment of accumulating assets—it covers central government agencies, but not the central bank, public non-financial enterprises, the military sector, and municipalities (IMF 2009).

There are three kinds of taxes paid on fuel in Chile: import taxes on imported products; specific taxes for fuels used in transport vehicles; and a value-added tax paid on all fuels. In 2010 import taxes have a rate around 6%, depending on the country of origin. Specific taxes for transportation fuels are applied to gasoline, diesel oil, LPG and CNG. The value-added tax is a direct tax on consumption and the 2010 rate is 19% (IEA 2009).

In 1991 the government of Chile created the Oil Price Stabilization Fund (FEPP) to cover fuel oil; in 2005 this became the Fuel Price Stabilization Fund (FEPC), to cover gasoline, diesel, domestic kerosene and LPG. The only influence that the authorities have over these retail prices (other than through the specific tax on liquid fuels) is through the credit or tax that they decide on a weekly basis. A change in 2008 was the extension of FEPC's coverage to include LNG that is re-gasified within the economy—this will allow LNG to receive credits or to be taxed to maintain parity with import prices of alternative fuels, to avoid distortions that could arise with other fuels covered by the funds, including diesel and LPG. Natural gas imported by pipeline is not covered by the FEPC (IEA 2009).

Chile's National Economic Development Agency (CORFO) is an agency administratively dependent on the Ministry of Economy. Its mission is to promote the economy's economic development by supporting production companies. CORFO handles subsidies for studies in the pre-investment stage and long-term credits for financing. CORFO also plays a role in consortia to develop biofuels projects and solar energy pilot projects (IEA 2009).

Chile's natural resources offer opportunities for investors in non-conventional renewable energies (NCRE); at the same time, the economy offers competitive prices that generate opportunities in this sector, which has growing energy demand. InvestChile, through its transversal investment program in NCRE, promotes and facilitates investment in the business niches that contribute to strengthening the sector. It seeks to include new players, to promote the technological upgrade of the companies' platform, as well as to promote local capacities. InvestChile offers information services, support in different stages of a project, access to business networks and financing sources, support in localisation, as well as help searching for investment partners. InvestChile's portfolio contains 150 projects, totalling 2386 MW in production and about USD 4691 million in investment. Of these, 21 are operating with a contribution of 162 MW (CORFO 2009).

ENERGY EFFICIENCY

One of Chile's most important initiatives in energy efficiency is the government's creation of the Ministry of Energy, an entity that will centralise the functions of developing, proposing and evaluating public policies in this area. The new ministry includes the Chilean Energy Efficiency Agency (Agencia Chilena de Eficiencia Energética, or AChEE), a public–private organisation (a foundation) in charge of implementing energy efficiency programs according to policies developed by the ministry.

The mission of AChEE is to consolidate energy efficiency in a way that contributes to Chile's sustainable energy development. The strategic objectives of AChEE are to:

- establish the institutional foundations and regulatory framework for energy efficiency
- develop incentives and support tools for energy efficiency
- develop useful and accessible information for public and private decision-makers, as well as collective and individual ones

- position and introduce energy efficiency in all levels of training, both formal and informal
- take advantage of international experiences and instruments to accelerate the development of energy efficiency and measure the emissions reduction.
- strengthen institutional management through quality control processes (ISO).

Chile has a product labelling program that leverages the European comparative labelling scheme—this breaks-down all similar models of a product into one of seven efficiency categories: A (most efficient) through G (least efficient). This labelling is currently applied to five lines of products in Chile (incandescent and compact fluorescent light bulbs, one- and two-door refrigerators, and microwaves), with another five or six planned for 2011 (motors, heating,ventilating and airconditioning, housing, automobiles, television sets, and decoders). Products covered are mostly for residential applications. The future coverage is aimed at residential to small commercial applications. Chile is in the process of developing a strategy to establish mandatory 'minimum energy performance standards' (MEPS)—the law that allows the Ministry of Energy to facilitate the Minister to dictate MEPS. The first MEPS under development are for light bulbs. Also, Chile is promoting energy efficiency programs for buildings: from 2009 the Chilean Government has published building energy efficiency guidelines as a recommendation for new house designs and the thermal insulation of existing homes in the economy (MINVU 2009 and 2010).

As part of the work to implement Chile's new energy strategy, CNE is working on the publication of the National Action Plan on Energy Efficiency 2010–2020 (known by its Spanish acronym, PAEE), which is expected to be available during 2011. The plan will help guide and encourage energy efficiency policy development and implementation, capturing synergies between policies and avoiding duplication while also prioritising resource allocation across the energy-efficiency portfolio (MINERGIA 2010a).

RENEWABLE ENERGY

In 2006, the CNE, in conjunction with Congress, examined the law for renewable energy projects with the aim of removing all commercial barriers to development. This initiative was a priority in the government's energy policy as a complementary measure to address energy security. In April 2008, Law 20.257 (the Law of Non-Conventional Renewable Energy) was enacted. It aims to provide an incentive for the inclusion of non-conventional renewable energy in the economy's electricity systems.

Law 20.257 took effect in 2010. It requires 5% of total production in new energy contracts to come from non-conventional sources. By 2024, the required level of non-conventional sources rises to 10% of total energy production (around 3410 MW). This provision is expected to result in nearly 1600 MW of additional power from NCRE sources by 2035. The only mechanism used to promote solar energy is the financing through CORFO of feasibility studies for projects—in most cases this amounts to 3% of the total cost. See the 'Fiscal regime and investment' section for more info on CORFO's NCRE program.

NUCLEAR

In 1964, Chile created the Chilean Commission of Nuclear Energy (CCHEN 2010). This agency is in charge of the operation and the regulation of the economy's two nuclear reactors, which are located in the Santiago Metropolitan region. CCHEN operates these reactors for research purposes only.

The President of the Republic created in 2007 the Nucleo-electricity Working Group (or Zanelli Commission) to contribute to the analysis of the opportunities, advantages, challenges and risks of the usage of nuclear energy in the futute. Nowadays, Chile is developing the technical capacity and legal framework that would be required to take a decision on the use of nuclear energy in the future. The nuclear option is seen as a possible response to the projected

energy demand for the economy; forecasts indicate double the currently installed capacity will be required during the next fifteen years (MINENERGIA 2010b).

CLIMATE CHANGE

In 1995, Chile signed the United Nations Framework Convention on Climate Change. It also ratified the Kyoto Protocol in 2002. In 2006, the Chilean Government published a National Strategy on Climate Change to promote action plans in that area. In December 2008, to complement the strategy, Chile published the *National Action Plan on Climate Change 2008–2012* in order to assign institutional responsibilities for adaptation, mitigation and strengthening Chile's capacities to address climate change (CONAMA 2008).

While Chile's contribution to global carbon emissions is low (0.2% at worldwide level), it is highly vulnerable to climate change. Glacial melt, shifts in rainfall patterns, expanding deserts, and greater frequency in El Niño would impact on the economy's water supply, food production, tourism industry, and migration, with resulting impact on socio-economic development and security.

Chile's action plan identified hydroelectric resources, food production, urban and coastal infrastructure, and energy supply as the four areas most vulnerable to climate change, where adaptation would be required. Mitigation meanwhile, was possible by targeting sectors with the highest levels of greenhouse gas emissions, working to reduce emissions there, and strengthening research and development. The government considers that action on climate change is directly connected to the education of the population on environmental issues and climate change, and its plan incorporates a climate change educational campaign.

NOTABLE ENERGY DEVELOPMENTS

PETROLEUM SECTOR

In November 2010, Latin America-focused oil and gas company GeoPark (one of the companies' active in Chile) announced the successful drilling and testing of a new discovery oil well, on the Guanaco prospect on the company's wholly owned Fell Block in Chile. The company reported that the Guanaco-3 production test represents the third successful well and first exploration discovery drilled by GeoPark in 2010. Preliminary interpretations indicate the Guanaco structure to be approximately 3.5 square kilometres in area (GeoPark 2010).

GeoPark supplies one-third of the hydrocarbons produced in Chile. It channels its oil output to ENAP and natural gas production to Methanex, a major producer of methanol at Cabo Negro, near Punta Arenas, from where it is shipped to its markets in Asia, South and North America, Europe and South Africa.

RENEWABLE ENERGY

In the geothermal area, 13 companies have bid for 20 new geothermal concessions in Chile, in a tender process opened by the government in September 2010. The companies included the Chilean unit of Italian power utility Enel SpA, power generator Colbun and mining company Minera Escondida. The Ministry of Energy is expected to award the concessions by the end of February 2011.

Chile's main areas of geothermal activity are in the Andes of the far north and in south-central areas of the economy. A project located in the concession area called San Gregorio, which is being explored by Geoglobal Energy Chile (GGE), is close to becoming the first operational geothermal project in Chile (potential capacity 75 MW). The company is preparing environmental assessment studies, with a targeted construction start in early 2011 (Geoglobal 2010).

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Government of Chile—www.gobiernodechile.cl

Ministry of Economy, Development and Reconstruction—www.economia.cl

Ministry of Energy—www.minenergia.cl

Nuclear Energy Chilean Commission (CCHEN)—www.cchen.cl

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National Energy Efficiency Program (PPEE)—www.ppee.cl
Ministry of Environment — www.mma.gob.cl
National Institute of Statistics (INE)—www.ine.cl
Superintendence of Electricity and Fuel (SEC) — www.sec.cl
Economic Load Dispatch Centre of (SIC) — www.cdec-sic.cl
Economic Load Dispatch Centre (SING) — www.cdec-sing.cl

CHINA

Introduction

China was the third-largest economy in the world, following the United States and Japan, when measured by its 2009 nominal GDP. However, in 2010 China overtook Japan to become the second-largest economy in the world. China is located in north-east Asia, and is bordered by the East China Sea, Korea Bay and the South China Sea, and lies between North Korea and Viet Nam. Its population of 1.32 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.

China is the world's largest energy producer and second-largest energy consumer (after the United States). Based on provisional statistics, total energy consumption in 2009 was 2.146 billion tonnes of oil equivalent (toe), 5.2% more than in 2008. However, its per capita primary energy consumption, at 1.61 toe in 2009, is far lower than that of many developed economies and below the world's average, and is almost one-fifth of the per capita energy consumption of the United States (NEA 2010).

Over the 30 years from 1978 to 2008, the average annual growth rate of primary energy consumption in China was 5.5% and the average annual growth rate of GDP was 9.8%, so China achieved its goal of quadrupling GDP supported by a doubling of energy consumption. Since 2001, along with strong GDP growth, industrialisation, urbanisation and motorisation, energy consumption has grown rapidly. Between 2001 and 2009, the average annual growth rate of GDP reached 10.4%. In 2009, China's GDP grew by 9.1%, with the primary, secondary and tertiary industries accounting for 10.3%, 46.3% and 43.4%, respectively (NBS 2010).

China is rich in energy resources, particularly coal. In 2009, it was the largest producer and consumer of coal in the world, as well as the fifth-largest producer and second-largest consumer of oil (BP 2010). China's 2009 coal output increased markedly, to 2.97 billion tonnes, a 6.1% increase compared with 2008 (NBS 2010). In the same year, China became a net coal importer, after a long history of being a net coal exporter (China became a net oil importer in 1993, after a similarly long period as a net oil exporter).

According to recent estimates, China has recoverable coal reserves of around 114.5 billion tonnes, proven oil reserves of 14 832 million barrels and proven natural gas reserves of 2455 billion cubic metres (bcm) at the end of 2009. In addition, China is endowed with 400 gigawatts (GW) of hydropower potential, more than any other economy. Coal and oil resources have been utilised more extensively than natural gas and hydro for power generation and industrial development.

Table 7 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (sq. km)	9 600 000	Oil (million barrels)	14 832
Population (million)	1 324.66	Gas (billion cubic metres)	2 455
GDP (USD (2000) billion at PPP)	6 461.66	Coal (billion tonnes)	114.5
GDP (USD (2000) per capita at PPP)	4 878		

a Proven reserves at the end of 2009 (BP 2010).

Source: EDMC (2010).

Energy supply and demand

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 2008, the total primary energy supply increased 4.34% compared with 2007, reaching 1952 million tonnes of oil equivalent (Mtoe)—including net imports and other; of this coal was the dominant source, accounting for 73.3%, followed by oil (18.9%), gas (3.9%) and others (EDMC 2010).

China has provided a lot of political and financial support for the development of its abundant indigenous coal reserves, to ensure the security of its energy supply. In 2009, China's total energy production reached 2746 million tonnes of coal equivalent (Mtce) (1922 Mtoe), of which coal accounted for 77.3%, followed by oil (9.9%), gas (4.1%) and other (8.7%) (NBS 2010). However, since as early as the 1990s, Chinese authorities have been encouraging fuel switching (for example, from coal to cleaner fuels), introducing energy-efficiency initiatives (to reduce pollution and emissions from energy use), and optimising the existing energy structure. After reaching a peak in 1996, coal use declined significantly between 1997 and 2000, but began to rise again in 2001, followed by strong growth during the next five years. Coal production reached 2123 Mtce (1486 Mtoe) in 2009 (NBS 2010), a historic high.

Table 8 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	1 816 625	Industry sector	754 164	Total	3 466 882
Net imports and other	193 027	Transport sector	145 300	Thermal	2 790 078
Total PES	1 951 993	Other sectors	319 292	Hydro	585 187
Coal	1 431 782	Total FEC	1 218 756	Nuclear	68 394
Oil	370 214	Coal	461 573	Other	23 223
Gas	76 025	Oil	334 189		
Other	73 974	Gas	123 698		
		Electricity and other	299 296		

Source: EDMC (2010). For full detail of the energy balance table see www.ieej.or.jp/egeda/database/database-top.html

In 2008, China's domestic crude oil output reached 190 million tonnes (Mt), of which 84.8% came from onshore fields (Xu 2009). China's oil import dependency has increased since 1993, rising from 6% in 1993 to 48% in 2008 and more than 50% in 2009(Cui 2010). International oil assets and domestic reserves of oil and gas grew rapidly and oil and gas infrastructure in China improved.

China's proven gas reserves and production have expanded rapidly. Since 2000, gas reserves have grown by an annual average of 475.3 billion cubic metres (bcm). Remaining recoverable reserves grew by an average of 226 bcm per year, from 940.5 bcm in 1998 to 3.2 trillion cubic metres in 2008. Since 2000, gas production in China has continued a rapid growth rate of 14% on average per year to reach 77.5 bcm in 2008 (Xu 2009), while the expansion of natural gas pipelines has also been rapid. Primary natural gas supply totalled 76.025 Mtoe in 2008, with the share of natural gas in the total primary energy supply remaining at 3.9%. Gas production in China has grown faster than coal and oil, and is the fastest growing in the world. Since 2000, Chinese coal production and oil production grew by 10% and 2% per year, respectively, while global gas production grew by 3% per year (Xu 2009).

In terms of installed electricity generation capacity, China has been the world's second-largest economy since 1996. Its 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 developed as a result of rapid economic expansion after 2001. Between 2001 and 2004, installed generation capacity increased steadily at an annual average rate of 10%, and since 2004, installed generation capacity has increased by 100 GW a year. In 2009, installed generation capacity reached 874 GW, an increase of 10.23% compared with 2008 (CEC 2010).

The power structure is becoming more diversified with wind power and nuclear power generation increasing rapidly. In 2008, total power generation in China was 3466.88 TWh. Thermal power accounted for 80.48% (2790.08 TWh) of total generation, hydropower 16.88% (585.19 TWh), nuclear power 1.97% (68.39 TWh) and other 0.67% (23.22 TWh) (NBS 2010).

FINAL ENERGY CONSUMPTION

Final energy consumption in China reached 1218.76 Mtoe in 2008, 3.1% higher than the previous year. Industry was the largest consumer, accounting for 61.9% of total final energy consumption, followed by the transportation sector (11.9%) and other sectors, including residential and commercial (26.2%) (EDMC 2010). In 2009, total energy consumption had risen further to 3066 Mtce (2146 Mtoe). Of the primary energy sources coal (70.4%) remained the most important in 2009, followed by oil (17.9%); hydropower, nuclear power, wind power (7.8%); and natural gas (3.9%) (NBS 2010).

Coal consumption, excluding coal consumption to generate electricity, was 461.573 Mtoe in 2008 (EDMC 2010). The electricity generation sector was the biggest coal consumer, followed by the metallurgical sector, the building materials sector, the chemical sector and others.

Electricity consumption increased in 2008 by 5.7% compared to the previous year (NBS 2009, NBS 2010). The demand rate growth was, as in previous years, based mainly on increased consumption in the commercial and residential, transport and industry sectors. In 2008, the industrial sector accounted for the majority of electricity consumption (68.8% or 167.819 Mtoe), followed by the residential and commercial sector (19.1% or 46.556 Mtoe), agriculture (3.1% or 7.629 Mtoe) and transport (2.0% or 4.918 Mtoe). In terms of growth, electricity consumption in the residential and commercial sector in 2008 increased by 8.43% compared with the previous year, the transport sector by 7.51%, industry sector by 2.48%, and the agriculture sector by 0.93% compared with the previous year (EDMC 2010).

China consumed 334.189 Mtoe of oil in 2008, making it the second-largest oil consumer behind the United States. In 2008, the industrial sector was the largest oil-consuming sector, accounting for 39.0% of total final oil consumption, or 130.349 Mtoe. The transport sector was the second largest in terms of total consumption, and the fastest growing; it accounted for 38.9% of total oil consumption or 130.122 Mtoe, an increase of 8.5% over the previous year (EDMC 2010).

The market for gas is mainly in south-east China, which accounts for a third of total natural gas consumption. However, the market is moving to north China and east China with the completion of the Shaanxi–Beijing gas pipeline and the West–East gas pipeline. Before 2000, Chinese gas consumption was dominated by industrial fuel and chemical sector use. As long-distance pipelines were completed, the gas consumption mix changed greatly: from 2000 to 2008, city gas consumption grew from 18% to 34%, industrial fuel consumption declined from 41% to 28%, chemical sector use declined from 37% to 23%, and consumption in power generation grew from 4% to 15% (Xu 2009).

China's energy structure is being continuously optimised, and the proportion of low-carbon energy has increased significantly. In 2009, the proportion of coal used was 70.3% (compared to 76.2% in 1990), the proportion of oil and natural gas consumption rose from 18.7% in 1990 to 21.9% in 2009, and hydropower, nuclear power and wind power rose from 5.1% in 1990 to 7.8% in 2009 (NBS 2010).

Policy overview

ENERGY POLICY FRAMEWORK

China's energy consumption has grown rapidly, in line with robust economic development and accelerated industrialisation. Energy has become an important strategic issue for China's economic growth, social stability and security. A low-carbon society is a goal for China: the structural transformation of energy is considered the key to economic restructuring, which is also seen as an important indicator of social progress. Achieving the goal of a low-carbon and orderly energy structure is the basis of China's energy strategy.

ORGANISATION

To strengthen coordination and decision-making, China has established a high-level coordinating body—the National Energy Committee, which is in charge of drawing up China's energy strategy and deliberating on major issues in energy security. Premier Wen Jiabao is chairman of the committee. In March 2008, the National Energy Administration (NEA) was formed, administrated by the National Development and Reform Commission (NDRC). The NEA comprises 10 departments, with an authorized staff size of 152 civil servants. It is responsible for developing and implementing energy industry planning, industrial policies and standards, as well as for administration of the energy sector including coal, oil, natural gas, power including nuclear power, new and renewable sources of energy, and it has assumed the responsibilities of the Office of the National Energy Committee. Some departments within the NDRC also contribute to energy conservation and climate change policy development. In 2009, the National Energy Conservation Centre was formed in the NDRC, to provide technical support to the government to implement energy efficiency and conservation management initiatives. Its main duties include energy efficiency and conservation policy research; assessment of fixed asset investment projects; information dissemination; promotion of technologies, products and new mechanisms; label management; and international cooperation in the field of energy conservation.

LAW

There are a series of laws related to energy in China today, such as the Coal Law, the Electricity Law, the Renewable Energy Law, the Energy Conservation Law, the Environmental Protection Law, and the Cleaner Production Promotion Law. The drafting of a comprehensive legal basis for the energy sector, the Energy Law, has also made positive progress.

The amended version of the Renewable Energy Law came into effect on 1 April 2010. It more clearly defines the responsibilities of power grid enterprises and power generation enterprises, and places an emphasis on completely secure purchase of power from renewable energy sources, and establishment of a development fund for renewable energy. The amendment provided that power grid companies would receive all of the revenue generated from the surcharge on retail power tariffs, and also set a minimum target for the amount of electricity that the grid companies must buy from renewable energy projects.

The Protection of Oil and Pipelines Law was endorsed by the Standing Committee of the National People's Congress on 25 June 2010 and came into effect on 1 October 2010. The law requires that oil and pipelines companies take safety measures while constructing pipelines, ensure the quality of construction materials, have regular patrols of pipelines and promptly eliminate any hazards.

FISCAL REGIME AND INVESTMENT

China has implemented a series of reforms around energy investment, government regulation, market adjustment, and management of state-owned energy companies. China encourages investment diversification in the energy sector, offers autonomy to business, and seeks to attract foreign capital and advanced technology to China's energy industry.

The Chinese energy tax regime includes resource tax, royalties, mineral resources compensation, and consumption tax. Since 1 October 1984, China has collected resource tax on oil, natural gas and coal, but the levying scope was expanded in 1994, after which the tax was levied according to the amount of production as well as the situation of resources. From 1999 to 2008, the resource tax revenues increased at an average annual rate of 16.98%. The collection of royalties is limited to offshore and onshore oil and gas exploitation. In offshore exploitation, since 1989, production up to 1 million tonnes of crude oil has royalties levied at a rate of 2.5%–4%. Similarly, production of up to 2 billion cubic metres of natural gas has royalties levied at a rate of 1%–3%. For onshore exploitation, since 1990, the collection of royalties is according to the annual production of each oil field or gas field. The rate ranges between 1%–12.5% for production up to 50,000 tonnes of crude oil and 100 million cubic metres of natural gas. All royalties can be paid in kind. Since 1 April 1994, China began to levy mineral resources compensation from mining operators. The rates differ between mineral resources, ranging from 0.5% to 4%. There are 13 kinds of energy-related products that incur consumption tax, including gasoline and diesel. Recently, China has released a tax incentive policy, which sets varying consumption tax rates dependent on the size of vehicles, and aims to encourage purchases of smaller cars (Cui 2010).

There are some financial incentives for efficient utilisation of energy and environmental protection. Since 2007, central and provincial budget organisations have followed a program of green government procurement, which requires government departments to make the purchase of energy-saving products a priority. China has established special funds for development of renewable energy. In addition to the central government initiatives, most provinces and some prefectures have established special funds for energy conservation and emissions reduction with annual budget allocations.

ENERGY SECURITY

'More coal, less oil and gas' characterises China's energy resource. The most efficient use of available resources is accepted as the economy's necessary guiding principle. China has also strengthened the security of its oil supply through building and supporting bilateral cooperation with new trading partners, and through globalisation of its oil and gas assets. The trend to energy diversification in China, in terms of the fundamental energy system, energy structure and regional energy development, is considered important for formation of a secure energy base.

Recognising its vulnerability to international market changes, China has been trying to increase the security of its oil supply by encouraging Chinese companies' upstream investment activities in Kazakhstan, Venezuela, Sudan, Iraq, Iran and Peru, in the way of cooperation with international or local companies. After 16 months of construction, the China–Russia crude oil pipeline was completed in September 2010; this is designed to transport 150 million tons of crude oil per year from 2011 to 2030. In addition, the China–Central Asia natural gas pipeline was completed in December 2009.

ENERGY MARKET

Reforms of the energy sector have been pushed steadily. The reforms focus on the establishment of an energy industrial system that adjusts to the socialist market economic system. The main reforms have included the reorganisation of the energy industry sector and the establishment of economy-wide energy sector companies; the establishment of coal market price mechanisms, such as removing controls on coal prices; perfecting the oil price mechanism and adjusting the oil price; establishing the modern enterprise system (including the participation of many electricity companies and oil companies in overseas markets); the implementation of electric power system reform, including the establishment of the electricity regulatory commission, two grid companies, five power generation groups and four auxiliary companies; and moving renewable energy commercialisation forward (NEAIO 2009).

Another area of market reforms is in energy capitalisation. Chinese energy companies have expanded their resource base through international capital markets, with the three top oil companies in China now listed in various locations around the world. The Chinese coal industry

includes between 40 and 50 listed companies, with a total market value of more than CNY 1000 billion, while the electricity industry also has between 50 and 60 listed companies with a total value of more than CNY 600 billion in early 2009 (Cui 2010).

COAL MARKET

A revised draft of the Coal Law was submitted to the State Council in September 2008. The aim of this is to establish a complete legal system for coal that will fully protect the development of the Chinese coal industry and help it progress in a healthy and sustainable direction. 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 proposing to establish a coal strategic resources reserve system. It also highlights some other points: the rationalisation of the coal industry management system, and emphasis on the coal industry development plan.

The Coal Industrial Policy, which is the first industrial policy for China's coal industry, was issued by the NDRC on 23 November 2007. The policy includes 10 chapters, including development targets, industrial distribution, industrial access, industrial organisation, industrial technology, safety, trade and transportation, economical use and environmental protection, labour protection, and ensuring measures. The policy aims to build a new coal industry system, change the industry's mode of economic development, and promote its healthy development in China.

The government has traditionally participated in negotiating the price of coal. After more than a decade of gradual reform, on 15 December 2009, NDRC issued a document of "instructions for improving the work of dovetailing the supply, transport and demand of coal", which declared that the government would exit the negotiations between coal buyers and sellers.

From April 2009, Shanxi province, the most important coal production area, started its process of coal enterprise merger and reform. According to the Shanxi coal industry restructuring and revitalization plan, issued by the Shanxi provincial government, the number of coal mines in Shanxi would be reduced by 2011 from a total of 2598 to 1000. This would involve the closure of 'backward' small coal mines and the concentration of production to several larger enterprises that are stronger in terms of technology, management and financing.

OIL MARKET

In 2008, based on the Highway Law and other relevant regulations, the NDRC, the Ministry of Finance, the Ministry of Transport and the State Administration of Taxation jointly drafted a proposal on a fuel tax reform program. The program was approved by the State Council and took effect from 1 January 2009. The main aim of the reform is to standardise government fees and charges, and it includes two aspects. First, it abolishes 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 the government approval of road charges on secondary loans, which will be done gradually and in an orderly fashion. Second, the reform raises the gasoline consumption tax allowance from CNY 0.2 to CNY 1 per litre for gasoline and from CNY 0.1 to CNY 0.8 for diesel; the unit tax on other oil products also increases similarly. For gasoline and diesel oil, the consumption tax aims to implement a fixed amount of taxation rather than ad valorem taxation.

When the National Standardisation Technical Committee for the Oil and Natural Gas Industry was set up on 9 May 2008, China's oil and natural gas industry standardisation 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 pipes, offshore oil engineering, production safety and environmental protection.

NATURAL GAS MARKET

Natural gas can be considered high quality and relatively clean energy, with its high conversion efficiency, lower environment cost, low investment cost, and short construction

periods. There is an increasing global trend in actively developing natural gas resources, and China's energy industry is now rapidly expanding in this area. The industrial chain to end users of natural gas is extending, while diversification in natural gas consumption is increased. On 30 August 2007, China released its National Gas Utilization Policy, which was intended to ease natural gas supply and demand, and optimise the structure of natural gas utilisation.

The Chinese Government has been accelerating the establishment of a market-based pricing mechanism for natural gas products. The disadvantages of a government-controlled natural gas price are becoming apparent, with the domestic price of natural gas well below the international price of natural gas and alternative energy prices. The price of natural gas has also varied between domestic regions. On 31 May 2010, the NDRC issued a notification increasing the benchmark price of domestic onshore natural gas, which took effect on 1 June 2010. It aims to create an appropriate increase in the domestic natural gas price and improve related policies concerning natural gas prices and supporting measures (NDRC 2010).

The National Standardization Management Committee issued a standard for determining natural gas energy (GB/T22723-2008) in 2008, with effect from 1 August 2009. The committee also provided metering methods based on international practice.

The Emission Standard for Coal-bed Methane/Coal Mine Gas was issued in 2008, which called for better utilisation of coal-bed methane/coal-mine gas and the development of small-scale power sources based on use of the gas.

ELECTRICITY MARKET

As well as the energy-related legislation listed earlier, these laws also regulate the electricity industry in China: the Electricity Law, the Energy Conservation Law, the Renewable Energy Law, the Regulations on Electricity Regulation, and the Basic Operating Rules for the Electric Power Market.

The State Electricity Regulatory Commission regulates electricity trading and ensures that markets play a greater role in resources allocation. Its main aims are to:

- continue the construction of regional electricity market platforms and complete the regional electricity market model
- deepen cross-provincial power transaction standardisation
- promote direct transactions between power-generating companies and large users and independent power transmission and distribution companies, thus creating bilateral trading markets
- build up the joint factory system for information sharing
- improve the early warning system for demand and supply of power and thermal coal.

China's power shortage problems experienced early in the new century have been largely resolved. From 2002 to 2006, installed electricity generation capacity increased rapidly; that growth rate has slowed since 2007. The power structure is becoming more optimal as the share of coal-fired electricity decreases and hydropower increases.

Since 2007, China has accelerated the closing of inefficient small thermal power plants. The economy achieved its goal of shutting down 50 million kW capacity of such plants between 2006 and 2010 – reaching the target early, in June 2009.

In November 2009, the NDRC, the State Electricity Regulatory Commission and the NEA jointly issued a tariff adjustment program, which came into effect from 20 November 2009. Under the program, the economy-wide average sales price of electricity would increase by CNY 0.028 per kilowatt-hour. At the same time, opinions are being widely sought on a proposal to accelerate tariff reform. On 9 October 2010, NDRC released a draft guidance document on the implementation of a residential electricity step tariff—public feedback is sought on the proposal to change the existing single form of residential electricity pricing to segment pricing

according to levels of electricity consumption (i.e. if the user consumed more electricity, the incremental electricity use would be paid for at a higher price).

RENEWABLE ENERGY

The development of renewable energy in China is seen as inevitable, and of benefit to the sustainable development of society and the economy. China plans to vigorously develop renewable energy and nuclear energy, with the aim of reaching a 15% share for non-fossil fuels in its primary energy consumption by 2020.

China announced the Medium- and Long-term Development Plan for Renewable Energy in September 2007, the general goal of which is to raise the share of renewable energy steadily. It also aims to promote the development of renewable energy technologies and industries so that essential renewable energy equipment can be produced domestically by 2010, and local manufacture can be based mainly on home-grown intellectual property rights by 2020. The target for power from renewable energy is 300 million kW of hydro power, 30 million kW of wind power, 1.8 million kW of solar power, 30 million kW of biomass energy, and 0.1 million kW of tidal power by 2020. China is actively encouraging the application of solar thermal technologies to build an area of 300 million square metres of solar water heaters by 2020. China will also promote household biogas and livestock farm biogas to achieve annual use of 44 billion cubic metres by 2020. The draft Development Plan for the Emerging Energy Industry has been submitted to the State Council for approval; this proposes that the targets for solar power, wind power and nuclear power by 2020 are adjusted to be much more ambitious.

In order to ensure smooth implementation of the Renewable Energy Law, China has also developed a series of implementation rules for renewable energy, listed as follows.

- Related Regulation on Power Generation from Renewable Energy, issued in January 2006 by NDRC.
- Trial Procedures for Power Pricing and the Cost-sharing Management of Renewable Energy, issued in January 2006 by NDRC.
- Interim Measures for Allocation of Additional Revenue from Power Tariffs for Renewable Energy, issued in January 2007 by NDRC.
- Catalogue for the Development of the Renewable Energy Industry, issued in October 2005 by NDRC.
- Regulation Approach for Grid Enterprises for Full Purchase of Electricity from Renewable Energy, issued in May 2007 by the State Electricity Regulatory Commission.
- Technical Specifications for Civil Solar Heating Systems, issued in December 2005 by the Ministry of Construction.

There are also some specific implementation rules for power generation from biomass and bio-liquid fuel. On 18 July 2010, NDRC published a Notification about the Ideal Pricing for Power Generation using Agriculture and Forestry Biomass, which came into effect on 1 July 2010, and which requires the implementation of a benchmark electricity price policy for power generation projects using agricultural and forestry biomass. Uniform implementation of a benchmark electricity price of CNY 0.75 per kilowatt-hour (including tax) for the new projects means the price will not be determined by bidding.

Since 2006, China has introduced a series of financial and tax policies to boost the development of renewable energy power projects, including the following:

- The Interim Measures for the Administration of the Special Funds for the Industrialisation of Wind Power Generation Equipment (2008) stipulate that a subsidy be granted to any qualified enterprise for its first 50 wind power units at the rate of CNY 600 per kW.
- The Measures for the Administration of the Subsidy Funds for the Utilisation of Straw for Energy (2008) stipulate that the types and quantities of crop straw

consumed by a qualified enterprise be calculated according to the types and quantities of straw energy products that it actually sells each year and that a comprehensive subsidy, with funds from the central government, be granted to the enterprise at a certain rate.

- The Interim Measures for the Administration of the Subsidy Funds from Public Finance for the Application of Photovoltaic Solar Energy in Buildings (2009) stipulate that the standard for the subsidy be, in principle, CNY 20/Wp in 2009 and that the rate should be adjusted in line with the development of the industry in the future.
- The Interim Measures for the Administration of the Financial Subsidy Funds to the 'Gold Sun' Exemplary Projects (2009) stated that a photovoltaic solar power project that is connected to the power grid and falls within a specified scope should receive a subsidy equivalent to 50% of the total investment in its generation units and the accessory systems for power transmission and distribution. For independent power units in remote areas with no access to other power, the percentage should be 70%.
- The Notice on Perfecting the Policy on the On-grid Prices of Wind-generated Power (2009) stipulates that the benchmark prices for wind-generated power will be CNY 0.51, 0.54, 0.58 and 0.61 in four types of resource areas, further standardises the administration of wind power prices, and promotes the healthy development of the wind power industry.
- The Interim Measures for Management of Special Funds for Architectural Applications of Renewable Energy (2005), stipulates that buildings which use renewable energy for cooling, heating, lighting and cooking, may be eligible for government funding, following an evaluation and selection process.

In addition, China is involved in many international cooperative projects, including with the World Bank, Global Environment Facility (GEF), United Nations Foundation (UNF), United Nations Development Program (UNDP), as well as with Denmark, the Netherlands, Italy, Norway and Germany.

NUCLEAR

Development of nuclear energy has become an option to optimise China's energy structure, ensure energy security and improve environmental protection. A draft Regulation on Nuclear Energy Management is being developed. This will mainly focus on construction planning, nuclear energy development rights and obligations of parties involved, nuclear power plant operation supervision, and technical standards issues. The Management Approach for National Energy Storage of Natural Uranium is also being developed. Documents that came into effect in 2008 included the Regulation on Supervision and Control of Civil Nuclear Safety Equipment, and the Rules for Personnel Qualification Management for Non-destructive Testing of Civil Nuclear Safety Equipment. At the same time the Reporting System for Construction of Nuclear Energy Projects, and the Reporting System for Nuclear Power Plants in Operation were also issued by the NEA. To support the development of nuclear energy, in April 2008 the Ministry of Finance and the State Administration of Taxation jointly issued a notice about taxation policy for the nuclear energy industry (Tax 2008, no. 38). According to the notice, the sale of electric power generation products, after the month that commercial nuclear energy generating units are put into operation, follows a unified policy of 'reimburse after levying value-added tax'. The return is 75% of the total tax in the first five years, 70% in the second five years, and 55% in the third five years.

The Medium- and Long-Term Nuclear Energy Development Plan (2005–2020), issued in 2007, planned for the total nuclear energy installed capacity to reach 40 million kW by 2020, and for the annual generation capacity of nuclear energy to reach 260–280 billion kilowatt-hours. An additional 18 million kW of installed capacity is expected to be under construction at the end of 2020. China approved three nuclear energy projects totalling 14 million kW in 2009. By the end of 2009, the installed capacity of nuclear power plants was 9.08 million kW, and at that time had

under construction units totalling almost 21.92 million kW (CEC 2010), giving it the biggest nuclear energy program in the world. Given the recent rapid expansion of the nuclear energy industry, China is now considering lifting the target for nuclear energy installed capacity by 2020 to about 80 million kW, nearly double the original target; the total investment is now expected to reach CNY 900 billion (Cui 2010).

ENERGY EFFICIENCY

China has a comprehensive program focusing on promoting energy conservation and reducing emissions. Recent initiatives include strengthening accountability systems for measuring energy efficiency, and continued phasing out of inefficient and high emission production units in key industries and sectors.

In the Eleventh Five-year Plan, the government set a target of decreasing energy intensity (energy consumption per unit of GDP) by 20% from the 2005 level by 2010, and reducing emissions of major pollutants by 10% by 2010—the equivalent of reducing energy consumption from 1.28 tonnes to 1.02 tonnes of coal per CNY 10 000 of GDP. If this target were achieved, it could save 620 Mt of standard coal equivalent and reduce CO_2 emissions by 15 Mt. The main measures implemented to achieve the target include strengthening the responsibility and accountability expectations; strict control of 'heavy energy consumption and heavy pollution'; elimination of outdated production capacity, including the closure of small coal mines, electricity plants, refineries, and iron and steel production plants; promotion of energy-efficient products; improvement of the energy structure; development of economic incentive policies and establishment of a long-term mechanism for energy conservation; improvement of the regulations and standards, with accompanying strengthening of supervision and inspection; economy-wide initiatives to strengthen the guidance of consumers; and the introduction of efficient technologies throughout the energy supply chain, from production and transportation through to consumption.

Overall the Chinese Government considers the adjustment of economic structures and the transformation of economic development patterns to be important. It has formulated and implemented a series of industrial policies and special programs with resource and energy conservation as important components, and has promoted the optimisation and upgrading of industrial structures, to form a pattern of economic growth with less input, less consumption, fewer emissions and higher efficiency.

In recent years, the State Council issued several important laws and regulations on energy conservation. Besides the revised Energy Conservation Law (issued on 28 October 2007, effective from 1 April 2008), the State Council issued the Public Sector Energy Saving Regulation on 2 August 2008 (effective from 1 October 2008). On the same day, the General Office of the 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 published. The Chinese Government also published the Notification about Further Strengthening Fuel-efficiency and Power-saving.

In July 2006 the NDRC and other departments issued the Opinion on Implementing 10 Key Projects of Energy Conservation in the 'Eleventh Five-year Plan' Period, based on the Mid- and Long-term Special Plan for Energy Conservation. The economy is expected to conserve 240 Mtce (168 Mtoe), and thereby reduce CO_2 emissions by 550 Mt, during the Eleventh Five-year Plan period (NDRC 2009).

The Standardization Administration has approved 46 economy-wide standards supporting the Energy Conservation Law since 2007, most of which have been in effect since 1 June 2008, including 22 mandatory standards on the limitation of energy consumption of energy-intensive products, 11 mandatory energy-efficiency standards for energy end-use products, and five vehicle fuel economy standards. China issued catalogues of the fifth batch of products for energy-efficiency labelling in 2009 together with implementation rules, increasing the number of products subject to energy-efficiency labelling to 19 at the end of 2009. In addition, there is a voluntary label in China, the energy-efficiency endorsement label, which at the end of 2009

covered 60 categories of products. The Ministry of House and Urban–Rural Development has issued three energy-efficiency design standards for residential buildings, one for public buildings and one design standard for efficient lighting systems.

In order to support energy performance contracting projects and promote the development of the energy service industry in China, the Ministry of Finance and NDRC jointly issued a notification about the Interim Measures for Funding Financial Incentives for Energy Performance Contracting Projects on 3 June 2010. The government will provide one-off funding to the energy conservation service company according to the energy conserved.

On 17 September 2010, NDRC published a regulation on Interim Measures for Energy Assessment and Review of Fixed Assets Investment Projects, which aims to strengthen the management of energy conservation in fixed asset investment projects.

In August 2010, a new government procurement list was issued, as a part of the System of Government Procurement of Energy-efficient Products: 28 categories covering about 30 000 models produced by 605 manufacturers were on the list. For nine categories it is compulsory to purchase from the energy-efficient list; this includes air conditioners, four lighting products, televisions, water heaters, computers, printers, monitors, toilets and water nozzles.

PROGRAM OF BENEFITING THE PUBLIC THROUGH ENERGY-EFFICIENT PRODUCTS

The Program to Benefit the Public through Energy-efficient Products, implemented from May 2009, covers financial subsidies for energy-efficient products with first or second grade energy efficiency in 10 categories (air-conditioners, refrigerators, washing machines, flat panel televisions, microwave ovens, electric cookers, induction cookers, water heaters, computer monitors and electric motors). The program aims to promote domestic demand for efficient products by subsidising manufacture of efficient equipment (local governments are also subsidised to procure efficient equipment). The subsidies aim to close the price gap between energy-efficient products and other products. The implementation of the program is expected to increase the demand for energy-efficient products and to increase their market share by 10–20 percentage points, reaching 30%. It could save more than 75 billion kilowatt hours of electricity each year and reduce CO_2 emissions by 75 Mt.

After 1 June 2010, the subsidy for high-efficiency air conditioners has been set at CNY 200–250 per set for grade 1, and CNY 150–200 per set for grade 2. Air conditioners were the first product subsidised, followed by passenger cars and motors. The implementation rules for the energy-efficient passenger cars incentive program have been issued, taking effect on 1 June 2010. The first and second versions of the product list of energy-efficient passenger cars have been issued: 140 models produced by 22 manufacturers were on the list. In August 2010, the first product list of energy-efficient motors was issued, covering 996 models of small and middle-sized three-phrase asynchronous motors produced by 11 manufacturers and 65 models of rare-earth permanent magnet three-phrase synchronous motor produced by three manufacturers. The subsidy for high-efficiency motors will be CNY 15–40/kW and CNY 40–60/kW, based on the energy-efficiency grade (NDRC 2010).

In February 2009, the Provisional Measures for the Administration of the Public Finance Funds for Subsidising the Demonstration and Promotion of Energy-efficient Vehicles and New Energy Vehicles were issued by the Ministry of Finance and the Ministry of Science and Technology. This supported 13 cities, including Beijing, to take the lead in popularising the use of these vehicles in the public service sectors (such as public transport, taxi services, government work, sanitation and postal services) and provided subsidies for the purchase of the cars and the construction of required facilities. In addition, China lowered the excise tax for small cars to encourage the purchase of energy-saving cars from September 2008. The Ministry of Finance and the State Administration of Taxation announced a change in the policy on car consumption tax. The change raised the rate of this tax from 15% to 25% for large passenger cars (3–4 litre engine capacity) and from 20% to 40% for cars with engines over 4 litres, and lowered the rate from 3% to 1% for cars with engines of 1 litre or less.

CLIMATE CHANGE

China regards addressing climate change as a strategic task. Deeply cognisant of the complexity and impacts of climate change and fully aware of the difficulty and urgency of the task of addressing climate change, the Chinese Government is determined to do so while pursuing sustainable development. In 2006, the aim of 'Controlling the emission of greenhouse gases' was incorporated into the Eleventh Five-year Plan. In June 2007, China's National Climate Change Programme was issued by the State Council. In 2008, the Chinese Government published a White Paper on China's Policies and Actions for Addressing Climate Change, describing the policies and actions that the economy had adopted for addressing climate change and the progress it had made. Follow-up annual progress reports have been issued at the end of every year since 2009. In addition, nearly all provinces of China have developed province-level programs to address climate change, most of which are under implementation.

In November 2009, the State Council decided on an action target for greenhouse gas emissions, cutting CO_2 emissions per unit of GDP by 40%–45% by 2020 from the 2005 level. This target will be integrated into the long- to medium-term plan for economic and social development, with corresponding measures for domestic statistics, monitoring and evaluation. China will intensify efforts to conserve energy and improve energy efficiency; vigorously develop renewable energy and nuclear energy; increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020; energetically increase its forest carbon sink (increasing forest coverage by 40 million hectares and forest stock volume by 1.3 bcm by 2020 from 2005 levels); step up efforts to develop a green, low-carbon and circular economy; and enhance research, development and dissemination of climate-friendly technologies.

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol, China is committed to the UNFCCC and the implementation of the Kyoto Protocol. At the UN climate change conference in Copenhagen in December 2009, China reiterated its position on climate change: that the UNFCCC and its Kyoto Protocol should be the basis and the mandate of the Bali Roadmap should be the focus; developed countries and developing countries should take common but differentiated responsibilities; within the overall framework of sustainable development, economic development, poverty eradication and climate protection should be considered in a holistic and integrated manner so as to reach a win-win solution and to ensure developing countries secure their right to development; mitigation, adaption, technology transfer and financial support should be on the same footing and have equal priority. It is emphasised that China's target for mitigating greenhouse gas emissions, which is founded on a sense of responsibility to the Chinese people and the whole of mankind, has not been attached to any condition or been linked to any other country. China will be fully committed to achieving and even exceeding the target.

Notable energy developments

COAL INDUSTRY

In December 2009, after 16 years state control of coal prices, the government completely pulled out of price negotiations on coal. Investment in fixed assets in the coal industry continued to increase rapidly, from CNY 116.3 billion in 2005 to CNY 305.7 billion in 2009. The production of coal increased in 2009, but because of continued sluggish exports, China became a net importer of coal in 2009. While China seeks to decrease coal's dominance in its primary energy mix, it also focuses on improving the efficiency of coal use, and strives to increase the proportion of coal in processing conversion. On 6 July 2009, construction began on China's first self-developed, designed, manufactured and constructed integrated gasification combined cycle power generation systems (IGCC) Demonstration Project – the Huaneng 'green coal' Tianjin IGCC demonstration power plant. The first unit is scheduled to be built in 2011. The move indicated that China's clean coal technology achieve substantive progress.

OIL INDUSTRY

In 2009, domestic oil production declined a little while downstream processing capacity of petroleum and petrochemicals expanded rapidly. The import of crude oil reached 203.79 million tonnes. There has also been fast growth in construction of oil industry infrastructure. The introduction of market-oriented pricing mechanisms in the oil industry has been controversial. From 1 January 2009, domestic refined oil prices were controlled indirectly by linking them to the international market price of crude oil. China has expanded its global oil assets, and has strengthened its energy security through new bilateral cooperation. On 1 November 2010, the first crude oil pipeline between China and Russia began its trial run, which will allow the transport of 15 million tonnes of crude oil a year.

NATURAL GAS INDUSTRY

There has been rapid expansion in China's gas pipeline capacity. By the end of 2008, about 35 000 kilometres of pipeline was built, with a total trunk-line transmission capacity of nearly 40 bcm per year. In December 2009, the China–Central Asia natural gas pipeline was completed, passing through China, Turkmenistan, Kazakhstan and Uzbekistan. Pipelines such as a second West–East gas pipeline and a Sichuan–East China gas transmission pipeline are under construction—the second West–East pipeline will be a main energy artery totalling 9139 kilometres and passing through 14 provinces and municipalities in China. Over the next 10 years, more than 25 000 kilometres of pipeline are expected to be commissioned, to form a gas trunk line network 'running through east–west and north–south and connecting overseas'.

The natural gas market in China is maturing, with an increase in companies in China involved in overseas mergers and acquisitions. During the first half of 2009, overseas mergers and acquisitions by Chinese companies increased by 40% compared with same period in the previous year, while the world total decreased by 35% (Cui 2010).

A Notification on the Increase of the Benchmark Price of Domestic Onshore Natural Gas issued by NDRC became effective on 1 June 2010; this aimed to appropriately increase the domestic natural gas price and to publicise related policies about natural gas pricing and supporting measures.

ELECTRICITY

The restructuring of China's power industry continued in 2009. Market competition has been introduced to power generation, and is increasing. However, state-owned generation still dominates, with the five big central-government-owned generation enterprises accounting for 48.15% of total installed capacity, while the power grids of China are monopolised by two state-owned grid companies.

The total 2009 electricity consumption in China was 3659.5 TWh. That year 24 100 000 MWh of electricity was traded, an increase of 18.01% over the previous year. Electricity imports reached 6 100 000 MWh, up 72.06%, and electricity exports reached 18 000 000 MWh, up 6.62%. Power tariffs in China are set by the government, and include feed-in tariffs, transmission and distribution tariffs, and retail power tariffs. In 2009, the feed-in tariff for thermal power generation enterprises was raised as a whole. The average transmission and distribution tariff (excluding transmission line losses) charged by main power grid companies was CNY 125.28 (excluding government funding or subsidy); this accounted for 23.45% of the retail power tariff (AESIEAP 2010).

China is now leading the world in ultra high voltage (UHV) power transmission technology. UHV is defined as voltages of 1000 KV alternating current or higher, and 800 KV direct current or higher. This technology has the advantage of delivering large quantities of power over very long distances with very little loss of power. In 2009, the Jindongnan–Jingmen 1000 KV Ultra High Voltage AC test and demonstration project was put into commercial operation. The Xiangjiaba–Shanghai 800 KV Ultra High Voltage DC power transmission project was also successfully energised. China is now actively working on UHV standards with the relevant international organisations. At the end of 2009, China had twenty-one 1000 MW ultra-

supercritical generating units under operation, more than any other economy in the world. There are another 14 units under construction (AESIEAP 2010).

The development of new and renewable energy sources has been rapid in China, and the share of renewable energy in total primary energy consumption has increased significantly. In 2009, newly installed hydropower capacity increased by 21.06 GW, and total hydropower capacity reached 196.29 GW—the highest in the world. The 2009 breakdown of newly installed renewable energy capacity was 9730 MW from wind power, 27.9 MW from solar power, 232 MW from biomass power and 113MW from waste-burnt power. The total electricity generation from renewable energy in 2009 was 662.76 TWh (18% of China's electricity production) (CEC 2010).

By the end of 2009, China had put into operation 11 nuclear reactors with a total installed capacity of 9.08 GW, accounting for 1.04% of the total installed capacity in the economy, and 20 nuclear power units with a total installed capacity of 21.92 GW were being built, making China the economy with the most nuclear energy capacity under construction (CEC 2010). In April 2009, the world's first reactor with third-generation AP1000 nuclear energy units was under construction in Zhejiang Province.

By the end of 2009, China's total accumulated installed power generation capacity reached 874 million kW, a 10.23% increase from the previous year. Total investment in the electricity sector in 2009 was CNY 755.84 billion, 19.93% higher than the previous year. Investment in wind power increased by 43.9%, and investment in nuclear energy had increased by 74.91% over the previous year. The investment in the power grid system was CNY 384.71 billion in 2009, an increase of 32.89%, accounting for 50.9% of the total investment in electricity sector (CEC 2010).

China has sped up the elimination of small thermal power units with high energy consumption and high pollution. From 2006 to 2009, China eliminated 60.06 million kW of small thermal power units, and from January 2010 to July 2010, China achieved the further elimination of 11 million kW of this kind of power production. China is now on track to build a diversified power supply system for low-carbon development, by optimising its power generation structure, and strengthening management and energy conservation. The structure of the generation sector has been changing as the total installed generation capacity grows, with a greater share coming from hydropower, nuclear power, wind power and other low-carbon energy.

ENERGY CONSERVATION AND ENVIRONMENTAL PROTECTION

China has progressed in energy conservation and environmental protection. During the period from 2006 to 2009, 60.06 million kW of small thermal power capacity was closed, and China eliminated 81.72 Mt of outdated iron-smelting capacity, 60.38 Mt of 'backward' steel production capacity, and 214 Mt of 'backward' cement production capacity – demonstrating the effective adjustment of economic structures. From 2006 to 2009, the total energy intensity per unit of GDP declined by 15.61%, and accumulated energy savings reached 490 Mtce (343 Mtoe), equivalent to reducing CO_2 emissions by 1100 million tonnes. By the end of 2008, the utilisation of renewable energy including hydropower and nuclear power reached 250 Mtce (175 Mtoe). Biogas was used by 30.5 million households in the countryside, which reduced CO_2 emissions by 49 million tonnes. The installed capacity of hydropower and the surface area of solar water heating systems are the highest in the world, while the installed capacity of wind power is the second highest. The percentage of land under forest coverage in China is 20.36% (CCD 2010).

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USEFUL LINKS

China Electricity Council (CEC)—www.cec.org.cn

Energy Research Institute of National Development and Reform Commission (ERI)—www.eri.org.cn

Ministry of Environmental Protection (MEP)—www.zhb.gov.cn

Ministry of Housing and Urban–Rural Development—www.mohurd.gov.cn

Ministry of Science and Technology—www.most.gov.cn

National Bureau of Statistics (NBS)—www.stats.gov.cn

National Development and Reform Commission (NDRC)—www.ndrc.gov.cn

National Energy Administration (NEA)—http://nyj.ndrc.gov.cn

Standardization Administration—www.sac.gov.cn

HONG KONG, CHINA

Introduction

Hong Kong, China—a special administrative region of the People's Republic of China—is a world-class financial, trading and business centre of some 6.98 million people situated at the south-eastern tip of China. It has 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 2008, the per capita GDP of Hong Kong, China, was USD 35 912, among the highest of the Asia–Pacific Economic Cooperation (APEC) economies. GDP expanded by a robust 2.37% in real terms in 2008. The services sector remained the dominant driving force of overall economic growth, accounting for 92% of GDP in 2008 (CSD 2010a).

The economy of Hong Kong, China, is driven by its vibrant financial services sector. The shift towards higher value-added services and a knowledge-based economy will continue. To stay competitive and attain sustainable growth, Hong Kong, China, needs to restructure and reposition 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 'one country, two systems'. As part of the liberalisation of trade in goods under CEPA, all products originating in Hong Kong, China, enjoy tariff-free access to mainland China on application by local manufacturers, provided all CEPA rules of origin are agreed and met. Since January 2008, the economy's service suppliers have enjoyed preferential treatment in 38 service areas in mainland China (HKTID 2010). In addition, the Pan–Pearl River Delta Regional Co-operation Framework Agreement has brought more business opportunities for Hong Kong, China. In October 2007, the government announced it was 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.

Table 9 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	1 104	Oil (million barrels)	–
Population (million)	6.98	Gas (billion cubic metres)	–
GDP (USD (2000) billion at PPP)	250.58	Coal (million tonnes)	–
GDP (USD (2000) per capita at PPP)	35 912		

Source: EDMC (2010).

Energy supply and demand

PRIMARY ENERGY SUPPLY

Hong Kong, China, has no domestic energy reserves or petroleum refineries; it imports all of its primary energy needs. It generates some electricity. Total primary energy supply in Hong Kong, China, was 13.8 million tonnes of oil equivalent (Mtoe) in 2008, a decrease of 4.05% from 2007. Coal maintained the highest share of the total primary energy supply (51%), followed by oil (29%), gas (14%) and other sources (6%).

In 2009, the total installed electricity generating capacity in Hong Kong, China, was 12 644 MW (CSD 2010b), including 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 (2500 MW), Castle Peak (4108 MW) and Penny's Bay (300 MW) power stations. Natural gas and coal are the main fuels used for electricity generation at the Black Point and Castle Peak power stations. 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 also has the right to use 50% of the 1200 MW capacity of Phase 1 of the Guangzhou Pumped Storage Power Station at Conghua. HEC's electricity is supplied by the Lamma Power Station, which has a total installed capacity of 3756 MW. Natural gas used at HEC's power station is mainly imported through a submarine pipeline from the Dapeng liquefied natural gas (LNG) terminal in Guangdong, China. HEC has also operated a commercial wind turbine (800 kW) since February 2006 (HEC 2010).

Table 10 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	103	Industry sector	658	Total[a] (gross)	39191
Net imports and other	25192	Transport sector	2 154	Thermal	39191
Total PES	13 762	Other sectors	4141	Hydro	–
Coal	6 850	Total FEC	6 850	Nuclear	–
Oil	3 917	Coal	–	Other	–
Gas	2221	Oil	2 666		
Other	774	Gas	659		
		Electricity and other	3 523		

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

Source: EDMC (2010).

Town gas and liquefied petroleum gas (LPG) are the two main types of fuel gas used in Hong Kong, China. Town gas is distributed by the Hong Kong and China Gas Company Limited. It is manufactured at plants in Tai Po and Ma Tau Kok, using naphtha and natural gas as feedstock. LPG is supplied by oil companies, imported into Hong Kong, China, by sea and stored at the five terminals on Tsing Yi Island (Towngas 2010).

FINAL ENERGY CONSUMPTION

In 2008, the total final energy consumption in Hong Kong, China, was 6879 ktoe, almost 2.2% lower than in the previous year. The other sectors (residential and commercial) accounted for the largest share at 58%, followed by the transport sector (31%) and the industrial sector (11%). By energy source, electricity and other made up 51% of end-use consumption, followed by petroleum products (40%), and gas (8.7%).

Gas is supplied for domestic, commercial and industrial uses in two main forms—town gas and LPG. In addition, LPG is used as a fuel for LPG taxis and light buses, and natural gas is used for electricity generation and city gas production.

Policy overview

ENERGY POLICY FRAMEWORK

The government of Hong Kong, China has pursued two key energy policy objectives. The first is to ensure the energy needs of the community are met safely, efficiently and at reasonable prices. The second is to minimise the environmental effects of energy production and consumption, and to promote the efficient use and conservation of energy. In keeping with the free market economic policy of Hong Kong, China, the government intervenes only when it is necessary to safeguard the interests of consumers, to ensure public safety and to 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 power companies' performances through the Scheme of Control Agreements and, in consultation with the power companies, promotes energy efficiency and energy-saving measures. It has also entered into an information and consultation agreement with the Hong Kong and China Gas Company Limited to make the town gas tariff adjustment mechanism more transparent.

ENERGY MARKETS

A memorandum of understanding signed by the government and the National Energy Bureau on 28 August 2008 ensures the long-term and stable supply of nuclear-generated electricity, and the supply of natural gas from three different sources: offshore gas, piped gas and LNG from a LNG terminal to be built as a joint venture on a neighbouring mainland China site. Gas-fired power plants generated 23% of the economy's electricity in 2009. To improve air quality and to address the challenges posed by global warming, the government is exploring ways to gradually increase the use of clean energy.

ENERGY EFFICIENCY

BUILDINGS

Energy consumption indicators and benchmarks have been developed for hospitals, clinics, universities, schools, hotels and boarding houses, offices and commercial outlets in the commercial sector. The periodically-updated indicators and benchmarks help users to compare energy efficiency performances and to identify and implement improvements. The indicators and benchmarking tools are available on the Electrical and Mechanical Services Department's website (EMSD 2010a).

A voluntary Energy Efficiency Labelling Scheme (EELS) covers 18 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.

To further encourage the use of energy-efficient products, the government introduced a mandatory EELS through the Energy Efficiency (Labelling of Products) Ordinance (EMSD 2010b). The initial phase of the mandatory EELS, covering room air conditioners, refrigerating appliances and compact fluorescent lamps, was implemented in November 2009. The second phase of the mandatory scheme, covering washing machines and dehumidifiers, started in March 2010 with an 18-month grace period.

The government has been promoting a voluntary building energy code (BEC) since 1998 through its Hong Kong Energy Efficiency Registration Scheme for Buildings. The BEC covers prescriptive minimum energy performance standards (MEPS) on lighting, air conditioning, electrical and lift and escalator installations. The government also takes an alternative performance-based approach to a building's total energy consumption as compared to the energy budget of a hypothetical building which can meet all prescriptive code requirements. Since March 2007, an alternative certification path for energy-audited buildings with good energy performance has been provided. By December 2009, 1086 building venues had been registered under the scheme.

To further enhance energy efficiency in buildings, the government introduced the Buildings Energy Efficiency Bill into the Legislative Council (LegCo) in December 2009 to start the vetting procedures for mandatory compliance with the BEC. The Bill was passed in November 2010 and the Buildings Energy Efficiency Ordinance was gazetted in December 2010. With an 18-month grace period, the Ordinance is expected to be fully implemented by mid-2012. It is estimated mandatory compliance will result in an energy saving of 2.8 billion kWh for new buildings in the first 10 years of the Ordinance's implementation. This will contribute to a reduction in carbon

dioxide emissions of 1.96 million tonnes. Further energy savings will be realised in existing buildings constructed before the new legislation came into effect, by requiring compliance with the BEC when prescribed major retrofitting works are carried out in these buildings.

In October 2008, the government of Hong Kong, China, announced a district cooling system (DCS) would be implemented at the new Kai Tak Development as one of the measures to promote energy efficient buildings. The proposed DCS will have a designed cooling capacity of 284 MW and will supply chilled water to non-domestic buildings for centralised air conditioning. The project will be developed in phases and the design and construction work is targeted to start in 2011 to match the schedule of development at Kai Tak.

Water-cooled air conditioning systems using cooling towers are more energy efficient than conventional air-cooled systems. To promote energy efficiency in buildings, the government launched a scheme for the wider use of fresh-water cooling towers for air-conditioning systems in 2000; it became a standing scheme in June 2008. The number of designated areas has expanded from an initial six areas to 102 as at the end of November 2010. The scheme now covers about 78% of the non-domestic floor area of Hong Kong, China, and 268 cooling tower installations have been completed and put into operation. It is estimated these installations could save up to 194 million kWh of electricity consumption and reduce carbon dioxide emissions by 136 000 tonnes per year.

In April 2009, the government promoted a comprehensive target-based green performance framework (the framework) for new and existing government buildings and set targets on various aspects of environmental performance. It also aims to achieve a 5% saving on the total electricity consumption in government buildings from 2009–10 to 2013–14 after discounting activity changes, using the electricity consumption in 2007–08 as the baseline.

The government has allocated HKD 450 million from the 2009–10 Budget to improve the green performance of government buildings, such as installing energy efficient lighting systems, retrofitting plumbing with water saving devices and incorporating energy efficient features in air conditioning, lift and escalator systems. Furthermore, the government has allocated an additional HKD 130 million in 2009–10 to carry out works to enhance the energy efficiency of government buildings and public utilities.

Two funding schemes totalling HKD 450 million were launched under the Environment and Conservation Fund in April 2009, to encourage building owners to carry out energy/carbon audits and energy efficiency projects. These schemes will create business opportunities for electrical, mechanical, building services and environmental and related industries. As at November 2010, there were over 600 audits/projects approved, with an estimated energy saving of about 106 million kWh or a carbon dioxide emission reduction of about 74 600 tonnes per year.

TRANSPORT

Energy consumption indicators and benchmarks have also been developed for private cars and light, medium and heavy goods vehicles in the transport sector. The indicators and benchmarks are updated periodically so users can compare energy efficiency performances, and identify and implement improvements. The indicators and benchmarking tools are available on the Electrical and Mechanical Services Department's website (EMSD 2010a).

The voluntary Energy Efficiency Labelling Scheme was extended to cover petrol passenger cars in 2002, to raise the level of public awareness of vehicle energy efficiency.

A competition entitled 'Eco-drivers' was launched in September 2008. This fuel economy run aimed to raise the awareness of energy and fuel conservation and the role it plays in sustainable development, and called for public actions to realise this principle in daily life, particularly through driving.

In Hong Kong, China, almost all the diesel taxis have 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 electric models. The scheme finished at the end of 2005; but as of the end of 2009, there were over 3100 LPG light buses in operation, representing about 49% of all public/private light buses in Hong Kong, China. Taking the leading role in the use of green vehicles, the government introduced petrol-electric hybrid vehicles in its vehicle fleet in 2005. From April 2007, the government has allowed a reduction of First Registration Tax to encourage car owners to use environment-friendly petrol private cars. A similar scheme to encourage the use of environment-friendly commercial vehicles was launched in April 2008. In addition, the government is continuously identifying possible ways to encourage vehicle owners to use cleaner alternative fuel vehicles.

In the 2009–10 Budget, the Financial Secretary announced measures to promote the use of electric vehicles in Hong Kong, China. These measures include extending the waiver of First Registration Tax on electric vehicles for five years until the end of March 2014, promoting the setting up of electric vehicle (EV) battery charging facilities, and setting up a steering committee to make recommendations on strategy and specific measures for their promotion. In the 2010–11 Budget, it was further proposed to accelerate the tax deduction for capital expenditure on electric vehicles so enterprises can enjoy a 100% profits tax deduction in the first year. The budget also proposed a HKD 300 million Pilot Green Transport Fund to provide funding support for the transport industry to introduce more innovative green technologies, including electric vehicles. Electric vehicles such as 'MyCar', Mitsubishi's 'i-MiEV' and Tesla's 'Roadster', have already been launched in the retail market in Hong Kong, China, and more new models are expected. By mid-2010, the two local power companies had set up around 60 EV charging points in the territory. The government is soliciting the support of property developers to sponsor the setting up of EV charging facilities at their developments. It is expected that there has been a substantial increase in the number of EV charging points in Hong Kong, China, by the end 2010.

DATA

The government maintains and updates an energy end-use database. The database provides a useful insight into the energy consumption patterns of different sectors, sub-sectors and end uses in Hong Kong, China. The Hong Kong Energy End-use Data 2010, using 2008 basic data, is publically available on the Electrical and Mechanical Services Department's website (EMSD 2010c).

RENEWABLE ENERGY

To support the development of renewable energy (RE) in Hong Kong, China, the government has put in place provisions under a new Scheme of Control Agreements for the two power companies, to encourage them to use RE and to invest in RE facilities. In the new agreements, power companies will enjoy a higher permitted rate of return of 11% for their investment in RE facilities, compared with a return of 9.99% for ordinary investments. The power companies will also be offered a bonus in the range of 0.01 to 0.05 percentage points on their return, depending on the extent of RE usage in their electricity generation.

To promote the wider use of RE in the community, the government provided tax incentives for RE installations during the 2008–09 assessment year. In view of the increasing popularity of RE installations, it has published a set of technical guidelines to help the public better understand the technical issues and the application procedures for grid connections of RE power systems. The guidelines apply to RE power systems with a rating up to 1 MW and are publically available on the Electrical and Mechanical Services Department's website. The government has also developed the Hong Kong Renewable Energy Net website (HK RE Net) to provide comprehensive information on renewable energy technologies, with an emphasis on those technologies suitable for applications in Hong Kong, China (EMSD 2007).

The findings of a government-commissioned study to investigate the viability of using renewable energy technologies suggested the eastern side of Hong Kong, China, may have sufficient wind resources for commercial wind farms. Five wind-monitoring stations were erected

at the Government Logistics Centre, Pottinger Peak, Town Island, Tung Lung Chau and Miu Tsai Tun to gather wind resource data in the region. The wind data collected at the five stations has been analysed and, with data collected from the Hong Kong Observatory, used to produce a detailed wind resource map covering all parts of the Hong Kong, China, territories. The map and an online wind resources calculator are publically available through the HK Sustainable Technology Net portal site (EMSD 2008). The technical guidelines for grid connections of small-scale RE power systems are on the Electrical and Mechanical Services Department's website.

A 350 kW photovoltaic (PV) installation, the largest in Hong Kong, China, has been installed on the roof of the EMSD headquarters in Kowloon Bay. It comprises (1) a solar array made up of more than 2300 PV modules which together has a total area of around 3180 m^2, and (2) a smaller system made up of PV glass laminates (EMSD 2009). The largest solar power system in Hong Kong, China, was commissioned by HEC on Lamma Island in July 2010.

NUCLEAR

CLP Power is contracted to purchase around 70% of the electricity generated by the two 984 MW pressurised water reactors at the Guangdong Daya Bay Nuclear Power Station at Daya Bay in mainland China, to help meet the long-term demand for electricity in its supply area (CLP 2010). In September 2009, the government approved the extension of CLP Power's contract for the supply of nuclear-generated electricity from Guangdong Daya Bay Nuclear Power Station for another 20 years, from 7 May 2014. The extension of the contract ensures a continued supply of cleaner electricity to Hong Kong, China, which will help to alleviate air pollution and greenhouse gas emissions locally.

CLIMATE CHANGE

The government aims to reduce the energy intensity of GDP by 25% by 2030 relative to 2005 levels, and to reduce electricity consumption in government buildings by 5% by 2013–14 relative to 2009–10 levels. It will also make efforts in support of China's target to reduce carbon intensity.

In July 2008, to help the users and managers of buildings to enhance their awareness of greenhouse gas (GHG) emissions, to measure the GHG emissions performance of their buildings and to voluntarily participate in reducing and/or offsetting GHG emissions to combat climate change, the government 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 (also known as the carbon audit guidelines). The guidelines have been designed for voluntary and self-reporting by the reporting entities, and they provide a systematic and scientific approach to accounting for and reporting on GHG emissions and emissions removals from buildings. In February 2010, a revised edition of the guidelines with updated emission factors was made publically available on the Environmental Protection Department's website (EMSD 2010d). At the same time the government launched the Green Hong Kong Carbon Audit campaign. Organisations from all sectors are encouraged to join the campaign as Carbon Audit Green Partners to conduct or help to conduct carbon audits on their buildings, and/or to initiate carbon reduction programs according to the Carbon Reduction Charter. By the end of November 2010, over 210 organisations from various sectors had joined the Carbon Audit Green Partners scheme.

Notable energy developments

REDUCING GREENHOUSE GAS EMISSIONS OF POWER GENERATION

Power generation is the largest source of greenhouse gas (GHG) emissions in Hong Kong, China. Revamping the fuel mix for local power generation is an essential step for suppressing the economy's GHG emissions and carbon intensity. In 2009, coal (about 54%) dominated the fuel mix for power generation in Hong Kong, China, followed by natural gas (about 23%) and nuclear-generated power imported from mainland China (about 23%). A consultation document

on climate change, rolled out in September 2010, proposes a revamp of the fuel mix by 2020 as follows:

1. To keep coal-fired power plants at a very low utilisation rate or as a reserve, such that coal would account for no more than 10% of the fuel mix
2. To increase the share of natural gas in the fuel mix to around 40%
3. To use substantially more non-fossil low-carbon fuels, such that renewable energy would make up about 3%–4% of the fuel mix, and the balance of about 50% would be met by imported nuclear-generated power.

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useful links

Census and Statistics Department—www.censtatd.gov.hk

Electrical and Mechanical Services Department—www.emsd.gov.hk
Environment Bureau—www.enb.gov.hk
Environmental Protection Department—www.epd.gov.hk
Transport Department—www.td.gov.hk

INDONESIA

INTRODUCTION

Indonesia is a large archipelago located south-east of mainland South-East Asia, between the Pacific Ocean and the Indian Ocean. 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 Indonesia's Exclusive Economic Zone). Indonesia's total land area (24.4% of its territory) is about 1.82 million square kilometres. The population was 227.35 million in 2008.

Indonesia had a gross domestic product (GDP) of USD 741.78 billion and a per capita GDP of USD 3263 in 2008 (USD (2000) at PPP). Manufacturing accounted for the largest component of GDP in 2008 (26.8%), followed by retail, hotel and restaurant (17.5%); agriculture, livestock, forestry and fisheries (13.7%); finance, leasing and corporate services (9.5%); other services (9.3%); mining and quarrying (8.3%); transport and communications (8.0%); construction (6.3%); and electricity, gas and water supply (0.7%). In 2008, Indonesia attained economic growth of 6.06%, a decline from 6.27% in 2007.

Indigenous oil, gas and coal reserves have played an important role in Indonesia's economy as a source of energy, industrial raw material and foreign exchange. In 2008, oil and gas exports contributed 21.2% of Indonesia's total exports of USD 136.76 billion; mineral exports (including coal) contributed 10.8%. Overall, tax and non-tax revenue from oil, gas and minerals accounted for 24.6% of the Indonesian Government's budget in 2008.

Indonesia's proven fossil energy reserves at the end of 2008 comprised 3.7 billion barrels of oil (2007: 4.0 billion barrels); 3.18 trillion cubic metres of natural gas (2007: 3.0 trillion cubic metres); and 4 328 million tonnes (Mt) of coal (2007: 4 328 Mt).

Table 11 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (million sq. km)	7.89	Oil (billion barrels)	3.7
Population (million)	227.35	Gas (trillion cubic metres)	3.18
GDP (USD (2000) billion at PPP)	741.78	Coal (million tonnes)	4 328
GDP (USD (2000) per capita at PPP)	3 263		

a Proven reserves at the end of 2008 (BP 2009).

Source: EDMC (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, Indonesia's total primary energy supply (TPES) was 157 722 ktoe of commercial energy—made up of oil (44.5%), coal (25.8%), natural gas (24.6%) and other energy (mainly hydropower and geothermal) (5.2%)—and 44 781 ktoe of biomass. Indonesia is a net exporter of energy: the overall energy exports of crude oil, condensates, natural gas, liquefied natural gas (LNG), petroleum products and coal totalled 115 052 ktoe in 2008. Total energy exports in 2008 increased by 7.66% from 2007 (106 864 ktoe), an increase driven primarily by coal exports.

OIL

In 2008, Indonesia produced 55 318 ktoe of crude oil and condensates; of this 20 619 ktoe (37.3%) was exported. Exports of crude oil and condensate increased by 16.9% from 17 633 ktoe in 2007. To meet domestic oil requirements, Indonesia imported 12 839 ktoe of crude oil and

20 618 ktoe of petroleum products in 2008, down 10.1% from 37 226 ktoe in 2007. Notably, oil production has declined significantly over the past decade (in 1997, Indonesia produced 72 474 ktoe of crude oil and condensates).

Most of Indonesia's crude oil is produced onshore 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 two fields are mature; notably the Duri oil field which is the site of one of the world's largest enhanced oil recovery efforts. In 2007, 81.2% of Indonesia's oil was produced from the province of Riau. Other principal oil-producing regions are South Sumatra, onshore and offshore East Kalimantan, East Java, Jambi on the east coast of central Sumatra, the province of Papua, and the Natuna Sea.

NATURAL GAS

Indonesia produced 72 604 ktoe of natural gas in 2008, an increase of 14.3% from 63 537 ktoe in 2007. Of the total natural gas production, 44% was processed into LNG for export. The economy produced 25 583 ktoe of LNG in 2008, an increase of 9.6% from 23 329 ktoe in 2007. Those LNG exports in 2008 went to Japan (70% of the total share), Korea (15.1%) and Chinese Taipei (14.9%). In 2008, Indonesia also exported 8290 ktoe of natural gas (11.4% of total natural gas production) by pipeline to Singapore and Malaysia. Overall, 55.4% of Indonesia's natural gas production is exported; 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, South Sumatra, the Natuna Sea, the Makassar Strait, and Papua; smaller gas fields are offshore from West and East Java. The LNG exports from Tangguh, Papua began in 2009; gas is supplied from the onshore and offshore Wiriagar and Berau gas blocks, which are estimated to have reserves of 14 trillion cubic feet (Tcf).

COAL

In 2008, Indonesia produced 134 652 ktoe of coal, an increase of 10.9% from 121 445 ktoe in 2007. Most of Indonesia's coal production in 2008 (94 080 ktoe or 69.8%) was exported to Japan (16.8%), Chinese Taipei (9.3%), other Asian economies (44.1%), Europe (12%), the Pacific area (1.9%) and other destinations (15.9%). Domestic consumption of coal was 40 635 ktoe in 2008; nearly half (44.9%) was consumed in power generation, while 55.1% was used to meet final energy demand.

About 57% of Indonesia's total recoverable coal reserve is lignite, while 27% is sub-bituminous coal, 14% is bituminous coal, and less than 0.5% is anthracite. Most of Indonesia's coal reserves are in South Sumatra and East Kalimantan; relatively small deposits of coal are in West Java and in Sulawesi. Indonesian coal has a heating value range of 5000 to 7000 kilocalories per kilogram and is distinctive for its low ash and sulphur content (sulphur content is typically less than 1%).

ELECTRICITY

Indonesia had 32 285 MW of grid electricity generation capacity in 2008 – this capacity was provided by the state-owned electricity company (PLN) and independent power producers (IPPs). In 2008, 149 436 GWh of electricity was generated, of which 24.2% was supplied by IPPs. In 2008 electricity generation was based on coal (41%), oil (28.1%), natural gas (17.5%), hydropower (7.8%), geothermal (5.6%), and biomass (0.3%).

Table 12 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production[a]	271 799	Industry sector	42 244	Total	149 436
Net imports & other	–115 052	Transport sector	26 025	Thermal	129 552
Total PES	157 722	Other sectors	32 077	Hydro	11 528
Coal	40 635	Total FEC	100 345	Nuclear	–
Oil	70 219	Coal	22 378	Others	8 356
Gas	38 731	Oil	54 276		
Others	8 137	Gas	12 589		
		Electricity	11 103		

a Excludes biomass.
Source: EDMC (2010).

FINAL ENERGY CONSUMPTION

Total final energy consumption of commercial energy was 100 345 ktoe in 2008, an increase of 13.6% from 88 297 ktoe in 2007. The share of the final energy consumption by sector in 2008 was 42.1% for industry, 25.9% for transport and 32% for other sectors. Indonesia's economy is highly dependent on oil; final energy consumption of oil in 2008 was 54 276 ktoe (54.1% of the total), a 4.9% increase from 51 733 ktoe in 2007.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

THE ENERGY LAW

On 10 August 2007, Indonesia enacted Law No. 30/2007 regarding Energy. This Energy Law elucidates principles regarding the 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. The Energy Law defines the outline of the National Energy Policy (*Kebijakan Energi Nasional,* or KEN); the roles and responsibilities of the government and regional governments in planning, policy and regulation; energy development priorities; energy research and development; and the role of enterprises.

Under the Energy Law, the National Energy Policy will address the sufficiency of energy to meet the economy's needs, energy development priorities, utilisation of indigenous energy resources, and energy reserves.

The Energy Law mandates the creation of a National Energy Council (*Dewan Energi Nasional*, DEN). Its tasks are to:

- draft the National Energy Policy (KEN)
- endorse the National Energy Master Plan (*Rencana Umum Energi Nasional*, RUEN)
- declare measures to resolve conditions of energy crisis and energy emergency
- provide oversight on the implementation of energy policies that are cross-sectoral.

The National Energy Master Plan (RUEN) implements the KEN. By law, RUEN is drafted by the government in a process that involves the regional governments and has due regard to input and recommendations from the public.

The assembly of DEN members is chaired by the President. As an institution, DEN is headed by the minister responsible for energy affairs. DEN has 15 members: 7 ministers and

high-ranking government officials responsible for the supply, transportation, distribution and use of energy; and 8 stakeholder members from industry, academia, expert groups, environmental groups, and consumer groups. The selection and appointment of members of DEN was finalised in late 2008.

DEN expects to finalise the draft of the National Energy Policy in late 2010 for endorsement by parliament (the DPR) and enactment by the government. The new energy policy would replace the existing National Energy Policy that was established by Presidential Regulation No. 5/2006.

ENERGY MARKETS

Over the past decade, Indonesia has reformed its energy sector through a series of new laws: the Oil and Gas Law (Law No. 22/2001), the Geothermal Energy Law (Law No. 27/2003), the Mineral and Coal Mining Law (Law No. 4/2009), and the Electricity Law (Law No. 30/2009).

These laws were established to promote an increased role for enterprise in the energy supply chain, in terms of fair competition on an equal playing field (as an alternative to a monopolistic industry), direct contracts between energy producers and buyers, and a transparent regulatory framework.

Advanced reform of the electricity sector, which would have established the possibility of direct competition in power generation through (the now annulled) Law No. 20/2002, was rejected by the Constitutional Court in 2004.

THE OIL AND GAS LAW

The Oil and Gas Law (Law No. 21/2001) created the upstream oil and gas implementing agency, *Badan Pelaksana Hilir Minyak dan Gas Bumi* (BP MIGAS), and the downstream oil and gas regulatory agency, *Badan Pengatur Hilir Minyak dan Gas Bumi* (BPH MIGAS). BP MIGAS and BPH MIGAS are independent government entities which report to parliament and are not part of government departments.

BP MIGAS manages, operates and has stewardship over upstream activities on behalf of the government as the holder of exclusive mining authority. Its duties include advising the minister with respect to policy on preparing and offering areas for work by investors and cooperation contracts; executing cooperation contracts; reviewing field development plans for the minister's approval; approving work plans and budgets; authorisations for expenditure; monitoring and reporting to the minister on the implementation of cooperation contracts; and appointing a selling agent for the state's share of oil and gas. BPH MIGAS has supervisory and regulatory functions in the downstream oil and gas sector with the aim of ensuring availability and distribution of fuel throughout Indonesia, and to promote gas utilisation in the domestic market, through fair and transparent market competition.

The enactment of the Oil and Gas Law required that the state-owned oil company, Pertamina, relinquish its governmental roles to the new regulatory bodies BP MIGAS and BPH MIGAS, and the termination of Pertamina's monopoly in upstream oil and gas activities.

Indonesia's oil and gas sector has a fiscal contractual system or regime, which relies mainly on production sharing contracts (PSCs) in oil and gas exploration and production; other types of joint contracts may also apply. PSCs are cooperative contracts for oil and gas exploration and production between the government and private investors (which include foreign and domestic companies, as well as Pertamina).

THE MINING LAW

On 16 December 2008, parliament passed a new law on minerals and coal mining to replace Law No. 11/1967, which had been in place for 41 years. The new law was enacted by the government on 12 January 2009 as Law No. 4/2009 regarding Mineral and Coal Mining.

The new Mining Law basically ended the concession of work areas by contracts of work (COW) and by work agreements for coal mining enterprises, *Perjanjian Karya Perusahaan*

Pertambangan Batubara (PKP2B). Concessions are now based on permits from the central and regional governments. Prior to the new law, the government arguably had less regulatory control over its concessions. For example, any changes to concession terms needed to be agreed by both the government and the investor. By instituting permits, the government expects to be better placed to promote investments and to regulate mining.

The law creates greater opportunity for smaller investments in mining and gives regional governments a greater role in regulating the industry, along with revenue from mining.

The Mining Law called for regulations on:

- concession areas and concession periods (for exploration permits) and production limits (for production permits) in mining for metals, non-metals and specific non-metals
- a requirement that prospective investors submit post-mining and reclamation plans before applying for a permit
- an obligation on permit holders to build smelters
- an obligation on foreign companies to divest shares to the government, or state-owned enterprises and private companies registered in Indonesia
- taxes, fees and allocation of profits
- reclamation and post-mining costs.

The set of Government Regulations with regard to the Mining Law was completed in 2010 and these are now operational.

THE ELECTRICITY LAW

On 23 September 2009, the government enacted Law No. 30/2009 regarding Electricity. This new Electricity Law replaced Law No. 15/1985, which the Constitutional Court had reinstated in December 2004, as a provisional law, upon annulment of Law No. 20/2002.

A notable difference between Law No. 30/2009 and Law No. 15/1985 is the absence of a Holder of Electricity Business Authority (*Pemegang Kuasa Usaha Ketenagalistrikan*, PKUK). Under Law No. 15/1985, the government had appointed the state-owned electricity company, PLN, as the sole PKUK and so had made it responsible for providing electricity to all parts of Indonesia.

Under the new Electricity Law, the electricity industry will be made up of electricity business entities that are title holders of electricity supply business licences, *Izin Usaha Penyediaan Tenaga Listrik* (IUPTL). The IUPTL could either be in integrated electricity supply, power generation, transmission, distribution or retailing of electricity. Indonesia's electricity systems would retain vertically integrated configurations; however, these could comprise several licensed systems—such as PLN's numerous power systems, provincial government owned systems (to be established, where necessary), and privately owned sector power systems, each operating within their respective business area (*wilayah usaha*). Licence holders of specific electricity supply types (such as the IPPs, as licence holders in power generation for supply of electricity to the public) would participate in the vertically integrated systems.

By law, the government and regional governments would regulate the electricity industry within their respective jurisdictions and through electricity regulatory authorities.

The Electricity Law allows electricity tariffs to be differentiated by region (to allow for different costs of supply). Under the previous Electricity Law, Indonesia had a uniform electricity tariff regime and applied cross-subsidies between regions. As yet, there is no ruling whether PLN will implement tariff differentiation over its extensive power systems across Indonesia.

Law No. 30/2009 requires the formulation of three Government Regulations on electricity supply businesses, electricity support businesses, setting of selling prices of electricity, charges for the use of power lines, and electricity tariffs. Other regulations for the electricity industry will be formulated by the government and the provincial governments; this will include regulations on the buying and selling of electricity across Indonesia's borders.

ELECTRICITY MARKET

Most of Indonesia's electricity is currently supplied by PLN through its many power systems, which consist of the large interconnected system that integrates the power systems in the islands of Java, Bali and Madura; several large partially interconnected power systems; and many small isolated ones in the other islands. These systems are developed around load centres; electricity is also delivered through extensive 20 kV rural electrification systems.

Initial steps to restructure Indonesia's electricity industry took place in 1994, when PLN was converted from a state enterprise to a government-owned limited liability company. Restructuring efforts continued in 1995 with the unbundling of PLN's Java, Bali and Madura generation, distribution and transmission assets. Generation assets were unbundled into two wholly owned subsidiaries of PLN: Pembangkit Jawa–Bali (PJB) and Indonesia Power (IP). The distribution unit was separated into four distribution entities (East, West, and Central Java, and Jakarta). Each distribution unit operates semi-autonomously, with an allocated budget to cover operational expenses to meet the performance targets set out in its contract with PLN. The Java–Bali transmission business was transferred to the Java–Bali Electricity Transmission Unit and Load Dispatch Centre (P3B Jawa–Bali). The market has since become a single buyer market, in which the PLN transmission unit coordinates dispatch of PLN and IPP generators. Outside Java, Bali and Madura, restructuring is taking place through the decentralisation of PLN's assets.

THE GEOTHERMAL LAW

Law No. 27/2003 regarding Geothermal states that geothermal resource development 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 based on the award of licences. The process involves the government offering geothermal work areas for competitive bidding to prospective business investors; public, private or cooperative entities may submit bids on work areas for offer.

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 required to complete a feasibility study within two years. During the exploitation stage, the awarded entity could be granted 30-year exploitation rights (which are extendable). Working areas are subject to tax, land rent, and royalties determined by the government (see following section). Laws and regulations that govern the electricity industry apply to the utilisation of geothermal energy for electricity generation.

FISCAL AND INVESTMENT REGIME

In late 2008, Indonesia announced an overhaul of its taxation system, effective in 2009, with improved tax collection and lower tax rates. The general corporate income tax rate for the 2009 year was reduced to a flat rate of 28% in 2009 from the previous maximum progressive rate of 30%. Tax rates are to be further reduced to a flat rate of 25% in 2010 (ASEAN Affairs 2008).

OIL AND GAS

The PSC regime (outlined in the earlier section on 'The Oil and Gas Law') was introduced in Indonesia in the mid-1960s and reportedly became the 'fiscal system of choice' for many economies over many years. Worldwide, slightly over half of the governments whose economies produce hydrocarbons now use PSCs (Johnston et al. 2008). Several types of PSC have since emerged internationally.

Technically, production sharing contracts do not have the type of royalties that apply to royalty/tax systems of concessions or licences in the oil and gas industry. However, industry analysts argue that there are equivalent elements in PSC and royalty/tax systems and that the major difference is in the title transfer (of oil or gas) (Johnston et al. 2008). In a PSC, title to the hydrocarbons passes to the contractor at the export or delivery point.

In 1988, Indonesia's third-generation PSC introduced a new contract feature called first tranche petroleum (FTP). The contractor's share of FTP is taxed; the remaining production is available for cost recovery. Some industry analysts view FTP as a royalty (Johnston 1994).

Table 13 Main features of Indonesia's production sharing contracts

Elements	Third generation PSC (1988–recent)
First tranche petroleum (FTP)	15%–20%
Cost recovery limit	80%–85% (limited by FTP)
Investment credit	17%–20%
Domestic market obligation	25% of equity of oil; full price for the first 5 years and 10% at export price thereafter
Depreciation:	
Oil	7 years DDB (switching to SLD in five years)
Gas	14 years (switching to SLD)
Interest recovery	Available
Abandonment liability	None. Since 1995, PSCs have required the contractor to provide for abandonment.
Equity split, government/contractor [a]:	
Oil	85%–15%
Gas	70%–30% and 65%–35%
Corporate tax (as of 1995)	44%
Life span of contract/work area or block	30 years, 10-year limit for exploration
Effective date (ED) of work	Upon signing by the Minister of Energy and Mineral Resources, on behalf of the Government of Indonesia
Relinquishment of work area	During exploration, 25% of work area is relinquished in the 3rd year from ED, 25% of the remaining work area is relinquished in the 6th year from ED, and 25% of the remaining work area is relinquished in the 10th year from ED.

DDB = double declining balance; SLD = straight-line decline.

a The government take is under a production sharing agreement (PSA).

Source: Miriawati (2006).

Indonesia has other types of joint contracts in oil and gas: the technical assistance contracts (TACs) and enhanced oil recovery (EOR) contracts. A TAC is a variant cooperation contract or PSC, and is typically used for established producing areas; therefore, it usually covers exploitation only. Operating costs are recovered from production. The contractor does not typically share in production. A TAC can cover both exploitation and exploration if it involves an area where the Indonesian Government has encouraged exploration. In accord with the new Oil and Gas Law, existing TACs will not be extended. In addition, the participants in PSCs, TACs and EOR contracts may also enter into separate agreements known as joint operating agreements (JOA) and joint operating bodies (JOB).

Indonesia revised the terms of the domestic market obligation (DMO) in 2009. Under Government Regulation No. 55/2009, the contractor must allocate 25% of its oil or gas share to the domestic market. In relation to the development of new gas reserves, the government would advise the contractor, on request, of the domestic gas supply requirement about a year prior to production. The contractor and prospective domestic buyers will negotiate directly on gas price and terms of supply. However, if there is no domestic demand for gas or if an agreement between the contractor and prospective buyers is not reached, the contractor may sell its entire share to the international market.

COAL BED METHANE

Business in coal bed methane gas is regulated by the laws and regulations that govern business activities in the oil and gas sector. The Directorate General of Oil and Gas has oversight

of business activities in coal bed methane gas development. The Minister of Energy and Mineral Resources issues regulations and establishes and offers coal methane gas work areas. The Directorate General of Oil and Gas technically establishes and offers coal bed methane work areas, with due consideration to the opinion of BP MIGAS.

Coal bed methane development is regulated by Ministerial Regulation No. 36/2008 regarding Business in Coal Methane Gas. The regulation covers exclusive rights and business of coal methane gas; the method of determining and offer of coal gas methane work area; use of data and information, equipment and facilities; research, assessment and development of coal gas methane; dispute resolution; ruling on coal methane gas as associated natural resource; and utilisation of coal bed methane for domestic needs.

MINERALS AND COAL MINING

Indonesia's new Minerals and Coal Mining Law (Law No. 4/2009) replaced the systems of contract of work (COW) and work agreements for coal mining enterprises (PKP2B) with two forms of permits—specifically, mining business permits (*Izin Usaha Pertambangan*, IUPs) and citizens mining permit (*Izin Pertambangan Rakyat*, IPRs), and a contract called the mining business contract (*Perjanjian Usaha Pertambangan*, PUP). The IUPs apply to large-scale mining. PUP is a contract between the government and a private mining company; the government is represented by an implementing body, yet to be established.

Under the new law, the mining fiscal regime includes corporate tax under prevailing taxation law, a surtax of 10%, and a mining royalty that is determined according to the level of mining progress, the level of production and the prevailing price for the mineral. The law allows for a transition period of current COW and PKP2B holders, some of which are large mining concessions for minerals and coal that will expire between 2021 and 2041. The law's explanation on transition stated that existing contracts will be upheld, but the specific transition of existing concessions is yet to be formulated.

GEOTHERMAL

Under the previous taxation law, geothermal companies are subject to corporate income tax at a flat rate of 34%. The government expects to revise this level of corporate tax to promote greater development of geothermal resources.

ENERGY EFFICIENCY

GOVERNMENT REGULATION ON ENERGY CONSERVATION

As called for by the Energy Law (Law No. 30/2007), the government issued Government Regulation No. 70/2009 regarding Energy Conservation, on 16 November 2009.

The Regulation mandates:

- formulation of a National Energy Conservation Master Plan (*Rencana Induk Konservasi Energi Nasional*, RIKEN) that is to be updated once every five years or annually, as required
- appointment of an energy manager, energy audit and energy conservation program for final energy users of 6000 toe or greater
- implementation of energy-efficiency standards and energy labelling
- government incentives of tax exemptions, fiscal incentives on import of energy-saving equipment, and low interest lending rates to encourage investments in energy conservation
- government disincentives of written notices to comply, public announcements of noncompliance, monetary fines, and reduced energy supply for noncompliance.

At the time of writing, the government is drafting the regulatory framework to implement Government Regulation No. 70/2009 regarding Energy Conservation throughout Indonesia.

BARRIER REMOVAL

Indonesia is participating in a UNDP–GEF project which involves six developing Asian economies. This project, Barrier Removal to the Cost Effective Development and Implementation of Energy Efficiency Standards and Labelling Project (BRESL), has five major programs promoting energy standards and labelling: policy making, capacity building, manufacture support, regional cooperation, and pilot projects.

RENEWABLE ENERGY

Until the time the National Energy Council (DEN) establishes a new National Energy Policy (KEN), the National Energy Policy of 2006 applies. The aim of this policy is to:

- Achieve energy elasticity to GDP of less than one by year 2025
- Realise an optimum primary energy consumption mix in 2025, with shares as follows:
  - oil—to become less than 20%
  - natural gas—to become more than 30%
  - coal—to become more than 33%
  - biofuels—to become more than 5%
  - renewable energy and other energy including nuclear—to become more than 10%
  - liquefied coal—to become more than 2%.

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* (DIM 2005).

Indonesia's 2006 energy policy expects the combined share of renewable energy and nuclear in the overall energy mix in 2025 to have exceeded 17%. The policy has special emphasis on enhancing the share of biofuels. Renewable energy and other energy including nuclear (as in the list above) is expected to be made up of at least a 5% geothermal share and a combined share of biomass, hydropower, solar, wind and nuclear power to make up the remainder to 10% by 2025.

BIOFUELS

In 2008, Indonesia passed Ministerial Regulation No. 32/2008 regarding the Supply, Use and Commerce of Biofuel as Other Fuel; this makes biofuel consumption mandatory from 2009.

The matters regulated are the utilisation priority of biofuels; categories of biofuels; standards and specification of quality; setting of price; commerce involving biofuels as other fuel; directives and oversight; and sanctions. The regulation sets mandatory targets in terms of the percentage share that biofuel has in the fossil fuels share of the total fuel consumption (biofuel blend), as shown in the following table.

Table 4 Minimum obligations for biofuel use (% blend)

Sector	2009	2010	2015	2020	2025
Biodiesel					
PSO transport	1.00	2.5	5	10	20
Non-PSO transport	1.00	3.0	7	10	20
Industrial and commercial	2.50	5.0	10	15	20
Electricity generation	0.25	1.0	10	15	20
Ethanol					
PSO transport	1.00	3.0	5	10	15
Non-PSO transport	5.00	7.0	10	12	15
Industrial and commercial	5.00	7.0	10	12	15
Straight vegetable oil fuel					
Industry	–	1.0	3	5	10
Marine	–	1.0	3	5	10
Electricity generation	0.25	1.0	5	7	10

PSO = public service obligation.
Source: GSI (2008).

The Global Subsidies Initiative (2008) estimates the volume of biodiesel (fatty acid methyl ester, or FAME) to fulfil this requirement would be about 10 780 million litres in 2025, while the volume of ethanol (anhydrous denatured bio ethanol) to fulfil the requirement would be about 5695 million litres in 2025.

GEOTHERMAL

The 2006 energy policy implicitly calls for Indonesia to increase total geothermal capacity to 9500 MW by 2025. In 2009 Indonesia's total geothermal capacity was 1196 MW, which is 4.3% of the total geothermal potential of 27 670 MW. Indonesia has identified 9076 MW of geothermal power potential, to come from existing geothermal plants, capacity expansion of productive geothermal resources, and from new geothermal projects, in 43 sites—specifically 4520 MW in Sumatra at 17 sites, 3635 MW in Java at 13 sites, 735 MW in Sulawesi at 4 sites, 146 MW in the Nusa Tenggara at 7 sites, and 40 MW in the Maluku Islands at 2 sites.

Under the 10 000 MW Accelerated Development of Electricity Generation—Phase II program, geothermal development projects will add a total of 3528 MW of new geothermal capacity over 2011–15; of this total capacity, 2551 MW will be developed by IPPs and 977 MW by PLN. Under PLN's 2009 Electricity Power Supply Business Plan 2009–2018 (*Rencana Usaha Penyediaan Tenaga Listrik,* RUPTL), further addition of geothermal capacity by 1902 MW is expected between 2016 and 2018.

HYDROPOWER

PLN's 2009 Electricity Power Supply Business Plan (RUPTL) also expects the addition of 4740 MW to Indonesia's hydropower capacity during 2010–18; of this capacity, 3835 MW would be developed by PLN and 905 MW by IPPs. The hydropower capacity addition includes three pump-storage power plants in Java—specifically Upper Cisokan (1000 MW) in West Java, Matenggeng (885 MW) at the border of West and Central Java, and Grindulu (1000 MW) in East Java. These pump-storage plants are considered important for stabilising system frequency, to provide spinning reserves and system stability.

Under the 10 000 MW Accelerated Development of Electricity Generation—Phase II program for 2011–15, Indonesia is committed to building two hydropower plants—specifically Asahan III (174 MW) in north Sumatra, and Bakaru II (126 MW) in west Sulawesi. These hydropower plants would increase Indonesia's total large hydropower capacity to 3804 MW, or 5% of Indonesia's total hydropower potential of about 75 000 MW. It is worth noting that

Indonesia's large hydropower potential is located in the eastern part of Indonesia, far from large demand centres.

NUCLEAR

Under current policy, Indonesia expects to have in operation its first series of four nuclear power plants, with a total capacity of 4000 MW, by 2025. A strong candidate site for these plants is the Muria peninsula on the north coast of Central Java. Nuclear plant site studies have been conducted in Indonesia since the early 1980s.

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

Indonesia has developed an indigenous nuclear fuel cycle, although certain stages are still at the laboratory scale. The economy has a well-established nuclear research program, which spans nearly five decades. The National Nuclear Energy Agency (BATAN) currently operates three nuclear research reactors—specifically the GA Siwabessy (30 MW) Materials Testing Reactor (MTR) pool-type reactor in Serpong; the Kartini-PPNY 100 kW Triga Mark-II reactor in Yogyakarta; and the Bandung 1000 kW Triga Mark-II reactor in Bandung. A fourth 10 000 kW pool-type research reactor is planned.

Indonesia currently has two prospective uranium mines: the Eko-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 0.10–0.30; and the Riang Tanah Merah Ore Body, a uranium vein that may contain uranium less than 5000 tonnes, grade range 0.30–1.00. The uranium mines are located in West Kalimantan.

CLIMATE CHANGE

Indonesia strongly supports the objective of the United Nations Framework Convention on Climate Change (UNFCCC) to prevent atmospheric concentrations of anthropogenic gases exceeding a level that would endanger the existence of life on Earth. To indicate its firm decision and serious concerns about global warming, Indonesia signed the convention on 5 June 1992. On 1 August 1994, the President of the Republic of Indonesia formalised this ratification by enacting Law No. 6/1994 regarding Approval of the UNFCCC. Indonesia is legally included as a party to the convention, which implies that Indonesia is bound by the rights and obligations it stipulates.

As a non-Annex 1 party in the Kyoto Protocol, Indonesia has no obligation to reduce GHG emissions. However, the Indonesian Government is committed to participating in and cooperating with the global effort to combat climate change. This position was expressed by the President of the Republic of Indonesia in the G20 Finance Ministers and Central Bank Governors Summit held in September 2009 in Pittsburgh, United States. In addition, the government of Indonesia has pledged to reduce GHG emissions from forestry and the energy sector by 26% through domestic effort, and by up to 41% through cooperation with other economies.

In response to the government's commitment and the challenges of climate change, the Indonesian Government has set out a roadmap to integrate climate change issues into development planning. The climate change roadmap will integrate mitigation and adaptation action into policy instruments, regulations, programs, projects, funding schemes and capacity building in all development sectors. Two initial phases of the roadmap are the integration of climate change into the Mid-Term Development Plan 2010–2014 (*Rencana Pembangunan Jangka Menengah 2010–2014*, RPJM) and the launching of the Indonesia Climate Change Trust Fund (ICCTF) on 14 September 2009.

The ICCTF is a financing mechanism for climate change mitigation and adaptation action within Indonesia's policy framework. The ICCTF has two key objectives:

- Achieving Indonesia's goal of a low-carbon economy and greater resilience to climate change through facilitation and acceleration of investment in renewable energy and energy efficiency, sustainable forest management and forest conservation; and reducing vulnerability in key sectors, such as coastal zones, agriculture and water resources.
- Enabling the government of Indonesia to increase the effectiveness and impact of its leadership and management in addressing climate change, by bridging the financial gap to address climate change mitigation and adaptation; and increasing the effectiveness and impact of external finance for climate change work in Indonesia.

Through the ICCTF, the government of Indonesia can utilise not only government budgets, but also bilateral and multilateral financial agreements, public–private partnerships, mandatory and voluntary international carbon markets, and the Global Environmental Fund and other funds to implement a policy framework for climate change.

The ICCTF consists of two funds: the Innovation Fund and the Transformation Fund. The Innovation Fund is a grants-based fund to finance demonstration and innovation projects, pilot projects, and research and development. The Transformation Fund is used to finance low-emitting activities, projects and initiatives by private actors. The Transformation Fund is not a grants fund but a revolving fund, so projects are expected to generate returns on the fund's investments.

NOTABLE ENERGY DEVELOPMENTS

OIL AND GAS PROJECTS

UPSTREAM OIL AND GAS

In December 2009, the Indonesian Government announced the mid-term oil and gas management roadmap, which includes a target of USD 31.2 billion in investments for oil and gas infrastructure from 2010 to 2014. Of the total investment, 69.5% (USD 21.68 billion) is for gas facilities, including LNG and LPG receiving terminals, LPG refineries and residential gas pipeline networks. The remaining 30.5% (USD 9.53 billion) is for oil facilities, including refineries and rigs. The government expects total investment to peak in 2013 at USD 10.57 billion.

Projects under consideration include two new gas rigs for Lapangan Rambutan in South Sumatra and Pondok Tengah in West Java, with a total investment of USD 2.42 billion. The two rigs are expected to produce up to 1020 million standard cubic feet per day (MMscf/D) of natural gas. In 2011, the government is planning to build five gas processing plants for gas fields: Block A in Nanggroe Aceh Darussalam; Jambi Merang in Jambi; Randublatung in Central Java; Gajah Baru in the offshore Riau Islands in the Natuna Sea; and Kepodang near Bawean Island, offshore from East Java.

By 2014, the government plans to build at least 16 new gas rigs with a capacity of up to 20 261 million cubic feet of gas per day (MMscf/D) of natural gas. To process gas from the new rigs, the government plans to construct LNG and LPG refineries with a total investment of USD 3.65 billion. In addition, the government expects total investments in new oil rigs and oil refineries of USD 3 billion and USD 6.52 billion, respectively.

Indonesia's largest newly developed oil reserve, the Cepu Block in East Java, jointly developed by ExxonMobil and Pertamina, is expected to reach peak output of 165 thousand barrels per day in 2012.

OIL REFINERIES

In December 2008, Pertamina signed a joint shareholder agreement to build an oil refinery near Bojonegara in the province of Banten, in the western part of Java. In its first phase, the refinery will have an intake capacity of 150 thousand barrels of crude oil a day, to expand to an ultimate intake capacity of 300 thousand barrels a day. Signatories to the agreement and

stakeholders in the project are Pertamina (40%), the National Iranian Oil Refining & Distribution Co. (40%) and Petrofield Refining Company (Malaysia) (20%). Investment for the project is estimated at USD 6 billion; loans will provide 65% of the financing. The three parties have agreed to set up a joint venture company, Banten Bay Refinery, in Indonesia.

Crude oil supply for the refinery is expected to be Iranian extra heavy crude and Iranian heavy crude in equal parts. The refinery is expected to come on stream in 2015 and to produce a broad range of refinery products. It will require 110 million cubic feet of gas per day, to be supplied in part by Perusahaan Gas Negara (PGN).

In June 2009, Pertamina confirmed plans to expand the intake capacity of its Balongan oil refinery on the north coast of West Java from its current 125 thousand barrels of crude oil a day to 325 thousand barrels a day. However, Pertamina has postponed its other refinery projects, including the Tuban oil refinery in East Java (planned intake capacity of 300 thousand barrels of crude oil per day). The decision was made after some difficulties in securing financing and crude oil supply.

LNG TERMINALS

In January 2010, the government and related companies confirmed plans to build Indonesia's first series of three floating LNG receiving terminals, to be located in Jakarta Bay, East Java and North Sumatra. The Java terminals will have capacities of 500 million cubic feet per day or about 4 Mt of LNG per year. Investment in each terminal is expected to be USD 230 million. The terminal in East Java will be built by Pertamina, while the terminal in Jakarta Bay will be built jointly by Pertamina and PGN; the government has a 51% share in the company. Completion of the LNG receiving terminal in East Java is expected in September 2011. The LNG terminal in North Sumatra, to be built by PGN, will have a capacity of about 150 million cubic feet a day.

LNG supply is expected to come from the LNG plants in Tangguh, Papua, and Bontang, East Kalimantan, with an option of LNG imports from Qatar.

ACCELERATED ELECTRICITY GENERATION PHASE I

In December 2009, the government revised Presidential Regulation No. 71/2006 regarding the 10 000 MW Accelerated Development of Electricity Generation—Phase I. The revision calls for additional coal-fired power plants in the provinces of East Kalimantan and Riau; each province will receive capacities of 2 × 100 MW. In 2009, 915 MW of new generating capacity was completed in Java. PLN expects that the additional power plants will be completed by 2012 during Phase I, which has been extended by two years due to delays in securing financing. Other planned completions are:

2010: 3240 MW in Java and 121 MW elsewhere

2011: 1975 MW in Java and 1558 MW elsewhere

2012: 700 MW in Java and 368 MW plus 400 MW elsewhere

2013: 660 MW in Java.

Overall power generation capacity increases from Phase I will be 9937 MW: 7490 MW in Java and 2447 MW elsewhere (including 1424 MW in Sumatra). The Adipala 660 MW supercritical power plant in Cilacap, on the south coast of Central Java, will be completed in 2013. Financing for the plant was secured in mid-2009. PLN expects the Phase I additions of generation capacity to be able to meet short-run power demand, which has been growing at an average annual rate of 6.8%.

UPSTREAM OIL AND GAS

OIL AND GAS

In October 2010, the government announced the second round (in 2010) of regular tenders and direct offer tenders for oil and gas work areas. A total of 24 oil and gas work areas were offered for bid in this round, five of them as work areas for direct offer.

In November 2010, the government announced the winners of the 2010 first round direct offer oil and gas work areas. Four of the work areas on offer in this round were awarded; they were: North Sokan, offshore of East Natuna Island; Titan, offshore of Pati, North Java; Bone, offshore of Bone, South Sulawesi; and North Arafura, offshore of and on land in Akimeugah, Papua. The winners have committed to undertake three years of geological and geophysical studies, seismic surveys, and exploration drillings.

COAL BED METHANE

In the first round of regular tender and direct offer tender bidding in 2010, the government offered nine coal bed methane (CBM) work areas; four of these were as direct offer tenders.

The government expected to finalise the Coal Bed Methane Development Guideline in partnership with stakeholders by the end of 2010. The guideline is intended to explain the Ministerial Regulation with regard to CBM development, particularly on the specifics of CBM and oil and gas development, such as the possible use of gas that occurs in the dewatering process. Indonesia has CBM potential of 453.3 Tcf in 11 hydrocarbon basins, of which there are 112.47 Tcf of total proven reserves and 57.6 Tcf of potential reserves.

KEROSENE TO LPG CONVERSION PROGRAM

In December 2009, Phase I of the government's kerosene-to-LPG conversion program was completed. The program distributed 23.8 million three-kilogram LPG canisters to the densely populated provinces of Jakarta, Banten, West Java, Yogyakarta, and South Sumatra. The program averted the need for Pertamina to supply 5.21 billion litres of heavily subsidised kerosene for use in households in those provinces.

RENEWABLE ENERGY

BIOFUELS

Indonesia's bioethanol production capacity increased from 10 000 kilolitres in 2006 to 153 000 kilolitres in 2009 (from five producers). In the same period, biodiesel production increased even more rapidly, from 0.214 million kilolitres in 2006 to 4.277 million kilolitres in 2009 (from 22 producers). Indonesia uses molasses, sugarcane, cassava and sweet sorghum as bioethanol feedstock, and palm oil and jatropha as bioethanol feedstock.

Government subsidies for the biofuels program are expected to increase from USD 91.5 million in 2009 to USD 170 million in 2010 for an overall total of 777 000 kilolitres of biofuels, which are still far below estimated production capacity (APROBI 2010). Indonesia exported 15.5 million tonnes of crude palm oil in 2009.

SOLAR ENERGY

In 2009, Indonesia distributed 77 433 photovoltaic solar home systems of 50 W-peak photovoltaic modules to individual households, and nine photovoltaic array systems of 150 kW-peak each to communities in rural and remote areas all over Indonesia. The number of home systems distributed in 2009 was lower than the 40 598 units distributed in 2008; however, the number of photovoltaic array systems distributed increased from the five systems of 102.4 kW-peak distributed in 2008.

Indonesia is utilising photovoltaic systems to increase its electrification ratio target, which was 66.2% in 2009. In 2009, the government allocated IDR 658.7 billion (about USD 65 million) to provide power generated from new and renewable energy sources for Indonesia's distributed power systems. The program provided electricity to around 94 000 households, particularly households in 18 of the outermost islands of Indonesia and in remote areas along the Indonesian border. In addition, the government allocated IDR 841.3 billion for the extension of PLN's 20 kV rural electrification network and generation capacity.

In the 2010 budget, the government indicated it expects to allocate IDR 561.5 billion to electrifying 81 000 households in very remote areas (based on new and renewable energy), and to allocate IDR 591.5 billion to further extend PLN's rural electrification network.

ENERGY POLICY

In its press release of 30 July 2010 with regard to the 5th Members Assembly, the DEN stated that the KEN would contain these chapters: Current Situation, Forecast of Energy Demand 2010–2050, Optimum Energy Supply Mix 2010–2050, and Major Aspects of the National Energy Policy 2010–2050.

The policy will emphasise these areas: greater energy security; greater access to commercial energy supply for urban and rural communities alike; greater supply of gas to the domestic market as substitute of oil and for its greater use in power generation; promotion of gas imports rather than oil; enhanced use of renewable energy through various incentives; enhanced energy efficiency and energy conservation; and gradual removal of subsidies on refinery products, to be completed in 2014.

REGULATIONS

NATIONAL MID-TERM DEVELOPMENT PLAN

On 20 January 2010, the government issued Presidential Regulation 5/2010 regarding the National Mid-Term Development Plan 2010–2014 (*Rencana Pembangunan Jangka Menengah Nasional Tahun 2010–2014*, RPJM Nasional).

Presidential Regulation 5/2010 mandates the formulation of RPJM Nasional 2010–2014 as the plan that elaborates the government's vision and mission. It defines the scope and purpose of the RPJN Nasional 2010–2014 as the guide for government ministries and agencies to formulate their Ministerial/Agency Strategic Plans 2010–2014 (*Rencana Strategis Kementerian /Lembaga 2010–2014*) and for regional governments in formulating their five-year Regional RPJMs (*RPJM Dareah*).

The formulation of RPJN Nasional 2010–2014 will be coordinated by the State Minister for National Development Planning and the Head of the National Development Planning Agency.

GOVERNMENT ASSIGNMENT FOR PLN

On 8 January 2010, the government issued Presidential Regulation 4/2010 regarding Assignment to PLN for the Execution of Accelerated Construction of Power Plants that Utilize Renewable Energy, Gas and Coal.

The regulation is legally binding from the day of its enactment to 31 December 2014. The major aspects of the regulation are:

- Power plant capacities, the sites of power plants to be constructed, and the requirement and capacity of power transmission lines would be regulated by the Ministry of Energy and Mineral Resources.
- All aspects with regard to licence, environmental impact analysis, land acquisition, the extent of financial compensation, and so forth, would receive respective official approval within 120 days from their initial submission.
- Existing laws and regulations on investment would apply. Terms of power purchase agreement would apply. The government will guarantee PLN's business viability under existing laws. The criteria for assessing PLN's business viability will be regulated by the Minister of Finance. Power plants and transmission lines that are constructed under this regulation would be waived import tax and other levies; this would be regulated by the Minister of Finance.

GOVERNMENT ASSIGNMENT FOR PLN: LIST OF PROJECTS

On 27 January 2010, the government issued a related Ministerial Regulation 2/2010 regarding List of Projects for the Accelerated Construction of Power Plants that Utilize Renewable Energy, Coal, Gas and Related Transmission.

The regulation was issued by the Minister of Energy and Mineral Resources, to inform the public about the specific power plant and transmission projects that the government has assigned

to PLN for accelerated realization. The regulation is legally binding from the day of enactment to 31 December 2014.

List 1: Power plants for implementation by PLN

- Geothermal power plants: 11 projects in the provinces of West Java, East Java, Jambi, Bengkulu, North Sulawesi, West Nusa Tenggara, and Maluku. Total capacity: 880 MW.
- Hydropower plants: 2 projects in the provinces of West Java (Upper Cisokan, 1000 MW pump-storage) and North Sumatra (Asahan-3, 174 MW). Total capacity: 1174 MW.
- Coal steam power plants: 6 projects in the provinces of West Java, North Sumatra, Central Kalimantan, South Kalimantan, West Kalimantan, South Sulawesi. Total capacity: 1764 MW.
- Gas turbine power plant: 1 project, Kaltim (100 MW) in the province of East Kalimantan.
- Gas combined cycle power plant: 1 project, Muara Tawar Add-On 2, 3 and 4 (600 MW) in the province of West Java.

Overall capacity: 4518 MW.

List 2: Power transmission projects for implementation by PLN

- Power transmission line: 14 projects—500 kV: 330 km; 150 kV: 536 km; 70 kV: 40 km.

List 3: Power plants for implementation through PLN cooperation with private investors

- Geothermal power plants: 33 projects in the provinces of Banten, West Java, Central Java, Nanggroe Aceh Darussalam, North Sumatra, West Sumatra, South Sumatra, Lampung, North Sulawesi, Central Sulawesi, South-East Sulawesi, West Nusa Tenggara, East Nusa Tenggara, and North Maluku. Total capacity: 3097 MW.
- Hydropower plant: 1 project, Simpang Aur (30 MW) in the province of Bengkulu.
- Coal steam power plants: 36 projects in the provinces of Bali, East Java, Nanggroe Aceh Darussalam, North Sumatra, Riau Islands, Bangka Belitung, West Kalimantan, East Kalimantan, South Kalimantan, North Sulawesi, Central Sulawesi, West Sulawesi, South Sulawesi, South-East Sulawesi, West Nusa Tenggara, East Nusa Tenggara, North Maluku, Maluku, Papua, and West Papua. Total capacity: 5035 MW.
- Gas combined cycle power plant: 2 projects, Bengkanai (120 MW) in Central Kalimantan and Senoro (240 MW) in Central Sulawesi.

Overall capacity: 5035 MW.

List 4: Power transmission projects through PLN cooperation with private investors

- Power transmission line: 35 projects—275 kV: 360 km; 150 kV: 1782 km; 70 kV: 532 km.

In total the government has assigned accelerated construction of 93 power plants across Indonesia (total capacity 9553 MW). The major procurement and construction work is expected to be completed by 2014, and the listed projects are eligible for the special preferences described under Presidential Regulation 4/2010.

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USEFUL LINKS

BP MIGAS—www.bpmigas.com/ENGLISH/

BPH MIGAS—www.bphmigas.go.id

Ministry of Energy and Mineral Resources (KESDM)—www.esdm.go.id

Directorate General of Taxes (Pajak)—www.pajak.go.id/eng/

Ministry of Energy and Mineral Resources (DIM)—www.dim.esdm.go.id/English/

PT PLN (Persero)—www.pln.co.id

Statistics Indonesia (Badan Pusat Statistik, BPS),—www.bps.go.id

JAPAN

Introduction

Japan, located in East Asia, consists of several thousand islands, the largest of which are Honshu, Hokkaido, Kyushu and Shikoku. Most of its land area of approximately 377 800 square kilometres is mountainous and thickly forested.

Japan is the world's third largest economy after the United States and China. Japan's real GDP in 2008 was about USD 3597.66 billion (USD (2000) at PPP). Japan's population of 127.7 million people had a per capita income of USD 28 172. The Japanese economy slowed down in 2008. Japan's GDP increased by 2.1% in 2007 compared to the previous year, but it decreased by 0.7% in 2008.

Japan possesses only modest indigenous energy resources and imports almost all of its crude oil, coal and natural gas requirements to sustain economic activity. In 2008, proven energy reserves included around 44 million barrels of oil, 21 billion cubic metres of natural gas and 355 million tonnes of coal.

Table 14 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	377 800	Oil (million barrels)—proven	44
Population (million)	127.7	Gas (billion cubic metres)	20.9
GDP (USD (2000) billion at PPP)	3 597.66	Coal (million tonnes)—proven	355
GDP (USD (2000) per capita at PPP)	28 172		

Sources: EDMC (2010), BP (2009), Oil & Gas Journal (2009).

Energy supply and demand

PRIMARY ENERGY SUPPLY

In 2008, Japan's total primary energy supply was 508.327 million tonnes of oil equivalent (Mtoe), 1.4% less than in 2007. Of fuel types, oil contributed the largest share (45%), followed by coal (22%) and natural gas (16%). In 2008, net imports of energy sources accounted for 85% of the total primary energy supply. With limited indigenous energy sources, Japan imported almost 99% of its oil, 98% of its coal and 96% of its gas.

In 2008, Japan was the world's third largest oil consumer after the United States and China (BP 2009) and almost all of the oil was imported. The bulk of the imports (88% in 2008) came from economies in the Middle East such as the United Arab Emirates, Saudi Arabia, Iran, Qatar and Kuwait (EDMC 2010). In 2008, the primary oil supply was 222.380 Mtoe, a decline of 5.9% from the previous year.

Japan is endowed with only limited coal reserves (355 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 importer of steam coal for power generation, pulp and paper and cement production, and of coking coal for steel production. Japan's main steam coal suppliers are Australia, China, Indonesia, Russia, the United States, South Africa and Canada. Coking coal is imported from Australia, Indonesia, Canada, China, Russia, the United States and South Africa. In 2008, primary coal consumption increased by 3.6% from the previous year, reflecting increased use for power generation.

Natural gas resources are also scarce in Japan. Domestic reserves stand at 20.9 billion cubic metres, and are located in Niigata, Chiba and Fukushima prefectures. Domestic demand is met almost entirely by imports of liquefied natural gas (LNG) (BP 2009), which come from Indonesia (20.4% of imports in 2008), Malaysia (19.0%), Australia (17.3%), Qatar (11.8%), Brunei Darussalam (8.9%), the United Arab Emirates (8.0%), Oman (4.6%) and others. In 2008, LNG imports to Japan comprised 40.6% of total world LNG trade. Natural gas is mainly used for electricity generation, followed by reticulation as city gas and use as an industrial fuel. In 2007, primary natural gas supply was 84 Mtoe, an increase of 2.4% from the previous year.

Japan has 277.671 GW of installed generating capacity and generated 1 250 738 GWh of electricity in 2008. Electricity is generated from thermal fuels (coal, natural gas and oil—70.5%), nuclear (20.1%) and hydro (6.5%); geothermal, solar and wind technologies produce the remainder (2.8%).

Table 15 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	89 139	Industry sector	152 470	Total	1 250 738
Net imports and other	433 725	Transport sector	80 519	Thermal	881 891
Total PES	508 327	Other sectors	102 735	Hydro	81 595
Coal	116 993	Total FEC	335 724	Nuclear	251 744
Oil	222 380	Coal	37 372	Other	35 508
Gas	84 779	Oil	176 063		
Other	84 175	Gas	29 250		
		Electricity and other	93 039		

Source: EDMC (2010).
For full details of the energy balance table see www.ieej.or.jp/egeda/database/database-top.html.

FINAL ENERGY CONSUMPTION

In 2008, Japan's total final energy consumption was 335.724 Mtoe, or 3.1% less than in the previous year. The industrial sector consumed 45% of the total, followed by the residential/commercial sector at 31% and the transportation sector at 24%. By energy source, petroleum products accounted for 52% of total final energy consumption, followed by electricity and other (28%), coal (11%) and city gas (9%).

In 2008, energy consumption in the industrial sector declined by almost 2.7%. The residential/commercial sector's energy consumption also decreased by 2.9% and the transport sector's consumption declined by 4.1%.

Policy overview

ENERGY POLICY FRAMEWORK

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 is responsible for the rational development of mineral resources, securing stable supplies of energy, promoting efficient energy use, and regulating electricity and other energy industries. The Nuclear and Industrial Safety Agency is responsible for the safety of energy facilities and industrial activities, while the Ministry of Foreign Affairs formulates international policies.

The aim of Japan's energy policy is to achieve the '3E' goals—energy security, economic growth and environmental protection (for example, against global warming)—in an integrated manner.

The Basic Law on Energy Policy (2002) presents the core principles of Japan's energy policy (METI 2008a): 'assurance of a stable supply', 'adaptation to the environment', and 'use of market mechanisms'. The Strategic Energy Plan based on this law was revised in 2007 (METI 2008a). It focuses on achieving the construction of an international framework for energy conservation and countermeasures to global warming; the establishment of the nuclear fuel cycle at an early stage; the promotion of new energy sources for electric power suppliers; assurance of the stable supply of oil and other fuels; the promotion of international cooperation in the energy and environmental fields; and the development of an energy technology strategy.

In 2006, Japan launched the New National Energy Strategy in response to the global energy situation (METI 2008a). The strategy contains a program of action to 2030 that places considerable emphasis on achieving energy security. Its five targets are further energy efficiency improvements of at least 30%; increasing the share of electric power derived from nuclear energy to more than 30%–40%; reducing oil dependence in the transport sector to about 80%; raising Japanese investment in oil exploration and development projects; and reducing overall oil dependence below 40%.

The Strategic Energy Plan was revised again in 2010. It is required to be reviewed at least every three years, and to be revised if needed. In this revision, two new principles—'energy-based economic growth' and 'reform of the energy industrial structure'—were added to the three existing principles of 'energy security', 'environmental suitability' and 'economic efficiency'.

The Strategic Energy Plan aims to fundamentally change the energy supply and demand system by 2030 and has set ambitious targets for 2030:

- Doubling the energy self-sufficiency ratio (18% at present) and the self-developed fossil fuel supply ratio (26% at present) and as a result, raising Japan's 'energy independence ratio' to about 70% (38% at present)
- Raising the zero-emission power sources ratio to about 70% (34% at present)
- Halving CO_2 emissions from the residential sector
- Maintaining and enhancing energy efficiency in the industrial sector at the highest level in the world
- Maintaining or obtaining top-class shares of global markets for energy-related products and systems.

If the policies in the Strategic Energy Plan are implemented in a strong and sufficient manner, the economy's total energy-related CO_2 emissions are expected to be reduced by 30% or more in 2030 compared to the 1990 level. A 30% emissions reduction means that about a half of the reduction that has to be achieved from the current level to 2050 (80% reduction compared to 1990) will have been realised in 2030.

ENERGY MARKETS

OIL

Japan aims to decrease its oil dependency, partly because of its experiences during oil crises. However, oil still accounts for around 50% of Japan's total primary energy supply and 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 because Japan imports almost all of its crude oil. In preparation for possible supply disruptions, Japan has been pursuing emergency measures by holding emergency oil stockpiles and by conducting the independent development of resources and promoting cooperation with oil-producing economies to manage emergencies.

The Japan National Oil Corporation (JNOC) managed the economy's 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 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. Japan's oil stocks are well in excess of the International Energy Agency's 90-day net import requirements. As of January 2008, Japan held the equivalent of 151 days of net imports, including state-owned and private-sector stocks.

Competition in the domestic oil product market continues. The major Japanese petroleum companies are seeking to reduce their refining capacity to comply with the law on the Promotion of the Use of Non-fossil Sources and Effective Use of Fossil Energy Materials by Energy Suppliers, which requires petroleum companies achieve a 13% share of heavy oil cracking unit capacity in their total distillation capacity.

The number of service stations has been declining over the last 15 years because of market liberalisation. In this context, the Japanese Government aims to establish a fair and transparent market in terms of quality and prices, where oil product retailers are able to play an important role as the point of interaction with final consumers.

NATURAL GAS

Demand for natural gas has been increasing rapidly over the past two decades. Between 1980 and 2007, natural gas demand grew at an annual rate of 5%—the fastest growth in all primary energy sources. This robust growth is expected to continue, partly for environmental reasons and 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.

Natural gas is supplied almost entirely by imports in the form of LNG from Indonesia, Malaysia, Brunei Darussalam, Australia and Russia (from April 2009). Since Japan has placed priority on the stable and secure supply of LNG, Japanese LNG buyers have generally been paying a higher price than buyers in Europe or the United States under long-term 'take or pay' contracts with rigid terms on volume and price.

However, Japanese gas and electric utilities are faced with mounting pressure to reduce costs because of the deregulation of gas and electricity markets. The utilities have been making efforts to secure LNG supply on flexible terms that enable them to quickly respond to changes in the market situation and to supply gas at lower prices.

In addition, Japan has promoted the technological development of production/processing of methane hydrate, which is abundant in ocean areas surrounding Japan and is viewed as a future energy resource.

COAL

In 2008, coal accounted for 23% of the total primary energy supply. Coal will continue to play an important role in Japan's energy sector, mainly for power generation and for iron, steel, cement, paper and pulp production. Coal mines in Japan have become increasingly deeper and remoter, and the cost of domestically mined coal is approximately three times that of imported coal. The government used to subsidise the domestic coal mining industry; however, through structural adjustments and the reduction of subsidies, coal production has gradually decreased. The domestic production of commercial coal ended at the end of the 2001 fiscal year.

Japan is the biggest coal importer in the world, accounting for more than 20% of total global coal imports. From the standpoint of Japan, it is therefore essential to promote the development of overseas coal for energy security in Asia and to address growing domestic coal demand.

ELECTRICITY MARKET

Electricity was the second-largest contributor (next to petroleum) to total final energy consumption in 2008. Increased use of electrical appliances in the home, 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 has been among the highest of the developed economies. To lower the electricity price and increase industrial competitiveness, Japan has undergone a program to reform the electricity sector, through three cycles of amendments to the Electricity Utilities Industry Law, in 1995, 1999 and 2004.

Japan aims to boost its solar power capacity to 10 times the 2005 level by 2020 and to 40 times the 2005 level by 2030 to help it cut greenhouse gas emissions. To meet these high targets, Japan started an economy-wide feed-in tariff system in November 2009 (EEA 2009), under which utilities buy surplus solar power produced by households and factories at a guaranteed price for about 10 years. The guaranteed price started at JPY 48/kWh for residences using less than 10 kW, and at JPY 24/kWh for residences using more than 10 kW and for non-residential producers. The cost of introducing the system is passed on to consumers evenly, resulting in a rise in electricity fees per family of about JPY 100 a month in 10 years.

FISCAL REGIME AND INVESTMENT

The Japanese government recognises the necessity of encouraging domestic petroleum companies to obtain oil and gas upstream equities overseas. JOGMEC offers technical support to domestic petroleum companies in areas such as geological structure studies and mining technologies. In addition, both JOGMEC and the Japan Bank for International Cooperation offer financial support to companies.

In the short term, the government will concentrate on financial support for existing upstream projects to assist with start-up and continuation. In the mid term, the government will continue to appropriately support domestic petroleum companies by borrowing money in the market with government guarantee and building JOGMEC's flexible and effective finance system, with the objective of reducing geopolitical and technical risks for future projects.

ENERGY EFFICIENCY

Within Japan's May 2006 National Energy Strategy, the Energy Conservation Frontrunner Plan reinforces the economy's strategy to reduce petroleum consumption. Setting a target to improve energy efficiency by 30% relative to 2006 by 2030, the Japanese Government pledged to establish a state-of-the-art energy supply–demand structure within a market of high prices, which the government expects to endure for the medium to long term. Beyond a sustained promotion of energy efficiency, the Japanese Government pledged to optimise energy use by reducing oil dependence through improvements in the energy intensity of the oil-intensive transport sector. The Energy Conservation Frontrunner Plan sets a strategy to achieve this energy efficiency target through strategic planning in the medium and long term. It establishes a plan to develop energy conservation technology and to develop and disseminate a benchmarking approach, so that the energy conservation effect can be quantitatively verified (METI 2006).

The Strategic Energy Plan in 2010 set these current initiatives:

- Enhancing Japan's energy efficiency (already the highest level in the world) through introducing the most advanced technologies for replacing equipment in the industrial sector
- Making net-zero-energy houses available by 2020 and realising net-zero-energy houses as the average across the economy by 2030
- Setting compulsory energy-saving standards for houses and compiling compulsory standardisation targets

- Replacing 100% of lighting with highly-efficient lamps (including LED and organic EL lighting) on a flow basis by 2020 and on a stock basis by 2030
- Introducing new integrated standards for energy consumption in all buildings for implementation in two years
- Enhancing support and regulatory measures (including top-runner standards) to increase the take-up of energy-saving consumer electronics, energy-saving information technology equipment, heat pump water heaters, fuel cells, hybrid construction machines and other highly efficient equipment
- Raising next-generation vehicles' share of new vehicle sales to up to 50% by 2020 and up to 70% by 2030 by mobilising all possible policy measures.

RENEWABLE ENERGY

Japan aims to raise the share of renewable energy in its energy mix to 10% by 2020, to alleviate global warming, diversify energy sources, and promote environment-related industries. The government will introduce sustainable standards for biofuels to reduce greenhouse gases. The target is to increase the share of biofuels to 3% of gasoline-equivalent sold in Japan by 2020. This is expected to reduce greenhouse gases and encourage the introduction of the next-generation of biofuels technologies (such as celluloid and algae).

Japan is implementing a system of feed-in tariffs, where electric power companies are obliged to buy electricity generated by renewable sources at a certain price. Utilities are required to pay attention to the burden to consumers, and implement measures for stabilising the power grid.

NUCLEAR ENERGY

Nuclear energy is considered in Japan to address three key energy issues: supply stability, environmental protection (as no CO_2 emissions are produced during generation) and economic efficiency. It has now become a major source of electricity and will most likely play a big role in the future. Promoting nuclear power generation is one of the main pillars of the Strategic Energy Plan, with these specific measures:

- Building nine new or additional nuclear plants (with an overall plant capacity utilisation rate of about 85%) by 2020, and more than 14 (with a rate of about 90%) by 2030
- Achieving long-term cycle operations and shortening operation suspensions for regular inspection
- Improving the power source location subsidy system (by considering measures to promote the construction and replacement of nuclear plants and place a greater weight on electricity output in calculating subsidies)
- Improving the nuclear fuel cycle including the development of 'plutonium thermal use' and fast breeder reactors
- International cooperation on non-proliferation of nuclear weapons and nuclear safety.

CLIMATE CHANGE

In 2007, the Japanese Government announced Cool Earth 50, a cooperative initiative with major greenhouse gas emitters to reduce worldwide emissions by 50% from current levels by 2050. The actions required to achieve these goals are set out in the Cool Earth Innovative Energy Technology Program, which includes the Innovative Energy Technology Roadmap (METI 2008b) and the Technology Development Roadmap (METI 2008c).

At the United Nations Summit on Climate Change in September 2009, Prime Minister Yukio Hatoyama pledged that Japan will cut its greenhouse gas emissions by 25% from 1990 levels by 2020. The target is premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets. Japan's greenhouse gas emissions stood at 1235.08 million tonnes of CO_2 equivalent in 2007 (an increase of 1.7% compared to the previous year) (Prime Minister of Japan and His Cabinet 2009).

In March 2010 the Japanese government submitted a Bill proposing a Basic Strategy Plan on Global Warming. The Bill passed the Lower House, but was abandoned in the Upper House in June 2010. In October 2010, the Bill was re-submitted to the Diet (the Japanese parliament).

Notable energy developments

NEW PROJECTS

OIL

In June 2010, the Nippon Oil Corporation (now JX Nippon Oil & Energy Corporation) signed a Heads of Agreement with PetroChina on a joint venture in the Osaka refinery (with a refining capacity of 115 000 barrels per day). Nippon Oil Corporation was to hold 51% of stocks, PetroChina 49%. The refinery's main target market is Asia-Pacific.

NUCLEAR

In October 2010, the International Nuclear Energy Development of Japan Co., Ltd (JINED) was established by a group of Japanese companies, including nine major electric power companies. The aim of JINED is to promote reliable nuclear technologies and know-how to economies that intend to introduce nuclear power plants for the first time. With assistance from the Japanese government, JINED will make comprehensive offers, including construction of nuclear power plants, operation and maintenance, and capacity building for staff.

SMART GRID

In September 2010, the Collaborative Smart Grid Experiment started in Rokkasho-mura. This experiment is undertaken by four Japanese companies (Japan Wind Development, Toyota Motor Corporation, Panasonic Electric Works and Hitachi Ltd) to investigate the effective use of energy as a means to achieve a 'low-carbon society'(JWD 2010).

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USEFUL LINKS

Agency for Natural Resources and Energy—www.enecho.meti.go.jp/english/index.htm
Institute of Energy Economics, Japan—http://eneken.ieej.or.jp
Ministry of Economy, Trade and Industry—www.meti.go.jp/english/index.html
Ministry of the Environment—www.env.go.jp/en/index.html
Ministry of Land, Infrastructure, Transport and Tourism—www.mlit.go.jp/index_e.html

KOREA

Introduction

Korea is located in north-east Asia between China and Japan. It has an area of 99 538 square kilometres and a population of around 48.5 million. Approximately 21% of the population lives in Seoul, Korea's largest city and its capital.

In the last few decades, Korea has been one of Asia's fastest growing and most dynamic economies. GDP increased at a rate of 4.4% per year over the period from 1980 to 2008, reaching USD 1139.4 billion (USD (2000) at PPP) in 2008. Per capita income in 2008 was USD 23 441, more than four times higher than in 1980. Korea's major industries include the semiconductor, shipbuilding, automobile, petrochemicals, digital electronics, steel, machinery, parts and materials industries.

Korea has few indigenous energy resources. It has no oil resources, and only 326 million tonnes of recoverable coal reserves and 3 billion cubic metres of natural gas. To sustain its high level of economic growth, Korea imports large quantities of energy products. In 2009, Korea was the world's fifth-largest importer of oil and the world's second-largest importer of both coal and liquefied natural gas (LNG).

Table 1 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	99 538	Oil (barrels)	–
Population (million)	48.61	Gas (billion cubic metres)—recoverable	3
GDP (USD (2000) billion at PPP)	1 139.4	Coal (million tonnes)—recoverable	326
GDP (USD (2000) per capita at PPP)	23 441		

Sources: EDMC (2010); EIA (2009); MKE and KEEI (2009).

Energy supply and demand

PRIMARY ENERGY SUPPLY

Korea's total primary energy supply increased almost sixfold between 1980 and 2008, from 38 million tonnes of oil equivalent (Mtoe) in 1980 to 227 Mtoe in 2008. In particular, in the period from 1990 to 2000, energy supply increased at an annual average rate of 7.7%, far exceeding the economic growth rate of 6.2% for the same period. Likewise, per capita primary energy supply grew from 1.0 tonne of oil equivalent in 1980 to 4.7 tonnes of oil equivalent in 2008. The level of increase was similar to that of Japan and of most European economies.

In 2008, Korea's total primary energy supply was 227.4 Mtoe, a 2.2% increase from the previous year. By energy source, oil represented the largest share (39%), followed by coal (28%) and gas (14%). The remaining 19% of primary energy supply came from other fuels, nuclear and hydro. Korea imported around 86% of its total energy needs in 2008, including all of its oil and gas requirements and 98% of its coal supply.

Oil supply in 2008 was 89.6 Mtoe, a 5.1% decrease from the previous year. In 2009, the economy imported about 85% of its crude oil from the Middle East.

Coal supply in 2008 totalled 63.1 Mtoe, a 12% increase from the previous year. This substantial increase was the result of strong demand from the power sector for coal, due to its

cost competitiveness against other fuels. Korea has modest reserves of low-quality, high-ash anthracite coal that are not sufficient to meet its domestic demand. Almost all 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 United States.

Since the introduction of LNG in 1986, natural gas use in Korea has grown rapidly. Gas supply reached 32 Mtoe in 2008, with its share in the primary energy supply accounting for 14% in 2008. Most of Korea's LNG imports come from Qatar, Indonesia, Oman, Malaysia, Brunei Darussalam and Russia (MKE 2009a). Korea began producing natural gas domestically in November 2004, after a small quantity of natural gas was discovered in the Donghae-1 offshore field south-east of the economy.

Korea's electricity generation in 2008 was 446 terawatt-hours, a 4.5% increase from 2007. Generation by thermal sources, including coal, oil and natural gas, accounted for 65% of the total electricity generated, followed by nuclear at 34% and hydro at 1%.

Table 2 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	44 856	Industry sector	43 075	Total	446 428
Net imports and other	195 122	Transport sector	28 686	Thermal	288 444
Total PES	227 364	Other sectors	75 001	Hydro	5 563
Coal	63 051	Total FEC	146 762	Nuclear	150 958
Oil	89 620	Coal	9 433	Other	1 463
Gas	31 818	Oil	77 686		
Other	42 875	Gas	17 582		
		Electricity and other	42 061		

Source: EDMC (2010).

FINAL ENERGY CONSUMPTION

Korea's total final energy consumption in 2008 was 147 Mtoe, a 0.1% increase from the previous year. Industry accounted for the largest share at 29%, followed by the residential and commercial sector (25%) and transport (20%). The remainder was non-energy consumption by agriculture and industry, such as for petrochemical feedstock. In general, demand in the industry sector has weakened since the late 1990s, and demand in the transport and commercial sectors has increased.

By energy source, petroleum products accounted for 53% of total energy consumption, followed by electricity (29%), natural gas (12%) and coal (6%). Because of the economy's policy measures, natural gas consumption has increased significantly, particularly in the residential and commercial sector, from 3% in 1990 to 31% in 2008.

Policy overview

ENERGY POLICY FRAMEWORK

Supporting high levels of economic growth despite inadequate indigenous energy resources has been the key driver of Korea's energy policy. The Ministry of Knowledge Economy (MKE) is responsible for developing and implementing energy policies and programs, administering the energy industry, supporting the research and development of new energy technologies and formulating international cooperation on energy-related matters. MKE was established in 2008 by merging the Ministry of Commerce, Industry and Energy with elements of the Ministry of

Information and Communications, the Ministry of Science and Technology, and the Ministry of Finance and Economy. The aim was to create an enhanced government instrument capable of meeting the challenges of the twenty-first century.

In the past, Korea's energy policy focused on ensuring a stable energy supply to sustain economic growth. The changing situation has induced the government to seek a new direction in energy policy that will support sustainable development in full consideration of the 3Es (energy, economy, and environment).

In August 2008, faced with high energy prices and rising concerns over climate change, Korea announced a long-term strategy that will determine the direction of its energy policy to 2030. The strategy's long-term energy goals are to:

- *Improve energy efficiency and reduce energy consumption*. By 2030, Korea will reduce its energy intensity by 46%, from 341 toe/USD million to 185 toe/USD million. This is expected to result in energy savings of 42 Mtoe (KEEI 2010a).
- *Increase the supply of clean energy and reduce the use of fossil fuels*. By 2030, the share of renewable energy in total primary energy will reach 11% from 2.4% in 2007.
- *Boost the green energy industry*. By 2030, Korea's green energy technologies will be comparable to those of most advanced economies.
- *Ensure that citizens have access to affordable energy*. The government will ensure energy sources are accessible and affordable to low-income households.

ENERGY MARKETS

MARKET REFORM

Korea has been restructuring its energy sector since the late 1990s, when it introduced the principle of free competition in industries traditionally considered natural monopolies, such as electricity and natural gas. In January 2009, in a move to introduce competition into the electricity industry, the government announced the Basic Plan for Restructuring the Electricity Industry. The plan included the 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 wholly-owned companies (five thermal generation companies and Korea Hydro & Nuclear Power Company Limited). The five thermal generation companies were to be privatised in stages. However, in July 2008, the government announced there would be no further privatisation of KEPCO and its five subsidiaries. At the end of 2009, 51% of KEPCO (as a holding company) was owned by the Korean Government. KEPCO is still a dominant player in the electricity sector, controlling 94% of total power generation and 100% of transmission and distribution in Korea (KEPCO 2009).

The Korean Government has also made moves to restructure the gas industry. In November 1999, the government sold 43% of its equity in the Korea Gas Corporation (KOGAS) and developed the Basic Plan for Restructuring the Gas Industry to further promote competition in the industry. The plan outlines a scheme to introduce competition into the import and wholesale gas businesses; promote the development of the gas industry; and enhance consumer choice and service quality. A detailed implementation plan was announced in October 2001. The plan covers how to achieve the smooth succession of existing import and transportation contracts, the privatisation of import and wholesale businesses, stabilised price and balanced supply and demand, and the revision of related legislation and enforcement (KEEI 2002).

Regarding competition in the import and wholesale sectors of KOGAS, a final decision on whether to split the sectors from KOGAS or to introduce new companies will be made following discussion among stakeholders. Given the strong public interest in this sector, the existing public utility system is expected to be maintained. Competition in the retail sector, currently operated

under a monopoly system within each region, will be introduced in stages, in conjunction with the progress made in the wholesale sector. As of the end of 2010, no decision on the liberalisation of the gas market has been made (KOGAS 2010).

OIL, GAS AND ELECTRICITY MARKETS

Oil

Due to Korea's dependence on oil imports, the government has been trying to secure supplies for the short and long terms. To ease short-term supply disruptions and meet International Energy Agency (IEA) obligations, the Korean Government has been increasing its oil stockpile since 1980. In April 2010, the government had 146 million barrels of stockpile facilities and 122 million barrels of oil reserves. The economy-wide stockpile capacity equates to about 158 days of net imports, substantially exceeding the IEA's 90-day requirement.

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 May 2010, KNOC had equity stakes in 47 overseas exploration and production projects in 17 economies, including Indonesia, Viet Nam, Yemen, Nigeria, the United States and Peru (KNOC 2010). The present long-term strategy for overseas oil and gas development includes raising Korea's crude oil and natural gas self-sufficiency level from 4.2% in 2007 to 18.1% by 2012, and increasing KNOC's daily production from 50 000 barrels per day in 2007 to 300 000 barrels per day in 2012 (MKE 2008).

Korea has also been trying to diversify its crude oil supply sources. The number of source economies increased from nine in 1980 to 29 in 2004, but Korea's dependency on oil imports from the Middle East remains high (84.5% in 2009). Korea is also actively strengthening its bilateral relations with oil-producing economies as well as its multilateral cooperation through the IEA, Asia Pacific Economic Corporation, Association of Southeast Asian Nations (ASEAN)+3, the International Energy Forum and the Energy Charter, to enhance its crisis management capabilities (MKE 2009b). In particular, the government plans to play a leading role in energy resource development and trade in north-east Asia by creating a collaborative framework on energy cooperation.

Natural gas

To reduce the economy's dependence on imported oil, Korea introduced natural gas based city gas to the residential sector in the 1980s. Since then, gas use has grown rapidly, replacing coal and oil in the residential sector; in 2008, its share of the primary energy supply was 14%. KOGAS has a monopoly over Korea's natural gas industry, including the gas import, storage, transport and wholesale businesses (KOGAS 2010). Thirty city gas companies operate in the gas retail business in each region of the economy. Not only is KOGAS the world's largest LNG importer, it also promotes the development of natural gas resources abroad, in economies such as Australia, Uzbekistan and Nigeria.

The Ninth Plan of Long-term Natural Gas Demand and Supply finalised by MKE in December 2008, projected natural gas demand would grow by 0.2% per year from 2007 to 2030. By sector, the city gas sector's demand for natural gas is projected to increase by 2% per year, while the demand for gas for power generation is projected to decrease by 3.8% per year.

Electricity

Due to Korea's economic growth, electricity consumption has risen substantially over the past few decades; throughout the 1990s, the average annual growth rate was 9.5%. Between 1990 and 2007, installed capacity increased more than threefold, from 21 GW in 1990 to 73 GW in 2007. The Fourth Basic Plan of Electricity Demand and Supply (2008–22) finalised by MKE in December 2008, projects electricity demand will grow by 2.1% per year from 2008 to 2022 and

an additional capacity of 33.6 GW will be required by 2022. Taking decommissioning into account, this translates to about 101 GW of total generation capacity for that period.

To rectify an energy supply and demand structure overly dependent on oil, the 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 first introduced in 1986. During the period of the Fourth Basic Plan, 12 nuclear power plants, seven coal-fired power plants and 11 gas-fired power plants are planned to be constructed.

Korea has been building nuclear energy plants since the 1970s. In 2007, the economy's 20 power-generating reactors accounted for around 26% of the total electricity production capacity. Nuclear energy is a strategic priority for the Korean Government, and its share of total electricity production capacity is projected to increase to 32.6% in 2022. This will surpass the share held by coal-fired power plants, which traditionally have held the largest share. The Fourth Basic Plan forecasts nuclear energy generation will account for 48% of all electricity generated in Korea in 2022, a sharp rise from 36% in 2007 (MKE 2009c).

FISCAL REGIME AND INVESTMENT

In December 2009, the Korean Government approved tax reforms to foster a business-friendly environment and to promote investment. The tax changes include a reduction in corporate tax rates and an increase in tax benefit for Research and Development.

In 2007, the corporate tax rate was 25% on taxable income over KRW 200 million, and 13% on taxable income below KRW 200 million. Under the tax reforms, the corporate tax rate was scheduled to be lowered further step by step from 22% in 2009 to 20% in 2010, and from 11% to 10% for the same period, respectively. However, the implementation of the tax rate reduction is postponed until the end of 2011.

To promote investment in R&D that will boost economic growth, the government has increased its tax assistance for R&D. The new measures include a R&D reserve fund which will be deductible up to 3% of the sales revenue, increase investment tax credits for R&D facilities from 7% to 10%, and expand the deduction for R&D grants paid by corporations to universities from 50% to 100%.

ENERGY EFFICIENCY

The Korean Government has allocated around USD 14.2 billion for an energy efficiency initiative effective until 2012 (KEEI 2008). This initiative aims to improve energy efficiency by 11.3% by 2012 compared with 2007, and to save 34.2 Mtoe. It is part of Korea's long-term energy plan, announced in August 2008, which aims to achieve a 4.6% annual energy efficiency improvement by 2030.

To meet the target, the government will provide incentives for companies to invest in energy efficiency, phase out incandescent lamps by 2013, and implement a program modelled on 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 (MKE 2009d), LEDs (KEEI 2010b), technologies to improve the energy efficiency of the most energy-intensive appliances, and green home appliances.
- By 2012, the average fuel economy for automobiles (MKE 2009e) will be improved by 16.5%. This means the fuel economy for engine sizes below 1.5 litres (L) will be improved from 12.4 km/L (29.2 miles per gallon (mpg) US) in 2008 to 14.4 km/L (33.9 mpg US), while the fuel economy for engine sizes above 1.5 L will be improved from 9.6 km/L (22.6 mpg US) in 2008 to 11.2 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%.
- When purchasing appliances for use in government buildings, the government will give preference to those models with the grade 1 energy efficiency label and products that deliver less than 1 watt of standby power (MKE 2009f).
- To encourage businesses to improve energy efficiency, the government will divide businesses into four categories according to energy consumption. Specific measures such as negotiated and voluntary agreements will be introduced for each category (KEEI 2010c).

RENEWABLE ENERGY

In January 2009, the Korean Government announced a renewable energy plan, under which renewable energy sources will account for a steadily increasing share of the energy mix to 2030 (MKE 2009g). The plan covers areas such as investment, infrastructure, technology development and programs to promote renewable energy.

Under the new plan, renewable energy sources will account for 4.3%, 6.1% and 11% of the energy mix in 2015, 2020 and 2030, respectively—a significant increase from the 2007 share of just 2.4%. According to this initiative, the government will:

- *Allocate funds and attract investment to increase the use of renewable energy sources.* The initiative will cost KRW 111.5 trillion (about USD 85.8 billion) between 2009 and 2030, of which nearly a third will come from the government. Of that amount, KRW 100 trillion (about USD 76.9 billion) has been allocated to promote renewable energy and KRW 11.5 trillion (about USD 8.8 billion) to develop green technologies. After 2020, when renewable energy sources become more economically viable, the proportion of private investment is expected to increase steadily. In 2009, private investment was expected to surge to KRW 3.1 trillion (about USD 2.4 billion, a 103% increase from 2008) and the renewable energy industry was expected to create nearly 2050 jobs to augment its existing work force of about 2900 people.
- *Support the development of green technologies to make renewable energy more cost effective.* The government will introduce a renewable portfolio standard in 2012, support the construction of 1 million 'green homes' between 2009 and 2020, and provide incentives for the wider use of renewable energy sources in new and newly-renovated buildings. It will also strengthen the role of local governments in encouraging the wider use of renewable energy.
- *Improve infrastructure for renewable energy.* These measures will take the form of a renewable energy investment fund; the amendment of any regulations hindering the transition to renewable energy; promotional efforts to raise the public's awareness of the benefits of renewable energy; a more detailed classification system which conforms to the system used by the IEA and which will facilitate a more effective analysis of statistics; and human resources programs to foster technical professionals with the necessary expertise.

CLIMATE CHANGE

On 15 August 2008, the Korean President proclaimed 'Low Carbon, Green Growth' as Korea's new vision. This vision aims to shift the traditional development model of fossil-fuel dependent growth to an environmentally friendly one (Republic of Korea 2010).

To realise this vision, the Presidential Commission on Green Growth was established in February 2009. The Basic Act on Low Carbon and Green Growth was subsequently submitted, and it took effect in April 2010. This legislation will provide the legal and institutional basis for green growth. To implement the vision of green growth more effectively, the National Strategy for Green Growth was adopted along with the Five-year Plan for Green Growth in June 2009.

The National Strategy for Green Growth is to build a comprehensive, long-term (2009–50) master plan to address the challenges caused by climate change and resource depletion. It consists of three main objectives and 10 policy directions:

- mitigation of climate change and achievement of energy independence
  - effective reduction of greenhouse gas emissions (MKE 2009h)
  - reduction in the use of fossil fuels and the enhancement of energy independence
  - strengthening of the capacity to adapt to climate change
- creation of new engines for economic growth
  - development of green technologies (KEEI 2010d)
  - greening of existing industries and promotion of green industries
  - advancement of industrial structure
  - engineering of a structural basis for the green economy (KEEI 2010e)
- improvement in quality of life and enhanced international standing
  - greening the land and water, and building a green transportation infrastructure
  - building the green revolution into people's daily lives
  - becoming a role model for the international community as a green growth leader.

To fulfil the policy goals set out in the strategy, the Korean Government is adopting the practice of five-year planning. Five-year plans are mid-term programs designed to implement the long-term strategy for green growth. Table 3 outlines the policy indicators of the first plan for 2009–13, and shows the years beyond as a reference.

Table 3 Policy indicators, Five-year plan, 2009–13

Policy indicator	2009	2013	2020	2030
Energy intensity (toe/USD '000)	0.317	0.290	0.233	0.101
Energy independence (%)	27	42	54	70

The Five-year Plan for Green Growth envisages fiscal spending of KRW 107 trillion (USD 86 billion) for 2009–13. Under the plan, the three objectives and 10 policy directions will be implemented in an efficient and predictable manner. The fiscal budget will be mainly spent on R&D in green technology such as solar energy and fuel cells, restoration of the four major rivers, and green transportation. As the economy recovers, the weight given to R&D will become more significant.

Roughly 2% of the economy's annual GDP is allocated to green investment, which is twice the amount recommended in the Green Economy Initiative advocated by the United Nations Environment Programme (1% of GDP). Table 4 shows rates of green investment in Korea to 2013.

Table 4 Rates of green investment, 2009–13 (KRW trillion)

Category	Total	2009	2010–20	2012–13	Rate of increase (%)
Total	107.4	17.5	48.3	41.6	10.2
Mitigation of climate change and achievement of energy independence	56.9	8.6	29.2	19.2	14.0
Creating new engines for economic growth	28.6	4.8	10.7	13.1	9.4
Improvement in quality of life and enhanced international standing	27.9	5.2	10.5	12.2	3.6

NOTABLE ENERGY DEVELOPMENTS

CLEAN ENERGY/ENERGY EFFICIENCY

As a way to improve energy efficiency, the Korean government is planning to implement TGEM (Targets for the GHG emissions reduction and Energy Saving Management Program). TGEM is a mechanism to set an energy consumption and GHG emissions reduction target based on negotiations between the government and industry. The government will help companies' efforts to achieve their targets by providing incentives and penalties.

The TGEM procedure will consist of three stages. At the 1st stage (target setting), the companies will set their energy consumption and GHG emissions reduction targets in negotiation with the government. GHG emissions reduction goals, the energy efficiency target and the business environment will be considered when setting the targets. During the 2nd stage (implementation), the government will provide incentives and penalties to help companies accomplish their targets. At the 3rd stage (MRV: measuring, reporting and verification), a third party verification will be conducted on companies' performances.

Energy-intensive companies set goals based on their previous performances—this depends on individual companies' capabilities, levels of technology and competitiveness. To increase awareness and to enhance the acceptability of the system, the government launched TGEM pilot projects for the industry sector from December 2009 to June 2010. Forty-seven companies, including the top 10 energy consumers, in 15 areas participated in the pilot project (Table 5). Total energy consumption for all participating companies accounted for 41% of the total energy currently used in the industry sector. Table 6 shows the government-designated 470 companies expected to participate in the TGEM project in 2010 after the pilot project, by sector.

Table 5 Number of companies participating in the TGEM pilot project

Type of business	Number of companies
Steel	3
Oil refining	4
Petrochemical	11
Chemicals	2
Food	1
Textiles	1
Non-metallic	2
Home appliances	1
Machinery	1
Cement	5
Automobiles	1
Semi-conductor	8
Electricity generation	5
Paper manufacture	1
Display	1
Total	**47**

Table 6 Expected participants in the TGEM project, 2010

Sector	Number	%
Industry, Power	374	79.6
Building, Transportation	46	9.8
Agriculture, Livestock	27	5.7
Waste	23	4.9
Total	470	100

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Korea Gas Corporation—www.kogas.or.kr
Korea National Oil Corporation—www.knoc.co.kr
Ministry of Knowledge Economy—www.mke.go.kr
Ministry of Strategy and Finance—www.mosf.go.kr
Statistics Korea—www.kostat.go.kr

MALAYSIA

INTRODUCTION

Malaysia is located in South-East Asia. Its territory covers 330 242 square kilometres, spread across the southern part of the Malay Peninsula and the Sabah and Sarawak states on the island of Borneo. In 2008, Malaysia's population was around 27.7 million. Since 2000, Malaysia's GDP has grown steadily, at an average rate of 5.1% a year. Between 2007 and 2008, GDP grew by 4.64%, to USD 313.7 billion (USD (2000) at PPP). The GDP per capita increased by 2.86%, to USD 11 613 (USD (2000) at PPP) in 2008.

Malaysia's economy depends heavily on manufacturing and resource extraction, although there are ongoing initiatives to expand services and higher-value-added activities. In 2008, the manufacturing sector's share accounted for 28.9% of GDP. The major energy-intensive segments of the manufacturing sector are iron and steel, cement, wood, food, glass, pulp and paper, ceramics and rubber industries. During the same period, the mining sector, including oil and gas extraction, accounted for 7.9% of GDP.

Malaysia is well endowed with conventional energy resources such as oil, gas, and coal, as well as renewable energy sources such as hydro, biomass and solar energy. Malaysia's domestic oil production occurs offshore, primarily near Peninsular Malaysia. At the end of 2008, Malaysia's crude oil reserve, including condensate, was 5.5 billion barrels. Malaysia also has an abundant natural gas reserve. At the end of 2008, Malaysia's proven natural gas reserves were 2.5 trillion cubic metres. Malaysia's hydropower potential is assessed at 29 000 megawatts (MW); 85% of potential sites are located in East Malaysia. Biomass resources are mainly from palm oil, wood and agro-industries.

Table 1 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	330 242	Oil (billion barrels)—proven	5.5
Population (million)	27.7	Gas (trillion cubic metres)—proven	2.5
GDP (USD (2000) billion at PPP)	313.72	Coal (million tonnes)	280.8
GDP (USD (2000) per capita at PPP)	11 613	Uranium (million tonnes)	N/A

Sources: EDMC (2010), MEGTW (2008).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Malaysia's total primary energy supply was 77 839 kilotonnes of oil equivalent (ktoe) in 2008. The largest energy source was gas, which accounted for 39 869 ktoe, or 51.2% of the total primary supply. Oil was ranked second, with 29 256 ktoe, followed by coal, with 8114 ktoe, and other sources, with 601 ktoe. In 2008, Malaysia produced an average of 689 900 barrels of crude oil per day. During the same period, domestic consumption was around 492 000 barrels (MEGTW 2008). Malaysia exports the majority of its oil to Singapore, Thailand, Japan and South Korea. Malaysia's oil production is expected to fall in future, mainly due to the natural depletion of its reserves.

In 2008, Malaysia's natural gas production was 198.8 million cubic metres per day and domestic consumption was 26.7 billion cubic metres (MEGTW 2008). The Peninsular Gas Utilisation pipeline system supplied 61.4 million cubic metres per day of domestic gas, mainly for

power generation and industrial use. Malaysia is one of the world's leading exporters of liquefied natural gas (LNG). In 2008, it exported a total of 22.5 million tonnes of LNG to Japan, Korea and Chinese Taipei (PETRONAS 2009).

Coal is one of the primary fuels in Malaysia's energy sector. Coal is used primarily for power generation, and by the iron and steel industry and cement manufacturers. Malaysia's coal consumption in 2008 was 8114 ktoe. Malaysia imports coal from China, Australia, Indonesia and South Africa.

In 2008, total gross electricity generation was 110 590 gigawatt-hours (GWh). Thermal generation, mostly from natural gas and coal, accounted for 93.2% of total generation and hydropower for the remainder. Natural gas accounted for 56.5% and coal accounted for 33.4% of the total fuels input for electricity generation.

Table 2 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	96 208	Industry sector	18 667	Total	110 590
Net imports and other	–17 637	Transport sector	16 378	Thermal	103 130
Total PES	77 839	Other sectors	9 309	Hydro	7 460
Coal	8 114	Total FEC	44 354	Nuclear	–
Oil	29 256	Coal	1 464	Geothermal	–
Gas	39 869	Oil	24 433	Other	–
Other	601	Gas	10 474		
		Electricity and other	7 983		

Source: EDMC (2010).

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

FINAL ENERGY CONSUMPTION

In 2008, total final energy consumption in Malaysia was 44 354 ktoe. The industrial sector was the biggest final energy user at 18 667 ktoe, or 42.1% of total final energy consumption, followed by the transport sector at 16 378 ktoe, or 36.9%, and other sectors (agriculture, residential/commercial and non-energy) at 21.0%. By energy type, petroleum products contributed the largest share, with 55.1% of consumption, followed by gas (23.6%), electricity (18.0%) and coal and coke (3.3%).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The key ministries and agencies for Malaysia's energy sector are the Energy Unit of the Economic Planning Unit of the Prime Minister's Department; the Ministry of Energy, Green Technology and Water; and the Energy Commission. The Economic Planning Unit sets the general direction of, and strategies for, energy policy and determines the level of its implementation.

The role of the Ministry of Energy, Green Technology and Water is to facilitate and regulate the electricity sector and to ensure that affordable energy is available to consumers throughout the economy (MEGTW 2008). This includes formulation of energy policy in coordination with the Economic Planning Unit. The Energy Commission has been the regulatory agency for the electricity and piped gas supply industries in Malaysia since 2002, replacing the Department of Electricity and Gas Supply. The commission's main tasks are to provide technical and performance regulation for the electricity and piped gas supply industries, to act as the safety

regulator for electricity and piped gas and to advise the Minister on all matters relating to electricity and piped gas supply, including energy efficiency and renewable energy issues.

In general, Malaysia's energy sector is guided by the National Energy Policy, which has 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 that factors pertaining to environmental protection are taken into consideration in the production and utilisation of energy, by minimising the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment.

The National Depletion Policy was formulated to prolong and preserve the economy's energy resources, particularly oil and gas resources. Under this policy, total annual production of crude oil should not exceed 3% of oil originally in place, which currently limits oil production to around 680 000 barrels per day. To diversify the fuel mix used in electricity generation, the economy introduced the Four-Fuel Policy. The initial focus of this policy was to reduce the economy's overdependence on oil as the principal energy source, and it aimed for an optimal fuel mix of oil, gas, hydro and coal for use in electricity generation. As a result, oil's domination of the generation fuel mix has been significantly reduced and replaced with gas and coal. In 2002, the Four-Fuel Policy was expanded to incorporate renewable energy as the fifth fuel after oil, gas, coal and hydro. Nuclear energy is not used in Malaysia. However, the economy is exploring nuclear potential as one option for its future power generation.

Short- and medium-term energy strategies are largely outlined in the Malaysian Government's five-year plan. The latest, the Tenth Malaysia Plan (2011–2015), was published on 10 June 2010. Under the plan, Malaysia will emphasise energy supply security and economic efficiency as well as environmental and social considerations by focusing on five strategic pillars: initiatives to secure and manage reliable energy supply; measures to encourage energy efficiency; adoption of market-based energy pricing; stronger governance; and managing change. The plan also lays out actions that need to be taken in developing a sustainable energy sector, with a focus on renewable energy and energy efficiency (EPU 2010).

ENERGY SECURITY

The Tenth Malaysia Plan outlines measures the government will embark on to improve energy supply security. The government's main strategy to enhance security is through diversification of energy resources. The development of alternative resources such as renewable energy through economic and regulatory measures will be intensified. The importation of liquefied natural gas (LNG) is also identified as a way to improve energy security, and the economy is planning to build a LNG receiving terminal in Malacca.

Malaysia also addresses energy security by cooperating closely with its neighbours under the Association of Southeast Asian Nations (ASEAN) framework. Malaysia and ASEAN members have agreed to strengthen the region's energy security by signing the ASEAN Petroleum Security Agreement. Malaysia is also working with ASEAN members through the Trans-ASEAN Gas Pipeline Project. The project is expected to provide the region with a secure supply of energy by means of an interconnected gas infrastructure. The ASEAN Power Grid Project aims to strengthen energy security by integrating the power grids of ASEAN members. Development of the grid will provide the necessary interconnectivity for the regional mobilisation of electricity sales and will optimise the development of energy resources in the ASEAN region.

GREEN TECHNOLOGY POLICY

In August 2009, the Malaysian Government launched the National Green Technology Policy. One objective of the policy is to provide a path towards sustainable development. The policy is built on four pillars: energy—seek to attain energy independence and promote efficient use; environment—conserve and minimise the impact on the environment; economy—enhance

economic development through the use of technology; and society—improve the quality of life for all.

The policy covers four key areas:

- *Energy*. Application of green technology in power generation and in energy supply-side management, including cogeneration by the industrial and commercial sectors, and in all energy-use sectors and in demand-side management.
- *Buildings*. Adoption of green technology in the construction, management, maintenance and demolition of buildings.
- *Water and waste management*. Use of technology in the management and use of water resources, wastewater treatment, solid waste and sanitary landfill.
- *Transport*. Incorporation of green technology in transportation infrastructure and vehicles, in particular, biofuels and public road transport.

To promote the development of green technology activities, the Malaysian Government established a fund amounting to MYR 1.5 billion. The fund will provide soft loans to companies that supply and utilise green technology.

To expand the use of green technology, including energy-efficient technology, in buildings, the government launched the Green Building Index (GBI) on 21 May 2009. In line with this effort, the government is providing the following incentives:

- Building owners obtaining GBI certificates from 24 October 2009 until 31 December 2014 are given income tax exemption equivalent to the additional capital expenditure in obtaining such certificates.
- Buyers purchasing buildings with GBI certificates from developers are given stamp duty exemption on instruments of transfer of ownership. The exemption amount is equivalent to the additional cost incurred in obtaining the GBI certificates. This exemption is given to buyers who execute sales and purchase agreements from 24 October 2009 until 31 December 2014.

ENERGY MARKETS

MARKET REFORM

The Malaysian energy market is regulated and subsidies are provided to energy users. However, the economy is considering implementing energy market reforms by withdrawing energy subsidies gradually. In the Tenth Malaysia Plan, the government has planned to achieve market pricing by 2015. The plan states that gas prices for the power and non-power sectors will be revised every six months to gradually reflect market prices. A decoupling approach for energy pricing will be undertaken to explicitly itemise subsidy value in consumer energy bills and eventually delink subsidy from energy use. However, assistance for low-income households and other groups for which the social safety net is required will be provided in different forms (EPU 2010).

UPSTREAM ENERGY DEVELOPMENT

Malaysia's upstream energy development is governed by the Petroleum Development Act, which was enacted to streamline the economy's upstream energy development. Under the Act, Petroliam Nasional Berhad (PETRONAS) is vested with entire ownership and control of petroleum resources in Malaysia. PETRONAS is wholly owned by the Malaysian Government.

PETRONAS is intensifying the exploration of deepwater and extra-deep water areas. In 2009, 16 new fields came on stream, increasing the total number of producing fields in Malaysia to 104, of which 68 are oil fields and 36 are gas fields. Six new production-sharing contracts were awarded during 2009, bringing the total to 71, with 25 in Peninsular Malaysia, 22 in Sarawak and 24 in Sabah.

The discovery of gas reserves by PETRONAS Carigali, a subsidiary of PETRONAS, during 2010 from the economy's first High Pressure High Temperature (HPHT) well in the Kinabalu field, which is offshore of Sabah, was a key milestone for the domestic exploration and production sector, and potentially opens up new exploration prospectivity for deeper reservoirs.

ELECTRICITY AND GAS MARKETS

Malaysia has a reliable and stable electricity supply system, which is regulated by the government. Under the Tenth Malaysia Plan, the government is focusing on efforts to ensure continued security of electricity supply as well as creating a sustainable electricity supply industry in light of volatile global energy prices and declining gas production particularly in Peninsular Malaysia. In addition, the productivity and efficiency of utility providers will also be enhanced. During the plan period, the government intends to improve and enhance the electricity sector by increasing and diversifying generation capacity; strengthening transmission and distribution networks; restructuring the electricity supply industry; and improving customer service delivery.

The main means of increasing and diversifying generation capacity is the development of alternative sources of energy, particularly hydro, as well as increased importation of coal and liquefied natural gas (LNG) by 2015. To improve the efficiency of coal use and to reduce carbon dioxide emissions, the government will explore super-critical coal technology for new investments. Specific initiatives to increase generation capacity include:

- *Peninsular Malaysia*. Two hydroelectric plants will be commissioned during the plan period in Ulu Jelai and Hulu Terengganu with a combined capacity of 622 MW.
- *Sabah*. Three new power plants will be commissioned with a combined capacity of 700 MW. These include two gas-based power plants in the west coast, and one coal-based power plant in the east coast using clean coal technology.
- *Sarawak*. The 2400 MW Bakun Hydroelectric Project will be commissioned in stages.

Transmission and distribution systems will be strengthened and expanded to reduce losses. By 2015, the System Average Interruption Duration Index (SAIDI), a measure of supply reliability, is expected to improve from 68 to 50 minutes per customer per year in Peninsular Malaysia. The potential of implementing a Smart Grid system will also be reviewed to minimise losses, reduce costs and increase reliability.

The gradual adoption of market pricing for gas (see 'Market reform' above) is expected to have significant effect on the electricity supply industry. Currently, gas for power generation supplied by the Peninsular Gas Utilisation system is heavily subsidised. The government is also planning to instil greater market discipline through measures such as creating separate accounting for generation, transmission and distribution activities, introducing performance-based regulation and renegotiation of power purchase agreements. Delivery of services by utilities to new and existing customers will be accelerated through the use of new technologies and performance-based regulations. These will include faster response time in providing new electrical connections and restoring supply interruptions.

The economy is exploring the possibility of using nuclear power. Currently, nuclear energy has no share in the generation fuel mix. However, recent developments in the world energy market—such as the volatility of oil and gas and coal prices, depletion of indigenous oil and gas resources, environmental concerns about coal-fired power plants—have made the government consider nuclear energy as an option for future power needs. The government has initiated a study on the potential of nuclear energy for power generation in Malaysia. The economy is considering nuclear energy in its power generation sector after 2020.

In 2009, the Peninsular Gas Utilisation system supplied 60.8 million standard cubic metres per day (MMscm/D) of gas, a decrease of 1.1% from 2008, for domestic consumption and export to Singapore. The power sector remains the largest domestic gas consumer, consuming 59.7% of gas transmitted through the system. Industrial, petrochemical and other users accounted for 34.1%, increasing from 19.9 MMscm/D in the previous year to 20.7 MMscm/D in 2009. About 6.2% was exported to Singapore. The Peninsular Gas Utilisation gas input was

obtained from the offshore Terengganu gas field and, through imports from the Malaysia–Thailand Joint Development Area, Indonesia and Viet Nam. The gas input from offshore Terengganu decreased by 3.5%, with almost 24% of total supply being imported in 2009.

ENERGY EFFICIENCY

Energy efficiency improvement is one of the important elements in Malaysia's energy policy. In the Tenth Malaysia Plan, the economy plans to intensify energy efficiency measures to harness energy savings potential and reduce Malaysia's carbon emissions and dependence on fossil fuels. Under this framework, the National Energy Efficiency Master Plan 2010 is intended as a holistic implementation roadmap to drive energy efficiency improvement in the industrial, commercial and residential sectors. The target of the plan is to reduce the electricity consumption by 10% (7.3 Mtoe) in the year 2020 compared to a 'business-as-usual' scenario. The plan sets out 18 programs in the sectors that will result in significant energy savings over the plan period and beyond.

RENEWABLE ENERGY

Malaysia encourages the development of renewable energy in the economy through various policies and strategies. The Five-Fuel Policy has made renewable energy one of the components in the fuel mix for power generation after oil, coal, gas and hydro. The Tenth Malaysia Plan specified a target of 985 MW by 2015 for grid-connected generation from renewable sources, which would contribute 5.5% to Malaysia's total electricity generation mix. This is to come from biomass (330 MW), biogas (100 MW), mini hydro (290 MW), solar photovoltaic (65 MW) and solid waste (200 MW).

The government is going to introduce feed-in-tariff (FiT) for power generated from renewable energy resources to support the plan target. The FiT is funded through levy imposed on electricity users in the economy. The government is also planning to establish a special agency, the Sustainable Energy Development Authority, under the Ministry of Energy, Green Technology and Water, to manage the FiT fund as well as to support development of renewable energy in the economy.

CLIMATE CHANGE

Malaysia's National Climate Change Policy was formulated in 2009. The main objectives of this policy are to streamline and coordinate government action across existing legislation and policies, to establish an inter-ministerial and cross-sectoral committee to drive and facilitate implementation of adaptation and mitigation measures, and to identify options and strategies to achieve a low-carbon economy. Under the Tenth Malaysia Plan, Malaysia will adopt a dual strategy in addressing climate change impacts: firstly, adaptation strategies to protect economic growth and development factors from the impact of climate change; and secondly, mitigation strategies to reduce emission of greenhouse gases (GHGs).

NOTABLE ENERGY DEVELOPMENTS

THE TENTH MALAYSIA PLAN (2011–2015)

The Tenth Malaysia Plan was unveiled on 10 June 2010 by the Prime Minister. This introduces a revised energy policy that emphasises energy security and economic efficiency as well as environmental and social considerations. Details are contained in the 'Policy overview' section.

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Ministry of Energy, Green Technology andWater—www.kettha.gov.my/en

Ministry of Finance—www.treasury.gov.my/index.php?lang=en

PETRONAS—www.petronas.com.my

MEXICO

INTRODUCTION

Mexico is the second-largest economy in Latin America, and one of the three Latin American economies in APEC. Mexico has a land area of around 1.96 million square kilometres and is located in North America, bordered by the United States to the north and Belize and Guatemala to the south. Mexico is a federal constitutional republic known officially as United Mexican States (Estados Unidos Mexicanos). The Mexican Republic is divided into 31 states and one Federal District. It has a total population of 112.3 million (INEGI 2010a), which is projected to grow to 121.85 million in 2050 (CONAPO 2009). According to Mexican Government statistics, 47.4% of the population is considered poor and 18.2% is considered to live in extreme poverty (CONEVAL 2009). The largest urban metropolitan areas are Mexico City, Guadalajara and Monterrey. Mexico City, formed by the Capital City (Distrito Federal) and its metropolitan area known as Zona Metropolitana del Valle de México (ZMVM), is one of the largest urban centres in the world, with a population of around 20.3 million people. Mexico has a rich bio-diversity and a wide range of climatic conditions, from dry in the north, moderate temperatures in the south, temperate in the centre and temperate and warm on the coasts. The currency is the Mexican peso (MXN) and the economy's growth depends heavily on crude oil exports, international remittances and tourism.

The Mexican economy was hit hard by the global economic crisis and the collapse of international trade during the last quarter of 2008 and the first quarter of 2009. In 2008, Mexico's real gross domestic product (GDP) was USD 1086 billion (USD (2000) at PPP) (EDMC 2010). During 2009, the economy faced reductions in manufacturing exports, restrictions on external financing and a reduction in crude oil export prices; the latest had a negative effect on the economy's external revenues. In addition, during the second quarter of 2009, Mexico was affected by the swine flu or A (H1N1) which reduced activity levels and the demand for several services. A rebound in external demand after the third quarter of 2009 led the economic recovery; private consumption and investment are trailing behind and have not yet contributed significantly to the upturn of the economy. As a result, the real GDP fell by 6.5% in 2009. According to international organisations, the Mexican economy is projected to grow at about 3.6% in 2011 (World Bank 2010).

The energy sector is very important to the Mexican economy. Mexico is a net crude oil exporter, exporting around 47% of its total indigenous crude oil production. In 2009, the economy's oil company, Petróleos Mexicanos (Pemex), exported about 1225 thousand barrels per day (Mbbl/D) or USD 25 693 million of crude oil, down 40.7% compared with 2008. This abrupt reduction was due to lower crude oil prices and lower export volumes. Pemex exported 85.9% of its total crude oil exports to the United States in 2009, while the remaining 14.1% was distributed among Europe, the rest of the Americas and the Far East (Pemex 2010a).

Mexico has made important decisions in the energy sector to strengthen the energy efficiency of the economy. After the Energy Reform of 2008, structural changes in the oil and power sectors have been achieved. In the oil sector, the new Law of Petróleos Mexicanos and the related modifications to Pemex's fiscal regime allow the company to operate with greater implementation capacity and operational flexibility (Pemex 2010a). In the power sector, the Mexican Government implemented strategic measures, such as the closure of the Luz y Fuerza del Centro (LyFC) in 2009, to reduce the transfer of public financing and to increase the productivity of the sector (Banxico 2010).

Table 16 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (million sq. km)[b]	1.96	Oil (thousand million barrels)	10.4
Population (million)[b]	112.3	Gas (trillion cubic feet)	16.8
GDP (USD (2000) billion at PPP)	1086.76	Coal (million tonnes)[b]	1211
GDP (USD (2000) per capita at PPP)	10 219	Uranium (million tonnes of uranium metal)[c]	1.3

a Proven reserves at the end of 2009 (BP 2010).
b Data from INEGI (2010a, 2010b).
c NEA (2010).
Source: EDMC (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Mexico has a rich energy mix, including oil, gas, coal, hydro, nuclear, wind and solar. In 2008, Mexico had indigenous energy production of 232 691 kilotonnes of oil equivalent (ktoe) and net exports of 46 451 ktoe (exports correspond mainly to crude oil and imports to gasoline and dry natural gas). The total primary energy supply was 197 991 ktoe: oil supply accounted for 48% of the total.

The oil industry plays a crucial role in the economy. Mexico has important crude oil and gas production fields in offshore and onshore facilities. By law, Pemex is the sole producer of crude oil and its derivatives in Mexico, from upstream exploration to final downstream distribution, by means of its four integrated companies. The economy's four crude oil and gas production regions are the North-eastern Marine region, the South-western Marine region, the Southern region and the Northern region. Most of Mexico's crude oil production occurs in the Gulf of Mexico, off the coast of Campeche. The two main production centres are Cantarell and Ku-Maloob-Zaap (KMZ). In 2009, Cantarell and KMZ accounted for 57% of Mexico's total crude oil production. For the production and exploitation of hydrocarbons, Pemex has 394 production fields, 6890 exploitation wells, 231 offshore platforms, 4658 kilometres (km) of oil pipelines and 7431 km of gas pipelines (Pemex 2010a).

As of 1 January 2010, Mexico had 13 992 million barrels (MMbbl) of hydrocarbon proven reserves, of which 74% consisted of crude oil, 10% of condensates and 16% of dry gas. Estimated crude oil proven reserves totalled 10 420 MMbbl (62% as heavy crude oil, 29% light crude oil and 9% extra-light crude oil). Natural gas proven reserves totalled 16 815 million cubic feet (MMcf) of which 64% consisted of associated gas and the remaining 36% of non-associated gas. Offshore fields contained 71% of crude oil reserves, onshore fields the remaining 29%. Of the total natural gas proven reserves, 60% is located onshore and 40% is located offshore (Pemex 2010b). In 2009, Pemex registered a decrease of 6.8% in crude oil production compared with 2008, from 2.8 MMbbl/D to 2.6 MMbbl/D. In contrast, over the same period, total gas production increased 1.6% from 6.9 billion cubic feet per day in 2008 to 7.0 billion cubic feet per day in 2009. Dry gas exports decreased from 107 million cubic feet per day (MMcf/D) in 2008 to 67 MMcf/D in 2009, primarily as a result of an increased demand from the Mexican electricity sector. Over the same period, imports of dry gas decreased from 1336 MMcf/D to 1259 MMcf/D, as a result of higher indigenous production and lower export volumes (Pemex 2010b).

Mexico has 1211 million tonnes (Mt) of recoverable coal reserves located in the states of Coahuila, Sonora and Oaxaca (with most of them in the north-east of Coahuila). Around 70% of recoverable reserves are anthracite and bituminous, 30% are lignite and sub-bituminous. Coal production decreased by 9.5% between 2008 and 2009, reaching 9.49 Mt in 2009 with a value of USD 359 million (INEGI 2010b; CAMIMEX 2010). The transformation sector (electricity

generation and coking plants) is the principal user of coal in Mexico but indigenous production satisfies only about 58% of the total demand for coal.

The Mexican electricity sector is made up of the public electric power utility and independent power producers (IPPs). After October 2009, Mexico's public power service was controlled by the Comisión Federal de Electricidad (CFE), including the transformation, transmission, distribution and sale of electricity. The Mexican electricity grid is well developed and is interconnected through the National Electricity System (Sistema Eléctrico Nacional, or SEN), controlled by the CFE through its National Centre of Energy Control (Centro Nacional de Control de Energía, or CENACE). In 2008, the total installed capacity was 51 105 MW: however, at the end of the third quarter of 2010 the economy had increased its installed capacity to 52 905 MW. The generation from Mexico's public power service (including IPPs) was 235 871 GWh at the end of 2008. In August 2010, total generation reached 236 543 GWh; from the total, 158 548 GWh were generated by CFE (67%) and 77 994 GWh by IPPs (33%) (CFE 2010).

Table 17 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	232 691	Industry sector	33 502	Total	258 913
Net imports and other	–46 451	Transport sector	58 108	Thermal	201 797
Total PES	197 991	Other sectors	25 595	Hydro	39 178
Coal	6 925	Total FEC	117 205	Nuclear	9 804
Oil	94 207	Coal	1 298	Geothermal	7 056
Gas	78 419	Oil	77 863	Others	1 078
Others	18 439	Gas	13 514		
		Electricity and others	24 531		

Sources: EDMC (2010); SENER (2009a).

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

FINAL ENERGY CONSUMPTION

In 2008, total final energy consumption in Mexico was 117 205 ktoe, an increase of 5.6% from the previous year. The transport sector accounted for 47.4% of total energy consumption, while the industry sector consumed 27.4% of final energy, and other sectors (including residential, commercial and agricultural) 20.9%. By fuel source, petroleum products accounted for 66.4% of energy consumed, natural gas 11.5%, coal 1.1% and electricity and others 20.9% (SENER 2009a; EDMC 2010).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Ministry of Energy (SENER) is responsible for Mexico's energy policy within the current legal framework. The Energy Sector Program 2007–2012 was developed from the long-term Visión 2030 project and is linked to the National Development Plan 2007–2012. The main objective of Mexico's energy policy is to ensure the supply of the energy required for development, while achieving competitive prices, minimising environmental impacts, and operating at high quality standards. The Energy Sector Program sets out the main policies, strategies, goals and measurable targets for the energy sector (SENER 2007a).

In February 2010, the Mexican Government, through the Ministry of Energy, launched the National Energy Strategy (SENER 2010a). The strategy is based on a sectoral diagnosis of the

current situations and challenges of the oil and power sectors and of energy efficiency. Its approaches and objectives were established from the National Development Plan 2007–2012 and confirmed by the Visión 2024 project. The strategy defines the energy objectives, action guidelines and facilitators. It has three guiding principles: energy security, economy and productive efficiency, and environmental sustainability. From these three principles, nine objectives were developed to respond to the economy's energy needs and its social development for the next 15 years. The nine objectives are to:

1. Increase oil reserves restitution; reverse the decline in crude oil production and maintain natural gas production levels
2. Diversify energy sources by increasing the use of clean technologies
3. Increase the efficiency levels of energy consumption
4. Reduce the environmental impacts of the energy sector
5. Ensure the efficient, reliable and safe operation of energy infrastructure
6. Reduce the cost of energy supply by the appropriate execution of needed investments for processing capacity
7. Strengthen the transportation, storage and distribution of natural gas and petroleum products
8. Provide quality energy at competitive prices to the marginal population of the economy
9. Promote technology development and high quality human resources to the energy sector.

Defined action guidelines have been established for each of the nine objectives. Several indicators grouped in the three principles show the proposed impact of the implementation of the action guidelines. From this, the Mexican Government launched its goals for energy security, economy and productive efficiency, and environmental sustainability to be achieved in 2024, which are described below:

- *Energy security*. Production of crude oil at levels of 3.3 MMbbl/D; Oil proven reserves (1P) restitution at 100%; Gasoline reserve margin (understood as maximum supply capacity/economy-wide gasoline demand) of 15%.
- *Economic and productive efficiency*. Improve the energy efficiency of the National Refining System; Achieve a reserve margin on electricity generation of 22%; Reduce electricity losses to 8%; Achieve electricity coverage of 98.5%.
- *Environmental sustainability*. Reduce natural gas flaring and venting to increase utilisation to 99.4%; Electricity generation capacity through clean technologies at 35%; Savings related to the efficient use of final energy consumption at 280 TWh.

To achieve the planned objectives, cross-cutting elements in the government's policies will support the implementation of the action guidelines. Such elements include the strengthening of the economy's institutions, access to financing resources, international collaboration and the enhancement of diffusion programs (SENER 2010b).

ENERGY MARKETS

In 2008, Mexico restructured its energy markets and legislation. The approval of the Energy Reform in October 2008 has allowed reform initiatives and new laws to strengthen the energy sector. Three laws were amended and four new laws were created.

As a result, the legal framework for Mexico's oil and gas industry has been modified, with the creation of the Law of Petróleos Mexicanos, the Regulations to the Law of Petróleos Mexicanos, and the Pemex Administrative Contracting Guidelines. The new Law of Petróleos Mexicanos allows Pemex to operate with greater implementation capacity and operational flexibility. According to the Law, any operational or commercial decision made by the company must be oriented towards increasing its economic value and equity. Among the main fiscal measures to strengthen Pemex, the Mexican Chamber of Deputies approved a new Fiscal Regime for Pemex–

Exploration and Production. This new scheme will provide changes in the fiscal regimes for crude oil and natural gas exploration fields (Pemex 2010a).

In October 2009, as one of the action plans in Mexico's power sector to make it more efficient, the decentralised power company Luz y Fuerza del Centro (LyFC) was abolished by presidential decree (DOF 2009). LyFC was the public power utility that provided electricity to the central region of Mexico. The control of all technical operations of the power sector has been taken over by the Comisión Federal de Electricidad (CFE), the only public electricity company in the economy.

Mexico's energy regulatory framework is constituted by the Comisión Reguladora de Energía (CRE). CRE was created in 1993 and the energy regulation in Mexico was assigned to CRE through the Law of the Regulatory Energy Commission of 1995. CRE's mission is to regulate the natural gas, petroleum products, hydrocarbon derivatives and electricity industries so they operate efficiently and transparently. Its main instruments for regulation are: issuing permits, authorising prices and tariffs, approving terms and conditions for services, and issuing general management attributions, among others. In 2009, the number of permits issued for the electricity and natural gas sectors declined; however five permits for wind projects, two of which correspond to independent producers, and one permit for the interconnection of LNG Manzanillo and the National Natural Gas Pipelines System in Guadalajara City were issued. CRE worked with the Ministry of Energy to develop the Law of Efficient Use of Renewable Energies and the Financing of Energy Transition, published in September 2009. In this same year, resolutions were approved concerning free access for LPG storage RES/250/2009, and the quality of natural gas and its first hand selling RES/178/2009 (CRE 2010).

FISCAL REGIME AND INVESTMENT

The reform of the energy sector in 2008 constituted important changes for the economy, given the fiscal dependency on oil revenues and the lack of competition in the sector. The Mexican Constitution reserves the right to exploit hydrocarbon resources for the state, and Pemex operates on its behalf. Although a new fiscal regime was introduced in 2006, the newly available funds were not sufficient for the investment needed. After the approval of the Energy Reform, Mexico's oil and gas industry modified its legal framework. Pemex now expects to be capable of exploiting hydrocarbons in a more efficient and flexible manner, which will in turn have the effect of increasing oil revenues for the benefit of the Mexican economy (Pemex 2009).

To continue strengthening Mexico's oil sector, in October 2009 the Mexican Chamber of Deputies approved a new Fiscal Regime for Pemex–Exploration and Production. This new scheme provides for the changes in the fiscal regimes for the Chicontepec fields and for the deep water fields in the Gulf of Mexico, effective as of January 2010. These fiscal regimes focus on three different duties: Special Duty; Hydrocarbon Extraction Duty; and Additional Hydrocarbons Duty. The Special Duty is applied when cumulative production of the relevant region exceeds 240 million barrels of crude oil equivalent (MMbcoe), and the rate will increase from 35% to 36%. In the case of the Hydrocarbon Extraction Duty, the rate was modified from a variable rate between 10% and 20% to a fixed rate of 15% of applicable total income; this rate will depend on the weighted average Mexican crude oil export price. Finally, the Additional Hydrocarbons Duty will be applied when the price per barrel of crude oil equivalent exceeds USD 60 per barrel; this duty is calculated by applying a rate of 52% to the product of total production volume multiplied by the difference between the reference price and USD 60 per barrel.

Pemex has developed the Business Plan of Petróleos Mexicanos and its Subsidiary Entities 2010–2024, approved on 1 June 2010. The plan includes 23 challenges to improve operational, administrative and financial efficiency under a sustainable framework. The plan's mission is to maximise the value of the economy's petroleum and hydrocarbon activities to satisfy efficiently, reliably and sustainably, the demand for petroleum products (Pemex 2010c).

Investment opportunities and incentives in Mexico must be considered in the context of political stability, the rule of law and macroeconomic factors. The current attractiveness of

Mexico as a source for serious, long-term private investment in energy and infrastructure results from many dramatic shifts over the past several years. Mexico has become a considerably more stable economy in which to invest since the 1994 passage of the North American Free Trade Agreement (NAFTA). Democratisation and a commitment to market discipline, especially in the financial sector, have strengthened the economy, the banking system, government institutions, the rule of law and monetary policy.

Mexico's relative political stability and investor-friendliness, along with the longer-term trend of economic liberalisation and political stability in Latin America's major economies, have combined for steady growth in inbound foreign investment. High global oil prices, a liquid domestic financial market and a more transparent tax system also contribute to currency stability and positive trends in Mexico's current account deficit. So while much remains to be done in these areas, the trends are positive. Consequently, Mexico appears to attract a much lower risk premium from foreign investors than in the past.

ENERGY EFFICIENCY

Mexico has had energy efficiency programs since 1989. It has strong public institutions that encourage the efforts in energy efficiency and conservation. The institution in charge of promoting the programs and providing technical advice in energy efficiency is the National Commission for the Efficient Use of Energy (CONUEE), formerly CONAE. Other institutions, such as the Trust Fund for Electricity Savings (FIDE), provide financing for energy audits and assessments, and facilitate the acquisition and installation of energy-efficient equipment. Several programs have been implemented to promote the efficient use of energy; one program is the Electric Sector Energy Savings Program (PAESE). This program includes accelerating the construction and entrance into operation of new electrical power stations, the changing of some concepts in the Law of the Public Service of Electricity Energy to allow private sector participation in electricity generation, and the establishment of energy efficiency as an objective for the industry.

Through CONUEE, the government has launched several programs in terms of regulation, public policies for the sustainable use of energy, promotion and dissemination, and information and evaluation. The most effective program has been the Official Mexican Norms (Normas Oficiales Mexicanas, NOMs), which contains all the specific mandatory regulations for the use, management, description, maintenance and warranty a product must comply with to be sold on the Mexican market (SE 2010). Mexico's mandate for Energy Efficiency Standards comes from a generic law, the Ley Federal sobre Metrología y Normalización of 16 July 1992, which defines the NOMs. Mexico first adopted energy standards in 1995: currently it has 18 energy efficiency mandatory standards for electrical appliances, energy building codes, and lighting. Under Mexican law, and as an element of the standards, CONUEE also implements a mandatory comparative labelling program for room and central air conditioners, refrigerators and/or refrigerator-freezers, clothes washers, centrifugal residential pumps, gas water heaters, commercial refrigeration, and non-residential building envelopes.

Currently, Mexico has programs for energy efficiency in transportation, buildings and residential, industries and education. In the transport sector, Mexico launched two programs in 2009, the Efficient Auto Driver and the Efficient Freight Driver (Automovilista Eficiente y Transportista Eficiente) programs. These programs provide technical assistance, training, information and general tools for efficient energy use in the transport sector at public, private and social levels. Another ongoing program is the Green Mortgage Program in the residential sector, which consists of a green credit from the economy-wide residential fund called Instituto del Fondo Nacional de la Vivienda para los Trabajadores (INFONAVIT). This program was created to assist workers wanting to buy a new home to install new 'eco-technologies' such as solar water heaters. In the industry sector, Mexico promotes ongoing energy saving programs through its two state-owned companies, Petróleo Mexicanos and Comisión Federal de Electricidad. For example, specific projects such as reducing gas flaring in Pemex's facilities (Pemex 2010a) and the CFE's energy savings campaign for household appliances (CFE 2010).

CONUEE has an online education campaign aimed at children called Niños con Energía–Children with Energy (CONUEE 2010).

RENEWABLE ENERGY

Since the 2008 Energy Reform, Mexico has developed new policies for the introduction of renewable energies. One of them is the objective for the diversification of energy resources of the National Energy Strategy which aims for the introduction of clean technologies such as renewable, hydro and nuclear technologies as key factors for energy security and a sustainable energy environment. To achieve these objectives, the promotion of renewable technologies for power generation, the profitable cogeneration potential and the free development of bio-energy markets should be done. The action plans to promote clean technologies for power generation and the development of a bio-energy market are to:

- Implement mechanisms for the development of clean technologies
- Recognise the environmental impacts and indirect benefits of applying the energy supply cost (for the short term and long term) to all technologies and fuels
- Establish a program for updating the inventory of the economy's renewable energy resources
- Provide profit opportunities through the generation of carbon credits
- According with the regulatory framework and availability of resources, evaluate the alternatives for the development of a bio-energy market for its introduction in the fuel transportation mix
- Promote biogas recovery and its use in anaerobic processes by the development of feasible economic opportunities.

In 2009, the Mexican Government published the Special Program for the Use of Renewable Energy, which is the framework for establishing public policies in the renewable energy sector and for determining the goals for the use of renewable energy and the action plans for achieving those goals (SENER 2009b). The program has three specific objectives:

- Encourage the development of a renewable energy industry in Mexico
- Expand the energy portfolio and energy security of the economy by encouraging the diversification of fuels so as not to rely on one fuel
- Expand the electricity supply in rural communities using renewable energies where grid connection is not technically and economically feasible.

The Law for the Promotion and Development of Bio-fuels, published on 1 February 2008, does not set any specific targets. Rather, it is a first step towards developing a bio-fuels industry in Mexico, outlining the regulatory responsibilities of different ministries within the federal administration. Bio-fuels for electricity generation, transport and the rural residential sector have considerable potential in Mexico. The use of this energy would allow the economy to foster sustainable development and create new jobs, combat poverty and increase the renewable element of the energy mix. According to estimates, the potential for bio-energy use in the energy sector could be as high as 16% by 2030, based on a high-penetration scenario (SENER 2009c).

NUCLEAR

One of the objectives of Mexico's National Energy Strategy is the diversification of energy sources through the use of clean technologies. To achieve the goals of the energy policy, the Mexican Government is analysing the possibilities of increasing its power capacity using nuclear technology. The economy's new energy policy calls for an increase in the share of carbon-free power generation from 27% to 35% of capacity in 2024. This means requirements focusing on external factors like carbon emissions will have a significant impact on Mexico's electricity industry. According to the Investment and Planning Program of the Power Sector (POISE 2009–2024), new additional capacity of 196.2 MW of nuclear energy is being considered; it will be derived from the maintenance of the nuclear energy power plant Laguna Verde (CFE 2009a).

Mexico has experience in nuclear energy, but the economy will need to address new challenges in nuclear electricity generation. These new challenges include the development of more qualified human resources; the updating of regulations; the strengthening of research and development; and the issue of nuclear waste final disposal. The Mexican Government is assessing the viability of increasing its nuclear energy production, taking into account opportunity cost and future prices to ensure it gets the best options to provide lower costs and optimal stability, as well as a quality and safe service (SENER 2010c).

CLIMATE CHANGE

Mexico has actively participated in several multilateral climate change forums. In 1993, the economy ratified the United Nations Framework Convention on Climate Change (UNFCCC) as a non-Annex I country; in 1998 it signed the Kyoto Protocol which was ratified in 2000. Mexico has presented four greenhouse gases (GHG) communications, being the only developing economy to make such inventories and action plans. Since 2006, Mexico has had voluntary counting and reporting of GHG emissions—110 public and private companies are participating at the present time. In the last communication, 150 million tonnes CO_2-e was reported, 21% of which were generated through the burning of fossil fuels and 30% from the generation and use of energy. Mexico holds the position that all economies must and can contribute, depending on their responsibilities, to confront the problems derived from global climate change.

As a strategy for mitigation and adaptation to climate change, the government presented the National Climate Change Strategy (ENCC, by its Spanish acronym) on 25 May 2007 (CICC–SEMARNAT 2007). As a result of the ENCC, the Special Climate Change Program 2009–2012 (PECC) was published in 2009. PECC lists specific objectives and goals to reduce GHG emissions by up to 20% by 2020, and by around 50% by 2050, compared with 2000 levels. It will do this with financing and the support of high technology, and in cooperation with developing economies (SEMARNAT 2009).

Concerning adaptation to climate change, the government is promoting the core strategy of the Global Framework for Climate Services. This strategy consists of creating specific climate services for each economic and social sector, so each will have the necessary technical tools to adapt to climate change consequences with the least negative impact and in the most advantageous way (SEMARNAT 2009). For Mexico, it is important to think globally and act locally through structured adaption responses to climate change. For that reason the government encourages the states to develop their own climate change action programs. As a result, several federal states in Mexico have looked positively at such initiatives—Veracruz, Nuevo León and Distrito Federal have completed their climate change action programs. The process is underway in the other states—some are working on their programs and will soon present them for public consultation; the remainder have the work methodology to develop them (SEMARNAT 2010).

In December 2010, Mexico hosted the 16th Conference of Parties (COP) of the UNFCCC in Cancun City. As incoming President of the COP16/CMP6, Mexico acted as a facilitator of the negotiations during 2010 to create an adequate technical and political framework to achieve successful results. In Cancun, Mexico sought:

- To ensure the conferences mark the beginning of a new era of global action on climate change
- To ensure a transparent and inclusive preparatory process that takes into consideration the concerns of all member States
- To strengthen the trust and communication channels between developed and developing economies
- To affirm the importance of the multilateral system in addressing climate change
- To provide channels for the participation of various civil society organisations.

Within this context, during 2010, Mexico undertook wide political and technical consultations with several economies and regions, addressing central aspects of the negotiation process (COP16 2010).

NOTABLE ENERGY DEVELOPMENTS

OIL SECTOR

Pemex has developed several notable projects to improve the production of liquids and gas in its upstream and downstream sectors.

As a result of optimisation works in the Cantarell project, the rate of decline of the Akal oil field (the most important field in the Cantarell project) decreased from 38% in the first half of 2009 to 15% in the second half of the same year. Gas flaring decreased by 22.6% compared with 2008, from 19.3% to 14.7% of gas production, due to the completion of works aimed at increasing the level of gas utilisation.

During 2009, the refining system in Mexico was improved by the maintenance program in the National Refining System (Sistema Nacional de Refinación (SNR)). As a result of this program, total crude oil processing and the production of petroleum products were increased by 2.7% and 2.3% respectively, compared with 2008. Also during 2009, Pemex began the design and planning works for the new refinery to be built in Tula, Hidalgo, at an estimated cost of USD 9 billion. This refinery will process Maya crude oil with a total capacity of 300 thousand barrels per day. Pemex expects to complete the gasoline phase of the Fuel Quality Project in five years; the overall project includes the construction of eight post-treatment plants to produce ultra-low sulphur gasoline.

Regarding gas and petrochemicals, the cryogenic plant 6 started operating in the Burgos Gas Processing Center in February 2009; the plant has a total processing capacity of 1.2 billion cubic feet per day and the objective of recovering propane, butane and natural gasoline found within natural gas. The other important project for Pemex, and the first large-scale Cogeneration Project is at Nuevo Pemex Gas Processing Center. This project is devoted to supplying steam and electricity to the GPC Nuevo Pemex and to providing surplus electricity to other gas processing centres.

In November 2009, Pemex entered into an agreement with counterparties Braskem and IDESA to supply 66 thousand barrels per day of ethane. The project, known as Ethylene XXI, seeks the construction of an ethylene cracker plant and polymerisation units for ethylene production. The plant is expected to begin operations by 2015.

POWER SECTOR

In the power sector, several energy developments occurred during 2008–09. These concern maintenance, the start-up and retirements of power plants and the planning of new projects.

The maintenance actions correspond to the permanent improvement of generation plants. This work consists of the preventive and predictive maintenance programs, the application of a Thermal Regime Monitoring System for optimal thermal efficiency, monitoring actions to achieve the goals of employment safety, and the achievement of minimum generation cost. There were 175 maintenance projects done for thermal power plants, from 226 planned maintenance projects. For hydro power plants, 133 units received maintenance (CFE 2010).

Regarding transmission developments, the Comisión Federal de Electricidad (CFE) started operations of 1502 million volts-ampere (MVA) of transmission capacity, which increased 1% during the period from September 2008 to August 2009. In distribution developments, the installation of 10 547 kilometres (including high and half tension) of electric lines was completed, resulting in an increase of 1.5% of transmission lines during 2009 (CFE 2009b).

Two new thermal power plants started operations in 2009, increasing electricity generation capacity by 388 MW for a total investment of USD 318 million. At the end of 2009, eight thermal generation power plants were under construction which will provide 2503 MW of additional capacity for an investment of USD 6602 million. Currently, CFE has seven projects under bidding phase with a total generation capacity of 2276 MW; these projects are expected to start operating between 2011 and 2013 (CFE 2009a). Regarding hydro generation capacity, La Yesca

hydropower plant is under construction and it is expected to start operations in June 2012. The La Yesca power plant will have 750 MW of installed capacity with an annual electricity generation of 1219 GWh.

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Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT)—www.semarnat.gob.mx

NEW ZEALAND

INTRODUCTION

New Zealand is an island economy in the South Pacific, consisting of two main islands—the North Island and the South Island—and a number of small outer islands. In land area it is a bit smaller than Japan or the Philippines, but larger than the United Kingdom. The relatively small population of about 4.3 million is comparable to a medium-sized Asian city. New Zealand's location is remote from other economies. There are no electricity or pipeline connections to other economies.

New Zealand is a mature economy. While the per capita GDP of about USD 24 000 (USD (2000) at PPP) puts it at the low end of the OECD economies, New Zealand generally rates highly in most 'quality of life' surveys. New Zealanders are generally environmentally conscious, and take pride in the 'clean and green' condition of their land, water and air.

New Zealand is self-sufficient in all energy forms apart from oil and it has modest energy resources, including 113 million barrels of oil, 34.3 billion cubic metres of natural gas, and 571 million tonnes of coal. In 2008, hydro, geothermal, wind and bioenergy resources met around 65% of electricity demand (MED 2009a).

Table 18 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	268 680	Oil (million barrels)[a]	113
Population (million)	4.27	Gas (billion cubic metres)[b]	34.3
GDP (USD (2000) billion at PPP)	100.97	Coal (million tonnes)[c]	571
GDP (USD (2000) per capita at PPP)	23 652	Uranium (million tonnes of uranium metal)	–

a MED (2010a), Table H.2, figure shown is 'Remaining Reserve P90 as at 1 January 2010' and includes LPG.

b MED (2010a), Table H.4, figure shown is 'Remaining Reserve P90 as at 1 January 2010'.

c Proven reserves at the end of 2009 from BP (2010).

Other data: EDMC (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, New Zealand's total primary energy supply was 18 156 kilotonnes of oil equivalent (ktoe). A number of energy sources contribute to this total, including oil (34%), geothermal (21%), gas (19%), hydro (11%), and coal (9%), with wind, biomass, biogas, waste heat, and solar providing the remainder (6%). Due to an assumed conversion efficiency of only 15% in geothermal electricity generation, the geothermal share of final energy supply is much smaller. New Zealand's energy self-sufficiency in 2008 was 89%, up from 85% in 2007 as growth in indigenous production outpaced growth in total primary energy supply. Since 2000, growth in New Zealand's primary energy supply has been modest, increasing at an average annual rate of 0.5%.

Lignite is New Zealand's largest fossil energy resource. However, almost all coal production is of sub-bituminous and bituminous coals. In 2008, coal production increased by 2% on an energy-equivalent basis compared with 2007 (MED 2010a).

Oil production is sourced from 16 fields in the Taranaki region. The production of crude oil, natural gas liquids and condensate was up 40% on an energy-equivalent basis in 2008 compared with 2007, underpinned by rapid growth in oil production from the newest offshore field, Tui. However, despite the growth in production, domestic oil production met only 47% of demand in 2008. Therefore, New Zealand imports a large volume of crude oil and petroleum products (MED 2010a).

Natural gas is produced from 14 fields in the Taranaki region. In 2008, natural gas production declined by 6% compared with 2007, reflecting a drop in electricity generation demand and consumer energy demand (MED 2010a). Gas is used indirectly by end-users, in electricity generation, and in methanol and urea production. All the gas used in New Zealand is domestically produced and there are no facilities for importing LNG. New Zealand's largest gas field is the offshore Maui field, which is believed to be nearing depletion. This has prompted concern New Zealand's gas supply could be inadequate to meet future demand (see the Gas Shortage Scenario in MED 2009b).

In 2008, New Zealand generated 42 287 GWh of electricity, a level almost unchanged from 2007. New Zealand has plentiful hydro and renewable energy resources. Reflecting this, more than 65% of electricity generation was from hydro and renewable sources. Hydro is the major source of electricity generation, accounting for 52% of the total. This is lower than in previous years due to drought conditions in 2008. Geothermal accounted for another 9%. More than two-thirds of New Zealand's hydro electricity is generated in the South Island, and all geothermal electricity is generated in the North Island. Most of the remaining electricity is generated in the North Island using a combination of natural gas, coal, wind, and wood waste (MED 2010a).

Table 19 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	16 081	Industry sector	3 623	Total	42 287
Net imports and other	2 955	Transport sector	4 745	Thermal	14 651
Total PES	18 156	Other sectors	4 052	Hydro	22 100
Coal	1 693	Total FEC	12 421	Nuclear	–
Oil	6 174	Coal	616	Geothermal	3 966
Gas	3 438	Oil	5 943	Other	1 570
Other	6 851	Gas	1 452		
		Electricity and other	4 409		

Source: EDMC (2010).

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

FINAL ENERGY CONSUMPTION

New Zealand's final energy consumption was almost unchanged in 2008 at 12 421 ktoe compared with the previous year. The transportation sector consumed 38% of final energy, the industrial sector consumed 29%, and other sectors 33%. Final energy consumption was dominated by oil, accounting for 5943 ktoe (48%), followed by electricity and other (mainly heat) 4409 ktoe (35%), gas 1452 ktoe (12%), and coal 616 ktoe (5%).

Domestic passenger and freight transport in New Zealand is dominated by private road vehicles. Consequently, transport is the main consumer of petroleum products, accounting for 79% of domestic oil consumption in 2008. Consumption of oil products in the other sectors was shared between industrial (8%), agricultural, forestry and fishing (4%), commercial and residential (3%), and non-energy (5%).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Ministry of Economic Development (MED) has the lead role in developing New Zealand's energy policies and strategies, although there are a number of other agencies involved. New Zealand no longer has a Ministry of Energy, although there is a Minister of Energy and Resources to whom the MED reports on energy issues.

New Zealand's oil and gas exploration and production activities are largely privately owned and open to competition. New Zealand generally welcomes investment in oil and gas exploration by foreign firms. Electricity generation and marketing is also largely open to competition, but three of the five major generators are state-owned firms, as is Transpower, the transmission grid operator. The New Zealand Electricity Authority oversees the conduct of the electricity market, but does not regulate electricity prices. The coal mining industry in New Zealand is dominated by Solid Energy, a state-owned firm, although there are private operators as well.

In July 2010, the government released the draft New Zealand Energy Strategy 2010: Developing Our Energy Potential (MED 2010b), intended to replace the 2007 New Zealand Energy Strategy. The new strategy focuses on four priorities: developing resources; promoting energy security and affordability; achieving efficient use of energy; and environmental responsibility. The draft New Zealand Energy Strategy 2010 includes a draft New Zealand Energy Efficiency and Conservation Strategy (NZEECS) intended to replace the 2007 NZEECS.

A new Ministry of Science and Innovation (MSI) is expected to be formed in early 2011 through the merger of the existing Foundation for Research, Science and Technology and the Ministry of Research, Science and Technology. The new Ministry of Science and Innovation (MSI) is part of a broader government effort to boost the research, science and technology sector's contribution to economic growth. The MSI will have two new investment boards—a Science Board and an Innovation Board. The former will deal with funding allocations for scientific research, while the latter will deal with funding allocations for business-facing technology schemes (MSI 2010).

ENERGY MARKETS

New Zealand's energy sector has been subject to major reforms since the mid-1980s, coinciding with the introduction of broader economic reforms. The broader reforms aimed to improve economic growth through efficient resource use, driven by clear price signals and, where possible, competitive markets. The greatest change occurred in the electricity and gas markets—the vertically-integrated sectors were dismantled to separate the natural monopoly and competitive elements, the former government-owned and operated electricity and gas monopolies were either corporatised or privatised, and the electricity market was deregulated.

Responding to concerns about rising electricity prices, especially for residential customers, and about governance arrangements in the electricity sector, the Minister of Energy and Resources initiated a Ministerial Review of Electricity Market Performance in April 2009. The review was led by an independent Electricity Technical Advisory Group (ETAG). A discussion paper was released in August 2009 (MED 2009c). The discussion paper made a number of recommendations that were included in the Electricity Industry Act 2010.

A key governance change in the Electricity Industry Act 2010 was the replacement of the Electricity Commission with an Electricity Authority that has more independence from the government. This change was effective from 1 November 2010 (EA 2010). Some of the responsibilities of the Electricity Commission which overlapped those of other agencies have been transferred to those other agencies, including the promotion of energy efficiency, the approval of grid upgrades, and the management of supply emergencies.

The Electricity Industry Act 2010 has several provisions to promote competition. These include ones for a swap of assets between the three state-owned generating companies to better align the generating and marketing assets of each firm, a fund to encourage customers to switch electricity providers, and better electricity market hedging arrangements. The Act also has provisions to improve the security of supply. These include rule changes to ensure electricity retailers do not profit from supply emergencies, and the requirement a state-owned reserve power station, criticised for distorting market incentives, be operated on a commercial basis (NZG 2010a).

Since 2004, New Zealand's gas sector has been co-regulated by the government and the Gas Industry Company, an industry body established under the Gas Act 1992. The Gas Industry Company pursues the government's objectives and outcomes as set out in the Gas Act 1992 and the Government Policy Statement on Gas Governance. Its work is driven by ministerial requests and its own engagement with the gas sector (MED 2009d).

FISCAL REGIME AND INVESTMENT

Corporations earning income in New Zealand are taxed at a flat rate of 30% (Inland Revenue 2010a), which will drop to 28% beginning with the 2011–12 tax year (Inland Revenue 2010b). A 15% tax credit for companies undertaking research and development, introduced in 2007, has been repealed effective from the 2009–10 tax year (Inland Revenue 2010c). Corporations are also required to pay other indirect taxes such as payroll tax and fringe benefits tax.

The ownership of all petroleum resources (including natural gas) in New Zealand rests with the Crown, regardless of the ownership of the land. However, some coal resources are privately owned (Harris 2004). The Crown Minerals Group within the Ministry of Economic Development manages the New Zealand Government's oil, gas, mineral and coal resources, known as the Crown Mineral Estate.

For petroleum production, companies must pay an ad valorem royalty of 5% (i.e. 5% of the net revenues obtained from the sale of petroleum) or an accounting profits royalty of 20% (i.e. 20% of the accounting profit of petroleum production), whichever is greater in any given year. For discoveries made between 30 June 2004 and 31 December 2009, an ad valorem royalty of 1% is applied to natural gas or an accounting profits royalty of 15% on the first NZD 750 million for offshore projects or 15% on the first NZD 250 million for onshore projects (Crown Minerals 2010a).

For the production of Crown-owned coal, an ad valorem royalty of 1% of net sales revenue is payable on net sales revenue between NZD 100 000 and NZD 1 million. For producers with net sales revenues in excess of NZD 1 million, the royalty payable is either 1% of net sales revenue or 5% of accounting profits, whichever is higher (Crown Minerals 2010b).

New Zealand has good oil and gas resources potential, but it is considered underexplored (see Samuelson 2008, Section 5.3). Responding to this challenge, the government has developed an action plan for realising the potential of New Zealand's petroleum resources. The Action Plan for the Development of Petroleum Resources, released in November 2009, aims to ensure New Zealand is considered an attractive destination for investment in petroleum exploration and production. The plan is based on a number of work streams, including:

- reviewing the fiscal and royalty framework to ensure the government receives a fair return from petroleum resources while providing sufficient incentives for investors
- investing in data acquisition to improve resource knowledge and to foster more investment, particularly in frontier resources
- developing a fit for purpose legislative framework for the petroleum sector (MED 2010b, NZG 2010b).

In September 2010, the government announced it will expand the Crown Minerals Group within the Ministry of Economic Development and give it a higher profile. The goal of the

reorganisation is to bring a more commercial and strategic approach to managing the petroleum estate, to better meet the needs of both industry and the government (NZG 2010c).

New Zealand's environmental permitting process, known as 'resource consent', is governed by the Resource Management Act 1991 (RMA) and its subsequent amendments. Resource consent is required for any project that might affect the environment, which essentially includes all energy development projects. Resource consents are generally obtained from regional, district, or city councils, depending on the nature of the resources affected. The RMA specifies that the guiding principle of decision making is sustainable management (MFE 2010a).

In December 2008, in response to concerns about the slow and costly consenting process under the RMA, the government appointed an RMA Technical Advisory Group to support the government's program of reform. A discussion paper was released in February 2009. The discussion paper made a number of recommendations that were included in the Resource Management (Simplification and Streamlining) Amendment Act 2009 (MFE 2010b).

A major criticism of the RMA had been that decision making was generally delegated to local governments, where local interests were likely to take precedence over economy-wide interests, especially for major projects. The Resource Management (Simplification and Streamlining) Amendment Act 2009 responds to this criticism by establishing a transitional Environmental Protection Authority (EPA) within the Ministry of the Environment, which will receive resource consent applications for proposals of significance to the economy and support the boards of inquiry (or the Environment Court) in making decisions on them (MFE 2010b). The role of the EPA will be further expanded in July 2011 under proposed legislation (NZG 2010d).

The Resource Management (Simplification and Streamlining) Amendment Act 2009 also includes provisions to streamline the consenting process. These provisions make it more difficult for competitors to challenge a resource consent application, impose stricter deadlines for decisions by local governments, and make procedural changes. There are also provisions for more effective enforcement and tougher penalties for non-compliance (MFE 2010b). An ongoing Phase 2 Review of the RMA takes on the more complex tasks of better aligning the RMA with other environmental laws, and of exploring better approaches to urban planning and water management (MFE 2010c).

ENERGY EFFICIENCY

New Zealand has a relatively long tradition of promoting energy efficiency. It passed the Energy Efficiency and Conservation Act 2000, which lead to the economy's first energy efficiency strategy and the establishment of the Energy Efficiency and Conservation Authority (EECA) to spearhead the strategy's implementation (EECA 2010).

In July 2010, the government released a draft New Zealand Energy Efficiency and Conservation Strategy (NZEECS) intended to replace the 2007 strategy. The new strategy sets an energy saving goal of 55 petajoules (PJ) across the economy by 2015. The energy saving from these efficiency improvements equates approximately to a 9% improvement (reduction) in New Zealand's economy-wide energy intensity by 2015. This improvement will increase New Zealand's rate of energy intensity improvement from 1% to 1.2% a year (from 2008 levels). To achieve this target New Zealand will need to lift its medium term (1995–2007) trend in underlying energy efficiency improvement from 0.7% a year to one more aligned with other International Energy Agency economies, which is approximately 1% a year.

New Zealand's major policies for promoting energy efficiency include:

- for transport, fuel efficiency labelling for light vehicles and support for public transport improvements, such as the electrification of the Auckland rail system
- for buildings, assistance for an expected 186 500 homes by 2015 to install insulation and clean heating equipment, energy efficiency building codes, and energy efficiency rating tools for homes

- for businesses, grants and loans for energy audits, fleet audits, and audits of proposed new buildings
- for products, Minimum Energy Performance Standards (MEPS) and related labelling (coordinated with Australia)
- in the public sector, a reduction of 10% in energy use per full-time equivalent staff by 2015, compared with 2008 levels (MED 2010b).

RENEWABLE ENERGY

New Zealand is well-endowed with hydro, geothermal, wind, biomass, and (potentially) ocean energy. New Zealand's high level of renewable electricity supply has historically developed without significant explicit subsidies. Although the state-owned electricity generating companies have had a major role in the development of these resources, they are required to operate as commercial businesses, and must compete with private generators (Treasury 2010).

As part of the draft New Zealand Energy Strategy, the New Zealand Government retains the target of 90% of electricity to be generated from renewable sources by 2025, provided security of supply is maintained. The major tool to achieve this goal will be the Emissions Trading Scheme discussed in 'Climate Change' (MED 2010b). A 10-year moratorium on new fossil-fuelled electricity generation greater than 10 MW imposed in 2008 has been repealed (NZP 2008).

Hydro has historically been New Zealand's major source of renewable energy. However, the best hydro sites have already been developed, so New Zealand will need to look to other forms of renewable energy to meet its 90% target. The government views the Resource Management Act 1991 (RMA), discussed above, as a major barrier to the development of renewable energy, and sees the reforms it is making to the RMA as beneficial for the development of renewable energy (NZG 2010e).

In the transport sector, the government has a NZD 36 million grant program for biodiesel production, and it has exempted electric vehicles from road user charges.

NUCLEAR

New Zealand does not have any commercial nuclear reactors. It currently has no plans to develop a nuclear energy industry.

CLIMATE CHANGE

The government has adopted an economy-wide target for a 50% reduction in New Zealand's carbon-equivalent net emissions, compared with 1990 levels, by 2050. As government representatives stated during the climate change negotiations at Copenhagen, New Zealand is prepared to take on a responsibility target for greenhouse gas emission reductions of 10−20% below 1990 levels by 2020, if there is a comprehensive global agreement and certain conditions are met (MED 2010b).

The Climate Change Response (Emissions Trading) Amendment Act 2008 established New Zealand's emissions trading scheme. The scheme places a price on greenhouse gas emissions to provide an incentive to reduce the volume of overall emissions. Six gases covered under the Kyoto Protocol are covered under the scheme—carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (CCINZ 2010a).

In November 2009, the government approved a number of amendments to the emissions trading scheme, including amendments to the timeframe for entry into the scheme. Between 1 July 2010 and 31 December 2012, participants will be able to purchase permits from the government at a fixed price of NZD 25 a tonne CO_2-equivalent. Over the same period, participants in the stationary energy, industrial, and liquid fuel sectors (all sectors in the scheme at that time except forestry) will have to surrender only one permit for every two tonnes of CO_2-

equivalent emitted, effectively reducing the price of permits to NZD 12.50 a tonne (CCINZ 2010b).

All sectors of the economy will be included from 2015. They will be introduced gradually over the course of seven years (Table 20). The stationary energy, liquid fuels, industrial processes, agriculture and waste sectors can voluntarily start reporting their emissions two years before they are obliged to surrender permits, and they must report their emissions the year before entering the scheme (CCINZ 2010c).

For energy, the point of obligation under the scheme generally lies with fuel or electricity suppliers, not with end-users. This means only energy suppliers and a few large industrial facilities are directly affected by the scheme. Some free units will be available to energy-intensive trade-exposed industries (FL 2010).

Table 20 Timeframe for entry into the emissions trading scheme

Sector	Voluntary reporting	Mandatory reporting	Full obligations
Forestry			1 January 2008
Liquid fuels (including transport)		1 January 2010	1 July 2010
Stationary energy (including electricity, coal, gas, geothermal)		1 January 2010	1 July 2010
Industrial processes		1 January 2010	1 July 2010
Synthetic gases	1 January 2011	1 January 2012	1 January 2013
Waste	1 January 2011	1 January 2012	1 January 2013
Agriculture	1 January 2011	1 January 2012	1 January 2015

NOTABLE ENERGY DEVELOPMENTS

NEW PROJECTS

In 2009, the first production was brought on line from the Maari and Kupe oil fields in the Taranaki region. Meridian Energy also opened its 143 MW West Wind Makara wind generating plant near Wellington. In early 2010, an additional 132 MW of geothermal capacity came online with the commissioning of the Nga Awa Purua power station near Taupo (MED 2010a). Construction work continues on two major electricity transmission grid upgrade projects, the NZD 824 million North Island Grid Upgrade and the NZD 672 million HVDC Inter-Island Link Project (Transpower 2010).

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Energy Efficiency and Conservation Authority (EECA)—www.eeca.govt.nz

Ministry of Economic Development (MED)—www.med.govt.nz/New Zealand Government—www.newzealand.govt.nz

New Zealand Government—www.beehive.govt.nz

New Zealand Parliament—www.parliament.govt.nz

Transpower—www.transpower.co.n z

PAPUA NEW GUINEA

INTRODUCTION

Papua New Guinea (PNG) is located in the south-west of the Pacific Ocean, just south of the equator. It is made up of more than 600 islands, including the eastern half of New Guinea—the world's second largest island—as well as the Bismarck Archipelago, D'Entrecasteaux island group, and the three islands of the Louisiade Archipelago. The mainland and the larger islands are mountainous and rugged, with a string of active volcanoes dotting the north part of the mainland and continuing to the island of New Britain. PNG has a population of more than six million, spread across its total area of 462 840 square kilometres.

In 2008, real GDP was estimated at USD 11.71 billion (USD (2000) at PPP), an increase of 6.4% from 2007 (USD 11.01 billion).

Table 21 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (sq. km)	462 840	Oil (million barrels)	88
Population (million)	6.58	Gas (billion cubic metres)	440
GDP (USD (2000) billion at PPP)	11.71	Coal (million tonnes)	–
GDP (USD (2000) per capita at PPP)	1 781	Uranium (million tonnes U)	–

a Proven reserves at the end of 2009 from BP (2010).

Source: EDMC (2010).

PROVENENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, PNG's net primary energy supply was 1984 kilotonnes of oil equivalent (ktoe), an increase of 5.4% from 2007. Light crude oil and petroleum products accounted for 78%, gas for 18% and hydro and other fuels for the remaining 4%.

Production of crude oil in PNG started in 1992 and peaked at over 150 000 barrels a day the following year. However, since then production has been declining, despite exploration activities resulting in the development of some additional oilfields. Oil production in 2009 was 35 050 barrels a day. Crude has been refined locally since the 2004 commissioning of the first refinery plant (Napanapa Oil Refinery owned by InterOil), which has a refining capacity of 33 000 barrels a day.

Much of PNG's natural gas reserves are undeveloped, except for the Hides gas field, which supplies 145–155 million cubic metres a year for power generation to supply the Porgera Gold Mine in the central highlands of PNG. The Hides gas field has about 113 billion cubic metres of proven gas reserves.

ExxonMobil and co-venturers—Oil Search, Santos, AGL, Nippon Oil and local landowners—are targeting the Hides field plus a string of other gas and associated fields to develop PNG's first LNG project (see 'Notable energy developments' section).

In 2008, PNG generated 3131 gigawatt-hours (GWh) of electricity (a 0.6% increase from 2007). The sources of generation were thermal at 72% and hydro at 28%. The quantity of electricity generated from hydro sources has remained steady over the past four years, while thermal-based generation has increased by 3.3% to meet demand. There is little economic

potential for the expansion of large hydropower plants due to the lack of substantive demand near supply sources. However, greater potential exists for developing smaller hydro schemes. Most thermal and hydro power stations are owned and operated by PNG Power Limited (formerly the PNG Electricity Commission).

The installed capacity of geothermal power stations is 56 MW (Geothermal Energy Association 2010). The Geothermal Energy Association categorises Papua New Guinea as an economy that could, in theory, meet all its electricity needs well into the future from geothermal sources alone.

Table 22 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	2 513	Industry sector	758	Total	3 131
Net imports and other	–	Transport sector	348	Thermal	2 276
Total PES	1 984	Other sectors	115	Hydro	855
Coal	–	Total FEC	1 222	Nuclear	–
Oil	1 573	Coal	–	Geothermal	–
Gas	338	Oil	970	Other	–
Other	74	Gas	–		
		Electricity and other	251		

Source: EDMC (2010).

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

FINAL ENERGY CONSUMPTION

In 2008, total final energy consumption in PNG was 1222 ktoe (an increase of 15.8% from 2007). The industrial sector's consumption increased 28.9% from 2007, and the sector was the largest end user, accounting for 62.1% of energy used, followed by transport (28.5%) and other sectors, including agriculture and residential/commercial (9.4%) in 2008. By energy source, petroleum products accounted for 79% of total consumption, while 'electricity and other' accounted for 21%.

In PNG around 85% of the population lives in rural areas and electrification rates remain low. Petroleum products such as diesel or petrol are used in the transport and electricity generation sectors. PNG Power Limited is continuously extending its rural distribution network throughout the economy, especially within the outskirts of urban areas.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Papua New Guinea Government has jurisdiction over energy matters. The PNG National Energy Policy and the Rural Electrification Policy are under review by the PNG Government Task Force on Policy. The exploration and development of petroleum resources are authorised and administered by the Department of Petroleum and Energy.

The Papua New Guinea Government has initiated The National Strategic Plan 2010–2050, which has seven 'pillars'. Natural resources, climate change and environmental sustainability are among the areas of focus.

ENERGY MARKETS

Sections 21 and 23 of the Electricity Industry Act 2000 outline the functions and powers of PNG Power Limited. Under the Act, PNG Power Limited's function is to plan and coordinate the supply of electricity throughout the economy, especially in urban areas.

The Act also authorised the Independent Consumer and Competition Commission (ICCC) as the technical regulator of the electricity sector, determining standards, carrying out inspections and controlling applications for all matters relating to the operations of electricity supply. The ICCC was established in 2002 to oversee and regulate price and service standard issues relating to utilities such as PNG Power Limited and selected corporatised government statutory entities. This made it responsible for setting prices or tariffs for electricity and petroleum products.

However, because of a lack of technical capacity to perform this regulatory role, the ICCC outsourced this role to PNG Power Limited on a contractual basis for an initial period of two years ending in 2005. The contract was extended for another three-year period ending in 2008. There is no further information on whether this role has been extended.

FISCAL REGIME AND INVESTMENT

In September 2003, the Papua New Guinea Government introduced special fiscal terms to provide incentives for oil and gas exploration in the economy. This was in response to the decline in investments in exploration, as well as the prospect of declining oil production from the Kutubu, Gobe and Moran oilfields between 2003 and 2010.

The special terms are known as 'incentive rate petroleum operations'; they offer a revised income tax rate of 30% of taxable income, which is lower than the tax rate for income from petroleum projects established before 1 January 2001 (50%), and the rate for projects established after that date (45%). The new 30% fiscal term is available for petroleum operations that have a petroleum development licence granted on or before 31 December 2017, and a petroleum prospecting licence granted within the period 1 January 2003 to 31 December 2007 (Department of Petroleum and Energy 2003).

Papua New Guinea has arguably the most competitive terms for oil and gas investment in the region (Papua Petroleum Limited 2008). There is no capital gains tax, and a full (100%) tax deduction is available for exploration expenditure. The PNG Government's equity is set at 20.5% and landowners' at 2 %. The effective royalty rate is 2%, and the government's take is about 50%.

ENERGY EFFICIENCY

Energy efficiency is not currently a major priority for the government of PNG.

RENEWABLE ENERGY

In February 2007, Lihir Gold Limited (which merged with Newcrest Mining Limited in 2010, and now operates under Newcrest Mining Limited) commissioned a 20 MW geothermal power plant. This is in addition to a 6 MW geothermal power plant constructed in 2003, and a 30 MW geothermal plant commissioned in 2005. The latest plant lifts Lihir Gold's total geothermal generating capacity to 56 MW, around 75% of the economy's total electricity requirements in 2007 (Newcrest Mining 2010).

Lihir Gold Limited is the first mining company in PNG to use geothermal energy for electricity generation and its expansion of capacity is in line with the government's goal of promoting green energy and reducing dependency on fuel oil for electricity generation.

NUCLEAR

PNG doesn't have a nuclear energy industry as of November 2010, and there are no plans for its development.

CLIMATE CHANGE

Climate change is one of the important pillars in the National Strategic Plan 2010–2050 (see 'Energy policy framework' section).

NOTABLE ENERGY DEVELOPMENTS

UPSTREAM DEVELOPMENT

A number of international companies have shown a renewed interest in investing in PNG's upstream oil and gas sector in recent years. At the end of 2007, the total number of petroleum prospecting licences (PPLs) was 37, compared with 17 in 2003. The surge in interest has been principally attributed to the introduction of internationally competitive fiscal incentives in September 2003 to attract oil exploration.

LNG PROJECTS

In March 2008, a joint operating agreement (JOA) for the PNG LNG Project was signed by the project's participants—ExxonMobil (41.6%), Oil Search (34.1%), Santos (17.7%), AGL, Nippon Oil and local landowners. The feed gas is to be sourced from the Kutubu, Gobe and Moran oilfields as well as the Hides, Juha and Angore gas fields. In May 2008, a gas agreement was signed by the joint project's participants and the state of Papua New Guinea. PNG's Deputy Prime Minister said that the first shipment of gas would be in 2014 and that it would quadruple the GDP of Papua New Guinea. The project aims to export 6.6 million tonnes of LNG from Papua New Guinea each year. ExxonMobil and its joint venturers completed the front-end engineering and design phase for the project in November 2009.

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USEFUL LINKS

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PERU

INTRODUCTION

Peru is one of three Asia-Pacific Economic Cooperation (APEC) economies in Latin America – it became a member in November 1998 and hosted the APEC Leaders Meeting in 2008. Peru is located on the Pacific Ocean coast of South America, and its land area covers nearly 1.28 million square kilometres. It shares borders with Chile to the south, Ecuador and Colombia to the north, and Brazil and Bolivia to the east. In 2008, Peru had a total population of 28.84 million people, an increase of 1.15% from 2007. Of that 2008 population, 36.2% was considered poor, including 12.6% classified as extremely poor. Peru has three main geographical regions: the Costa to the west, the Sierra (Andes mountains), and the Selva covered by the Amazon rainforest. Most of its population (54.6%) live in the Costa region, while 32% live in the Sierra region and 13.4% live in the Selva region. Peru is also divided into 25 departments; the major population centre is located in the Lima department, with 8.44 million people. Peru's urbanisation rate is 75.9% (INEI 2009).

Peru has a market-oriented economy which until recently was tied to exports that provided hard currency to finance imports and external debt repayments. Of late, the Peruvian economy's growth has been fuelled by macroeconomic stability, improving terms of trade, and rising investment and consumption. Peru's GDP is dependent on services (53%), manufacturing (22.3%), heavy industry (15%) and taxes (9.7%). Peru is the world's top producer of silver, second of zinc, third of copper and tin, fourth of lead, and sixth of gold. Mineral exports have consistently accounted for a significant portion of the economy's export revenue (63% in 2008).

Peru's GDP in 2008 was USD 200.45 billion, while GDP per capita was USD 6951 (both in USD (2000) at PPP) (EDMC 2010). Recent economic expansion has been driven by construction, mining, private investment, exports, and domestic consumption. Inflation increased to an annual average of 5.8% in 2008, due mostly to substantial global food and oil price increases, while the fiscal surplus was 2.1% of GDP. In 2008, Peru's external debts dropped to USD 19 billion and foreign reserves were a record USD 31.2 billion (BN 2009).

Peru produces both natural gas and crude oil; however the crude oil produced is not suitable for refinery feedstock. Peru is a net energy importer, and in 2008 reduced its primary energy imports to 3 430 ktoe, down 8.5% from 2007. Peru's proven energy reserves at the end of 2008 were 1190 million barrels of crude oil, including crude oil and gas liquids (MINEM 2010a), 0.317 trillion cubic meters (tcm) of natural gas and 1211 million tonnes of coal. Peru also has proven uranium reserves of around 1.3 million tonnes in the Puno region. A considerable proportion of Peru's primary energy supply comes from non-conventional energy sources, including wood, biogas, solar and other (MINEM 2009a).

Table 23 Key data and economic profile, 2008

KEY DATA		ENERGY RESERVES[A]	
Area (million sq. km)	1.28	Oil (million barrels)	1 190
Population (million)	28.84	Gas (TCM)	0.317
GDP (USD (2000) billion at PPP)	200.45	Coal (million tonnes)	1 211
GDP (USD (2000) per capita at PPP)	6 951	Uranium (million tonnes)[b]	1.3

a Proven reserves at the end of 2009 (BP 2010.

b. Proven reserves at the end of 2009 (MINEM 2009a).

Sources: EDMC (2010) and MINEM (2009a).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Peru's total primary energy supply (TPES) in 2008 was 13 260 kilotonnes of oil equivalent (ktoe). This growth of 6.04% on 2007 figures was due mainly to the production of natural gas and its liquids. In 2008, around 54.1% of TPES came from oil, an increase of 11.6 % from 2007; 25% came from natural gas (3 321 ktoe), an increase of around 28%; and 7% came from coal (923 ktoe), a decrease of 9.32% from 2007. Non-conventional energy sources provided 1 845 ktoe or 13.9% of the total primary energy supply in 2008, a decline of 25.1% between 2007 and 2008 (EDMC 2010).

Peru's energy imports declined by 8.49% between 2007 and 2008, from 3749 ktoe to 3430 ktoe. These imports represented 25.9% of Peru's energy requirements. Crude oil imports made up 91.2% of all imports, reaching 4908 ktoe at the end of 2008; coal imports made up the remainder. Energy exports of 911.62 ktoe in 2008 were 34% less than in the previous year, with crude oil still the major energy export. The decrease was due to a reduction in indigenous production.

Peru produced 145 280 barrels per day (B/D) of total oil liquids in 2009. Crude oil made up 48% of total production (71 023 B/D), and natural gas liquids (NGL) made up the remainder (74 256 B/D). Increasing NGL production represents the bulk of the increased oil production in the last five years, including the 150% increase between 2004 and 2005, from 14 260 B/D to 35 840 B/D (MINEM 2010a). The refining sector in Peru is well developed and has a total capacity of 192 950 B/D within its six refineries (O&GJ 2009). In 2009, 19 790 million barrels of indigenous crude oil was processed in Peru; the total quantity of crude oil (including imports) processed in Peru was 69 694 million barrels. Production of petroleum products increased 10% on 2008 figures, to around 69 362 million barrels in 2009 (MINEM 2010a).

In 2009 Peru produced around 0.1 million cubic meters (mcm) (or 3.54 million cubic feet (mcf)) of natural gas, an increase of 2.4% on the previous year. Natural gas production is concentrated in the Selva region; 91.8% of the total 2009 production came from there (Perúpetro 2010). Almost all the natural gas processed is non-associated natural gas and comes from the Camisea gas basin – this is made up of several natural gas fields in the Ucayali basin in south-eastern Peru, principally in Block 88 along the Camisea River. The project currently provides natural gas for domestic consumption, but its ultimate goal is to develop an export market. The initial production capacity at Camisea was 12.74 million cubic metres per day of natural gas and 34 000 B/D of NGL. However, output capacity is expected to increase steadily as drilling continues on Camisea's Block 56, adjacent to Block 88. Besides Camisea, a large concentration of natural gas lies in the Aguayita gas field in central Peru, in Block X in the north-west region, and in Block Z–2B off the north-western coast (Pluspetrol 2009).

Peru's electricity generation totalled 32 945 gigawatt-hours (GWh) in 2009, an increase of 1.5% from 2008. Hydropower's share of this increased to 60.4% (19 904 GWh) in 2009, an increase of 4.4% from 2008. Generation from thermal plants in 2009 was 13 040 GWh, a decrease of 2.7% from 2008. All the electricity was generated in the National Interconnected Electrical System (SEIN), the Isolated Systems (SA) and by producers for their own use. Of the total, 30 922 GWh was traded on the electrical market and the remainder was for own use. Total electricity losses through transmission, distribution and feeders were 3 410 GWh in 2009, a 5.2% increase from 2008 (MINEM 2010a).

Peru's coal reserves are around 49.9 million tonnes; almost 97% of the reserves are anthracite with the remainder bituminous coal. All coal is sourced from the La Libertad region, Ancash and Lima. In 2008, proven reserves reached 30.5 Mtoe, an increase of 5.1% from 2007. Peru's total indigenous coal production in 2008 was 100.2 ktoe, an increase of 26.8 % from 2007. Peru is a net importer of coal. In 2009, the economy imported 5560 ktoe of coal, which was 28% of the total primary supply (MINEM 2009a).

Renewable energy sources in Peru include biomass, solar and mini-hydro. Mini-hydro and biomass (mostly sugarcane bagasse) are used for electricity generation, while other biomass (including firewood, vegetable coal, dung and yareta) and solar energy are used for heating. In 2009, energy supply from renewable sources totalled 2609 ktoe, with firewood making up 73.1% and bagasse most of the remainder (MINEM 2009a).

Table 24 Energy supply and consumption, 2008

PRIMARY ENERGY SUPPLY (KTOE)		FINAL ENERGY CONSUMPTION (KTOE)		POWER GENERATION (GWH)	
Indigenous production	10 876	Industry sector	4 162	Total	32 986
Net imports and other	–3 430	Transport sector	4 382	Thermal	13 659
Total PES	13 260	Other sectors	2 458	Hydro	19 040
Coal	923	Total FEC	11 002	Nuclear	0
Oil	7 171	Coal	579	Others	287
Gas	3 321	Oil	7 123		
Others	1 845	Gas	737		
		Electricity and others	2 563		

Sources: EDMC (2010) and MINEM (2009a).

FINAL ENERGY CONSUMPTION

Total final energy consumption in Peru grew robustly in 2008, reaching 11 002 ktoe (an 11.8% increase from 2007). Transportation use grew vigorously, with an increase of 22%; in 2008; this sector accounted for 39.8% of total final energy consumption. The industrial sector's share was 37.8%, while 'other sectors' consumed 22.3%. Petroleum products dominated end-use consumption, accounting for 64.7% of demand in 2008, an 11.8% increase from 2007. Diesel fuel was the majority of the petroleum product consumed, accounting for 52.2% of total petroleum products; diesel consumption grew 13% between 2007 and 2008. Electricity and others account for 23.3% of final energy use (2563 ktoe). Natural gas use rose steeply for the third year in a row, increasing 37.6% between 2007 and 2008; its share of total final energy consumption was 6.7%. This increase was driven by the industrial and mining metallurgical sectors. Coal consumption meanwhile declined 5.46% in 2008, compared to 2007 levels (EDMC 2010).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

In Peru, the organisation responsible for the formulation and evaluation of energy–mining policies is the Ministry of Energy and Mines (MINEM), which has two sub-ministries: the Vice-Ministry of Mines and the Vice-Ministry of Energy. MINEM also has responsibility for environmental issues in relation to mining and energy activities. The Vice-Ministry of Energy, through its General Directorate of Electricity (DGE), awards, promotes and regulates electricity activities, and oversees expansions of the rural service through its Rural Electrification Division. The autonomous regulatory organisation created in 1996, Organismo Supervisor de la Inversion en Energía (OSINERG), was expanded to cover mining as well as energy in January 2007 and is now known as Organismo Supervisor de la Inversión en Energía y Minas (OSINERGMIN). It has regulatory functions and looks after technical and legal aspects as well as payment for services in its different phases (OSINERGMIN 2010).

In 2002 MINEM published the Long-term Policy Guidelines for the Energy Sector, which contains the vision, objectives, strategy guidelines, and the medium and long-term policy tools

for the energy sector (MINEM 2002). This is intended to guide the development of an efficient energy system, covering the basic energy needs of the population, contributing to economic growth to achieve better social equity, and to limit environmental impacts. The guidelines have two general objectives:

- Covering the energy basic requirements of the population, both in quantity and quality, thus diminishing social and regional asymmetries, making possible the development of productive activities, and improving the population's living conditions.
- Achieving a good balanced situation between the final consumption structure, supply infrastructure characteristics, and the availability of natural energy resources in the economy.

Subsequently, the Vice-Ministry of Energy has developed Peru's Energy Policy Proposal 2010–2040. This was issued for public discussion in May 2010. After discussions and forums the National Energy Policy of Peru 2010–2040 was approved on 24 November 2010 (Supreme Decree No. 064–2010–EM). The vision of the policy is to supply Peru's energy needs in a safe, sustainable, regular and efficient way, supported by planning and continuous research and technological innovation (MINEM 2010b). Its objectives are:

- to have a diversified and competitive energy matrix with emphasis on renewable energy and energy efficiency
- to have a competitive energy supply system
- to have universal access to energy supply
- to achieve the highest possible efficiency levels in the energy chain and energy use
- to achieve self-sufficiency in energy production
- to develop an energy sector with minimal environmental impact and low carbon emissions, as part of sustainable development
- to develop the natural gas industry and its use in household, transportation, commercial and industrial activities as well as efficient electricity generation
- to achieve institutional strength in the energy sector
- to be integrated with regional energy markets to support Peru's long-term vision.

How each objective will be achieved is detailed in the policy; this will form the basis of the instruments, activities and actions that will be set out in the proposed National Energy Plan – expected to be released before 2012.

It is expected that public consultation and studies and activities in support of the new energy policy will help build a consensus on sector policies, strategies and plans. The next step is expected to be the formulation of a Benchmark Energy Plan, to be implemented when basic policy definitions are in place.

ENERGY MARKETS

Peru's economy has become more market-oriented following the reforms of the 1990s. The mining, electricity, hydrocarbons and telecommunications industries have all been partially privatised. Several new laws have established that domestic and foreign investments are subject to the same terms and this has encouraged foreign companies to participate in almost all economic sectors. One example is the promotion of foreign investment in the natural gas industry. In 1999, Peru gazetted the Law for Promotion of Natural Gas Industry Development (Law No. 27133) which has as its purpose the establishment of specific conditions in order to promote the development of the natural gas industry, fostering competition and the diversification of energy sources to increase the reliability of energy supply and competition in the productive sector of the economy (El Peruano 1999). See also the 'Fiscal regime and investment' section following.

In the electricity sector, reforms started in 1992 and introduced a model very close to the Chilean system implemented in 1982. An important difference is the limits the Peruvian model puts on vertical and horizontal integration within the sector. The reform had four main components: the vertical and horizontal de-integration of Electroperú and Electrolima in

generation, transmission and distribution; the progressive and partial privatisation of those state utilities; the creation of a 'free market' where customers with a capacity higher than 1 MW could freely negotiate the conditions of their supply contract; and the establishment of a new mandate for the old Electricity Tariffs Commission (CTE), which became the energy tariff regulation agency, regulating prices according to marginal cost principles.

Although Peru had an open electricity market, there were still barriers to the market's efficient operation. In July 2006, the government therefore expanded the rules established in the Electricity Concessions Law to:

- ensure the supply of 'sufficient efficient generation' in order to reduce the economy's exposure to price volatility and to help ensure that consumers receive more competitive electricity tariffs
- reduce administrative intervention in determining prices for generation by means of market solutions
- take the necessary measures to create effective competition in the generation market
- introduce 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 the introduction of bidding and incentives for the optimal supply of electrical energy; the establishment of a spot market; the modification of functions held by the Comité de Operación Económica del Sistema with the purpose of forming an independent operator for the electricity system; and an adjustment of the legal framework corresponding to the formation of transmission prices.

FISCAL REGIME AND INVESTMENT

The Peruvian fiscal regime aims to be attractive to foreign investors. The energy sector is subject to a royalty system and corporation taxes. The Peruvian authorities have welcomed new oil companies, with the intent of stimulating further investment. Oil and gas exploration and production activities are conducted under license or service contracts granted by the government. The government guarantees that the tax law in effect on the agreement date will remain unchanged during the contract term. Under a license contract, the investor pays a royalty; while under a service contract, the government pays remuneration to the contractor. The rates are determined through two methodologies: a production scale and the economic results.

The production scale methodology establishes a percentage of royalty (or brackets of royalties starting at 5%) over certain scales of production (volume of barrels per calendar day) for liquid hydrocarbons and natural gas liquids, and other royalty percentages for natural gas for each valuation period. Under the economic results methodology, the royalty percentage is set by adding the fixed royalty percentage of 5% to a variable royalty percentage, established according to certain economic results ratios (Ernst & Young 2010).

To promote domestic and international investment in the Peruvian electricity sector, two laws have been enacted. The first one, in 1991, is the Foreign Investment Promotion Law, Supreme Decree No. 662, which guarantees a level playing field for foreign investors alongside Peruvian ones. The second law, on private investment in public services and regulatory agencies (Ley Marco de los Organismos Reguladores de la Inversión Privada en los Servicios Públicos, Law No. 27332), came into force in 2000. It provided a framework for private investors in telecommunications, energy, transport and sanitary services, specifying how the operations in each of these public service sectors were organised.

Finally, the last law directly relevant to the electricity sector is the 1997 law against oligopolies and monopolies (Ley Antimonopolio y Antioligopolio del Sector Eléctrico, No. 26876). It limits the horizontal concentration of firms to a 15% market share in the electricity

sub-sectors of generation, transmission or distribution, and to a 5% market share in the case of vertical concentration.

In 2010, Peru's President announced that the economy would invest around USD 35 billion in gas, oil and mining over the next five years. Such investments have helped to turn Peru's economy into one of the most dynamic in Latin America (The Economist 2010).

ENERGY EFFICIENCY

The Peruvian Government has actively pursued energy efficiency since the 1980s and 1990s, when it created the Energy and Environment Centre (CENERGIA) and the Energy Conservation Project (PAE). PAE was created in 1994 after an energy shortage in Peru, and was the basis of a strong energy conservation campaign run by the government; after international awards and good results, in 2001 PAE was converted from a temporary project to a permanent program and it is still continuing (MINEM 2009b).

In 2000, the government passed the Law for the Promotion of Efficient Use of Energy (Ley de Promoción del Uso Eficiente de la Energía), Law No. 27345. In line with this legislation, and with the 2007 Supreme Decree No. 053–2007–EM, the Peruvian Government through the President made significant initiatives to support energy efficiency through mechanisms; these include DS–No. 034–2008–EM of 19 June 2008 (Energy Saving Measures in Public Service), and RM No. 038–2009–MEM/DM of 21 January 2009 (Energy Consumption Indicators and its Monitoring Methodology). In Supreme Decree No. 034–2008–EM of June 2008, the Peruvian Government promoted energy-saving measures in the public sector, such as replacing less efficient incandescent lamps with compact fluorescent lamps and acquiring equipment with energy efficiency labels.

In September 2009, the government through MINEM organised a workshop on efficient use of energy where the Referential Plan for the Efficient Use of Energy 2009–2018 was approved. This is the main instrument to achieve the economy's energy efficiency goals through action plans proposed for each sector (MINEM 2009c). The Referential Plan aims to reduce energy consumption by 15% from 2007 levels by 2018, through energy efficiency measures. The plan includes an analysis of energy efficiency in Peru, identifying sector programs that could be implemented to achieve the proposed targets.

In workshop discussions, these actions were identified as current priorities:

- Reinforce strategic alliances with other economies to promote electricity security, efficient use of energy, and environmental protection.
- Develop tax benefits for private companies that operate with efficient technologies.
- Strengthen the Energy and Mines Regional Offices (DREMs) to be able to implement the Referential Plan.
- The use of renewable energies according to the geography and climatic conditions of several regions.
- Mining and energy sectors to commit to being role models of efficiency.

In May 2010, the Peruvian Government created the General Directorate of Energy Efficiency (DGEE) within the Vice-Ministry of Energy (through Executive Decree No. 026–2010–EM). DGEE is the technical regulatory body in charge of the proposal and assessment of energy efficiency and non-conventional renewable energy policies, and of the promotion of efficient production of energy as well as the lead agency for energy planning (El Peruano 2010).

RENEWABLE ENERGY

Peru has set goals to increase renewable energy use, and has begun a legislative and policy program to support its development. The economy has some advantages in this area: experience with many technologies and their implementation (the only relatively new renewable energy technologies for Peru are large-scale wind energy and geothermal electricity generation), and existing official targets for biofuels.

Biofuel targets were first set in 2003. There are three regulations that provide the legal framework for the development of biofuels in Peru: Law No. 28054 (Biofuels Market Promotion); Supreme Decree No. 013–2005 EM (Regulation of the Biofuels Market Promotion); and Supreme Decree No. 021–2007 EM (Regulation of the Commercialization of Biofuels). Production of ethanol for fuel in Peru began in August 2009, with operations in the northern region of Piura. High yields and year-round harvest grants Peru's ethanol producing companies a competitive advantage when compared to other producers in the region. Biodiesel production in Peru was estimated to reach 30,000 million tonnes in 2010; Peru's largest biodiesel producer has an operation of 7357 hectares of palm in the San Martín region. Under Peru's biofuels legislation, beginning in 2010, gasoline must contain 7% ethanol (E7) and diesel must include 5% biodiesel (B5) (USDA 2010).

Electricity generation from renewable resources is being expanded from an already significant reliance on hydro generation. The Law on Promotion of Investment for Electricity Generation with Renewable Energies was enacted in May 2008, and the Regulations for Generation of Electricity with Renewable Energies were issued in October of that year (El Peruano 2008a, El Peruano 2008b). Among the incentives contained in the law are: i) a five-year share of domestic power consumption to be generated from renewable energy sources; ii) a firm price guaranteed for bidders who, at auction, are awarded energy supply contracts for up to 20 years; and iii) priority in loan dispatch and access to networks. In February 2010 the first auction for renewable energy supply to the National Interconnected Electric System (SEIN) was made (a total of 411 MW was awarded in 26 projects using wind, solar, biomass and mini-hydro)—prospective projects include three wind farms, four solar plants, two biomass plants and seventeen mini-hydro plants. A second auction is planned to obtain 427 GWh/year from solar and biomass sources (IADB 2010).

NUCLEAR

Although Peru does not currently use nuclear energy for electricity generation, it has had a goverentment-run nuclear program since 1975. This involved the construction of basic infrastructure, human resources training, and the establishment of the Peruvian Institute of Nuclear Energy as part of MINEM. In 1995 the Nuclear Plan 1995–2000 was approved, which emphasised the optimal use of nuclear facilities available in the economy. The plan proposed three planning stages (Modesto & Llamas 2004).

On 26 June 2006, the governments of Peru and the Russian Federation signed a bilateral agreement on the use of nuclear energy for peaceful purposes. A supreme decree was subsequently published on 21 August 2009 (Supreme Decree No. 057–2009–RE), to validate this ratification and disclose it in the Peruvian Parliament (El Peruano 2009).

Meanwhile the Peruvian Government has been working on the implementation of the Nuclear Energy Programme Implementing Organization (NEPIO) of Peru. An important aspect of the economy's energy policy published in 2010 is the consideration of nuclear energy development in the long-term, with potential for it to be integrated into the energy matrix.

CLIMATE CHANGE

Peru, as one of the economies most vulnerable to climate change, has identified the need for an effective strategy for climate change. On 5 December 1993, the Peruvian Government, by Legislative Resolution No. 26185, approved the United Nations Framework Convention on Climate Change (UNFCCC), which was signed in Rio de Janeiro on 6 December 1992. Peru also ratified the Kyoto Protocol of the UNFCCC by Legislative Resolution No. 27824 on 10 September 2002. As part of its environment strategy policy, the Peruvian Government, in October 2003 by Supreme Decree No. 086–2003–PCM, approved the National Strategy on Climate Change (NSCC), Version 8, for the mitigation and adaptation of climate change (El Peruano 2003). The main objectives of the NSCC are to reduce climate change impacts by means of integrated studies of vulnerability and adaptation and to control both local pollution and greenhouse gas emissions by means of the use of renewable energies and energy efficiency

programs in production sectors. During the Conference of Parties 14 (COP14) in 2008, Peru agreed to reduce its emissions by 47% (0.06 gigatonnes of CO_2-e) over 10 years through reforestation management.

Peru also has established a Climate Change Adaptation Programme (PACC), which is implemented by the Ministry of Environment at an economy-wide level, and by regional governments and Apurimac at regional levels. The specific objective of PACC is to promote the implementation of climate change adaptation strategies and measures by the local population and public and private institutions, as well as to capitalise on knowledge and allow dialogue on public policies at different levels (PACC 2010). PACC works at both the local and national level. It considers how political and participative processes at a regional level can incorporate climate change scenarios and adaptation demands, and to this end has formed two regional Climate Change Technical Groups. These technical groups provide a multi-institutional working platform for the development of regional climate change strategies. These schemes can be adjusted to local level (watersheds), in areas that already have decision-making processes at that level.

NOTABLE ENERGY DEVELOPMENTS

OIL AND NATURAL GAS SECTOR

During 2009, investment in oil and gas exploration in Peru reached USD 540 million, while the exploitation tally reached USD 610 million. A large share of the exploration investment was in Lote 64, under the Talisman Petrolera del Perú Company (USD 113.4 million), while around 41% of exploitation investment was in Lote 88, under Pluspetrol Peru Corporation S.A. (MINEM 2010a).

In June 2010, Peru received its first natural gas shipment and started operation of South America's first natural gas liquefaction plant (the Melchorita Plant). The USD 3.8 billion invested in this plant represents the largest investment ever made in a single project in Peru. The plant has a nominal capacity of 4.4 million tonnes per year and will process 0.49 MMcm/D (or 17.5 MMcf/D) of natural gas. The development, construction and operation of the Melchorita Plant were undertaken by a consortium of four world-class energy companies: Hung Oil Company of the United States, with a 50% participating interest; SK Energy of South Korea, with a 20% participating interest; Repsol of Spain, also with a 20% participating interest; and Marubeni Corporation of Japan, with a 10% participating interest (Peruvian Times 2010).

POWER SECTOR

According to the Supreme Decree No. 026–2010–EM of 28 May 2010, the Energy Efficiency Directorate (DGEE) was established within the Vice-Ministry of Energy. The DGEE is also in charge of energy planning, and so is contributing to the development of the proposed National Energy Plan. The overall plan will incorporate a national plan for electricity sector development; both plans will be based on the 2010 energy policy.

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Presidencia de la República del Perú—www.peru.gob.pe
Programa de Adaptación de Cambio Climático—www.adaptacionalcambioclimatico.info
Proyecto Camisea—www.camisea.pluspetrol.com.pe

THE PHILIPPINES

INTRODUCTION

The Philippines is located along the western rim of the Pacific Ocean and covers 300 000 square kilometres of land, spread over an archipelago of 7107 islands and islets. The total population in 2008 was 90.46 million, more than half of which was concentrated in Luzon, the largest of the three major island groups in the Philippines. Between 2000 and 2008, the economy's GDP grew at an annual average rate of around 5% to USD 259.46 billion (USD (2000) at PPP) in 2008. GDP per capita likewise improved, reaching USD 2868 (USD (2000) at PPP) in 2008, up from USD 2824 (USD (2000) at PPP) in 2007.

The Philippines' indigenous energy reserves are relatively small, with only about 30 million barrels of crude oil, 1639 billion cubic feet of natural gas and 440 thousand tonnes of coal, mainly lignite. However, the Philippines has extensive geothermal resources that could make the economy the world's largest producer and user of geothermal energy for power generation. The Philippines is also endowed with a significant hydro power resource, while other renewable energy resources (solar, wind, biomass and ocean) are theoretically estimated to have a power-generating potential of more than 250 000 MW.

Table 25 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (sq. km)	300 000	Oil (million barrels)—proven	30
Population (million)	90.46	Gas (billion cubic feet)—proven	1 639
GDP (USD (2000) billion at PPP)	259.46	Coal (thousand tonnes)—proven	440
GDP (USD (2000) per capita at PPP)	2 868	Uranium (million tonnes U)	—

a Philippine Department of Energy, www.doe.gov.ph

Source: EDMC (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, the total primary energy supply was 40 574 kilotonnes of oil equivalent (ktoe), of which 43.3% (17 557 ktoe) was imported. The remainder (23 017 ktoe) was supplied through the domestic production of indigenous resources. Geothermal and other renewable energy resources accounted for 42.3% of the total primary energy supply; oil and coal, which are largely imported, contributed 34.4% and 15.7%, respectively.

OIL, GAS AND COAL

Indigenous crude oil production in 2008 was 715 ktoe, which accounted for only 5.2% of the economy's crude oil requirement. The amount of oil supplied (including from imports) in 2008 (13 874 ktoe) decreased slightly by 0.7% from that supplied in 2007 (13 976 ktoe). As of December 2009, production from existing oil and gas fields yielded 2.7 million barrels (MMbbl) of oil, 138 billion cubic feet (Bcf) of gas and 5.5 MMbbl of condensate. Since its commencement

in October 2008, the Galoc oilfield has already supplied an average of 7000 barrels of oil per day from its two production wells, which is equivalent to 2.3% of the economy's daily oil demand.

Currently, the economy's gas production is enough to meet its domestic requirements. Gas production increased from 3033 ktoe in 2007 to 3192 ktoe in 2008. Most of the gas produced is from the Malampaya gas field. The coal supply increased from 5 391 ktoe in 2007 to 6 356 ktoe in 2008. More than two-thirds of the coal supply was sourced through imports.

RENEWABLE ENERGY

Among the renewable energy resources, geothermal contributed the most to the economy's indigenous energy supply in 2008, accounting for around 9227 ktoe (22.8%) of the total primary energy supply. The untapped geothermal resource is estimated to have a potential of about 2600 megawatts (MW).

ELECTRICITY GENERATION

The economy's power generation grew by 2.0% in 2008, from 59 612 gigawatt-hours in 2007 to 60 821 gigawatt-hours in 2008. The bulk of the economy's power requirements was supplied by natural gas-fired and coal-fired power plants. Natural gas-fired power plants were the biggest power generators with a 32% share in 2008; coal-fired power plants were the second-biggest source, with a 26% share. Other power generation sources were geothermal (18%), hydropower (16%) and sources in the other category (9.0%).

Table 26 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	23 017	Industry sector	6 171	Total	60 821
Net imports and other	17 557	Transport sector	8 456	Thermal	40 193
Total PES	40 574	Other sectors	8 549	Hydro	9 843
Coal	6 356	Total FEC	23 176	Nuclear	–
Oil	13 874	Coal	1 746	Other	10 785
Gas	3 192	Oil	11 655		
Other	17 151	Gas	70		
		Electricity and other	9 705		

Source: EDMC (2010).
Philippine Department of Energy, www.doe.gov.ph

FINAL ENERGY CONSUMPTION

In 2008, total final energy consumption in the Philippines was 23 176 ktoe, lower by 0.7% from its 2007 level (23 350 ktoe). The transport sector remained the largest energy consumer, accounting for 36.5% of this total, followed by the industry sector at 26.6%. By energy source, petroleum products accounted for 50.3% of the total energy consumed, followed by electricity and other sources (42.2%), and coal (7.5%).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Department of Energy (DOE) is the principal government agency charged with monitoring the energy sector, including oil. The department is also responsible for issuing exploration and production licences and for ensuring compliance with relevant regulations.

The development of the energy sector in the Philippines is based on the economy's two-tiered energy agenda for realising energy self-sufficiency and an efficient and globally competitive energy sector. The Philippine Energy Plan, updated in 2007, outlines the government's two major priorities. The first is to attain a 60% energy self-sufficiency level from 2010 and to maintain this until 2014 (self-sufficiency was 57% in 2007). To achieve this target, it aims to increase oil and gas resources by 20% from 2007 levels, to increase indigenous coal production to meet local demand and to increase renewable energy (RE) capacity. The government also aims to increase the use of alternative fuels and to strengthen energy efficiency and conservation programs. The second priority is to promote a globally competitive energy sector through reforms to the power sector and downstream oil and gas industries

With the New Aquino Government, plans and programs of the energy sector is guided by the Energy Reform Agenda's vision: "Energy Access for More", the key priority to mainstream access of the greater majority to reliable energy services and fuel, most importantly, local productivity and countryside development. The reform agenda is outlined on three (3) major pillars as its overall guidepost and direction such as:

a. Ensuring energy security,
b. achieve optimal energy pricing, and
c. develop a sustainable energy system.

The programs that will lead to the realisation of the pillars are cut into three timelines such short- (2010-2011), medium-(2011-2013) and long-term (2013-2016) timelines.

a. The implementation will focus on the following:
   - ensuring energy security
   - accelerate the exploration and development of oil, gas and coal resources
   - intensify development and utilisation of renewable and environmentally-friendly alternative energy resources/technologies
   - accelerate development and utilization of RE sources
   - enhance energy efficiency and conservation
   - put in place reliable power supply
   - attain economy-wide electrification (implement 90% household electrification)
   - improve transmissions and distributions systems
   - ensure industry compliance to quality standards for products and facilities
   - promote oil supply security
   - provide climate conducive to investments and fair and orderly competition (to expand local refining/storage/handling/distribution capability)
b. Achieve optimal pricing
c. Develop/institute optimal price setting in the energy and power industries, Promote transparency of oil prices, and Develop a sustainable energy plan
   - Pursue energy legislative agenda, Formulate/update energy plans and programs consistent with national and local development plans, and Strengthen policy research and studies in aid of executive and legislative action

- Interface with stakeholders for a more participative delivery of energy service

ENERGY MARKETS

OIL AND GAS

The government is actively promoting intensive upstream exploration and development through the Philippine Energy Contracting Round (PECR). Twelve areas were evaluated in 2009 to become part of the 2010 PECR. The economy has 34 active service contracts (SCs) for oil and gas exploration and development, and one geophysical survey and exploration contract (GSEC) due for conversion into a service contract.

Exxon Mobil started drilling operations in October 2009. The company recently acquired 50.0% ownership of SC 56 and the right to operate the oil and gas exploration project in the Sulu Sea Basin. The Dabakan-1 well was drilled by ExxonMobil Exploration and Production Philippines BV (EMEPP) under SC 56. The well registered a total depth of around 5000 metres and encountered significant hydrocarbon. The Galoc Pro duction Company (GPC) completed extended production testing (EPT) of the Galoc oilfield under SC 14C (Galoc Block) and started producing oil from its two production wells in 2008. In 2009, 3704 line-kilometres of offshore and onshore 2D seismic data was collected under four SCs, and 1754 square-kilometres of 3D seismic data was acquired under three SCs.

Total oil production in the Philippines in 2009 was 2 920 388 barrels. Of this total, the Galoc oilfield accounted for 2 736,323 barrels, the Nido oilfield 83 342 barrels, Matinloc 67 594 barrels and North Matinloc 33 129 barrels. Production from the Malampaya gas field was 138 029 million cubic feet; condensate production from Malampaya was 5 456 583 barrels.

COAL

The Philippines has around 13 coal basins that contain significant coal deposits. Total coal resource potential in these areas are estimated at 2.3 billion tonnes. In December 2009, the economy had 60 active coal operating contracts (COCs) with development, production and exploration commitments. In 2009, 18 new COCs to explore and develop coal resources were issued in the provinces of Sorsogon, Zamboanga Sibugay, Zamboanga Del Norte, Cebu, Agusan Del Norte, Agusan Del Sur, Davao Oriental, Sultan Kudarat, Sarangani and South Cotabato and Surigao Del Sur. The economy's coal operating contractors produced 5.1 million tonnes in 2009.

MARKET REFORMS

The economy's continuing reforms in the power sector and the downstream oil and gas industries are expected to result in a more efficient and globally competitive energy sector. The government is undertaking a transparent privatisation process of its generation and transmission assets to enhance the investment climate for greater private sector participation. The government's efforts to advance the privatisation of the National Power Corporation's (NPC's) generation assets and the transfer of the National Transmission Corporation's (TransCo's) transmission assets to private owners, notwithstanding several setbacks, demonstrate its resolve to implement reforms in the power industry.

Initiatives pursued as part of the Electric Power Industry Reform Act (EPIRA) include the commercial operation of the wholesale electricity spot market (WESM), the privatisation of the NPC's generating assets; the privatisation of TransCo's transmission assets and of its concession; the implementation of retail competition and open access; the administration of a universal charge for missionary electrification[1] and an environmental charge for the preservation of the environment; and loan relief for electric cooperatives.

[1] 'Missionary electrification' refers to the provision of basic electricity services in unviable and far-flung areas with the ultimate aim of improving the economic condition of these areas.

The WESM began commercial operations in Luzon in June 2006, signalling an important phase in promoting open access in accordance with the EPIRA.

To reduce the impact of increases in the price of electricity, particularly from rising fuel prices, some measures were prioritised. These measures included: energy conservation and demand-side management; the NPC's internal efficiency measures; economic dispatch; time-of-use pricing; the implementation of the WESM; and work towards opening access to provide economic price signals, power of choice, and market-based and retail competition.

As of December 2009, the government had successfully bid out 23 operating power generation plants and 5 decommissioned power plants. Eighteen of the 23 operating plants represent about 81% of the total capacity of the operating plants in Luzon and Visayas.

The privatisation of its transmission assets is the economy's biggest privatisation effort so far. The TransCo concession was awarded to the National Grid Corporation of the Philippines (NGCP). The TransCo Franchise Law (RA 9511) became effective on 20 December 2008. The NGCP started operations on 15 January 2009.

As of March 2009, the sale of 58 sub-transmission assets to 54 distribution utilities was realised, amounting to PHP 3.0 billion.

The Downstream Oil Industry Deregulation Act of 1998 (RA 8479) was passed to liberalise and deregulate the economy's downstream oil industry. Its purpose was to ensure a competitive market under a regime of fair prices, a level playing field and an adequate and continuous supply of environmentally clean and high-quality petroleum products. Under a fully deregulated environment, the DOE closely monitors the downstream oil industry activities to ensure moderated oil price increases and compliance of industry players to quality and quantity standards. In addition, the DOE ensures the reasonableness of domestic prices through monitoring the international price of crude oils (such as Dubai, Brent and West Texas Intermediate) and petroleum products (Mean of Platts Singapore). Corresponding adjustments in domestic prices are estimated considering the movements in these international benchmarks and in foreign exchange.

To reduce the effects of intermittent increases in the price of oil to the economy, DOE ensures consumer protection and healthy competition among industry players. The various oil players have also offered price discounts for diesel sold at the pump economy-wide, for the public transport sector.

ENERGY EFFICIENCY

DOE launched the National Energy Efficiency and Conservation Program (NEECP) as part of the SWITCH movement, in July 2008. SWITCH aims to persuade people to switch from a lifestyle of expenditure and waste to a lifestyle of conservation and efficiency. It also aims to promote a shift from petroleum-based fuels to alternative fuels such as biodiesel and bioethanol.

The NEECP outlines the following goals to be achieved by 2014:

- to reduce the impact of increases in the prices of petroleum products and electricity through the implementation of energy efficiency and conservation measures
- to promote cost avoidance/savings on fuel and electricity without sacrificing productivity
- to help protect the environment
- to generate cumulative energy savings for the planning period 2007–14 of 9.1 million barrels of fuel oil equivalent (MMBFOE), which is equal to a deferred megawatt capacity of 210.56 MW and greenhouse gas (GHG) emissions of 2.92 million tonnes of carbon dioxide equivalent at the end of the planning period.

The NEECP consists of nine components across six sectors (NEECP 2009):

- *Component 1*: Information, Education and Communication Campaign

- *Component 2*: Standards and Labelling for Household Appliances
- *Component 3*: Government Energy Management Program
- *Component 4*: Energy Management Services/Energy Audits
- *Component 5*: Voluntary Agreement Program
- *Component 6*: Recognition Award Program
- *Component 7*: Fuel Economy Run Program (currently part of the Information, Education and Communication Campaign, but necessary to establish/generate significant data for the Vehicle Labelling Program in the future)
- *Component 8*: Locally Funded Projects that promote Energy Efficiency Conservation
  - Fuel Conservation and Efficiency in Road Transport
  - Power Conservation and Demand Management (Power Patrol)
  - Philippine Energy Efficiency Project—a USD 31 million Asian Development Bank loan to the Philippine Government to promote energy efficiency conservation
- *Component 9*: Foreign Assisted/Technical Assistance. This includes the Philippine Industrial Energy Efficiency Project for the Philippines (a United Nations Industrial Development Organization assisted project with the objectives of showing optimisation system models in industrial manufacturing facilities and establishing a Philippine Energy Management Standard in line with ISO 5001).

The NEECP provides the framework for the government's efforts to promote the efficient and judicious use of energy. The ongoing implementation of its energy efficiency and conservation program will generate average annual energy savings of 17.7 MMBFOE (2.9 Mtoe) across the planning period 2007–14. Savings are expected to be 7.5 MMBFOE (1.08 Mtoe) in 2010 and up to 9.1 MMBFOE (1.31 Mtoe) by 2014.

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

To strengthen the implementation and monitoring of new and existing energy efficiency programs with government agencies, the government adopted and issued a number of legal framework documents. These documents cover the Guidelines for Energy-Conserving Design of Buildings and Utilities; a ban on the importation of inefficient second-hand vehicles; the establishment of an energy efficiency and conservation testing centre to include testing of vehicle engine performance and energy saving gadgets, among others; the energy efficiency fuel mileage labelling of all brand new vehicles; and the inclusion of energy efficiency projects costing at least PHP 50.0 million in the Omnibus Incentives Bill.

The energy labelling and efficiency standards program is expected to contribute the most to energy savings: 6.7 MMBFOE (0.97 Mtoe) in 2010 and 8.1 MMBFOE (1.17 Mtoe) in 2014. To realise this target, the government will:

- pursue the standardisation of technical specification requirements in the procurement of energy efficient lighting systems and other electrical equipment and devices in government offices (for example, the use of 32-watt instead of 40-watt CFLs (compact fluorescent lamps) and the use of energy-efficient LCD computer monitors)
- formulate a benchmark in government buildings (in kilowatt-hours per square metre, subject to the age of building, its usage/function, height/number of floors and floor area, among others), which will serve as a reference in managing energy consumption
- promote a market-based application under the Demand Reduction Program in the absence of utility-based demand-side management

- strengthen product testing and research through the establishment of a lighting testing facility to determine and recommend more efficient lighting designs for office buildings and street lighting
- draw up an inventory of legitimate and accredited testing laboratories to encourage the private sector to set up independent and competent testing laboratories
- review and formulate policies and guidelines on the disposal of mercury-containing lamp wastes (DOE 2007).

RENEWABLE ENERGY

The Renewable Energy Act of 2008 (RA9513) was enacted in December 2008 to further promote the development, utilisation and commercialisation of renewable energy resources. This Act facilitates the energy sector's transition to a sustainable system with RE as an increasingly prominent, viable and competitive fuel option. The shift from fossil fuel sources to renewable forms of energy is a key strategy for ensuring the success of the transition. Current initiatives in the pursuit of this policy are directed towards creating a market-based environment conducive to private sector investment and participation and encouraging technology transfer and research and development.

Immediately after the Act's publication on 15 January 2009, the DOE started formulating its Implementing Rules and Regulations (IRR) through a series of economy-wide consultations. The IRR was signed on 25 May 2009. In accordance with the Act, the National Renewable Energy Board (NREB) was created; its members are representatives from other government agencies, stakeholders and non-government organisations (NGO).

The passage of the RE Act has spurred investor interest in the development of renewable energy sources. To speed up the processing of renewable energy projects, the DOE issued other enabling guidelines, such as the Department Circulars (DCs) covering the accreditation of manufacturers, fabricators and suppliers of locally-produced RE equipment and components; and guidelines governing a transparent and competitive system of awarding RE service and operating contracts, including the registration process of RE developers. Currently, various Technical Working Groups are formulating other equally important policy mechanisms such as the Renewable Portfolio Standards (RPS), Net-Metering, and Feed-in Tariff (FiT) systems.

The economy's total estimated potential of untapped geothermal resources is about 2600 MW. Over the next 10 years, the development of proven reserve areas will make available a maximum 1200 MW of this estimated potential. About 610 MW of potential capacity can be generated from resources in service contract areas belonging to the Energy Development Corporation.

The economy's total installed capacity from hydropower reached 3291 MW in 2009, which represents 62% of the total RE capacity. To further develop hydropower as the mainstay of the economy's power-generating options, the government is pursuing greater private sector participation in the development of hydropower resources. It has identified 41 hydropower projects with a total potential generating capacity of 1025.1 MW, composed of 10 large hydropower projects and 31 mini hydropower projects. The completion of four mini hydropower projects in 2010 added an estimated 4.6 MW to the economy's existing installed hydropower capacity.

To promote the use of other RE sources, the government identified about 707 MW of generating capacity for possible development from biomass, wind and solar energy sources. About 551 MW will come from wind power projects and 156 MW from biomass and solar projects.

NUCLEAR

As a net energy importer, the Philippines is looking at developing a nuclear energy program to support its development needs, and is considering it as a long-term option. In collaboration with the Department of Science and Technology (DOST), DOE is reviewing scientific and technical options to revive the economy's nuclear energy program. With nuclear energy viewed as one of the cheapest options for ensuring electricity supply, the joint DOE–DOST initiative will prioritise capability-building activities to develop the required local expertise. For example, a vital component of a science-based approach to the nuclear option would be to ensure the training of young nuclear scientists and technical experts in various aspects of nuclear-generated power through internships with, and scholarship grants from, economies with advanced nuclear energy technology. DOE will also look at measures to address public acceptance and stakeholder involvement.

In January 2008, an International Atomic Energy Agency mission visited the economy to help assess the options of rehabilitating the mothballed Bataan Nuclear Power Plant in Morong, Bataan, or of constructing a new plant. The mission recommended an extensive review and evaluation of the Bataan plant, particularly of its structure and facilities. At the Association of Southeast Asian Nations (ASEAN) level, the consideration of nuclear energy as a potential area of regional cooperation is making moderate progress.

CLIMATE CHANGE

To ensure the compliance of energy projects to environmental regulations and standards, DOE actively participates in Multipartite Monitoring Team activities that include the regular monitoring of air and water quality. Under the framework of the Philippine Environmental Impact Statement System, DOE provides technical support and advice to the Environmental Impact Assessment Review Committee in the evaluation of energy projects. In August 2007, DOE chaired the Presidential Task Force on Climate Change (PTFCC) and took the lead in the Philippine's campaign to mitigate the impact of climate change. Under DOE leadership, the PTFCC presented the economy's climate change response framework and action plan entitled Climate Change: Philippines Response. The PTFCC signed a Memorandum of Agreement (MOA) on Watershed Reforestation to plant 10 000 hectares of open and low-lying areas in the 11 watersheds of the National Power Corporation. Similarly, a MOA was signed with the Department of Education to put in place the Curriculum Development of Climate Change Education at the primary and secondary school levels.

In October 2009, the Philippine Climate Change Act of 2009 (RA 9729) was passed, creating the Climate Change Commission. The Commission is a policy-making body attached to the Office of the President tasked with coordinating, monitoring and evaluating programs and action plans relating to climate change. Headed by the President, the four-member commission will have the same status as a central government agency.

NOTABLE ENERGY DEVELOPMENTS

POLICY UPDATES

The DOE introduced The Renewable Energy Act of 2008 (RA 9513) in 2008 and the Implementing Rules and regulations (IRR) of Republic Act No. 9513 in 2009. Details are contained in the Renewable Energy section. In addition, in 2009, the Department of Energy issued the legal framework document for enforcing The Renewable Energy Act of 2008—the Guidelines Governing a Transparent and Competitive System of Awarding Renewable Energy Service/operating Contracts and providing for the Registration Process of Renewable Energy Developers.

POWER SECTOR

For the privatisation of the transmission business, TransCo was successfully bid out in December 2007 with the consortium of Monte Oro Grid Resources Corporation, Calaca High Power Corporation and the State Grid Corporation of China declared as the winning bidder. The 25-year concession contract provided the government with USD 3.95 billion in revenues. The consortium established the National Grid Corporation of the Philippines (NGCP) or the 'Concessionaire'. The NGCP started operations in January 2009.

As of March 2009, the sale of 58 sub-transmission assets to 54 distribution utilities was also realised, amounting to PHP 3.0 billion.

MARKET REFORMS

The government achieved some large accomplishments in its privatisation efforts between November 2009 and April 2010. The sale of the Angat HEPP power plant brought the privatisation of the National Power Corporation's (NPC) assets in the Luzon and Visayas grids to 91.8%. Following the success of the Ilijan Independent Power Producer Administrator (IPPA) bidding process, the government was able to hand over the management and control of nearly two-thirds of its energy outputs under contract with NPC.

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USEFUL LINKS

Asian Development Bank—www.adb.org
Department of Energy, Republic of the Philippines (DOE)—www.doe.gov.ph
Department of Science and Technology (DOST)—www.dost.gov.ph/
National Power Corporation (NPC)—www.napocor.gov.ph/
National Transmission Corporation (TransCO)—www.transco.ph/
Philippine National Oil Company (PNOC)—www.pnoc.com.ph/
Wholesale Electricity Spot Market (WESM)—www.wesm.ph/

THE RUSSIAN FEDERATION

INTRODUCTION

With a land area of more than 17 million square kilometres, the Russian Federation is the world's largest economy in land area. It is located in Eastern Europe and Northern Asia, bordered by the Arctic and the North Pacific oceans. Its terrain is characterised by broad plains west of the Urals, vast coniferous forests in Siberia, tundra along the Arctic seaboard, and uplands and mountains in the southern regions. Russia has a vast natural resource base that includes major deposits of coal, natural gas, oil and other minerals. Despite its land area advantage, it lacks an optimal climate for agriculture, as most of its area is either too cold or too dry.

The overall population density is low (fewer than nine people per square kilometre) and the northern and eastern regions are sparsely populated. The urban population accounts for 73% of the total. From 1990 to January 2010, the permanent population declined from 147.7 million to 141.9 million.

After a decade of economic contraction (about 40% compared to the 1990 GDP level), the Russian economy began to grow again in 1999. The recovery was triggered by a devaluation of the rouble 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 also drove the recovery.

The Russian Oil Stabilisation Fund was established in January 2004 to reduce the vulnerability of the state budget to the volatility of world oil prices (a stabilisation function), and to decrease the impact of oil-related foreign exchange inflows on the money supply and inflation (a sterilisation function). Since 2008, the fund has been split into the Reserve Fund and the National Wealth Fund, with total assets of more than RUB 6.6 trillion (USD 225 billion) as of 1 January 2009. Russia's economy continues to develop strongly, achieving 6% growth in 2008 and an average growth rate of 6.9% since 2000. GDP in 2008 reached USD 1847 billion (USD (2000) at PPP). The unemployment rate in 2008 was 7%, and inflation stayed high at 13.3%.

Table 27 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (sq. km)	17 075 200	Oil (billion barrels)	74.2
Population (million)	141.6	Gas (billion cubic metres)	44.4
GDP (USD (2000) billion at PPP)	1 846.5	Coal (billion tonnes)	157.0
GDP (USD (2000) per capita at PPP)	13 008	Uranium (kilotonnes of uranium metal)[b]	181.4

a Proven reserves at the end of 2009 are from BP (2010).

b Reasonably Assured Resources are from IAEA and NEA OECD (2010).

Source: EDMC (2010).

In terms of proven reserves, Russia holds a quarter of the world's gas, 7% of its oil reserves, 17% of its coal reserves, and about 14% of its uranium ore reserves. Even more resources remain undiscovered, but the formidable obstacles of climate, terrain and distance hinder their exploitation. Russia is the world's second-largest primary energy producer (behind the United States), its third-largest energy consumer (behind the United States and China), its largest exporter of energy (about 45% of total energy produced is exported), its largest exporter of natural gas, and its second-largest

exporter of oil. The energy sector's output accounts for almost 30% of Russia's GDP, and is important not only to Russia's economic development but to the survival of its population during harsh winters.

In 2008, exports of crude oil, petroleum products and natural gas accounted for two-thirds of the total economy's exports and approximately 9% of GDP. Russia holds leading positions in each of the world's energy markets: 40% of uranium enrichment, 25% of natural gas trading, 16% of reactor construction, 15% of spent nuclear fuel conversion, 12% of crude oil and petroleum products trading, and 12% of coal trading. In 2008, Russia's net exports of energy declined to 530 million tonnes of oil equivalent (Mtoe), but the economy is still the world's top energy exporter.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Russia's total primary energy supply in 2008 was 678.8 Mtoe, comprising natural gas (54%), crude oil and petroleum products (21%), coal (16%) and others, including nuclear and hydro (9%). By destination, more than 91% of Russia's total energy exports go to Western and Eastern Europe (including the Commonwealth of Independent States (CIS)). To secure its future energy exports, Russia is diversifying its export routes towards regional markets in the Asia–Pacific region, aiming to deliver oil, natural gas and coal to China, Japan and Korea in East Asia, and economies in North America.

Russia produced 488.6 million tonnes of crude oil and gas condensate in 2008. The oil heartland province of West Siberia accounted for about two-thirds of total production. Refiners consumed 236 million tonnes of crude oil as feedstock, producing 35.7 million tonnes of gasoline, 69 million tonnes of diesel oil and 63.9 million tonnes of fuel oil. Oil exports reached 243 million tonnes of crude oil and 118 million tonnes of petroleum products. Prospective oilfields are onshore in the Timano–Pechora and East Siberia regions and offshore in the Arctic and Far East seas, and on the North Caspian shelf.

Table 28 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	1 239 621	Industry sector	123 527	Total	1 042 327
Net imports and other	–530 194	Transport sector	101 527	Thermal	707 569
Total PES	678 760	Other sectors	217 350	Hydro	168 659
Coal	109 953	Total FEC	442 405	Nuclear	163 085
Oil	140 491	Coal	22 102	Geothermal	411
Gas	366 194	Oil	98 599	Others	3 014
Others	62 122	Gas	133 947		
		Electricity and others	187 756		

Source: EDMC (2010).

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

Natural gas production reached 664 billion cubic metres (bcm) in 2008. Net exports accounted for 187 bcm or 28% of production. Nearly all natural gas exports were destined for Western and Central Europe, including Turkey, with small amounts piped to the Transcaucasian states—Armenia,

Azerbaijan and Georgia. Huge but undeveloped resources of natural gas are located in remote regions, where the lack of infrastructure prevents the start-up of upstream operations.

Russia produced 326 million tonnes of coal in 2008. Coal exports reached 100.5 million tonnes, or 30% of production, despite the fact the main coal-producing areas (Kuznetsky and Kansko–Achinsky basins) are landlocked in the South of Siberia, some 4000–6000 km from the nearest coal shipping terminal for the Atlantic/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 1042 TWh of electricity in 2008, of which 68% was by thermal power plants, 16% by hydropower and 16% by nuclear energy. The economic potential of hydropower is estimated at 852 TWh per year, but only 20% of this has been developed. Russia has enormous technical potential for renewable energy production, like hydro and biomass in Siberia, wind along its Arctic and Pacific shores and geothermal in Kamchatka and Kuril Islands. However, the use of this potential is constrained by the huge distances over which renewable energy would have to be delivered to consumers.

FINAL ENERGY CONSUMPTION

In 2008, total final energy consumption in Russia was 442 Mtoe, an increase of 1.1% compared with the previous year. By sector, industry accounted for 28%, transport for 23% and other sectors for 49%. By energy source, coal accounted for 5%, petroleum products 22%, natural gas 30% and electricity, heat and others 43%. Because of Russia's extremely cold climate, the most important energy use is for space heating (about one-quarter of total final energy consumption). The traditional energy-intensive industrial structure has been one of the major drivers of economic development. New measures to improve energy efficiency in existing industries, to increase the share of less energy-intensive services, and to improve the efficiency of the heat supply to the residential and commercial sectors are important issues in energy policy. Estimates suggest Russia has a huge untapped technical potential for energy savings, ranging from one-third to almost half of its total final energy consumption.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

In May 2008, a new Ministry of Energy was established, taking parts of government control from the former Ministry of Industry and Energy. The ministry's objectives are to develop and monitor an economy-wide energy policy and regulation framework for the energy supply chain, including energy export. The importance of energy export for the Russian economy is shown by the more than 20% share of energy-related industries in Russia's GDP (directly measured value added in 2008 is 14%, and total related activity in other sectors is assessed at a similar level), and by the volume and structure of its net energy exports that put the economy among the world's top four energy exporters (Table 3).

Table 29 Top four world net energy exporters, 2009 (Mtoe)

	Russia	Saudi Arabia	Norway	Australia
Total	**623**	**338**	**188**	**173**
Oil	369	338	99	−19
Gas	124		89	15
Coal	58			177
Nuclear[a]	71			
Electricity	1. 0		0. 8	

a Nuclear fuel enrichment.
Sources: BP (2010); IAEA and NEA OECD (2010).

ENERGY STRATEGY TO 2030

The adoption of the Energy Strategy of Russia to 2020 in August 2003 was a milestone in Russia's energy sector development. The strategy identifies the economy's long-term energy policy and the mechanisms for its realisation. A revised version of the strategy—Energy Strategy of Russia to 2030, with an extended timeframe to 2030—was adopted by the government in November 2009. The strategy is a framework within which more detailed industry-oriented medium-term and short-term programs can be developed.

The strategic objective of Russia's external power policy is to effectively use its energy potential to maximise its integration into the world's energy markets, to strengthen Russia's position in the markets and to maximise the benefits from energy resources to the economy. To achieve this, it will implement several measures to secure domestic energy consumption, energy export obligations, and efficiency improvements along the whole energy supply chain. The measures will:

- sustain a high degree of energy security for Russia as a whole and for the energy-rich regions
- help Russia develop a global energy security system, including the diversification of export delivery routes (at least 27% of Russia's total energy exports in 2030 should be delivered to the Asia–Pacific region, and the share of foreign direct investments to the energy-related industries should increase to 12%, from 4% currently)
- decrease economic dependence on the oil and gas sector (the share of energy in Russia's GDP should be reduced from 30% to 18%)
- reduce the energy intensity of the economy by 40% to 2030.

To facilitate international cooperation on energy security, Russia has adopted the following strategic initiatives:

- development of the closed nuclear fuel cycle and the expansion of nuclear power generation
- development of new hydrocarbon provinces in remote areas and offshore
- rehabilitation, modernisation and development of the energy infrastructure, including the construction of trunk oil and gas pipelines, to enhance the economy's energy export capacity
- enhancement of energy exports to the Asia–Pacific region's international markets.

The most important tool of the Energy Strategy of Russia to 2030 is the development of energy market institutions, such as fair pricing mechanisms, transparent trading principles, and sufficient energy transportation infrastructure. The federal government will do this through:

- legislative support for transparent and non-discriminatory access for all domestic market participants to energy infrastructure (pipelines, power and heat supply grids), tougher antimonopoly regulations to prevent cartel-type market monopolisation, and the creation of an integrated monitoring system for energy markets

- stimulating private companies' participation in energy trading by means of commodity exchange, by creating a regulatory framework for the energy 'derivatives' trade (futures, options etc.) in roubles through stock exchanges, and by increasing its role in pricing energy resources
- ceasing cross-subsidies and reducing the state regulation of natural monopolies' tariffs, while maintaining a socially-acceptable level of residential energy expenses
- steadily liberalising the gas, electricity, and heat domestic energy markets.

The total cost of implementing the Energy Strategy to 2030 is assessed at USD 2.4–2.8 trillion.

Under the Energy Strategy to 2030 general framework, long-term and medium-term programs and industry-wide schemes are being developed. These include the Federal Program for Development of the Nuclear Industry to 2015, approved in October 2006 and the General Scheme for the Development of the Power Industry to 2020, approved by the federal government in February 2008, and currently being amended to extend it out to year 2030.

In September 2007, the federal government approved the East Gas Program to develop natural gas fields and build extensive trunk gas pipelines in Eastern Siberia and the Russian Far East up to 2030. The program also includes building export pipelines to the East Asian economies. Gazprom, the state gas monopoly and owner of the economy-wide gas pipeline system, is the coordinator of the program and is responsible for conducting long-term sales contracts for natural gas deliveries.

In addition to industrial approaches to energy policy formulation, the Federal Programme on Energy Saving and Energy Efficiency Improvement to 2020 was approved by government in November 2010. The draft General Scheme for the Natural Gas Industry Development to 2030 will be a major development stimulus for Russia's energy sector, considering the soaring importance of the gas industry on the international stage and the importance of natural gas in the economy's primary energy supply.

The mid-term Scheme on the Unified Energy System Development is a tool to coordinate federal, regional, and local governments with private businesses and industry regulators. The scheme is amended on an annual basis and serves as a seven-year outlook for generation and transmission line projects. It includes an outlook for electricity demand by regions, maximum loads, generation capacity reserves, power exchange, the retirement of old facilities, maintenance, retrofitting, and commissioning for new generation and transmission facilities (with more than 5 MW capacity/110 KV and higher voltage, respectively).

LAW AND REGULATIONS

The basic laws on specific energy-related industries are either being implemented or developed. The set of acting laws include On Subsoil (since February 1992), On Price Control for Electricity and Heat Supply (since April 1995), On Natural Monopolies (since August 1995), On Production Sharing Agreements (since December 1995), On Energy Conservation (since April 1996), On Gas Supply (since March 1999), On Power Industry (since March 2003), On Nuclear Industry (since February 2007), On Heat Supply (since July 2010), On Energy Conservation and Increase of Energy Efficiency (since August 2010). The latter is the logical extension of the On Power Industry law, due to the fact major heat supply in Russia is provided by cogeneration plants (CHP), where electricity is a by-product of residential and industrial heat supply. However, while crude oil extraction and refining is an important industry in Russia, considering its international influence and its growing domestic economic and social challenges, the draft of the On Oil law is still being developed. This law will be important for facilitating investments in the industry, both domestically and abroad.

As a rule, the Ministry of Energy is responsible for issuing regulations and instructions etc., to enforce the smooth implementation of the basic energy laws and to coordinate current economic development with long-term energy policy. Other major government institutions actively participate in the development and implementation of the regulatory framework, regarding

energy consumption and energy supply, and the export and import of energy. The major federal government institutions involved in the development and endorsement of Russia's energy policy and its regulatory framework include the:

- Ministry of Energy
- Ministry of Natural Resources and Environmental Protection
  - Federal Service for the Oversight of Natural Resources
  - Federal Service for Environmental, Technological, and Nuclear Supervision
  - Federal Agency for Water Resources
  - Federal Agency on Mineral Resources
- Ministry of Industry and Trade
  - Federal Agency for Technical Regulation and Metrology
- Federal Antimonopoly Service
- Federal Customs Service
- Federal Tariff Service.

ENERGY SECURITY

Russia considers issues related to energy security as a global phenomenon. Due to the increasing interdependence of energy producers, importers, and transition economies, improving partnership relations is regarded as an effective mechanism for international energy security. The key approach is to coordinate the actions of energy producers and consumers in emergency and/or crisis situations. To facilitate international energy security cooperation, the draft Convention on International Energy Security was developed.

The infrastructure projects, including new oil and gas export trunk lines from Russia to its European and Asian markets, provide a solid contribution to improving global energy security. The development of the international infrastructure for the reliable maintenance of the nuclear fuel cycle, under strict International Atomic Energy Agency (IAEA) supervision, is another Russian input into the improvement of global energy security.

ENERGY MARKETS

MARKET LIBERALISATION

One of the main issues in Russia is the gradual move from state-regulated energy pricing to free market institutions for natural gas and electricity pricing (coal and petroleum prices are already fully liberalised). The federal government will keep control over tariff-setting for natural monopolies—power transmission lines, and pipelines (gas, crude oil, petroleum products transportation systems, heat supply for residential and commercial sectors). The Federal Tariff Service is authorised to set the maximum allowable regional tariffs for natural gas, electricity and centralised heat supply. One of the objectives of the Energy Strategy of Russia to 2030 is to complete the full liberalisation of domestic energy markets, where at least 20% of energy should be traded on commodity exchanges. In December 2006, the government approved the liberalisation of natural gas and electricity prices simultaneously in 2011, ensuring the smooth development of the natural gas industry and the restructuring of the power industry. The synchronisation of price liberalisation is important for both industries, as 70% of the thermal power plants' fuel mix is provided by natural gas, while more than 40% of total domestic natural gas consumption comes from the power industry. However, due to social issues, the regulated tariff for residential energy supply will remain until 2014.

The oil market in Russia has been deregulated since the 1990s, but crude oil and petroleum trading is not based on commodity exchanges. Most crude oil in the domestic market is traded on a term basis, in which prices are linked to international benchmarks. Petroleum is traded in irregular tenders, which allows producers to control the market. Regional petroleum storages play an important role in establishing fuel markets. The government intends to make up to 25% of compulsory purchases of the government's petroleum products supply by means of commodity exchanges, such as the St Petersburg Oil Exchange established in late 2006. The Federal

Antimonopoly Service has an element of control over oil and gas prices through its role in monitoring the market share of sellers, but it has no responsibility for regulating prices.

The government's control on coal pricing was removed in the early 1990s and the coal market is liberalised, with similar institutions to the crude oil and petroleum product markets.

Access to Gazprom's gas transportation system by independent producers, as well as the wholesale gas price system, is regulated by federal government decree. In August 2006, tariff regulations for new pipelines came into force, which is important for independent companies' access to Gazprom's pipeline system. In July 2007, new regulations for natural gas sales in Russia were introduced, including a schedule for contracted industrial gas prices to 2011, to create a netback pricing mechanism for international gas markets. Upper limits for tariff growth were set at 15% in 2007, 25% in 2008, 14% in each half of 2009, and 40% in 2010. The transition to transparent free trading pricing mechanisms in domestic markets was originally scheduled to be completed in 2011, but the transition period has since been extended to 2013. However, independent gas producers provide about 15% of the natural gas producted in Russia; they do not fall under the price regulations and currently enjoy free contract prices. Regulated prices will remain for the residential and commercial sectors for some time, as the pace of tariff increases for such consumers should be lower than that for industrial users.

INDUSTRY RESTRUCTURING

Oil and gas

The oil and gas industry was privatised in the 1990s. However, the state still has a controlling stake in major oil companies, crude oil and petroleum trunk pipelines, and it has close to 50% of Gazprom's shares. Currently, the oil industry in Russia consists of 10 large companies producing more than 90% of the crude oil, about 300 small-scale enterprises, and operators of three production-sharing agreements. The refining sector consists of 27 large and more than 50 small refineries. After the merger of the crude oil and petroleum products pipeline companies Transneft and Transnefteprodukt, the state controls 75% of the combined company's shares. Private oil pipelines do exist in Russia—the most important is the Caspian Pipeline Consortium for crude oil transit from Kazakhstan to the Black Sea ports, but other private pipelines operate in the European part of Russia and in Siberia.

The federal government remains the key shareholder in the economy's gas monopoly, Gazprom (extractor of 85% of the natural gas in Russia and owner of the economy-wide gas pipeline system). Independent companies produce the other 15% and supply about 25% of domestic consumers.

International oil companies such as ConocoPhillips, ExxonMobil, Royal Dutch Shell, BP, CNPC and Total hold up to 10 billion barrels of oil and natural gas reserves in Russia through their stake in state and private companies, and produce at least 14% of the economy's crude oil and 7% of its natural gas. Foreign investments accounted for USD 52 billion of cumulative investments in the Russian energy sector from January 2000 to June 2010.

At the beginning of 2001, there were no Russian oil/petroleum export facilities on the shores of the Baltic Sea. Since then, the Baltic Pipeline System (BTS) and the new Primorsk and Vysotsk oil export terminals have been developed. The general capacity of this system reached 75 million tonnes in 2006. In July 2009, work began on the construction of BTS-2, which will be able to deliver 50 million tonnes to the new oil export facilities at Ust-Luga port on the Baltic Sea.

Refining volumes are expected to stay flat over the next decade, but quality will be a key issue. Gas developments are planned to increase the share of independent producers (i.e. other than Gazprom) from 16% currently to about 30% in 2030. The Nord Stream pipeline is already under construction and should help to maintain Russia's traditional European market, but more gas trunk pipelines are needed to tap into the Asian market, specifically China. New LNG projects in European Arctic like Shtokman and Yamal are considered an important means of delivering natural gas to international markets.

Coal

The Russian coal sector was restructured and fully privatised in the 1990s, and foreign participation in the sector is practically absent. Industry development is based two-thirds on equity and one-third on loans. There are no restrictions on exporting coal, but the geographical size of Russia's vast economy requires coal haulage over long distances. Coal is the single largest commodity transported by Russia's railway network, accounting for over 27% of its total freight.

Power

Russia started restructuring the power industry in 2000. Federal laws and federal government decrees identified the main principles for the future functioning of the power industry under competitive conditions. All thermal generation and regional power distribution companies were privatised before July 2008. From July 2008, the generation and transmission assets in Russia have been separated under binding regulations. Generation assets are consolidated into interregional companies of two types: seven wholesale thermal power plant generation companies (WGCs) and 14 territorial generation companies (TGCs). Six thermal WGCs are constructed according to extraterritorial principles, with one state-owned holding company, RusHydro (which controls over 53 hydropower plants). TGCs manage facilities in neighbouring regions. The initial design of the WGCs provides them with roughly equal starting conditions in the market, as far as installed capacity, asset value and average equipment are concerned. Each WGC has power plants sited in different regions of the Russian Federation, to prevent possible monopoly abuse.

Backbone transmission lines are assigned to the Federal Grid Company, while distribution grids are owned and operated by 11 interregional distribution grid companies. The Federal Antimonopoly Service is in charge of monitoring the long-distance power transportation market, in which the threshold is less than 20% of transmission line capacity per company. The wholesale power market infrastructure includes the following organisations:

- Non-profit Partnership Administrator of Trading System
- System Operator—Central Dispatch Administration of the Unified Energy System
- Federal Grid Company of the Unified Energy System.

The Non-commercial Partnership Administrator of Trading System of the Wholesale Power Market (NP ATS) was established in November 2001. The main purposes of NP ATS are to organise trade and arrange financial payments in the wholesale electricity and power markets, to increase the efficiency of power generation and consumption, and to protect the interests of both buyers and suppliers. NP ATS provides infrastructure services (which are related to the organisation of trade) to the wholesale power market, ensuring the execution and closing of transactions and the fulfilment of mutual obligations. The System Operator (with 100% state ownership) exercises technological control within the power grids and provides dispatching services to wholesale market participants. The Federal Grid Company (established in 2002, with 77.7% state control) owns and operates the transmission lines, provides the consistency of technological management and is responsible for the reliability of power transmission services.

In monetary terms, the market shares needed to maintain the system's power reliability are 48% of electricity sales, 47% of power sales, and 5% of services sales.

The free electricity trading 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 contracts to be concluded between the buyers and sellers of electricity and electric power. The day-ahead market covers all power produced and consumed, except that covered by regulated contracts. In April 2007, the federal government specified a schedule for further reductions of electricity traded under regulated contracts:

Second half of 2007—90% (of total consumption)	First half of 2008—85%
Second half of 2008—75%	First half of 2009—70%
Second half of 2009—50%	First half of 2010—40%

Second half of 2010—20%	January 2011—0% (no regulated tariffs, except for residential consumers)

From January 2011, regulated tariffs will be eliminated (excluding tariffs for residential supply on a contract basis) and all electricity will be sold at competitive prices in wholesale and distribution electricity markets. A total of 50 generation companies and 203 distribution companies and large consumers had joined the electricity wholesale trading system by November 2010. The supply contracts in the distribution market are compulsory for sellers—they should be at least three years long and the contracted volume should not exceed 35% of the supplier's total electricity output. To avoid a lack of supply to residential consumers, 'guarantor suppliers' (suppliers of last resort) were introduced. These suppliers cannot deny any application for a supply contract provided by consumers.

In the FOREM, power generators and importers sell electricity and power to guarantor suppliers and distribution companies, as well as to large consumers and exporters. In the distribution market, guarantor suppliers and distribution companies sell electricity and power to end-use consumers in the residential, commercial and industrial sectors.

Since 2008, the share of tariffs established by the regulatory asset base (RAB) methodology for distribution grids has been increasing. It is expected to become the major method for calculating middle-term tariffs. The methodology is regarded as transparent and provides incentives for investors to rehabilitate and improve the operations of the energy service companies.

Heat supply

Residential and commercial heat supplies have important social implications and are a major concern for local governments in Russia. Historically, the heat supply industry was subsidised by local budgets and thus has room for a lot of efficiency improvements. The law On Heat Supply was introduced in July 2010 to create investment opportunities, to minimise energy losses (and subsidies), and to provide business incentives. A transparent market for heat supply will provide additional incentives to develop CHP (combined heat and power) facilities as a primary option for generators. The use of registration equipment will be compulsory for new buildings. The industry's restructuring will be a cornerstone for energy conservation activities and provide enormous business opportunities for both domestic and international businesses (see Notable Energy Development section).

Nuclear

Russia's nuclear industry restructuring started in 2001, when the state-owned company Rosatom took over all civil reactors (including those under construction) and their related infrastructure. In February 2007, a new law On Nuclear Industry was adopted. It provided a legal framework for industry restructuring by separating military and civil facilities, and by introducing regulations for nuclear materials management. Russian business entities are now allowed to hold civil-grade nuclear materials, but those materials are still under state control.

In April 2007, a single vertically-integrated, state-owned nuclear energy company was established. The new corporation—AtomEnergoProm (AEP)—includes uranium production, engineering, design, reactor construction, power generation and research facilities. AEP holds a significant share of the world's enriched uranium and nuclear fuel supply, has 24 GW of existing Russian nuclear energy plants, and manages the construction of 14 reactors. There are seven reactors under construction in Russia (including one floating-type unit to power remote areas), and seven reactors in four Asian and European countries. AEP provides the full production cycle of nuclear energy engineering, from uranium extraction to nuclear fuel services to nuclear energy plant construction and electricity production. The company has up to 16% of the world's market for new nuclear energy plant construction, and is affiliated with Tenex (40% share of the world's uranium enrichment services market), TVEL (17% share of the world's nuclear fuel market), and Atomredmetzoloto (9% share of the world's uranium mining).

TRANSPORT

Russia's original schedule for implementing fuel standards was delayed by two years, as the federal government amended the schedule ahead of the deadline for the introduction of the Euro-3 standard in July 2009. The Euro-3 standards will be mandatory from January 2011, while the Euro-5 standards will be implemented from January 2015.

Strong attention is paid to alternative motor fuels, particularly to LPG and compressed natural gas. Alternative motor fuels are seen as an environmentally compatible and economically viable option for government and public transportation, and their use is consistent with the recently-adopted law On Energy Saving and Energy Intensity. Such alternative fuels currently have a 3% share of the total motor fuel consumption in Russia.

FISCAL REGIME AND INVESTMENT

In 2007, dozens of oilfields and gas fields were decreed to be 'strategic' fields. Strategic status makes the hydrocarbon deposits inaccessible to foreign companies unless they establish joint project operations with Russian companies. Under the current regulations, strategic status is applied to oilfields with reserves larger than 70 Mt and gas fields with reserves larger than 50 bcm. In March 2009, regulations were adopted for the compensation of costs associated with the discovery and exploration of deposits under exploration licences, the further development of which is prohibited due to their strategic status.

From January 2009, tax holidays from the mineral extraction tax for crude oil production in East Siberia were extended to areas north of the Arctic Circle, the Azov Sea, the Caspian Sea, and the Nenetsk and Yamal regions. In addition to the existing tax reductions for East Siberian oil, this creates favourable conditions for the development of new capital-expensive projects in remote areas that lack an energy infrastructure. From 1 January 2010, zero export duty was introduced for crude oil extracted from East Siberia oilfields to maintain a stable market for Russian crude exported eastward to the Asia–Pacific region.

A draft plan for a new tax regime will be prepared in 2011 as a part of the development of the new law On Oil. It is expected the new tax regime will include the move from revenue-based to profit-based taxes, an excess-profits tax and equalised export duties for light and heavy refined petroleum products. These changes could reduce the tax burden on producers from 73% in 2010 to about 65% after their implementation and should encourage investments in new oilfield developments.

To facilitate coal exports, rare subsidies to the coal industry are provided under the railway's cargo tariff regulations for some export routes.

ENERGY EFFICIENCY

The energy intensity of the Russian economy is considerably higher than that of most developed economies. With the introduction of effective energy efficiency (EE) measures, it is estimated the energy savings from the improvement of Russia's energy intensity could exceed 300 Mtoe, including more than 160 Mtoe from the energy extraction, transformation and transportation industries only.

EE has become a critical factor in the government's energy policy since 2008, when a Presidential decree set a target to reduce the energy intensity of Russia's GDP by 40% in 2020, compared with 2005. The improvement of EE and energy savings has become one of the priority areas of the Energy Strategy to 2030.

On 23 November 2009, the federal government adopted a law On Energy Conservation and Increase of Energy Efficiency, to take effect from 1 August 2010. To supplement and make the new EE law more effective, about 40 sub-laws amending some existing laws and technical regulations are being drafted. The new federal law sets a legal framework and targets for the use of energy resources in Russia by promoting the rational use of energy resources and alternative fuel resources for electricity and heat generation. The law introduces various measures to

improve EE and energy conservation across all sectors of the Russian economy. These measures include EE standards for equipment and buildings (including mandatory energy passports, EE labelling of goods and the compulsory commercial inventory of energy resources); improvements in EE monitoring (focusing on mandatory energy audits and the compulsory installation of metering systems); creating a single and unified interagency information network and analytical EE system; and other measures to help achieve energy savings (promoting energy service contracts, prohibiting incandescent light bulbs, introducing incentives and tax benefits for Russia's heavy industries to replace highly energy-inefficient machinery and equipment, and so on).

In addition to the new federal law, on 21 January 2011 the federal government adopted the Federal Targeted Program On Energy Saving and Energy Efficiency Improvement to 2020 (the FTP).

The FTP will be carried out in two stages—from 2010–15 and from 2016–20. The energy intensity of Russia's economy will be expected to decline by at least 7.4% (by 2015) and 13.5% (by 2020). In addition, the program outlines measures to achieve the federal target of an at least 40% decrease in the economy's energy intensity by 2020, compared to 2007, through the rational use of energy resources and other measures to encourage EE and energy conservation. These measures include the enhancement and coordination of federal, regional and municipal energy efficiency and energy saving programs; the establishment of information dissemination, public awareness and the promotion of education initiatives; the introduction of financial measures to promote the efficient use of energy; and a 4.5% target for the share of renewable energy in power generation by 2020.

In accordance with the EE federal law and the FTP, all regions are required to prepare their respective regional programs on energy efficiency improvements. The implementation of these programs will be financed jointly by regional governments and the federal government.

On 22 December 2009, the government established the Federal Energy Agency within the Ministry of Energy. The Federal Energy Agency has 70 regional branches. Its key tasks focus on operating the federal EE and energy saving information system; and administering, monitoring, and coordinating efforts for the effective implementation of the EE law, the FTP, and other measures for improving EE and energy conservation efforts in the budgetary, power generation, industrial, and residential sectors of Russia's economy.

In addition to the above-mentioned measures and policies for strengthening the EE legal framework, the federal government has launched the following six pilot Presidential energy efficient projects in several regions:

- metering (installing metering devices and automation)
- EE in budget sector (piloting energy performance contracting in schools and public buildings)
- energy efficient district (targeting the residential sector)
- energy efficient lighting (replacing street lighting and other measures)
- small-scale cogeneration
- new energy sources (renewable and other non-carbon energy resources).

Upon their successful completion, these projects are expected to be applied across all regions.

The technical potential exists to save almost half of Russia's primary energy demand through energy conservation. A major impediment for businesses to improve their energy efficiency has been the absence of appropriate financial mechanisms in Russia. The regulatory framework described in the FTP On Energy Saving and Energy Efficiency Improvement adopted in January 2011 estimates total investments into energy efficiency up to 2020 will be approximately RUB 9.3 trillion (USD 320 billion), with 8% coming from governments, and 92% from private investments. The economic effect of such investments in 20 years (up to 2030) is expected to exceed RUB 26.5 trillion (over USD 880 billion). Governments at different levels will provide more than USD 10 billion in guarantees on loans for businesses involved in activities to improve energy efficiency in either the industrial, residential or commercial sectors.

RENEWABLE ENERGY

The technical potential for renewable energy in Russia is estimated at 3200 Mtoe per year, or almost eight times more than Russia's current total final energy consumption. However, the economic potential is much smaller, leaving only less than 1% for renewable electricity production. In 2010, renewable energy capacity (for hydro, less than 25 MW) totalled 2200 MW.

The government's policy goals and mechanisms to promote renewable energy were introduced in January 2009 through the federal government's order, The Basic Directions of a State Policy of Renewable Energy Utilisation to 2020. Renewable energy is expected to provide 2.5% of electricity in Russia in 2015, and 4.5% in 2020. The major mechanisms to increase the share of renewables are feed-in tariffs and subsidies for grid connection. The government is expected to develop regulations for feed-in tariffs and grid connection subsidies, for the compulsory share of renewable energy in the wholesale market to be purchased by electricity consumers, and for tying-up renewable energy generators, transmission lines, and guarantor suppliers of energy.

In October 2010, the government published the ruling for federal subsidies for renewable energy generators connection to the power grid, to encourage 'green' energy production in Russia. Conditions of the ruling include the nominal capacity of renewable energy generators should not exceed 25 MW, and owners should not be under bankruptcy proceedings. The ruling paves the way for financial mechanisms for renewable energy.

NUCLEAR

The Russian Federation holds important stakes in the international nuclear fuel market. All of the Russian, Commonwealth Independent States and Eastern European nuclear reactors are supplied by Tenex—the state company responsible for the nuclear fuel cycle business. In addition, Tenex meets 40% of the United States', 23% of Western Europe's, and 16% of the Asia–Pacific region's nuclear fuel requirements.

In the Global Nuclear Infrastructure Initiative announced by Russia in early 2006, Russia proposed to host several types of international nuclear fuel cycle service centres as joint ventures with other economies. The centres will be strictly controlled by the International Atomic Energy Agency (IAEA). Their most important roles will be uranium enrichment, reprocessing and the storage of used nuclear fuel, along with standardisation, uniform safeguard practices, training and certification, and research and development.

In 2007, the International Uranium Enrichment Centre (IUEC) was established in Angarsk, Siberia, as a joint venture between Russia and Kazakhstan, but open to other interested parties. Ukraine joined the IUEC in 2010. The IUEC's objective is to provide low-enriched uranium (LEU) to those economies interested in nuclear energy development and ready to comply with the IAEA's non-proliferation regulations. The existing enrichment plant in Angarsk will be used to serve the IUEC.

In February 2007, the IUEC was certified by the IAEA for international operations. A program for the IUEC's expansion at Angarsk to 2015 was developed. The program includes three phases:

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

Russia also announced that guaranteed reserves of low-enriched uranium hexafluoride (equivalent to two 1000 MW reactors loads) will be created at the IUEC as a fuel bank available under the IAEA's control. The first phase of the capacity enhancement is scheduled for 2011, when 1 million separation work units (SWUs) are expected to be commissioned. A target of 5 million SWUs is expected to be achieved in 2017 under the project.

In November 2009, the IAEA's Board of Governors adopted a resolution supporting a Russian initiative to establish and maintain in Russia a stock of LEU, and to carry LEU supplies for the IAEA member states. This was a breakthrough in the establishment of an international system guaranteeing reliable nuclear energy plant fuel supplies and lowering the risks of proliferation of sensitive nuclear technologies. It is suggested the stock will be managed by the IUEC and transferred under contract from the IUEC to the IAEA when an appropriate supply request arrives from the IAEA.

One major concern for world energy development is nuclear safety. Russia has adopted the 'closed' fuel cycle, which includes spent nuclear fuel processing and the mandatory return of fissionable nuclear materials to the fuel cycle. To provide the legal framework for managing spent nuclear fuel and radioactive wastes, the laws On Environmental Protection and On Use of Nuclear Energy were amended in June 2010. Since 2007, expired contracts for depleted uranium hexafluoride enrichment/conversion are not being extended, and no such new contracts were signed as at the beginning of 2010.

Rosatom's long-term strategy up to 2050 involves moving to inherently safe nuclear energy plants using fast reactors with a closed fuel cycle and MOX (mixed oxide) fuel. Starting from 2020–25, fast neutron reactors will play an increasing role in Russia. The improved design will lead to an extended operating life—up to 60 years, a shorter construction period—up to 40–46 months, and operating costs at less than RUB 1 per kWh. The prospects for future international cooperation in the nuclear energy industry are promising; the construction of 35 reactors in 15 economies is in the pipeline, and contracts have been signed for 19 reactors in seven economies.

For the next 20–25 years, three core reactor technologies have been chosen for nuclear energy development in Russia:

- Water reactors VVER type and their modifications and advanced developments
- Sodium fast neutron reactors
- High-temperature helium reactors.

CLIMATE CHANGE

In November 2004, Russia ratified the Kyoto Protocol. That decision confirmed Russia's strong commitment to addressing climate change and to working with the international community on dealing with this global problem. Ratification by the Russian Federation satisfied the '55%' clause and brought the Kyoto Protocol into force, effective from 16 February 2005.

Russia is considered to be the world's largest potential host for 'joint implementation' projects under the Kyoto Protocol. In May 2007, procedures for the approval and verification of Russia-based joint implementation GHG (greenhouse gas) reduction projects were adopted. Responsibilities were assigned for setting up and keeping the Registry of Carbon Units, thus paving the way for the implementation of GHG mitigation projects in Russia.

At the Conference of Parties 15 (COP15) in December 2009, Russia pledged to reduce its GHG emissions by 25% from 1990 levels, by 2020, a figure comparable to the targets of the European Union member states; and by 50% from 1990 levels, by 2050. These emission reductions are contingent on the conditions that appropriate accounting of the contribution of emissions reductions from Russia's forestry activities will be introduced, and all major emitters will undertake legally-binding obligations to reduce greenhouse gas emissions caused by human activities.

NOTABLE ENERGY DEVELOPMENTS

ENERGY EFFICIENCY IMPROVEMENT

THE LAW ON HEAT SUPPLY CAME INTO FORCE

The law On Heat Supply came into force in July 2010. Its importance for industry restructuring in Russia is enormous given the scale and social sensitivity of the heat supply and its corresponding infrastructure issues. The law provides guidelines for developing a secure service while making related business activities profitable—the major principles of the establishing framework. The inclusive list of regulated activities and the cost-based approach for tariff regulation are described. These will eventually rehabilitate industry, increase the transparency of tariff calculations and put an end to subsidies for the residential sector. The law supports the development of cogeneration facilities as the most effective way to increase energy efficiency, improve supply security, and minimise the environmental impact of energy services to consumers. The law also stipulates the importance of long-term technological schemes for heat supply at municipality levels and puts the deadline for establishing such schemes and their approval by local governments by the end of 2011.

THE PROGRAMME ON ENERGY SAVING AND ENERGY EFFICIENCY IMPROVEMENT UP TO YEAR 2020

This program relies on voluntary agreements between businesses and governments to reduce energy intensity. In return the federal government will guarantee financial institutions to reduce investment risks. Local governments are expected to develop their own programs; the federal government has pledged to financially support initiatives and to reserve RUB 16.8 billion (USD 540 million) for these commitments over the next three years. The preferred sectors are heat supply—the rehabilitation of cogeneration equipment, the construction of advanced heat supply and transportation facilities; the refurbishment of water supply and sewage systems; the replacement of 95% of street lighting; and the switch to advanced and energy saving technologies for railroads, and oil and gas pipelines. A total of eight sub-programs are included under the federal program's umbrella, and they are expected to reduce consumer bills for energy supply by RUB 11.7 trillion (USD 380 billion) up to 2020.

The Inter-regional Distribution Grid Company for Siberia has finalised its campaign for the extensive rehabilitation of its 0.4–10 KV distribution lines, by replacing 5% of their pylons in three years. After that, the usual annual replacement rate of 0.5% of pylons is expected.

Gazprom has adopted the FTP On Energy Saving and Energy Efficiency Improvement to 2020, which should lead to a 1.2% annual decline of energy consumption by this giant energy company up to 2020. Gazprom's current energy demand for natural gas extraction, processing, and transportation is close to 10% of the extracted energy. The major share of improvements will come from measures related to its pipeline operations (estimations are up to 85%).

POWER MARKET DEVELOPMENT

MIDDLE-TERM POWER CAPACITY MARKET UNDER ESTABLISHMENT

The regulation of power capacity in the wholesale market came into force in 2010. In November 2010, the campaign to sign contracts on long-term capacity deliveries was finalised with generators and the Centre of Financial Settle up within Power and Electricity Wholesale Market. Generators are bound to build and commission 25 GW of new power generation facilities within the next five years. This type of contract is an essential part of the long-term power market development. It puts in place transparency requirements for new capacity construction and realises one of the objectives of the power industry restructuring—improving accountability on investment commitments to build and/or upgrade generating facilities. The next stage of the market development will be a campaign to sign long-term capacity deliveries contracts between the Centre of Financial Settle up and power consumers. A proposed legal

framework will guarantee commitments issued in 2007–09 and inherited by IPO (initial public offering) buyers of the generation companies. The new rules on the wholesale power market introduce long-term price signals, which guarantee generators non-loss sales at least, and significant profits in the case of lower costs and higher efficiency in power generation.

The average price for territorial generation companies power capacity is estimated at RUB 833 thousand per MW·month, and for WGC power capacity at RUB 722 per MW·month (USD 27 770 per MW·month and USD 24 060 per MW·month, respectively).

From January 2010, the Federal Grid Company's (the operator of transmission lines in Russia) tariff is determined on the basis of a costs economic feasibility (the 'cost plus' method). It means the electricity transmission tariff covers grid maintenance costs incurred by the company, as well as compensation for electricity losses during transmission over the network.

The law On Power Industry has been amended to determine special cases when state regulations should be implemented (e.g. the lack of competitiveness in market segments).

The first investment project under the power capacity deliveries contracts framework was successfully finalised at the Ryazanskaya Power Plant. Russia's first ever conversion of a steam turbine to a combine cycle gas turbine facility will improve the plant's efficiency to 44% from 38% pre-conversion, and increase its power generation capacity by 35%.

OIL AND GAS DEVELOPMENT

- The first stage of the TANEKO refining and petrochemical project was commissioned in Tataria, Volga region. The project's objectives are to boost the processing of sour and heavy types of local crude from 7 Mt per year to 14 Mt per year, to increase light petroleum products output, and to improve petroleum products quality to Euro-5 standards. It is expected Ural crude oil—Russia's benchmark crude used in the European market—will improve in quality and decrease in volatility.
- The first oil from the Russian sector of the Caspian Sea was delivered from the offshore Korchagina oilfield. The production capacity is 2.5 Mt of crude oil and 1 bcm of natural gas.
- The St. Petersburg International Mercantile Exchange (SPIMEX) became the first institution to create a petroleum products spot market in Russia. More than 7% of domestically consumed petroleum products were traded in 2010. Petroleum futures trading began at SPIMEX in September 2010.
- The technological scheme for the development of the giant Chayanda gas fields in Yakutia was approved in September 2010. The output of 25 bcm per year is expected to feed Russia's Far East region and the export gas pipeline to north China.
- The design project to increase the capacity of the ESPO (East Siberia–Pacific Ocean) oil pipeline to 50 Mt per year was finalised, with a goal to reach 80 Mt per year in 2014.
- The ESPO phase two pipeline (the extension from Scovorodino to the destination point on the Pacific coast, Kozmino Harbour) is under construction; 48% of the pipes are already in place, and the construction rate has reached 5 km per day.
- The oil pipeline from Scovorodino (the final destination point of the ESPO phase one pipeline) and the connector to China under the Amur River bed was constructed. The direct deliveries of Russian crude oil to China started in November 2010, two months ahead of the original schedule.
- A new export capacity to handle 4 Mt of LPG and light petroleum products was commissioned at Ust-Luga, the Baltic Sea harbour and destination point for the BTS-2 export oil pipeline.
- The first offshore stationary oil platform capable of operating in a pack ice environment under –50 degrees centigrade at the Prirazlomnoye offshore oil field in the Arctic Pechora Sea (south-east of Barents Sea) was transferred to Murmansk to finalise its construction. The GazpromNeftShelf company, the field operator and the platform owner, is scheduling a start to oil production in the fourth quarter of 2011. The platform is designed to operate year round in the harsh Arctic sea environment.

- In April 2010, the first offshore crude oil production in the Russian sector of the Caspian Sea began when the Lukoil company commissioned facilities at the Korchagina field.
- The 200th LNG shipment was made from Sakhalin-2 in October 2010. The nameplate capacity of LNG production (9.6 Mt per year) was exceeded in July 2010. Sakhalin-2 is the world's largest offshore oil and gas production project.
- The gas pipeline from onshore gas fields to the capital of Kamchatka Kray started operations in September 2010, improving the energy supply security of this remote region in Russia's Far East.
- The coal bed methane (CBM) project started operations in the West Siberian coal region of Kuzbass. This marks the beginning of unconventional natural gas reserves tapping in Russia. Production should reach 4 bcm, while long-term projections of up to 18 bcm exist for consumers in the South Siberian regions.
- An Aframax-sized cargo of gas condensate makes a route along Arctic shores from Murmansk at Barents Sea to Ningbo at East Yellow Sea in 22 days, which is twice as fast as travelling the traditional Suez route from Europe to East Asia.
- The construction of the Sakhalin–Vladivostok gas pipeline continues. The pipeline will take Sakhalin's offshore natural gas to the non-frozen harbour in Vladivostok in the south of Russia's Far East region for both domestic consumption and deliveries to China, Korea, Japan, Mexico, and other Asia–Pacific region consumers.
- Gazprom and the independent gas producer Novatek reached an agreement in June 2010 to develop the Yuzhno-Tambeyskoye gas field on the Yamal peninsula in the Arctic and to deliver LNG to the Atlantic and Pacific international markets. The export-oriented 15+ Mt facility is scheduled to start construction in 2012, and to start LNG deliveries in 2016. The project will use its arbitraging position in both the Atlantic and Pacific LNG markets.
- GDF Suez became the fifth and last stakeholder in the North Stream undersea gas pipeline consortium, joining Gazprom, Germany's Wintershall and Eon, and the Netherland's Gasunie after the political and environmental objections of Baltic and Scandinavian states were successfully settled. The first delivery over the 1224 km undersea pipeline is scheduled at the end of 2011. More than 50% of the pipeline is completed.

NUCLEAR AND RENEWABLE ENERGY DEVELOPMENT

- The state-owned nuclear energy company, AtomEnergoProm, finalised the program to increase its operational capacities for VVER 100 reactors by 4%. Since 2008, the program has added 2 GW of new capacity at low cost (USD 200–900 per kW, by various estimations). A new program is under development to increase its operational capacities to 110% of nominal nameplate capacity.
- The state nuclear energy corporation, Rosatom, published a voluntary report on its 2009 activities. The report summarises the last five years of nuclear energy industry development in Russia, and is the first example of voluntary public reporting of state corporations in Russia.
- In January 2010, the Bratsk hydropower plant produced its first one trillion kWh of electricity since September 1967.
- The Russian Federation and the IAEA reached an agreement in March 2010 to set up a guaranteed reserve of 120 tonnes of LEU in Russia and to supply IAEA's member states with LEU from the reserve. The purpose of the agreement is to create the mechanism of guaranteed supply, available to all economies that strictly follow the principle of the non-proliferation of nuclear weapons. The cost of the LEU guaranteed reserve realisation is estimated on the basis of the spot market quotes of internationally-recognised companies; the quotes are averaged over the period which precedes the request of a potential customer. In May 2010, the IAEA notified Rosatom that, starting on 1 July 2010, the agency defines the LEU storage facility of the IUEC as being subject to the IAEA's safeguards.

- The world's first floating power plant was put afloat in St. Petersburg on 30 June 2010. The purpose of this facility is to provide a mobile power supply for remote areas with a lack of power grids or with power generation constraints.
- Ukraine joins the IUEC after settling payment for its 10% share holding in October 2010. Kazakhstan also has a 10% stake, while Russia is keeping the remaining shares until new stockholders join the international project.
- New generation equipment was installed at the Tomsk nuclear enrichment facilities, significantly improving the economics of the nuclear fuel cycle, improving energy efficiency and reducing the environmental impact.
- An advanced design of next-generation nuclear fuel for VVER reactors was developed to improve their reliability and economic efficiency by extending the fuel cycle and increasing energy productivity.
- The tests were completed for the BN-800 reactor body in November 2010. The reactor will be the first industrial fast neutron reactor to create a closed nuclear fuel cycle.
- The first on-grid photovoltaic power plant was commissioned in November 2010 in Belgorod Oblast, Central Russia. The nameplate capacity is 0.1 MW.
- The E4 Contractor Company is constructing the first phase of spent nuclear fuel storage, scheduled for commissioning at the end of 2010. The second stage is scheduled for completion by 2015.

ENERGY SECURITY IMPROVEMENTS

The strategic partnership in energy security between Russia and China was improved as a result of the high-level meeting of the Russian and Chinese Presidents in Beijing, in September 2010. Russia/China strategic energy cooperation was extended by the signing of several agreements and contracts. The two economies agreed on enhancements to the current projects for oil, gas, coal and electricity export to China. In addition, new mechanisms for cooperation in energy efficiency, renewable energy, and power-grid development were approved. The extension of nuclear energy technology transfer from Russia was emphasised.

In April 2010, Russia and Norway agreed on sea-shelf delimitation in the Arctic, paving the way for cooperation in the exploration and production of hydrocarbons in Russia's and Norway's sections of the Barents Sea.

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USEFUL LINKS

OFFICIAL BODIES OF THE RUSSIAN FEDERATION

Structure of the Government of the Russian Federation—http://government.ru/eng/power/

Ministry of Energy—www.minenergo.gov.ru/

Ministry of Natural Resources—www.mnr.gov.ru/

Federal Service on Ecological, Technological and Nuclear Supervision—www.gosnadzor.ru/

Ministry of the Economic Development—www.economy.gov.ru/minec/main/

Federal State Statistics Service—www.gks.ru/

Ministry of Industry and Trade—www.minprom.gov.ru/

Federal Agency on Technical Regulating and Metrology—www.gost.ru/wps/portal/pages.en.Main

Federal Antimonopoly Service—www.fas.gov.ru/

Federal Customs Service—www.customs.ru/en/

Federal Tariff Service—www.fstrf.ru/

ENERGY-RELATED NON-PROFIT AND STATE-OWNED BUSINESS INSTITUTIONS OF THE RUSSIAN FEDERATION

Non-commercial Partnership of the Wholesale Power Market—www.np-ats.ru/

Federal Power Grids—www.fsk-ees.ru/

RusHydro—www.rushydro.ru/

AtomEnergoProm—www.atomenergoprom.ru/en/

Gazprom—www.gazprom.ru/

Rosneft—www.rosneft.ru/

Transneft—www.transneft.ru/

Transnefteprodukt—www.transnefteprodukt.ru

STATE ENERGY POLICY-RELATED RESEARCH CENTRES OF THE RUSSIAN FEDERATION

Institute of Energy Strategy—www.energystrategy.ru/

Energy Research Institute of the RAS—www.eriras.ru/

Energy Systems Institute of the SB of RAS—www.sei.irk.ru/eng/index.htm

Centre for Energy Policy—www.cenef.ru/

IMPORTANT ENERGY-RELATED MEDIA OF THE RUSSIAN FEDERATION

Official newspaper, *Rossiyskaya Gazeta*—www.rg.ru/

Central Dispatching Unit of the Fuel and Energy Complex—www.riatec.ru/

SINGAPORE

INTRODUCTION

Singapore is situated in South-East Asia, south of the Malaysia Peninsula between the Strait of Malacca and the South China Sea. In 2008, Singapore had a total land area of 710.3 square kilometres and a population of 4.84 million, of which 1.2 million were non-residents. Despite its small land area and population, Singapore is one of the most highly industrialised and urbanised economies in South-East Asia.

Singapore is a highly developed and vibrant free-market economy. In 2008, its gross domestic product (GDP) declined by 4.09% from 2007 to USD 195.00 billion in 2008; per capita GDP was USD 40 294 (both in USD (2000) at PPP).

In Singapore's 2008 GDP, the service producing industry accounted for 65.8% of the overall value added, the goods producing industry accounted for 30.7%, ownership and dwellings accounted for the remaining 3.5%. In 2008, the largest subsectors of the service producing industry were the wholesale and retail trade which accounted for 16.4% of the value added, financial services 12.6%, and business services 12%. In the goods producing industry, manufacturing accounted for 80.4% of the total value added, and it is Singapore's single largest economic subsector, accounting for 24.7% of GDP.

In 2008, Singapore's exports were worth USD 476.7 billion, made up of domestic exports (51.9%) and re-exports (the remainder). Domestic exports comprised mineral fuels (36.2 %); electronics (25.5%); chemicals and chemical products (15.2%); other machinery and equipment (10.4%); and other manufactured goods, crude materials, food and beverage, and tobacco (the remainder). Most of Singapore's manufacturing output is exported.

Strategically located, Singapore is one of the world's busiest shipping ports, an important petroleum hub, a major equipment supplier for the oil and gas industry in South-East Asia, and an emerging leader in the biotechnology industry.

Table 30 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	710.3	Oil	–
Population (million)	4.84	Gas	–
GDP (USD (2000) billion at PPP)	195.00	Coal	–
GDP (USD (2000) per capita at PPP)	40 294		

Source: EDMC (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Singapore's total primary energy supply (TPES) in 2008 was 24 788 kilotonnes of oil equivalent (ktoe). Singapore almost entirely relies on energy imports to meet its domestic energy needs. In 2008, the economy imported 50 271 ktoe of crude oil and 72 760 ktoe of petroleum products. Crude oil refined in Singapore's oil refineries produced 46 871 ktoe of petroleum products, of which 66.7% was for exports and international bunkers. The combined total for petroleum product exports and international bunkers was 104 476 ktoe.

Natural gas supply grew by 3.5% in 2007–08, to 6167 ktoe (a lower rate of increase than the 5.5% in 2006–07). Oil supply increased by 4.8% in 2007–08, to 18 485 ktoe; by comparison, oil supply declined by 1.45% in 2006–07.

In 2008, 41 717 gigawatt-hours (GWh) of electricity was generated, which is a 1.4% increase over the 41 134 GWh generated in 2007.

Peak demand for electricity was 6073 megawatts (MW) in 2008 compared with 5946 MW in 2007. Singapore's power generation is based entirely on thermal power plants—using combined cycle gas turbines (52%), steam turbines (43%), open cycle gas turbines (3%), and incineration and other generating technologies (2%). Singapore has four large incinerators, with a total incinerating capacity of 2.5 million tonnes of solid waste per year. The Tuas South Incinerator Plant, with a licensed capacity of 132 MW, is one of the world's largest.

The fuel mix for power generation consists of natural gas (80.3%), fuel oil (15.2%) and other fuels (synthetic gas, diesel oil and waste) (4.5%). In 2008, power generation consumed 6167 ktoe of natural gas supplied via pipelines from Indonesia and Malaysia.

In 2008, the licensed power generation capacity was 10 453 MW. The power generation reserve margin is about 70%, well in excess of Singapore's 30% minimum reserve margin for power system security.

Table 31 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	136	Industry sector	8 423	Total	41 717
Net imports and other	59 588	Transport sector	5 494	Thermal	40 991
Total PES	24 788	Other sectors	2 212	Hydro	–
Coal	–	Total FEC	16 129	Nuclear	–
Oil	18 485	Coal	–	Geothermal	–
Gas	6 167	Oil	12 787	Other	726
Other	136	Gas	113		
		Electricity and other	3 230		

Source: EDMC (2010).

FINAL ENERGY CONSUMPTION

Singapore's total final energy consumption (TFEC) was 16 129 ktoe in 2008, an increase of 1.9% from 2007 (15 824 ktoe). In the economy's 2008 TFEC, petroleum products accounted for 79.3% of the energy used, electricity 20.1%, and natural gas 0.7%. TFEC share by sector was: industry 52.2%, transport 34.1%, and residential and commercial 13.7%.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

In 2007, the interagency Energy Policy Group, chaired by the Permanent Secretary of the Ministry of Trade and Industry, announced the economy's energy policy framework. The framework strives to maintain a balance between the policy objectives of economic competitiveness, energy security and environmental sustainability. To meet its energy policy objectives, Singapore focuses on the following key strategies (MTI 2007):

- *Strategy 1: Promote competitive markets.* Promote competitive markets to keep energy affordable and to ensure Singapore's economic competitiveness. The correction of any market failures will be made by using market-based instruments or by imposing

standards and regulations. The private sector will be encouraged to innovate and achieve energy security and the environmental outcomes 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 will have incentives to diversify and reduce their 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 enable Singapore to achieve the objectives of its energy policy, while reducing business costs, pollution and CO_2 equivalent emissions. The government has set up the Energy Efficiency Programme Office (E^2PO) and developed a comprehensive 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 the rising global and regional demand for energy. Singapore will increase its refining capacity to consolidate its status as Asia's premier oil hub, and expand its range of energy trading products to include liquefied natural gas (LNG), biofuels, and carbon emissions credits. It will also 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 forums, including the Association of Southeast Asian Nations, the Asia–Pacific Economic Cooperation, and the East Asia Summit. Singapore also participates actively in the United Nations Framework Convention on Climate Change, and in international discussions on climate change in other forums.

ENERGY SECURITY

Natural gas has become the major fuel for electricity generation in Singapore. Four offshore natural gas pipelines supply Singapore's natural gas needs. The first gas pipeline, located in the northern part of the main island, was commissioned in 1991 and supplies 150 million standard cubic feet per day (MMscf/D) of natural gas from Malaysia. Senoko Energy Ltd (formerly known as Senoko Power Ltd) imports the gas from Malaysia for use in its own power generation plant. Since January 2001, the second pipeline, from the West Natuna gas field in Indonesia has supplied 325 MMscf/D of natural gas; large customers use about 98% of the gas. Sembcorp Gas (SembGas) was the importer, transporter and retailer of gas from the West Natuna field until the new gas industry framework required it to transfer its onshore natural gas pipeline assets to PowerGas Ltd and to exit the gas transportation business. The third pipeline, from South Sumatra, Indonesia, started supplying gas to Singapore in September 2003. It supplies 350 MMscf/D of natural gas for power generation and industry use. Gas Supply Pte Ltd is the importer of the gas from South Sumatra, which is retailed by Gas Supply and City Gas. Both Gas Supply and City Gas engage the services of PowerGas Ltd for gas transportation. The fourth pipeline, from Malaysia, started operations in 2007 and supplies 110 MMscf/D of natural gas mainly for power generation. Keppel Gas Pte Ltd is the importer for the natural gas from the fourth pipeline.

With gas representing a large share of electricity production, the diversification of supply has become an important issue. This has been highlighted by a number of power outages since 2003.

In 2006, following a feasibility study done in 2005, the Singapore Government decided to import LNG. Singapore's initial plan was to have an LNG receiving terminal operating in 2013, with a capacity of 3 million tonnes (Mt) per year. The LNG terminal will be located in the south-west of Jurong Island, Singapore. Singapore has introduced controls on new natural gas imports by pipeline, to allow for the build-up of LNG demand until the capacity of 3 Mt per year is fully utilised.

PowerGas Ltd, a subsidiary of Singapore Power, was appointed the developer of the LNG terminal in 2007. However, due to the difficulty of proceeding with the project on a commercial basis, the Singapore Government announced its decision to take over the development and ownership of the Singapore LNG terminal in June 2009. With this development, the Energy Market Authority (EMA) formed the Singapore LNG Corporation Pte Ltd (SLNG) to develop, build, own and operate the LNG terminal. On 8 February 2010, SLNG awarded the contract for the engineering, procurement and construction of Singapore's first LNG terminal. It was decided to increase the design capacity of the LNG terminal to 3.5 Mt per year, with provisions to expand it to 6 Mt per year.

In April 2008, the EMA appointed the BG Singapore Gas Marketing Pte Ltd (BG) as the aggregator of LNG demand for the Singapore market with the two parties signing the Aggregator Agreement in June 2009. BG will be responsible for supplying up to 3 Mt per year of LNG for up to 20 years. Initial deliveries are expected to begin in 2013 when the LNG import terminal is completed.

ENERGY TECHNOLOGY/R&D

R&D is one of the main pillars in Singapore's Sustainable Development Blueprint for building a clean energy industry 'global hub', where clean energy solutions are developed and exported. Although the clean energy push centres on solar energy, resources are also being channelled into biofuels, wind energy, tidal wave energy, energy efficiency, and carbon services. The government has provided initial funding support of SGD 350 million for the program. By 2015, the clean energy industry is expected to contribute SGD 1.7 billion to Singapore's GDP and to create 7000 jobs (EDB 2007).

The Clean Energy Programme Office (CEPO), an interagency work group, was formed to synergise the growth of the clean energy industry. The CEPO has launched several programs, including two programs to support the solar industry in Singapore—the Solar Capability Scheme and the Clean Energy Research and Testbedding Programme. Launched in 2008, the SGD 20 million Solar Capability Scheme encourages the test bedding of clean energy solutions, as well as the innovative design and integration of solar panels into green energy buildings. Other CEPO programs include the SGD 50 million Clean Energy Research Programme, which supports R&D efforts in education and industry; the SGD 25 million National Research Foundation (Clean Energy) PhD Scholarships, which provides scholarships for research on clean energy at PhD level and, with eligible companies, funds local scholarships for clean energy research and coursework at Masters and PhD levels; and Quickstart, a repayable grant program to nurture Singapore-based cleantech start-ups.

Singapore has the most comprehensive solar research centre in Asia—the Solar Energy Research Institute of Singapore (SERIS) at the University of Singapore. SERIS will invest SGD 130 million in solar energy research (EDB Singapore 2010).

ENERGY MARKETS

ELECTRICITY

Singapore started to restructure its energy sector in 1995 with the corporatisation of the electricity and gas industries as vertically integrated companies. Notable milestones since mid-1995 have included corporatisation and industry structure reforms, the creation of an institutional regulatory framework, and market rules for the contestable parts of electricity generation and retail, separate from the natural monopoly of electricity transmission at the ownership level. The Singapore Electricity Pool was established in 1998 to facilitate the trading of electricity between generation and retail companies in a competitive environment.

In 2000, the government undertook further reforms. It separated the natural monopoly or non-contestable part of the electricity market (that is, the electricity transmission and distribution grid) from the competitive or contestable parts (that is, power generation and retail) of Singapore Power Ltd. The electricity grid—PowerGrid Ltd (now known as SP Power Assets Ltd) and Power Supply Ltd (now known as SP Services Ltd)—remained under Singapore Power Ltd; the

power generation companies Senoko Power Ltd and PowerSeraya Ltd would compete with one another and with other power generation companies in Singapore. The government also established an independent power system operator and liberalised the electricity retail market.

In April 2001, the Energy Market Authority (EMA) was formed to regulate the electricity and gas industries and to promote competition in these industries. In 2003, the National Electricity Market of Singapore (NEMS) commenced operations. In the NEMS, generation companies compete to sell electricity at every half-hourly interval to the wholesale electricity market. The liberalisation of the retail market has been implemented in phases, with plans to open up the market to full retail contestability.

The final phase of retail market liberalisation (full retail contestability) is under review. This phase covers the remaining non-contestable consumers, mainly small businesses and household consumers—more than 1 million in number—that represent 25% of total electricity sales. EMA is currently studying how best to introduce retail competition, which would leverage on smart meter technology. Currently, 10% of household electricity demand is put out to tender for the generation companies to bid on a competitive basis.

In June 2007, Temasek Holdings (Temasek) confirmed its plan to divest all three of its wholly-owned Singapore power generation companies—PowerSeraya Ltd, Senoko Power Ltd and Tuas Power over the following 12 to 18 months. The sale was made with due consideration of amendments to the Gas Act by the Singapore Parliament and the completion of a regulatory framework governing the competitive wholesale supply of gas and power. The divestment of the three generation companies was considered the next step towards the liberalisation of Singapore's electricity market.

The sale of PowerSeraya Ltd in December 2008 concluded Temasek's divestment of its three power generation companies. It marked the completion of the transition to a fully competitive power generation market in Singapore, a process which began with the restructuring of Temasek's generating assets into three independent operating companies in 1995.

GAS

The restructuring of the gas industry began when the Gas Act (Act 11 of 2001) was passed in 2001. The Gas Act sets the legal basis for the separation of the contestable part of the gas industry (that is, gas retail and gas import) from the monopolistic part (that is, gas transportation). The gas transmission and distribution network will be owned by a gas grid company that will provide market players with open and non-discriminatory access to the network.

In January 2002, PowerGas Ltd divested its contestable businesses of gas import, production and retail. The manufactured gas production and gas retail business undertaken by City Gas Ltd and the natural gas import business undertaken by Gas Supply Ltd were transferred to Temasek Holdings. With this divestment, PowerGas Ltd became a gas transporter. Under the new gas industry framework, the transportation of natural gas will be regulated.

Singapore's newly restructured gas market became operationally effective from 15 September 2008 (EMA Singapore 2008). Upon operation of the new restructured gas market, the Gas Network Code (GNC) correspondingly came into effect. The GNC was developed and enacted by the EMA in consultation with industry players. The GNC's rules govern the activities of gas transportation, providing open and non-discriminatory access to Singapore's onshore gas pipeline network. The GNC outlines the common terms and conditions between the gas transporter (PowerGas Ltd) and those industry players who engage the transporter to transport gas through the pipeline network. To ensure the gas transporter is not in commercial conflict with common interests, PowerGas Ltd is banned from participating in those parts of the electricity and gas businesses open to competition, such as gas import, trading and retailing businesses. No other gas industry participant will be allowed to transport gas.

On 15 September 2008, Sembcorp Gas, which had diversified interests in gas transportation, import and retail businesses, exited from the gas transportation business and transferred its gas pipelines to PowerGas Ltd, via a statutory transfer under section 98 of the Gas Act. The exit of Sembcorp Gas from the gas transportation business affirms PowerGas Ltd as the gas transporter

monopoly.

The restructuring of the gas market is largely to support the liberalisation of the electricity industry by providing a competitive source of natural gas for electricity generation. The government expects greater competition in the gas and electricity sectors, and the benefits of competition, such as lower prices and a wider choice of retailer, to be passed through to consumers.

TRANSPORT

In the interests of fuel efficiency and conservation, Singapore promotes the use of public transport and has innovative policies to discourage car ownership and usage, such as a vehicle quota system and electronic road pricing. Since 2001, the government has offered a green vehicle rebate to encourage the take-up of green vehicles such as hybrid, compressed natural gas and electric cars. In January 2006, the rebate was increased from 20% of the open market value to 40% of the open market value, to offset the additional registration fee.

In 2009, a multi-agency electric vehicle (EV) task force led by the Singapore Energy Market Authority (EMA) and the Land Transport Authority (LTA) embarked on the EV test-bed project to assess the benefits and applicability of EVs in Singapore. The project will involve interested industry players to test bed, identify and develop the EV industry in Singapore. Participating companies can register their EVs under the Transport Technology Innovation and Development Scheme, jointly administered by the LTA and the Economic Development Board. The EV task force will roll out a small network of EV charging stations (EMA Singapore 2009).

The EV test-bed project is expected to run for three years, between 2010 and 2012. In 2010, the EV task force appointed a company to design, develop, deploy, operate and maintain the initial phase of Singapore's EV charging infrastructure for the test-bed program. The company will deploy 25 normal charging stations (full charge within 8 hours) and one quick charging station (full charge within 45 minutes). This does not restrict other players from setting up EV charging stations on a commercial basis. The EV test-bed project is expected to also serve as a platform for companies to experiment and adapt innovative solutions for use in other economies (LTA 2010).

ENERGY EFFICIENCY

In 2007, the E²PO (Energy Efficiency Programme Office) launched E² Singapore–Energy Efficiency Master Plan. The E² Singapore Programme has four key thrusts:

- To support the adoption of energy efficient technologies and measures
- To raise awareness to stimulate energy efficient behaviour
- To develop capability to drive and sustain energy efficiency
- To support energy efficiency research and development (R&D).

The program applies to power generation, industry, transport, buildings and households.

POWER GENERATION

The implementation of a competitive electricity market has enabled greater efficiency to be achieved in the power generation sector. Singapore's overall power generation efficiency improved from 38% to 44% over the 2000–06 period. This efficiency improvement was driven mainly by a move in the power generation mix from oil-based thermal plants to combined cycle gas turbines. The E²PO expects further improvements in Singapore's generating efficiency in the future, and it is promoting cogeneration and tri-generation in the economy.

INDUSTRY

Energy efficiency measures for industry include:

- *The Energy Efficiency Improvement Assistance Scheme (EASe).* A program to encourage and help companies identify potential energy efficiency improvement opportunities.

Under EASe, the National Environmental Agency (NEA) co-funds up to 50% of the cost of appraisals for buildings and individual facilities.

- *The Investment Allowance Tax Scheme.* A program to encourage companies to invest in energy efficient equipment. The Economic Development Board administers the Investment Allowance Tax Scheme, which is a capital allowance on qualifying equipment costs that allows a deduction against chargeable income.
- *Design for Efficiency Scheme (DfE).* A program to help companies incorporate efficiency considerations during the conceptual design phase of a new facility.
- *The Grant for Energy Efficiency Technologies (GREET).* A scheme to help companies to offset part of the cost of implementing energy efficiency measures.

TRANSPORT

Singapore's land transport strategies are characterised by integrating transport and land-use planning, promoting the greater use of public transport and applying intelligent transport systems to manage the road use. In addition, the Singapore Government has pioneered innovative policies such as a vehicle quota system and electronic road pricing to reduce congestion, a green vehicle rebate to encourage more fuel-efficient vehicles, and trial of green technologies such as diesel hybrid buses and electric vehicles.

BUILDINGS

Sustainable development remains a key national priority for Singapore. Energy efficiency is one of the main considerations for achieving a sustainable built environment. To realise this vision, the Building and Construction Authority (BCA) and the National Environmental Agency (NEA) set out to accelerate the adoption of environmentally-friendly green building technologies and building design practices, and to encourage energy efficiency in buildings. Energy efficiency initiatives include:

- *EASe for buildings.* The EASe scheme is available to building owners and operators.
- *BCA Green Mark Scheme.* The BCA Green Mark Scheme was launched in January 2005. This green building rating system promotes the adoption of green building design and technologies that improve energy efficiency and reduce the impact of buildings on the environment. Under the BCA Green Mark Scheme, buildings are assessed for energy, water efficiency, indoor environmental quality and environmental protection. In April 2008, the Building Control (Environmental Sustainability) Regulations 2008 took effect, requiring new buildings and existing ones undergoing major retrofitting with a gross floor area greater than 2000 m^2 to achieve the minimum Green Mark Certified level.
- *Green Mark Incentive Scheme for New Buildings (GMIS-NB).* A sum of SGD 20 million was set aside for the Green Mark Incentive Scheme for New Buildings (GMIS-NB) on 15 December 2006 for a period of three years. The scheme offers cash incentives to developers, building owners, project architects and engineers who make efforts to achieve at least a BCA Green Mark Gold rating or higher in the design and construction of new buildings. The fund is fully committed.
- *Green Mark Incentive Scheme for Existing Buildings (GMIS-EB).* A sum of SGD 100 million was set aside for the Green Mark Incentive Scheme for Existing Buildings (GMIS-EB) on 24 April 2009 for a period of five years. The GMIS-EB provides a 'cash incentive for upgrading and retrofitting' scheme that co-funds up to 35% (capped at SGD 1.5 million) of the costs of energy efficient equipment installed to improve the energy efficiency of existing buildings. In addition, the GMIS-EB includes a 'health check' scheme; this is an energy audit which determines the efficiency of the air-conditioning plants. BCA co-funds 50% of the cost for conducting this health check; the remaining 50% is borne by the building owner.
- *The Design Prototype (GMIS-DP).* A sum of SGD 5 million was set aside for the GMIS-DP on 1 December 2010 for a period of four years. GMIS-DP aims to

encourage developers and building owners to strive for greater energy efficiency in buildings by placing more emphasis on it at the design stage. The scheme provides funding support for the engagement of Environmentally Sustainable Design (ESD) consultants to conduct collaborative design workshops and to help in simulation studies early in the project to achieve an optimal design for green buildings.

- *Higher Green Mark Standards for Land Sales Conditions at Strategic Growth Areas.* To achieve higher Green Mark standards (i.e. Green Mark Platinum or Green Mark Gold^{Plus}) for projects developed on government sales sites, the higher Green Mark standards will be set as land sales conditions for all new developments in selected new strategic growth areas. This will ensure these land sales projects are truly green, high quality and distinctive. The aim is to accelerate the adoption of environmentally-friendly green building technologies and building design practices to enable the development of more economically-viable green buildings in the future.
- *Public sector taking the lead.* The public sector is taking the lead in moving toward environmental sustainability for its buildings. It aims to demonstrate the associated environmental and economic benefits and set an example for the private sector. New public sector buildings and existing public sector buildings undergoing major retrofitting works with air-conditioned area of more than 5 000m^2 would need to attain Green Mark Platinum rating, and existing public sector buildings with air-conditioned area of more than 10 000m^2 needing to attain Green Mark Gold^{Plus} rating by 2020.

HOUSEHOLDS

Households account for about a sixth 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. Programs for households include:

- *Mandatory Energy Labelling Scheme (MELS).* From 2008, household refrigerators and air conditioners sold in Singapore must be affixed with an energy label under the MELS. Minimum energy performance standards (MEPS) will be introduced for household air conditioners and refrigerators in the second half of 2011.
- *Reducing standby power consumption.* The NEA has been encouraging households to switch off the standby power when appliances are not in use.
- *Residential Envelope Transmittance Value standard.* From 2008, residential buildings with a gross floor area of 2000 m^2 must comply with the BCA Residential Envelope Transmittance Value standard.

RENEWABLE ENERGY

As part of its strategy to meet its energy policy objectives, the Singapore Government is keen to pursue growth opportunities in clean and renewable energy, including biofuels and solar energy. Several renewable energy initiatives are underway to deal with the economy's energy challenges.

- Singapore's modern, electricity-generating incineration plants make large-scale use of renewable energy, annually consuming 2.5 million tonnes of biomass and wastes.
- Singapore expects its biodiesel production to exceed 1 million tonnes per year in 2010, and to reach 3 million tonnes by 2015. Most of the existing and planned facilities are set up to use palm oil, soya oil, and small amounts of used cooking oil.
- The government's main focus on renewable energy is solar power. Singapore expects to become the leader in developing solar photovoltaic technology. Among the investors in the technology is Renewable Energy Corporation (REC) ASA of Norway, which has invested EUR 3 billion in building a world-scale solar manufacturing complex in Singapore. The plant will have an integrated and highly

automated production line to produce wafers, solar cells and modules. The project is expected to attract other solar activities to Singapore.

The REC facility in Tuas, Singapore, was inaugurated in November 2010. The facility uses multi crystalline silicon technology. Wafer production capacity is 740 MW; cell production capacity is 550 MW from eight production lines; and module production capacity is 590 MW from four production lines. Full production capacity is expected by 2012.

In July 2010, REC won the tender bid to supply 1 MW photovoltaic residential roof top solar power systems for Singapore's Housing Development Board (HDB) homes in six precincts (REC 2010). HDB currently has a SGD 31 million solar test-bed program that involves solar capability trials in 30 HDB precincts (EDB 2010).

NUCLEAR

Singapore currently does not have a nuclear energy industry. However, in March 2010, the Senior Minister of State for Trade and Industry announced that the Singapore Government will embark on a feasibility study of nuclear energy, to objectively evaluate the opportunities and challenges involved with nuclear energy.

CLIMATE CHANGE

In April 2009, the Inter-Ministerial Committee on Sustainable Development launched Singapore's Sustainable Development Blueprint—A Lively and Liveable Singapore: Strategies for Sustainable Growth. The blueprint aims to bring about changes that would shape Singapore into a sustainable city-state.

The blueprint employs a four-pronged strategy to achieve the vision for Singapore as a sustainable city. This includes boosting resource efficiency, enhancing the urban environment, building capacities, and fostering community action. The blueprint has a 20-year timeframe, with identified key goals for 2030 and intermediate goals for 2020. The blueprint's goal for the energy sector is to reduce energy intensity (consumption per dollar GDP) by 20% from 2005 levels by 2020 and by 35% from 2005 levels by 2030.

NOTABLE ENERGY DEVELOPMENTS

SUSTAINABLE DEVELOPMENT BLUEPRINT

Singapore's Sustainable Development (SD) Blueprint was unveiled on 27 April 2009 by the Inter-Ministerial Committee on Sustainable Development (IMCSD). The SD Blueprint contains strategies and initiatives for achieving both economic growth and a good living environment for Singapore over the next 20 years.

It details new targets and initiatives to improve resource efficiency and to enhance Singapore's urban environment. Being more efficient in the use of resources such as energy, water and land will contribute to enhancing the city-state's competitiveness in the long run. Under the blueprint, efforts will be made to improve air quality, expand and open up green and blue spaces, conserve biodiversity and enhance public cleanliness. These efforts will contribute to making the city a more liveable and attractive place to live in, even as Singapore continues to grow and develop. Targets have been set to measure the progress in these areas.

LNG TERMINAL CAPACITY INCREASE

The Singapore LNG Corporation (SLNG) announced that Singapore's liquefied natural gas (LNG) terminal on Jurong Island will have a third 180 000 cubic metre LNG tank, in addition to the two tanks already being built. The terminal will now have the capacity to handle 6 Mt per year of throughput. The investment in the third tank will give Singapore greater flexibility to meet its future gas needs and to pursue new business opportunities in the LNG market (SLNG 2010).

The increased storage capacity is expected to cope with the new demand and to act as a catalyst for new business opportunities. It will allow LNG traders to store and re-export LNG cargoes. International LNG traders have expressed a keen interest to use the LNG terminal for the trans-shipment of LNG cargoes throughout the region.

GAS SALES AND LNG SUPPLY

In March 2010, BG signed the first LNG sales and purchase agreements with six Singapore power generation companies. The initial total of gas sold is approximately 1.5 Mt per year for up to 20 years. BG will source LNG supplies for Singapore from its large, growing and diversified portfolio. It is envisaged BG's proposed Queensland Curtis LNG facility in Australia will serve as one of the sources of supply for Singapore.

The six power companies have contracted for an increase in their uptake of regasified LNG from the initial uptake of 1.5 Mt per year to 2 Mt per year. These six companies have either started or are planning to build around 3600 MW of new gas-fired power generation capacity. There is also keen interest by industrial companies outside the power generation sector.

START UP OF NExBTL RENEWABLE DIESEL REFINERY

In November 2010, the Finnish oil refining and marketing company Neste Oil announced the start up of its 800 000 tonnes per year renewable diesel refinery in Singapore, currently the world's largest of its kind. The refinery uses Neste's NExBTL proprietary technology to produce a renewable diesel product superior to regular biodiesel and fossil-based diesel. Renewable diesel achieves a 40%–80% reduction in greenhouse gas emissions compared to fossil-based diesel (Neste Oil 2010). Unlike biodiesel, which is produced by a process of esterification, renewable diesel entails catalytic hydrogenation that does not produce a glycerol sidestream. The renewable diesel product is clear and colourless paraffin, with high cetane number (85–99).

COAL POWER GENERATION

Tuas Power, Singapore's third largest power generating company, owned by China's Huangeng Group, is planning to invest SGD 2 billion in Singapore's first coal power plant on Jurong Island. The plant will be a thermally efficient ultra-supercritical coal-fired power plant that will employ various clean coal technologies. The plant is expected to begin supplying electricity to the grid in 2012.

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BG Group—www.bg-group.com

Economic Development Board—www.edb.gov.sg/edb/sg

Energy Market Authority—www.ema.gov.sg

Land Transport Authority—www.lta.gov.sg

Ministry of the Environment and Water Resources—www.mewr.gov.sg

Ministry of National Development—www.mnd.gov.sg

Singapore LNG Corporation—www.slngcorp.com

Solar Energy Research Institute of Singapore (SERIS)—www.seris.nus.edu.sg

Temasek Holdings—www.temasekholdings.com.sg

CHINESE TAIPEI

Introduction

Chinese Taipei, consisting of the islands of Taiwan, Penghu, Kinmen and 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. Its position, just 160 kilometres off the south-eastern coast of China, makes it a natural gateway to East Asia. It has an area of around 36 188 square kilometres. Only one quarter of the land is arable, but the subtropical climate permits the multi-cropping of rice and the growing of fruit and vegetables all year round.

In 2008, Chinese Taipei's GDP was USD 634.41 billion, and its per capita income was USD 27 652 (USD (2000) at PPP). Rapid economic development over the past decade has substantially changed the economic structure of Chinese Taipei, shifting the emphasis from industrial production to the services sector. In 2008, the services sector contributed 69.1% to GDP, followed by the industrial sector (29.3%) and the agriculture sector (1.6%). There has been an increase in the population of Chinese Taipei, which is one of the most densely populated areas in the world, but the rate of increase has been relatively mild. The population of 22.94 million grew at a rate of 0.33% between 2007 and 2008. This was much slower than the average annual growth of 0.4% between 2000 and 2008.

Chinese Taipei has very limited domestic energy resources and relies on imports for most of its energy requirements. There are no oil or coal reserves in Chinese Taipei, but it has gas reserves of around 6.2 billion cubic metres (EIA 2010). In 2008, installed electricity generation capacity totalled 46 381 MW.

Table 32 Key data and economic profile, 2008

Key data		Energy reserves[b]	
Area (sq. km)[a]	36 189	Oil (million barrels)	–
Population (million)	22.94	Gas (billion cubic metres)	6.2
GDP (USD (2000) billion at PPP)	634.41	Coal (million tonnes)	–
GDP (USD (2000) per capita at PPP)	27 652		

a Directorate-General of Budget (2010).

b EIA (2010).

Source: EDMC (2010).

Energy supply and demand

PRIMARY ENERGY SUPPLY

In 2008, Chinese Taipei's total primary energy supply was 107 218 kilotonnes of oil equivalent (ktoe), a decline of 4.6% from the previous year. By fuel, oil contributed the largest share (40%), followed by coal (36%), natural gas (12%) and other fuels (12%). Chinese Taipei has limited indigenous energy resources and imports around 99% of its energy needs.

Chinese Taipei imports almost its entire crude oil requirement. The Middle East is its major supplier, accounting for 82% of total imports. In 2008, Chinese Taipei imported 45.6 million tonnes of crude oil. However, because the refining capacity of the economy exceeds domestic demand, Chinese Taipei is a net exporter of petroleum products. Exports of petroleum products were around 10 million tonnes in 2008. To prevent supply disruption, Chinese Taipei's refiners are required by the Petroleum Administration Act to maintain stocks of more than 60 days of sales volumes.

The total refining capacity of 1.26 million barrels per day is operated by Chinese Petroleum Corporation (CPC) (57.1%) and Formosa Petrochemical Corporation (FPCC) (42.9%). CPC—the 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 petrochemical firm Formosa Plastics Group. In August 2006, FPCC completed an upgrade of its refinery facility at Mailia, increasing its refining capacity from 450 000 to 510 000 barrels per day. Although refining capacity exceeds the domestic consumption of petroleum products, both CPC and FPCC are considering constructing new refineries or expanding their existing plants (BOE 2008a).

As natural gas resources are also limited, domestic demand is almost entirely met by imports of liquefied natural gas (LNG), largely sourced from Indonesia and Malaysia. LNG imports in 2008 were 9.0 million tonnes, a 9% increase from 2007. CPC operates Chinese Taipei's only LNG receiving terminal at Yungan, Kaohsiung, with a handling capacity of 8.56 million tonnes a year. To meet the increasing demand and the first-stage goal of supplying gas for use by Taiwan Power Company's (TPC's) Datan Power Station from 2008, CPC has built a second terminal at Taichung Harbour, with a design capacity of 3 million tonnes a year. It was completed at the end of 2009 (CPC 2009).

Table 33 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	13 727	Industry sector	24 261	Total	235 108
Net imports and other	98 078	Transport sector	8 469	Thermal	183 720
Total PES	107 218	Other sectors	31 602	Hydro	4 257
Coal	38 729	Total FEC	64 332	Nuclear	40 827
Oil	42 395	Coal	6 240	Other	6 304
Gas	12 700	Oil	37 889		
Other	13 394	Gas	2 036		
		Electricity and other	18 167		

Source: EDMC (2010).

Coal is used for electricity generation as well as by the steel, cement and petrochemical industries. All Chinese Taipei's coal requirements are imported, mainly from Australia (69.9%) and Canada (25.6%). In 2008, the primary coal supply was 38.7 million tonnes of oil equivalent (Mtoe), which was 3.9% lower than in 2007. To secure a stable supply of coal, joint ventures to undertake exploration and development overseas are necessary.

Chinese Taipei generated 235 108 GWh of electricity in 2008. TPC's thermal power and nuclear power contributed 47.6% (29% from coal, 4.8% from oil and 13.7% from LNG) and 17.1%, respectively; privately owned cogeneration 16.5%; independent power producers (IPPs) 15.5%; hydro power 3.3% and wind power 0.1%. TPC dominates Chinese Taipei's electric power sector, and IPPs account for only 15.9% of the total capacity. IPPs are required to sign power purchase agreements with TPC, which distributes power to consumers. To expand foreign participation, in January 2002 the government permitted foreign investors to own up to 100% of an IPP. Currently, two 1350 MW advanced light water reactors in the Fourth Nuclear Power Project are under construction to boost electricity generation (EDMC 2010).

FINAL ENERGY CONSUMPTION

Final energy consumption in Chinese Taipei was 64 332 ktoe in 2008, 5.18% lower than in 2007. Other sectors (including residential and services) consumed 49.1% of the total, followed by the industrial sector (37.7%) and transportation (13.1%). By energy source, petroleum products

accounted for 58.9% of the total final energy consumption, followed by electricity (28.2%), coal (9.7%) and city gas (3.2%).

The other sectors (heat and other) was the main energy consumer (31 602 ktoe). Rising gasoline prices and a more convenient mass transportation system have moderated energy consumption in the transportation sector. Consumption in the sector was 8469 ktoe in 2008, a 30.28% decrease from 2007 (12 148 ktoe). In 2008, consumption in the industry sector increased by 5.93%.

Policy overview

ENERGY POLICY FRAMEWORK

POLICY

The Bureau of Energy is responsible for formulating and implementing Chinese Taipei's energy policy. It is also charged with enforcing the Energy Management Law and Electricity Law; regulating natural gas utilities, petroleum and liquefied petroleum gas filling stations; regulating the importation, exportation, production and sale of petroleum products; maintaining an energy database; evaluating energy demand and supply; promoting energy conservation; implementing research and development programs; and promoting international energy cooperation.

The fundamental goal of Chinese Taipei's energy policy is to promote energy security, supported by the secure importation of oil, natural gas and coal, and the development of domestic energy resources, including nuclear, fossil fuels and new renewable energy.

In December 2005, the Bureau of Energy released an Energy Policy White Paper addressing worldwide trends, short-term and long-term energy security challenges and the corresponding measures to be taken. Future energy policy will focus on:

- stabilising energy supply to increase energy independence
- increasing energy efficiency and reinforcing the management of energy efficiency
- further promoting the liberalisation of the energy market
- coordinating the development of the 3Es (energy, environment, economy)
- reinforcing research and development
- promoting education campaigns and expanding public participation.

The aims of Chinese Taipei's 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.

The Bureau of Energy released the Framework of Sustainable Energy Policy on 5 July 2008. It includes:

- policy objectives—to achieve a win-win-win solution for energy, environment and economy, and to set targets for improving energy efficiency, developing clean energy and securing a stable energy supply
- policy principles—to establish a high-efficiency, high value-added, low-emissions and low-dependency energy consumption and supply system
- a strategic framework—divided into two parts: cleaner energy supply and rationalised energy demand
- follow-up work—government agencies to formulate concrete action plans which clearly set carbon reduction targets and build monitoring and follow-up mechanisms to review effectiveness and performance and to establish quantitative objectives for each task to measure performance and facilitate implementation (BOE 2008b).

ENERGY SECURITY

As Chinese Taipei is almost completely dependent on oil imports, the government has been working to secure supply. To stabilise oil supply, private oil stockpiling could replace the 60 days of sales volumes (which is defined as the average domestic sales and private consumption over the past 12 months) required under the Petroleum Administration Act. Using the Petroleum Fund to finance the storage of oil, the government is responsible for stockpiling 30 days of oil demand (BOE 2009a, Article 24). Under the Act, the liquefied petroleum gas stockpile should be more than 25 days of supply.

For many years, CPC has engaged in cooperative exploration with governments and large international oil companies under the name of the Overseas Petroleum and Investment Corporation (OPIC), in operations throughout the Americas, the Asia–Pacific region and Africa. Following rising oil prices in recent years, CPC made strenuous efforts to develop upstream exploration to secure oil sources. In line with the government's policy of 'deepening the energy supply safety mechanism and promoting international energy cooperation', CPC has engaged in international cooperation in exploration and development in the hope of discovering new reserves of oil and natural gas. In 2008, CPC engaged with international oil companies in cooperative exploration in 13 fields in eight economies.

On 26 December 2008, CPC signed exploration cooperation agreements with the China National Offshore Oil Corporation (CNOOC). Among other things, the agreements covered the renewal of an agreement on joint exploration in the Tainan Basin of the Taiwan Strait, a feasibility study of exploration in the Nanridao Basin off northern Taiwan, and the transfer of a 30% stake in CNOOC's onshore Block 9 in Kenya to CPC.

In the future, CPC's strategy is to increase overseas exploration and production by raising the value of its existing overseas oil and gas fields and establishing core areas with high rates of growth, participating actively in bidding for open blocks, seeking opportunities to take over fields from large oil companies, and pursuing opportunities for mergers and acquisitions in new oil and gas fields to add to the company's reserves (CPC 2010).

ENERGY MARKETS

MARKET REFORMS

The Petroleum Administration Act has been amended to further liberalise the petroleum market. The government is now coordinating with the relevant agencies to implement the amendments. Key actions include the following:

- Petroleum prices will be determined by market mechanisms. The equation used to adjust gasoline and diesel prices, originally determined by CPC, was abolished in September 2000 after FPCC's petroleum products were released to the market. Following significant fluctuations in international petroleum prices in the second half of 2005, the Ministry of Economic Affairs (MOEA) authorised CPC to adopt a floating fuel pricing mechanism at the beginning of 2007; this is still in force.
- The petroleum market will be further liberalised through the following three actions. First, the amendments made to the Petroleum Administration Act in 2008 and 2009 to reflect changes that had occurred over time in the social environment and to ensure a secure supply of domestic petroleum. Second, the security reserve threshold for the petroleum import business was reduced from 50 000 kilolitres (kL) to 10 000 kL, while the reserve for the petroleum refinery will be maintained at 50 000 kL. This is expected to reduce the barriers to entry to the market. Third, the partial import tariff on petroleum products was relaxed in line with global trends. The Ministry of Finance has accepted the World Trade Organization's suggestion to reduce the tax difference between petroleum products and crude oil (that is, tariffs on gasoline, kerosene, jet fuel and diesel should be reduced to 0%).
- There are 23 private and two state-run natural gas companies, administered by the MOEA according to the Act for Regulating Privately Owned Public Utilities and the

Regulations Governing the Administration of Gas Utilities. To establish the sound management of natural gas utilities and to incorporate the production and importation of natural gas into regulations, a draft Natural Gas Business Bill has been completed and submitted to the Legislative Yuan for deliberation. The Bill outlines the responsibilities of authorities and has provisions for the operation of businesses, the safety of related facilities, disaster prevention, customers' rights and the establishment of a safety inspection system. Penalties for noncompliance are also addressed (BOE 2008c).

ELECTRICITY MARKETS

The Chinese Taipei Government's aim is to have a total electricity supply that provides a reserve capacity of 15%–20% based on peak demand. During the 1990s, some of TPC's new power plants were unable to meet their construction schedules because of environmental issues and complex government approval processes. This kept the total electricity supply below reserve capacity between 1990 and 2004. Reserve capacity was under 8% between 1990 and 1996. Beginning in 1995, to stabilise the power supply, Chinese Taipei's electricity market was opened to IPPs when the reserve capacity fell below 16%. Power produced by IPPs is sold to TPC through TPC's transmission lines. To prevent electricity supply outages, the MOEA announced the Fourth Stage of Opening the Electricity Market to IPPs in June 2006. IPP investors did not meet the bidding price offered by TPC for this stage. Fortunately, power demand is not expected to increase between 2011 and 2013. The MOEA will announce a fifth stage of opening the electricity market to IPPs if the reserve capacity falls below 16% in the future.

To comply with the schedule for privatising TPC and promoting the liberalisation of the domestic power market, the MOEA has completed a program of liberalising the electricity industry. Based on the program, a draft amendment to the Electricity Act was submitted to the Legislative Yuan for review. Now the legislative process to amend the Electricity Act has been completed, the generation sector will be able to set up and invest in the integrated utility, transmission utility and distribution utility. In addition, generators will be able to sell power to consumers directly, which means the market structure will no longer be a monopoly. A competitive mechanism will also be established to improve the performance of utilities (BOE 2008b).

FISCAL REGIME AND INVESTMENT

Chinese Taipei has limited indigenous resources so it has no formal policy on investment in upstream assets. Foreign investors are welcome to participate in the IPP electricity market bidding process discussed above.

ENERGY EFFICIENCY

Chinese Taipei's energy efficiency strategy will target both the supply and demand sides (BOE 2008d).

On the supply side, the strategy has two main aims:

- Increasing the proportion of low-carbon and high-efficiency electricity generation plants by increasing the ratio of efficient gas combined-cycle generation. In 2025, gas combined-cycle generation is expected to account for 25% of the power generation system.
- Introducing the world's best available technology for electricity generation by speeding up power plant replacement, setting plans to raise the overall efficiency of power plants and calling for the world's best practice power conversion efficiency standards for all new power plants.

On the demand side, the strategy has three main aims for the manufacturing sector:

- Establishing financial incentives and regulatory mechanisms by providing preferential loans and investment tax credits, accelerated depreciation, and other

financial incentive measures; by establishing energy-saving performance measurement verification mechanisms; by promoting energy-saving performance guarantee projects; and by introducing energy services companies to provide technology, capital and human resources.

- Improving energy efficiency by promoting high-efficiency motor programs and boiler efficiency plans and by establishing specific energy consumption indicators.
- Establishing full-service energy-saving systems by establishing the MOEA Service Centre and in-house counselling services; and strengthening and deepening energy technology services.

On the demand side in the residential sector, the strategy has four main aims:

- Encouraging the service industry to sign a voluntary agreement for energy conservation and setting an energy-saving goal of 5%–10%.
- Enhancing the use of electrical appliances with high energy efficiency, expanding electrical products energy-efficiency management, subsidising the purchase of energy-saving products, and promoting the use of high-efficiency and low standby power products.
- Promoting a revolution in lighting. By 2012, incandescent bulbs will be extensively replaced and LED lighting will be promoted.
- Promoting price discount programs. Residential customers and primary schools using less than the average daily kWh usage in the same period of the previous year will be given a discount.

In the transportation sector, the aims are to raise standard fuel efficiency for private vehicles (measured in passenger kilometres per litre) stepwise to 25% by 2015, and to promote the replacement of traditional traffic lights with LED lighting.

In the government sector, the intention is to promote negative growth in oil and electricity consumption within government agencies and schools, aiming for an accumulated saving of 7% in 2015.

RENEWABLE ENERGY

In response to high oil prices and the global trend towards reducing greenhouse gas emissions, promoting the development and use of renewable energy is considered a critical strategy internationally. In Chinese Taipei, 99% of energy supply is imported. Therefore, promoting renewable energy development can diversify the energy supply, increase the share of domestically produced energy and lead the development of local industry. This will help the economy reach the goal of the three 'wins' of energy security, environmental protection and economic development. To promote the use of new renewable energy, the government has selected some major areas with viable market potential: solar energy, wind energy, geothermal energy, ocean energy, biomass, and energy from waste.

Chinese Taipei mainly emphasises wind power, solar photovoltaic and biofuels, and also promotes other renewable energies as auxiliary means. By December 2008, the total installed capacity of renewable electricity generation was 2843 MW, which can produce approximately 7.65 billion kWh of electricity annually (BOE 2008d).

To effectively promote renewable energy and to respond to the requirements of the private sector for institutionalised incentive measures, Chinese Taipei promulgated the Renewable Energy Development Bill on 8 July 2009 (BOE 2009b). The essence of the Bill is based on fixed feed-in tariffs and grid-connecting obligations to secure the market for electricity generated from renewable energy. The subsidisation of photovoltaic, hydrogen energy and fuel cells was also proposed. Because of the differences between the non-renewable electricity generating costs of power utilities and the renewable electricity feed-in tariffs, a fund will be established to subsidise utilities when they produce or purchase renewable electricity. It is hoped that electricity from renewable resources will account for 8% of total electricity generation by 2025.

NUCLEAR

To diversify the electricity generation mix, the government encourages the development of nuclear energy. At the end of 2009, there were three nuclear energy plants with six units and a total installed capacity of 5144 MW; the first reactor has two units of 636 MW, the second two units of 985 MW and the third two units of 951 MW. The first unit of the fourth nuclear energy plant (1350 MW) will be completed in 2011, and the second (1350 MW) will be completed in 2012. By 2012, there will be 7844 MW of installed nuclear energy generation capacity (TPC 2010).

CLIMATE CHANGE

In view of global climate change and energy shortages, the policies of the Chinese Taipei Government focus on energy conservation and reducing carbon emissions. To achieve those aims, the Executive Yuan approved the Sustainable Energy Policy on 5 June 2008, and issued the Sustainable Energy Policy—Energy Carbon Reduction Action Program on 4 September 2008. However, because the action program spans only four years of policy planning, long-term and controversial energy issues, which require extensive discussion, are discussed through the National Energy Conference. The Executive Yuan held the Third National Energy Conference on 15–16 April 2009. The main topics included sustainable development and energy security; energy management and efficiency enhancement; energy prices and the opening of the market; and energy technology and industrial development (BOE 2009c). Chinese Taipei's targets are to reduce economy-wide CO_2 emissions so total emissions return to the 2008 level during the period 2016–20, and are then further reduced to the 2000 level in 2025. The main measures to achieve this goal are to develop carbon-free renewable energy, to increase the use of low-carbon natural gas, and to promote energy conservation schemes in various sectors.

Chinese Taipei has overall energy efficiency goals of reducing energy intensity by 20% by 2015 and by 50% in 2025, based on the 2005 level. All sectors have specific energy efficiency goals, such as: reducing the CO_2 intensity of industry by 30% by 2025; raising new car energy efficiency standards by 25% by 2015; improving the energy efficiency of appliances and devices by 10%–70% by 2011; and a 7% reduction in the government's energy use by 2015. In 2006, the MOEA conducted four projects for: establishing the auditing, registry, verification and certification systems of the energy industry; building the capacity of the energy industry to reduce emissions and promoting a program of voluntary CO_2 emissions reductions; promoting an environmental accounting system for the energy sector; and promoting a greenhouse gas emissions management system.

The main achievements of these and related activities include:

- the establishment of a domestic greenhouse gas emissions auditing tool
- the selection of 40 energy industry companies to participate in demonstration projects
- the provision of education and training to demonstration companies
- assistance for five demonstration companies to obtain international certification.

Notable energy developments

PEER REVIEW ON ENERGY EFFICIENCY (PREE)

Chinese Taipei hosted an APEC Peer Review on Energy Efficiency during 23−27 August 2010. The Peer Review was well organised; the government arranged a comprehensive consultation program with government officials and industry representatives, and provided the review team with detailed background information to help with their analysis.

The review team noted a strong history of government engagement with businesses and the public on energy efficiency and conservation issues. This leadership element is critical to ensure further progress is made on energy efficiency in Chinese Taipei. The commitment to energy efficiency and conservation extends from the highest level of government (the Executive Yuan)

to the general public, and is reflected in the implementation of international best practice energy efficiency policies and measures. The review team made 35 recommendations in its draft final report to support the Chinese Taipei Government's energy efficiency strategy. The recommendations cover the institutional context; energy efficiency goals, targets and strategy; energy data collection and monitoring; the industry, electricity, residential and commercial and transport sectors; appliances and equipment; and education and energy efficiency related R&D.

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Useful links

Bureau of Energy, Ministry of Economic Affairs—www.moeaboe.gov.tw

Chinese Petroleum Corporation—www.cpc.com.tw

Directorate General of Budget, Accounting and Statistics, Executive Yuan—www.dgbas.gov.tw

Industrial Development Bureau, Ministry of Economic Affairs—www.moeaidb.gov.tw

Ministry of Economic Affairs—www.moea.gov.tw

Ministry of Transportation and Communications—www.motc.gov.tw
Taiwan Power Company—www.taipower.com.tw

THAILAND

INTRODUCTION

Thailand is in South-East Asia and shares borders with Malaysia to the south and Myanmar, Lao People's Democratic Republic and Cambodia to the north and east. It has an area of 513 115 square kilometres and had a population of 67.39 million at the end of 2008. In 2008, Thailand's GDP was USD 445.18 billion, and GDP per capita was USD 6606 (USD (2000) at PPP).

Thailand is highly dependent on energy imports, particularly oil. In 2008, net energy imports accounted for 44% of energy supply in the economy; down significantly from 96% in 1980. According to statistics from the Department of Mineral Fuels and the Department of Alternative Energy Development and Efficiency of the Ministry of Energy, Thailand had proven onshore and offshore reserves of 183 million barrels of crude oil, 271 million barrels of condensate, and 12 003 billion cubic feet of natural gas. Total reserves of lignite, including remaining resources in areas currently in production and proven and probable reserves in undeveloped areas, were 2023 million tonnes.

Table 1 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	513 115	Oil (million barrels)[a]	183
Population (million)	67.39	Condensate (million barrels)[a]	271
GDP (USD (2000) billion at PPP)	445.18	Natural gas (billion cubic feet)[a]	12 003
GDP (USD (2000) per capita at PPP)	6 606	Coal (million tonnes)[b]	2 023

a Proven reserves.
b Proven, probable and possible reserves.
Sources: EDMC (2010); DMF (2009); DEDE (2009a); EPPO (2009).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Thailand's total primary energy supply in 2008 was 112 957 kilotonnes of oil equivalent (ktoe). Oil accounted for 38% of the total, while gas, coal and others accounted for 29%, 13% and 19%, 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 2008, the coal supply was 14 947 ktoe, a 7.8% increase from the previous year, due mainly to increasing consumption in the industry sector. In the power sector, coal accounted for 23% of power generation. Total oil supply was 42 868 ktoe in 2008, a 2.6% decrease from 44 010 ktoe in 2007 due to a significant reduction in imported oil products and an increase in exported oil products.

In 2008, the natural gas supply was 33 230 ktoe, a 5.8% increase from 31 418 ktoe in 2007. Natural gas is used mainly for power generation, which accounted for 66.5% of the gas consumed. In Thailand, natural gas use is promoted, particularly in the power generation and transport sectors, to replace petroleum products such as fuel oil, diesel and gasoline. Because world oil prices have increased over recent years, more industries have switched from oil to natural gas. As a result, Thailand will increasingly rely on imported natural gas, both pipe gas and liquefied natural gas (LNG). Imported pipe gas accounted for 36% of the natural gas supply in 2008, and the first LNG imported cargo is expected in 2011. The government is now aiming for

more diversification of energy sources. By revisiting the Power Development Plan launched in 2010, nuclear and coal (with clean coal technology) will be the main sources of energy diversification. The demand for natural gas for power generation is projected to increase by an average of 1.2% per year from 2009 to 2030. If industry and transport demands are included, the demand for natural gas will grow at an average of 2% per year.

In 2008, total electricity generation was 147 427 GWh, a 2.8% increase from 2007. Thermal generation, mostly from natural gas and coal, accounted for 85% of electricity production and hydropower for 5%. Natural gas made up about 70% of the fuel used for power generation; the balance was derived from fuel oil, coal, diesel, and hydro and other renewable fuel sources. In addition to Thailand's domestic capacity, power was purchased from Lao People's Democratic Republic and Malaysia.

Table 2 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	62 695	Industry sector	24 195	Total	147 427
Net imports and other	50 262	Transport sector	23 097	Thermal	125 663
Total PES	112 957	Other sectors	18 598	Hydro	7 113
Coal	14 947	Total FEC	65 890	Nuclear	–
Oil	42 868	Coal	7 744	Other	14 651
Gas	33 230	Oil	31 207		
Other[a]	21 912	Gas	3 153		
		Electricity and other	23 786		

a Including renewable energy and biofuel.
Source: DEDE (2009b).

FINAL ENERGY CONSUMPTION

Thailand's total final energy consumption in 2008 was 65 890 ktoe, a slight increase of 1.6% from the previous year. The industry sector was the largest energy-consuming sector, accounting for 24 195 ktoe, or 37% of total final energy consumption. The second largest consumer of energy was the transport sector, which consumed 23 097 ktoe in 2008, a decrease of about 2.3% from 2007. By fuel type, oil accounted for a 47% share (31 207 ktoe) of total energy consumption in 2008, followed by electricity and other (36%), coal (12%) and gas (5%).

Oil consumption decreased by 3.4%, to 31 207 ktoe in 2008 (down from 32 318 ktoe in 2007) due to high oil prices during the first half of the year and the government's policy of promoting alternative fuels. Natural gas consumption, in contrast, increased dramatically by 21.5%, due mainly to the promotion of natural gas for use in vehicles. Natural gas consumption by the transport sector grew by 214% from 208 ktoe in 2007, to 654 ktoe in 2008. Coal consumption increased by 10.9% to 7744 ktoe in 2008 compared with the previous year.

As a result of economic expansion, the demand for domestic electricity increased by 3.5% from the previous year. The growth in demand was due mainly to increased consumption in the industrial, commercial and residential sectors.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Ministry of Energy's aim is for sustainable energy management so the economy has sufficient energy to meet its needs. It is responsible for: establishing energy security; promoting the use of alternative energy; monitoring energy prices and ensuring prices are at levels appropriate to the wider economic and investment situation; effectively saving energy and

promoting energy efficiency; and supporting energy developments domestically and internationally while simultaneously protecting the environment.

Organisations also responsible for energy include the:

- Office of the Minister—responsible for coordination with the Cabinet, the parliament and the general public
- Office of the Permanent Secretary—establishes strategies, translates policies of the ministry into action plans, and coordinates international energy cooperation
- Department of Alternative Energy Development and Efficiency—promotes the efficient use of energy, monitors energy conservation activities, explores alternative energy sources, and disseminates energy-related technologies
- Department of Energy Business—regulates energy quality and safety standards, environment and security, and improves the standards to protect consumers' interests
- Department of Mineral Fuels—facilitates energy resource exploration and development
- Energy Policy and Planning Office (EPPO)—recommends economy-wide energy policies and planning
- Electricity Generating Authority of Thailand—the state generation enterprise
- Petroleum Authority of Thailand (PTT) Exploration and Production (E&P) Public Company Limited and the Bangchak Petroleum Public Company Limited—two autonomous public companies
- Energy Fund Administration Institute—a public organisation
- Energy Regulatory Commission and the Nuclear Power Program Development Office—two independent organisations.

The government's energy policy seeks to build an energy sufficient society; achieve a balance between food and energy security; build a knowledge-based society; promote Thailand's role in the international arena; and enhance economic linkages with other economies in the region to harmoniously cooperate in energy and other sectors.

Currently, Thailand's energy policy is based on the following five strategies: energy security, alternative energy, supervising energy prices and safety, energy conservation and efficiency, and environmental protection.

ENERGY SECURITY

The government's energy security policy is to intensify energy development for greater self-reliance, with a view to achieving a sufficient and stable energy supply. It will do this by advancing the exploration and development of energy resources at domestic and international levels; negotiating with neighbouring economies at government level for the joint development of energy resources; developing an appropriate energy mix to reduce risks to supply, price volatility and production costs; encouraging electricity production from potential renewable energy sources, particularly from small-scale or very small-scale electricity generating projects; and investigating other alternative energy for electricity generation.

ALTERNATIVE ENERGY

The government's alternative energy including renewable energy policy is to encourage the production and use of alternative energy, particularly biofuel and biomass such as gasohol (E10, E20 and E85), biodiesel, solid waste and animal manure to enhance energy security, reduce pollution, and benefit farmers. It will do this by encouraging the production and use of renewable energy at the community level using appropriate incentive measures; encouraging the greater use of natural gas in the transport sector by expanding the natural gas transportation system nationwide; and promoting the research and development of all forms of alternative energy. The strategies with targets and actions to achieve the policy under the current 15-year Renewable Energy Development Plan (REDP) 2008–22 are:

1. *Promote the production and use of biofuels, e.g. ethanol and biodiesel, to replace oil consumption*. The targets are to replace oil consumption with the use of ethanol; promote the use of gasohol E85 and flexible fuel vehicles (FFV) in Thailand; and promote the domestic production capacity of B100. The actions to achieve this include:
   - Establishing the production and utilisation of ethanol and biodiesel as an economy-wide agenda and providing clear directions for its implementation
   - Supporting the establishment of ethanol production plants to enhance Thailand as the 'ethanol hub' for ethanol production and distribution in Asia
   - Promoting the wider use of E85 fuel, by supporting an E85 automobile manufacturing line in Thailand, with an initial target of 1 000 000 E85 cars by 2018
   - Revising the regulations for ethanol export
   - Promoting community-scale biodiesel projects, emphasising technology transfer and suitable technical management so as not to cause an environmental impact on the communities
   - Making the use of biodiesel B5 mandatory economy-wide by 2011.
2. *Promote the use of natural gas in the transportation, industrial, commercial and household sectors*. The target is to increase Natural Gas Vehicle (NGV) mother stations by a minimum of seven stations by 2010. The actions to achieve this include:
   - Applying NGV's to public fleets, focusing on taxis, tuk-tuks (motored tricycles), public and private buses, and trucks
   - Reviewing NGV prices, taking into consideration the actual costs and Thailand's overall economic situation
   - Planning the expansion of the natural gas transmission pipeline system to be the backbone of NGV growth.
3. *Promote all forms of renewable energy*. The target is to increase the use of wind, solar, hydropower, biomass, biogas, and energy from waste, with adjustable targets (flexible to current situations). The actions to achieve this include:
   - Promoting power generation from renewable energy in all forms, by providing incentives, e.g. the current adder provision ('adder' is an additional energy purchasing price on top of the normal prices power producers receive when selling electricity to power utilities)
   - Promoting the conversion of plastic waste into crude oil, providing incentives similar to the adder provision, but by using the Oil Fund to support the costs incurred in the adder provision to oil refineries that purchase oil derived from plastic waste for further processing
   - Reviewing the adder provision so it better suits the domestic situation.
4. *Carry out research and development of alternative energy, renewable energy and other innovative energy technologies*. The target is to develop and integrate the alternative energy research and development (R&D) plans of the concerned agencies, to enhance the capability to respond to the renewable energy development already approved in the 15-year Renewable Energy Development Plan (REDP). The actions to achieve this include:
   - Supporting the R&D necessary for the development of alternative energy, especially R&D on energy from plants, in terms of both the second generation biofuels and equipment for generating energy from biomass and biogas
   - Supporting the R&D on modifying old-modelled cars to use gasohol E20 and E85
   - Supporting the R&D on car engines to use biodiesel B10
   - Supporting research on advanced technologies, e.g. hydrogen and solar cells
   - Increasing the share of domestic technology utilisation (local content).

5. *Set alternative energy as an economy-wide agenda and determine incentive measures*. The target is to have the National Alternative Energy Master Plan implemented. The actions to achieve this include:

   - Using the 15-year REDP, approved by the National Energy Policy Council (NEPC) and Cabinet as the master plan, to promote and support alternative energy in all forms
   - Developing an integrated plan of action for alternative energy development under the targets set out in the 15-year REDP.

6. *Establish and strengthen renewable energy networks*. The target is to encourage participation at the community, district and provincial levels, to create energy security from the foundations. The actions to achieve this include:

   - Establishing one prototype village-based or community-based energy source in each province, using the local cultures to foster the economical and wise use of energy in a community and to increase the economic value of the community
   - Speeding up the expansion and development of prototype community-based energy sources to popularise the concept, by integrating them into community energy planning projects with a target of 'one district, one community energy source' by 2011
   - Setting up 'community energy volunteers' by selecting community leaders or mentors
   - Devising an alternative energy development plan at the provincial level and at the provincial cluster level, using the 'cluster concept' in the 15-year REDP framework
   - Implementing community-scale energy projects in an additional 300 tambon (sub-district) administrative units economy-wide, aiming to reduce the energy cost of each community by 15%–20%
   - Promoting technology appropriate for people's way of living, particularly in rural communities, e.g. community-scale biodiesel projects and training courses on the manual production of biodiesel, 200-litre charcoal-making stoves, high-efficiency stoves, charcoal briquette-making machines and household biogas digesters
   - Promoting the 'green home' concept for urban communities, by developing technologies appropriate for urban communities, housing estates and condominiums.

ENERGY SAFETY

The Thailand government's energy safety policy is to improve service quality and safety in energy-related businesses, facilities, service stations and equipment. It will do this by promoting 'absolute zero accident' information; establishing Provincial Energy Offices (PEOs) for the protection of energy consumers; establishing NGV quality standards to ensure safety, including supervising the installation costs of NGV kits to ensure the costs are appropriate, fair and in line with economic conditions; and establishing an energy technique development institute, including procuring product-testing equipment, developing safety standards suitable for Thailand's energy businesses, and disseminating the safety standards to provincial areas and local administration organisations.

The actions to achieve this include:

- Building the capacity of the PEOs so they can perform their duties efficiently, particularly the protection of energy consumers
- Upgrading the Regional Energy Coordination Offices of the PEOs to Regional Energy Learning Centers, to create knowledge and understanding of the government's energy policies
- Establishing quality and safety standards for the entire NGV business chain
- Regulating for the safe use of liquefied petroleum gas (LPG), by preventing the misuse of LPG and the transfer of household LPG for use in the transport sector, and ensuring the regulations have the least impact on taxis.

FISCAL REGIME AND INVESTMENT

ENERGY PRICES

The government's energy prices policy is to supervise and maintain energy prices at appropriate, stable and affordable levels. It will do this by setting an appropriate fuel price structure which supports the development of energy crops and which best reflects actual production costs; managing prices through the market mechanism and the Oil Fund to promote the economical use of energy; and encouraging competition and investment in energy businesses, including the improvement of service quality and safety.

The strategy to achieve this is to supervise energy prices through market mechanisms to ensure domestic energy prices are stable, fair and affordable, and reflect the actual production costs. The energy cost for Thai people must not be higher than that in neighbouring economies. The government is supervising the pricing policies and price structures of oil, LPG and natural gas to align them with world market mechanisms and to reflect actual costs; ensuring fairness for the general public through the efficient use of the Oil Fund; and monitoring the refining and marketing margins to maintain them at appropriate levels. For LPG and NGV, prices will reflect the resolutions of the NEPC/Cabinet, which will not place a burden on consumers. For ethanol, the EPPO is soliciting the Ethanol Producer Association for a more suitable pricing formula for monitoring domestic ethanol prices.

INVESTMENT

The Government is keen to encourage competition and investment in energy businesses by creating a favourable environment for investment, transparent competition and internationally-accepted energy-related standards. It will do this by designating an agency, the Investor Relation Office, to be responsible for investment procedures and processes in the energy industry; and by creating a mechanism for a company to be a 'service company' in the operations and maintenance of the electricity industry, refineries, gas separation plants and both domestic and overseas oil/gas rigs.

ENERGY EFFICIENCY

The government's energy efficiency and conservation policy is to encourage energy conservation and efficiency in the household, industry, service and transport sectors. It will do this by fostering an energy-saving discipline and conscience and promoting effective energy use; providing incentives to the private sector to invest in energy-saving appliances; setting incentive measures for the household sector to reduce electricity consumption during peak periods; supporting research and development and standard-setting for electrical appliances and energy-saving buildings; and supporting the development of a mass public transportation and railway system to improve energy efficiency, deferring the economy's investment in energy procurement. The strategies with targets and actions to achieve the policy are:

1. Promote energy development and energy conservation.

Target

- To increase the energy conservation target set out in the Energy Conservation Program to 20%, focusing on increasing energy savings in the industry and transport sectors.

Action

- Draft the Energy Conservation Program, Phase 4 (2012–16) to address future crises caused by oil price volatility, climate change and a world food crisis, with the participation of the public and stakeholders at all levels.

2. Organise campaigns to create an energy-saving conscience and provide knowledge about energy conservation.

Targets

- To speed up the implementation of 11 Energy-Saving Measures for the People to quickly attain practical achievements and set an energy-saving target at THB 100 000 million per year

- To enhance local administration organisations (LAOs) as focal agencies in creating and disseminating an energy-saving culture to target groups such as children and young people, housewives and senior citizens through Community Energy Volunteers
- To attain the participation of 100 000 households in the Household Energy Credit project, which will contribute to energy savings at no less than THB 1000 million per year
- To set the energy credit provision target at THB 60 000 million per year, contributing to energy savings at no less than THB 40 000 million per year.

Actions

- Implement the 11 Energy-Saving Measures at three scales in pilot provinces (i.e. large-scale province: Nakhorn Ratchasima; medium-scale provinces: Phitsanulok and Krabi; small-scale province: Mae Hong Sorn), and emphasise community participation through Community Energy Volunteers, before expanding the scheme to other provinces in 2011
- Enforce measures on mandatory energy performance labelling by 2010, starting with refrigerators and air conditioners by upgrading/increasing the efficiency of No. 5 refrigerators and air conditioners by at least 10%
- Coordinate with the Office of the Consumer Protection Board (OCPB) and concerned agencies to enable the mandatory measure on Standby Power 1-Watt to be issued in early-2010 for pilot appliances such as televisions and air conditioners, and set a target of electricity savings worth THB 4000 million per year
- Replace light bulbs with energy-saving lights (No. 5 and T5 fluorescent tubes) in 100 sample temples or mosques by 2010, and complete this replacement in 500 facilities by 2011, to achieve a change in the use of energy-saving light tubes totalling 1 000 000 units, including creating a sensitising presenter in each facility
- Issue relevant ministerial orders and announcements under the Building Energy Code by 2010, and organise training/conferences for architects, engineers and concerned institutions to attain at least a 10% energy saving in new buildings, accounting for electricity savings at 2365 GWh per year
- Speed up the enforcement of laws and announcements about the regulation of energy conservation in factories (ISO–Energy) by 2010, to attain energy savings worth THB 90 000 million by 2011
- Assign the Energy Mobile Units, via the Regional Energy Coordination Offices of all 12 Provincial Energy Offices, to carry out their field work in at least 576 sub-districts economy-wide
- Review the Clean Air-conditioners Increase Money for Households and Engine Tune-up to Reduce Oil Consumption projects, and implement them on an annual basis, especially in summer.

3. Devise incentives and provide privileges to induce investment in energy saving.

Target

- To reduce energy intensity, or energy consumption per production unit, in the industrial sector by 20% compared with the base year (2006).

Action

- Promote four major measures:
  - Energy Credit and Revolving Fund for energy efficiency and alternative energy
  - Tax measures and privileges on both a cost-based and performance-based basis
  - Joint ventures using the Energy Services Company (ESCO) Fund (the government's co-investment program)
  - DSM (demand-side management) bidding.

4. Promote R&D on energy-saving systems and technologies.

Target

- To put in place integrated resources planning for energy conservation R&D.

Actions

- Gather information about energy-saving innovations in each locality and encourage further development
- Determine the ratio of state budget and budget from the Energy Conservation Promotion Fund to be used for R&D promotion.

5. Set standards, rules and regulations for energy-saving equipment, materials and energy management.

Targets

- To announce the Minimum Energy Performance Standards (MEPS) of 15 electrical appliances by 2010
- To issue ministerial orders, particularly on the Building Energy Code and International Organisation for Standardization (ISO)–Energy.

Action

- Issue ministerial orders with immediate effect.

6. Promote the creation of prototype networking, e.g. small and medium enterprises (SMEs) with distinguishing features or with interests in energy-saving.

Target

- To make the Thailand Energy Awards recognised by the groups targeted for energy savings.

Actions

- Intensify the implementation of the Thailand Energy Awards project.

Thailand has set up three categories of energy efficiency measures:

- Social campaigns for the public
- Investment promotions for industry
- Laws and regulations to introduce standards or codes.

Thailand is in the process of setting up the 20 years Roadmap for Energy Conservation Policy. There is significant potential to cut down CO_2 emissions by enhancing energy efficiency in the economy. This is in line with the International Energy Agency's (IEA's) stabilisation of greenhouse gas emissions at 450 parts per million (ppm) of CO_2-equivalent scenario (the 450 ppm scenario), in which most of the world's CO_2 emissions reduction will come from energy efficiency. Energy efficiency and conservation accounts for almost 60% of the greenhouse gas emissions reduction.

The steps Thailand has already taken to conserve energy include:

- Setting up concrete measures in the Building Energy Code
- Creating the standards and labelling on appliances such as light bulbs, air conditioners, and refrigerators
- Setting up supporting programs for industries and SMEs, e.g. USD 4 billion has already been approved and allocated to finance energy efficiency projects.

RENEWABLE ENERGY

In 2009, the Thai Cabinet adopted the 15-year Renewable Energy Development Plan (REDP) (2008–22) to increase the proportion of renewable energy in the energy mix. It expects the percentage share of clean energy will increase from 8% in 2009 to 20% by 2022. The renewable energy will be used for power generation, thermal applications, and in the production of biofuels such as ethanol and biodiesel. The government is adjusting the current plan by type of renewable

energy, e.g. increasing the goals of solar energy from 400 MW to 2000 MW and wind energy from 800 MW to 1900 MW due to the private sector's interest, and reducing the goal of biomass from 2600 MW to 1600 MW due to the public's protest.

To achieve these targets, Thailand has set up incentive programs and mechanisms to encourage investment, such as the Fund for Energy Services Companies that act as the special purpose vehicles (SPVs) for the renewable energy development projects, the Revolving Fund that provides low interest rates, and investment grants from the Energy Conservation Fund.

To move the REDP into action, the 15-year period was broken down into three stages of about five years, with targets and actions for the short term, medium term, and long term of the plan. The continuous development spectrum will involve revising legislation and setting up guidelines and standards, undertaking R&D and installing the infrastructure necessary to support renewable energy development. Thailand expects to attract more than USD 15 billion in 'green investment' and to cut down CO_2 emissions by 42 million tonnes per annum by 2022.

NUCLEAR

Thailand is still looking into the issues of regional nuclear cooperation, nuclear energy safety as well as capacity building, education and training, and information sharing. The development of a nuclear energy program is a step process. It will require strong political will and public acceptance. The government is disseminating information to the public so Thai citizens will be aware of what is needed.

The Nuclear Power Program Development Office's (NPPDO's) 2010 update for the 20-year Power Development Plan (PDP) 2010–30 showed supply from nuclear energy generation should not be higher than approximately 10% of the total power generation capacity (e.g. 2021—6%, 2030—11%); the expected total capacity of nuclear energy plants by 2030 will be 5000 MW (updated from 2000 MW in the previous PDP plan). This was approved by the National Energy Committee on 12 March 2010, and it is now waiting for Cabinet approval by the end of 2010.

The commissioning schedule for nuclear energy plants in the current plan (PDP 2010–30) is:

2020	First Nuclear Power Plant	1000 MW
2021	Second Nuclear Power Plant	1000 MW
2024	Third Nuclear Power Plant	1000 MW
2025	Fourth Nuclear Power Plant	1000 MW
2028	Fifth Nuclear Power Plant	1000 MW.

The US consultant, Burns & Rolls, reports the most effective places for the site of the First Nuclear Power Plant are the provinces of Nakorn Sawan (central) and Ubon Rachathani (northeast).

CLIMATE CHANGE

Thailand has a strong policy of protecting the environment from the impact of energy production and consumption, especially impacts from the transport sector. The government's environmental protection policy is to encourage energy procurement and consumption which attach importance to the environment, with public participation, by setting relevant standards and promoting Clean Development Mechanism (CDM) projects to reduce the social and environmental impact as well as greenhouse gas emissions. The strategies with targets and actions to achieve the policy are:

1. Monitor the environmental impact caused by energy production, conversion and utilisation.

Target

- To set a target and develop a plan to boost the management of greenhouse gas (GHG) emission rates in the energy sector, to reduce Thailand's CO_2 emissions by at least 1 million tonnes per year.

Actions

- Select pilot power plants and conduct a study on the reduction of GHG emissions from one natural gas-fired thermal power plant, one coal-fired thermal power plant, and one combined cycle power plant
- Devise a plan to reduce GHG emissions in the energy industry, e.g. determine the baseline, and develop a clear response plan.

2. Promote the CDM in the energy sector to reduce greenhouse gas emissions.

Targets

- To enable Thailand to submit energy projects for certification under the CDM, at a total of 1 million tonnes CO_2 per year
- To enhance Thailand as a leading exporter of carbon credits in Asia.

Actions

- Promote the wider use of flare gas, e.g. as a substitute for LPG in the production process of community products or as fuel in community-scale power generation
- Manage energy production to keep the level of flare gas at the minimum, or prepare to announce a Zero Flare policy, particularly for onshore petroleum sites
- Promote study and research on the carbon capture and storage (CCS) technology to compress and store carbon dioxide underground
- Conduct a feasibility study on the application of CCS technology in Thailand, and develop a pilot project for an operational trial.

3. Control and monitor the volatile organic compounds (VOC) emissions from petrochemical and refining industries to minimise the environmental impact.

Targets

- To control the VOC emissions of all factories to meet the standards
- To create low-cost 'appropriate technology' innovations which are environmentally friendly and easy to operate and maintain at a rate of at least five innovations per year, with support from the Energy Conservation Promotion Fund.

Actions

- Further implement the policy on vapor recovery units from four provinces to an additional seven provinces in areas where a large number of oil reserve depots are located
- Prepare for consultations with refineries regarding the enforcement schedule of the EURO 4 standards.

NOTABLE ENERGY DEVELOPMENTS

POLICY DEVELOPMENTS

In 2010, the Thailand Government announced expanded targets and goals relating to nuclear energy capacity, renewable energy and energy efficiency. Details of these are in the Policy Overview section.

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USEFUL LINKS

Department of Alternative Energy Development and Efficiency (DEDE)—www.dede.go.th

Electricity Generating Authority of Thailand (EGAT)—www.egat.co.th/en

Energy Policy and Planning Office (EPPO)—www.eppo.go.th

Ministry of Energy (MoEN)—www.energy.go.th/en

Prime Minister's Office—www.opm.go.th

UNITED STATES

INTRODUCTION

The United States (US) is the world's largest economy, with a GDP of USD 11.5 trillion (USD (2000) at PPP) in 2008 (EDMC 2010). The US spans 9.8 million square kilometres and has a population of 304 million people (2008) (CIA 2009, EDMC 2010). The population has grown steadily, at a rate near 1% per year, since 2000 (EDMC 2010).

The US enjoyed a long economic expansion from 1991 through to 2000. Growth was particularly robust from 1995 to 2000, averaging 4.1% per year in real terms. A brief recession slowed growth to 1.1% in 2001, but growth then gradually recovered to 3.6% by 2004, before slowing to 2.7% in 2006 (EDMC 2010). By the end of 2008, however, the US was caught at the centre of the global financial crisis, and real GDP declined 2.6% in 2009 (BEA 2010). Economic growth resumed in the third quarter of 2009, but unemployment reached 10.1% in 2009, the highest level in over 25 years. By late 2010 unemployment was at 9.6%, still well over the 2000–08 average rate of 5.1% (BLS 2010).

As at 2008, the US remained the largest importer and consumer of energy in the world, though some preliminary figures suggest China became the world's largest consumer in 2009 (EDMC 2010, IEA 2010). Despite its large imports, the US is rich in energy resources. At the end of 2008, it had 19.1 billion barrels of proven oil reserves, 6930 billion cubic metres of proven natural gas reserves and an estimated 237 billion tonnes of recoverable coal reserves (EIA 2010a, EIA 2010b). According to the US Department of Energy's Energy Information Administration (EIA), total (net summer) electricity generating capacity across all sectors was 1010 GW in 2008, of which 76% was fossil fuel, 10% was nuclear, 10% was hydro (conventional and pumped storage), 2.4% was wind, and 1.4% was other renewable energy (biomass, geothermal, solar etc) (EIA 2010c). The economy consumed 5.1 tonnes of oil equivalent per capita in 2007, over three times the APEC average (EDMC 2010).

Table 34 Key data and economic profile, 2008

Key data		Energy reserves[a]	
Area (sq. km)[b]	9 826 675	Oil (billion barrels)	19
Population (million)	304	Gas (billion cubic metres)	6 930
GDP (USD (2000) billion at PPP)	11 514	Coal (million tonnes) – recoverable	237 000
GDP (USD (2000) per capita at PPP)	37 870	Uranium (million tonnes) – recoverable[c]	0.472

a EIA (2010a, 2010b).
b CIA (2009).
c NEA (2010).
Source: EDMC (2010).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2008, total primary energy supply in the US was nearly 2292 million tonnes of oil equivalent (Mtoe). By fuel type, 37% of supply came from crude oil and petroleum products, 24% from coal, 24% from natural gas and 15% from nuclear, hydro, geothermal and other fuels. Net imports provided about 28% of the US primary energy requirement in 2008 (EDMC 2010).

In 2008, oil provided 851 Mtoe of the US primary energy supply. Though this represented a decline to pre-2000 levels, import dependence was still high. In 1990, 42% of crude oil and products demand was met by net imports, but the net import share had climbed to 60% by 2005, and declined only slightly to 57% in 2008 (EDMC 2010). About half of the imported petroleum in 2008 came from Canada, Saudi Arabia, Mexico and Venezuela (EIA 2010d). The US itself remained the third-largest crude oil producer in the world (EIA 2010e). Of the states, Texas, Alaska and California are the largest oil producers, and more than half of domestic reserves are in those three states (EIA 2010d).

The US primary natural gas supply totalled 543 Mtoe in 2008, of which 13% was met by net imports, almost all from Canada (EDMC 2010, EIA 2010f). Consumption growth was assisted by a period of falling wellhead gas prices following 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%. Then, amid high gas prices, primary gas supply declined at an average annual rate of 1.4% between 2000 and 2006. In 2005, power generation passed industry (including industry's non-energy gas use) to become the largest user of gas in the US and by 2007 total primary gas supply returned to within 1% of the 2000 peak (EDMC 2010). The fast growth of gas use by power producers has been driven in part by the fuel's low emissions compared with other fossil fuels.

Table 35 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	1 714 249	Industry sector	292 230	Total	4 369 099
Net imports and other	634 136	Transport sector	613 995	Thermal	3 100 961
Total PES	2 291 599	Other sectors	645 482	Hydro	281 995
Coal	545 764	Total FEC	1 551 707	Nuclear	837 804
Oil	850 809	Coal	26 859	Other	148 339
Gas	542 927	Oil	814 169		
Other	352 100	Gas	327 743		
		Electricity and other	382 937		

Source: EDMC (2010).

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

The US transports gas through an extensive pipeline network, with more than 492 384 kilometres of transmission pipeline and 6.1 billion cubic metres per day of transmission capacity (EIA 2007). Underground gas storage capacity in the US has grown only modestly since the 1980s, and total end-of-year storage volume stood at approximately 37% of annual consumption in 2008, compared with 45% in 1988 (EIA 2010f). Interest in liquefied natural gas (LNG) has grown in the US because of LNG's potential as a means to diversify overall energy supplies while fuelling relatively clean power generation, but proposals to construct new LNG receiving terminals on the east and west coasts have faced local public and regulatory opposition. Nevertheless, the EIA forecasts that net LNG imports to the US will grow from about 9 billion cubic metres in 2008 to 41 billion cubic metres in 2018 as pipeline imports from Canada decline. After 2018, increasing domestic production is forecast to reduce imports, an important departure from past EIA forecasts. Successful commercialisation of production from the economy's abundant shale gas resource is the main reason for the increased estimate of future production (EIA 2010g).

Primary energy supply of coal in the US totalled 546 Mtoe in 2008 (EDMC 2010). US coal reserves are concentrated east of the Mississippi River in Appalachia and in several key western states. Eastern coal, which accounted for 42% of production in 2008, is mainly high-sulphur coal from underground mines. Western coal, which accounted for most other production, is mainly

low-sulphur coal from surface mines (EIA 2010h). Western coal production, which first surpassed eastern production 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 (EIA 2010h, EPA 2008).

In 2008, the US was the fourth largest coal exporter in the world, behind Australia, Indonesia and Russia (EIA 2010e). After 1998, US coal exports dropped sharply due to lower world coal prices. In 2002, total US coal exports fell to 35.9 million tonnes, their lowest level since 1961. Since then, coal exports have recovered gradually, reaching 75.7 million tonnes in 2008. Europe took half of US coal exports, while Canada alone took more than one quarter (EIA 2010h).

The US produced 4.4 million gigawatt-hours of electricity in 2008; of that total, 71% came from thermal plants, 19% from nuclear power, 6.5% from hydropower and 3.4% from other sources (EDMC 2010).

The US generates more nuclear power than any other economy, but no new nuclear reactors have been ordered since 1977 (CRS 2007a). The Three Mile Island accident in 1979 raised concerns about nuclear power plant safety, while ad hoc regulatory responses to those concerns made some new plants very expensive; both factors deterred further expansion. In 2002, the average utilisation rate of the 104 operable commercial nuclear units (down from a peak of 112 units in 1990) rose to over 90%, where it remained through 2008 (EIA 2010h). Moreover, many nuclear plants have applied to the Nuclear Regulatory Commission (NRC) for 20-year extensions of their operating licences, to 60 years. By November 2010, the NRC had approved licence extensions for 59 nuclear reactor units and had applications for another 16 extensions under review, while 12 other units had informed the agency of their intention to seek extensions by 2017 (NRC 2010a).

Total renewable energy production in the US in 2008 was approximately 186 Mtoe, or 7.4% of total primary energy supply, according to the EIA. Production from non-hydro sources increased 13.6% from the previous year, and at an average annual rate of 7.9% since 2002. By consumption of renewable energy type, biomass as a whole represented 52% of the total, hydroelectric power 34%, geothermal 4.9%, wind 7.4% and solar 1.3% (hydroelectric, wind and solar power converted using fossil-fuelled plant heat rates). Of these, biomass used for biofuels (approximately 35 Mtoe consumption, 38% annual growth for ethanol and biodiesel combined) and wind power (approximately 13.7 Mtoe, 60% annual growth) experienced particularly rapid expansion (EIA 2010h). Government incentives, including subsidies and renewable energy mandates (discussed below), and cost reductions relative to fossil-fuelled alternatives spurred the growth of renewable energy production.

FINAL ENERGY CONSUMPTION

In 2008, total final energy consumption in the US was 1552 Mtoe, a decrease of 2.3% from the previous year. By sector, transport consumed 40%, industry accounted for 19%, and other sectors (including non-energy uses) consumed nearly 42%. By fuel, petroleum accounted for 52% of final consumption, natural gas 21%, coal 2%, and electricity and other fuels 25% (EDMC 2010).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

JURISDICTION AND POLICY

Within the US Government, jurisdiction over the production, transformation, transmission and consumption of energy is shared by several agencies in the executive branch. Supervision of the use of natural resources falls under the Department of the Interior. Energy-related research, development and deployment (RD&D) are under the auspices of the Department of Energy. The Federal Energy Regulatory Commission (FERC) oversees the interstate transmission of energy, and the Environmental Protection Agency (EPA) regulates the environmental impacts of energy transformations throughout the economy. The Department of Transportation (DOT) also plays an important role as the regulator of vehicle fuel economy. A new White House Office of Energy and Climate Change Policy was created in 2009 to coordinate some of the activities of these agencies.

While all of these federal agencies have some voice in energy policy, the US Congress is responsible for creating the laws that govern the activities of these agencies and set the rules for energy markets. Since the 1970s, several major legislative packages have been introduced to define US energy policy. The National Energy Act of 1978 included legislation to promote energy conservation, to shift towards alternative energy sources, to create a market for independent power producers, and to give FERC greater authority over natural gas markets (DOE n.d.) The Energy Policy Act of 1992 further opened electricity markets to competition; encouraged integrated resource planning by utilities; targeted improved energy management in federal agencies; promoted alternative transportation fuels; and required RD&D of technologies to enhance the production and efficient utilisation of renewable, fossil and nuclear energy resources (US House 1992).

In 2005, a new comprehensive Energy Policy Act (EPAct 2005) was introduced as the successor to the 1992 Act. This was followed shortly after by the Energy Independence and Security Act of 2007 (EISA 2007). Together, these recent legislative packages substantially define the current US federal energy policy. The American Recovery and Reinvestment Act of 2009 (Recovery Act) is also noteworthy for having dramatically increased the funding of many federal energy programs. Key elements of these recent acts are described in the following thematic discussions.

ENERGY SECURITY

Given the high dependence of the US on imported oil, policies meant to improve energy security have often focused on three areas: efficiency in the transportation sector, where more than 70% of oil products are consumed; enhancing domestic production of liquid fuels; and advancing transportation technologies that are less dependent on liquid fuels, such as hybrid electric vehicles.

EISA 2007 mandated a 40% increase in combined car and light truck fleet fuel economy (CAFE) standards by 2020, reaching 14.9 kilometres per litre (35 miles per gallon), and required study of commercial vehicle fuel economy (CRS 2007b). In 2009, the administration proposed a

plan to speed the introduction of the new CAFE standards. Under that plan, the EPA and the Department of Transportation's National Highway Transportation Safety Administration (NHTSA) jointly developed vehicle greenhouse gas (GHG) emissions standards and fuel economy standards that will increase average fuel economy from 11.6 kilometres per litre (27.3 miles per gallon) in 2011 to 14.5 kilometres per litre (34.1 miles per gallon) in 2016 (EPA and NHTSA 2009). Recently, the DOT and EPA have also announced plans to regulate the fuel efficiency of heavy duty vehicles beginning in 2014 (NHTSA 2010).

The 2005 EPAct promoted enhanced domestic production of oil by removing some regulatory barriers and offering incentives for production from deepwater resources, low-production wells and unconventional resources. One regulatory change was to exclude the underground injection of hydraulic fracturing fluids from regulation under the Safe Drinking Water Act, which cleared an obstacle to the exploitation of tight sand and shale hydrocarbon resources. In this Act, Congress also made a clear statement that development of unconventional oil resources should be encouraged in order to reduce US dependence on foreign oil imports (US Congress 2005).

Biofuels represent another avenue for improving US energy security and have received strong policy support. Development of vehicles powered by alternative fuels and biofuel production were promoted by the 2005 EPAct, but EISA 2007 brought biofuels to the forefront of US energy security policy. EISA mandated a fivefold 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. To meet environmental objectives, from 2016, new biofuel production towards the mandated target is to be derived from cellulosic or other advanced biofuels that reduce lifecycle greenhouse gas emissions by at least 50%. Most of the new biofuel is to be produced domestically, and the target includes provisions to reduce the required volumes if costs are judged too high or supplies are inadequate (CRS 2007b).

The Recovery Act sought to advance the commercialisation of electric vehicles by investing in facilities that manufacture batteries and other electric vehicle components. The government invested more than USD 2 billion in nearly 50 different electric vehicle and component manufacturing projects (DOE 2010a). Electric vehicles offer energy security benefits by shifting transportation energy demand from oil to electricity. Roughly half of US electricity is provided by coal-fired power plants, and coal is a domestically abundant resource and thus provides energy security benefits. However, coal's high CO_2 emissions present a challenge for US climate policy, which is discussed below.

ENERGY MARKETS

In 2007, US consumers spent an estimated USD 1.2 trillion on energy purchases and major US energy companies' domestic operations netted around USD 46 billion (EIA 2010h). The government plays many roles in this large market, including as owner of resources, regulator of industry, and supporter of research and development.

UPSTREAM DEVELOPMENT

The Department of Interior's Bureau of Land Management (BLM) administers over 2.8 million square kilometres of mineral estate, of which about 180 000 square kilometres is currently leased for oil and gas development (BLM 2010). The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), another office of the Department of Interior, leases another 174 000 square kilometres of offshore energy and mineral resources (BOEMRE 2010). The BLM and BOEMRE also lease public lands and offshore areas for the development of above-ground energy resources such as solar and wind. While the US Government plays a large role in leasing surface and mineral rights, it is not the sole owner of such rights. States and individuals also own and lease surface lands and underground mineral rights for energy extraction (BLM 2009).

Regulation of upstream development is shared by state and federal governments. In some cases, the division between state and federal is clear. For example, state oil and gas commissions prevent the waste of resources and protect public safety in state territory (IOGCC n.d.) In the federal offshore territory, offices of the Department of Interior exercise similar responsibilities. But such clear divisions are not always the case. For example, state offices of environmental protection monitor environmental impacts and enforce state environmental laws. At the same time, the EPA acts as a backstop on environmental issues, ensuring that, at minimum, upstream activities comply with such federal laws as the Clean Air Act and the Clean Water Act. In such cases where state and federal regulatory responsibilities overlap, coordinating the activities of state and federal agencies is an important task (EPA 2010a).

ELECTRICITY AND GAS MARKETS

The federal government regulates the interstate transmission of electricity and gas, as well as wholesale sales of electricity, under the Federal Energy Regulatory Commission (FERC). FERC's mandate is to 'ensure supplies of energy at just, reasonable and not unduly discriminatory or preferential rates'. In regulating wholesale electric power markets, FERC has implemented a policy of fostering competition (FERC 2008). This has meant granting open access to transmission lines and thereby allowing wholesale customers to meet their needs with purchases from any number of wholesale suppliers connected across a regional grid. Competitive wholesale electricity markets function using distinct models in different regions. Regional Transmission Organizations and Independent System Operators administer transmission networks and operate wholesale markets across a large part of the US and Canada. In other regions, bilateral contracting between consumer and supplier with separate contracting for transmission remains the norm (DOJ et al 2007).

Retail electricity markets are regulated by the states. There are thousands of retail electricity providers in the US and they operate under a variety of regulations. Most retail customers are served by regulated, investor-owned utilities (69%), but public power systems (14%) and cooperatives (12%) also serve millions of customers (DOJ et al 2007). State regulators ensure that these providers serve their customers at rates that are 'fair, reasonable and non-discriminatory' (NARUC 2009). In the 1990s, many states began to explore options for restructuring retail electricity markets to create competition among electricity providers while continuing to regulate distribution networks as natural monopolies. Fifteen states now allow some customers a choice of electric service provider, but efforts to deregulate retail electricity markets slowed when, in 2000 and 2001, California's newly deregulated retail market proved vulnerable to abuse, leading some customers' bills to quickly triple and forcing some distribution utilities into bankruptcy (EIA 2010i, DOJ et al 2007).

Natural gas markets are similar to electricity markets, with competitive wholesale markets supplying federally regulated transmission pipelines, delivering into state regulated distribution networks. The Federal Energy Regulatory Commission once set natural gas prices, but wellhead prices were fully deregulated in 1993. Now FERC's pricing activities for natural gas are limited to determining pipeline rates for gas transmission. The Department of Transportation's Pipeline and Hazardous Materials Safety Administration regulates gas transmission pipelines to ensure they are operated safely. Pricing and safety on natural gas distribution networks is regulated by state agencies (FERC n.d., EIA 2009a).

RESEARCH AND DEVELOPMENT

The scope of energy-related research and development (R&D) supported by the US Government has expanded from a focus on nuclear energy and basic science in the 1960s to include fossil fuels, energy efficiency, renewable energy and carbon sequestration. Much of this expansion occurred in the immediate aftermath of the 1973 oil crisis. In the five years following the crisis, energy R&D spending more than tripled. New support for fossil energy, renewable energy, and efficiency absorbed much of the increase. Though the amount of spending then declined sharply during the 1980s, the broader scope was preserved (Dooley 2008).

The Department of Energy (DOE) is the lead agency for research and development activities. The DOE funds 21 laboratories and technology centres, as well as research conducted at universities across the US. Currently supported research ranges from particle physics to pilot projects for carbon capture and sequestration (DOE 2010b). The total government spending for energy-related research and development had remained relatively stable since the 1990s at around USD 3 billion a year (constant 2005 dollars) (Dooley 2008). The Recovery Act changed this by investing billions more in R&D facilities, pilot projects and the new Advanced Research Projects Agency for Energy (DOE 2010c). However, the Recovery Act was a one-time economic stimulus and R&D spending may soon return to previous levels. Some US business leaders have argued that to confront the energy challenges that the US faces, the government should more than triple spending on clean energy research and development (AEIC n.d.)

FISCAL REGIME AND INVESTMENT

US fiscal policy is quite complex, particularly as it relates to the energy sector. This section provides a limited introduction to the taxation of energy commodities and to the multitude of fiscal incentives that shape energy-related investments. Energy producing businesses are taxed like other US corporations, at a maximum statutory federal rate of 35%, while state rates range from 0% to 10%. However, tax rules result in very different effective tax rates (CBO 2005). A detailed discussion of the taxation of energy businesses is beyond the scope of this overview, but some provisions specifically related to energy investments are described here.

Royalty payments on production of oil, gas and coal are paid to the owner of mineral resources, which is often the government. The US Office of Natural Resources Revenue collected USD 7.6 billion in royalty payments in 2009 (ONRR 2010). Downstream, sales of some important energy commodities, such as gasoline and diesel, are taxed by state and federal governments. The federal tax on gasoline is about USD 0.49 per litre (18.6 cents per gallon) and on diesel is USD 0.64 per litre (24.4 cents per gallon). On average, state taxes on these fuels are similar to the federal taxes, but there is considerable variation among the states (API 2010). Some states have also introduced a 'public goods charge' on retail electric and natural gas sales, the proceeds of which go to funding energy efficiency programs.

A variety of tax breaks have been introduced by the federal and state governments to promote investments in energy-related infrastructure. Two key federal instruments are investment tax credits and production tax credits. Investment tax credits allow taxpayers investing in certain qualified energy facilities to reduce their tax burden by some fraction of the amount invested. Production tax credits similarly reduce a taxpayer's tax burden, but in an amount proportional to the energy production of the facility over a defined period. The types of facilities qualifying for investment tax credits range from coal gasifiers to hydrogen refuelling stations. Products eligible for production tax credits range from certain coal-derived fuels to electricity produced from wind energy. The two most expensive energy-related federal tax provisions are estimated to be the deductions allowed for oil and gas exploration and development, and for depletion of oil and gas properties. These are followed by the production tax credit for wind and a deduction for refiners (Joint Committee on Taxation 2009).

Tax credits for investments in renewable energy or in energy-efficient home improvements are also available to individuals. At the state level, reduced sales and property tax rates are often granted to preferred energy technologies (DSIRE 2010). Some of these incentives are described in the following sections on energy efficiency and renewable energy.

ENERGY EFFICIENCY

Incentives to promote energy efficiency exist at federal, state and local levels. Federal tax credits and loans support residential efficiency improvements. Taxpayers may claim a tax credit for up to 30% of the cost of a residential efficiency measure through the end of 2010. Homeowners can also obtain loans from the federal government to finance energy-efficiency measures in new or existing homes (DSIRE 2010). Much of the Recovery Act allocation for

energy efficiency will be distributed through state energy programs that provide loans, grants and other assistance for energy-efficiency projects in homes, businesses and public facilities (CRS 2009). Locally, utilities are generally required to consider energy efficiency on an equal basis to new generation in their planning, and many utilities administer demand-side management programs that provide incentives and technical assistance to reduce demand for electricity and natural gas (DSIRE 2010, US House 1992).

RENEWABLE ENERGY

The production of wind, geothermal, bioenergy and marine power is currently eligible for a Federal Renewable Energy Production Tax Credit (PTC) of USD 0.021 per kilowatt hour (inflation-adjusted for 2009), generally for a period of 10 years. This credit has historically been renewed and adjusted by Congress every few years, and this process has led to boom–bust cycles in new renewable energy (NRE) investment, particularly in the wind industry, as the credit has been allowed to expire on a few occasions. Thus, an important provision of the Recovery Act was the extension of PTC eligibility for wind facilities through 2012, and for other eligible facilities through 2013. Another significant change under the Recovery Act is that new NRE facilities may select either the PTC, a 30% business energy investment tax credit (ITC) or, for a limited period, a cash grant equal to the value of the ITC. Manufacturers of renewable energy technologies are also eligible for tax credits under the Recovery Act to offset investments in new or expanded manufacturing capacity (DSIRE 2010).

New solar facilities do not qualify for the PTC as a result of the 2005 EPAct, but they are eligible for the ITC. A related individual tax credit of 30% is available for residential solar electric system expenditures without cap, as are similar tax credits for residential small wind and geothermal systems. Several federal loan and loan guarantee programs also exist to encourage the development of renewable energy and other advanced energy facilities (DSIRE 2010).

Many state and local governments have in place financial measures that complement federal incentives for NRE investment. In addition to subsidies, state legislation has also provided significant indirect incentives for NRE development through the establishment of policy frameworks such as renewable portfolio standards (RPS), which mandate that a certain share of electricity sales be sourced from renewable energy. Forty-two states and the District of Columbia had enacted RPS legislation, with varying degrees of stringency, by the end of 2010. Other measures have also been introduced to support NRE development, such as generation disclosure rules, mandatory utility green power options and the use of public benefit funds (DSIRE 2010).

NUCLEAR

The US Government has partnered with industry to support research, development and deployment of nuclear energy for civilian applications since the Atomic Energy Act of 1954 (NRC 2010b). This partnership yielded a domestic fleet of commercial nuclear reactors that in 2010 remained the largest in the world (IAEA 2010). Since the Energy Reorganization Act of 1974, responsibility for the development and promotion of nuclear energy has been held by the Department of Energy, and regulatory oversight of the industry has been provided by the Nuclear Regulatory Commission. The federal government is also required to provide a site for the permanent disposal of high-level radioactive waste, with disposal costs to be paid by nuclear operators. However, a suitable site remains to be found (NRC 2010b).

Support for the nuclear industry has continued under recent legislation. The 2005 Energy Policy Act included several provisions considered important to revitalising the domestic nuclear power industry. It extended the Price–Anderson Act limiting the legal liability of nuclear operators, introduced loans to cover costs incurred by legal or regulatory project delays, and established a public–private project to design and construct a pilot Next Generation Nuclear Plant. The Act also continued support for nuclear energy research and development and established a loan guarantee program intended to improve access to financing for new nuclear

plants and other projects that reduce air pollution emissions or introduce new technologies (US Congress 2005).

The US also participates in international efforts to develop safe and reliable nuclear energy for civilian use through the Global Nuclear Energy Partnership (GNEP) and the Generation IV International Forum (GIF). GNEP was established in 2007 and now has 25 partner economies. The partnership 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 economies so they do not need to develop uranium enrichment or spent-fuel reprocessing capabilities (GNEP 2009). GIF, established in 2001, is a US-led multilateral partnership fostering international cooperation in R&D for the next generation of nuclear energy systems. The 13 member states of GIF work together to address several remaining challenges to the increased use of nuclear energy, including management of fuels and wastes, reliability and cost, safety, and proliferation risks (GIF n.d.)

CLIMATE CHANGE

The US pledged to reduce economy-wide GHG emissions 'in the range of 17%' by 2020 from 2005 under the 2009 Copenhagen Accord. However, this pledge also states that the final US target will be determined by domestic legislation (Department of State 2010). To date, no climate legislation has been passed by Congress, so an economy-wide emissions goal has yet to be conclusively defined. Nonetheless, the administration has declared its commitment to reducing GHG emissions, and state and local governments have developed their own goals and action plans.

GREENHOUSE GAS ENDANGERMENT FINDING

There are two ways that GHGs may be regulated at the federal level in the US. First, Congress may pass legislation to control GHG emissions. Alternatively, the EPA may issue a ruling (an 'endangerment finding') that carbon dioxide poses a danger to human health and should therefore be regulated under existing air quality legislation. The former solution offers a more flexible approach to reducing emissions. However, a 2007 decision by the Supreme Court judged that GHGs are pollutants that should be covered under the Clean Air Act. This decision required the EPA to determine whether or not to issue an endangerment finding. In December 2009, the EPA issued an endangerment finding. The finding gives the EPA the authority to issue rules to limit GHG emissions (EPA 2009). So far, EPA has used this authority to move forward vehicle emission standards and to define GHG permitting requirements for large emitters (EPA 2010b).

STATE AND CITY LEVEL CLIMATE CHANGE INITIATIVES

In the absence of an economy-wide plan to reduce US GHG emissions, a number of regional, state and city level initiatives have been formed and were active in 2010.

In California, the Global Warming Solutions Act (AB 32) was signed into law in September 2007. 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 sets a mandatory state-wide GHG emissions cap equal to 1990 levels by 2020, with penalties for non-compliance (COG 2007). In December 2008, the California Air Resources Board approved the implementation of a climate action plan, which includes regulations, market mechanisms, voluntary actions and other measures, with the option of adopting a cap-and-trade program in the 2012–20 period (ARB 2008).

Ten states in the north-eastern US are members of the Regional Greenhouse Gas Initiative (RGGI). This initiative has a narrower scope than the California plan, focusing on reducing carbon dioxide emissions from the power sector by 10% by 2018. The first permit auction for the cap-and-trade system was conducted in September 2008, and the first three-year compliance period began in January 2009 (RGGI 2009). Six New England states are also party to the New England Governors/Eastern Canadian Premiers Climate Change Action Plan, whose 11 members have resolved to reduce the region's GHG emissions to 10% below 1990 levels by 2020 (NEG and ECP 2008).

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 that might be used to achieve them (MGA 2007). A host of other regional initiatives focused on climate change or clean energy have now also been formed across US and Mexican states and Canadian provinces, including the Western Governors 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, aiming for 15% below 2005 levels by 2020) (WCI 2007). These regional initiatives represent attempts to actively collaborate on goal setting and the development of action plans. Except for the RGGI in the north-east, all the initiatives are still in the design phase.

Municipal governments have undertaken other GHG initiatives, notably the US Mayors' Climate Protection Agreement, launched in Seattle in 2005. By December 2009, there were 1016 signatories to the voluntary agreement, under which US mayors 'strive to meet or beat the Kyoto Protocol targets in their own communities', urge state and federal governments to meet the US Kyoto Protocol GHG emissions targets, and commit to taking actions within their own communities that will help to meet or beat Kyoto Protocol targets (USCM 2009).

FUTUREGEN INITIATIVE

FutureGen is a public–private partnership undertaken by the US Department of Energy and the FutureGen Industrial Alliance that focuses on the sequestration of carbon dioxide from coal-fired power plants. When it was first announced in 2003, its aim was to build a single smaller-than-commercial scale demonstration of a near-zero emissions power plant that could produce electricity and hydrogen from coal and serve as a laboratory for further R&D. Construction was scheduled to begin in 2009 on a plant using integrated gasification combined cycle technology. The initiative has since been restructured and a project to retrofit an existing unit with oxy-combustion technology is now proposed. The Department of Energy awarded USD 1 billion in funding, made available through the Recovery Act, to support the retrofit project (DOE 2009, DOE 2010d).

NOTABLE ENERGY DEVELOPMENTS

CLEAN ENERGY MINISTERIAL

In September 2007, the US convened the first Major Economies Meeting on Energy Security and Climate Change, hosting representatives from 17 developed and developing economies to set goals for reducing GHG emissions and establishing mid-term targets (White House 2007). Similar meetings continued in 2009 as part of the Major Economies Forum on Energy and Climate (White House 2009), and in 2010, the US hosted representatives of 24 economies at a Clean Energy Ministerial. The participants of the Clean Energy Ministerial together launched 11 initiatives designed to increase the spread of clean energy technologies (DOE 2010e).

THE GULF OIL SPILL

On 20 April 2010, the blowout of a well being drilled by BP in the Gulf of Mexico caused an explosion on the Deepwater Horizon drilling rig. The accident killed 11 workers and the millions of barrels of oil that poured from the damaged well over the next three months caused considerable environmental damage (DOI 2010a). In response to this accident, the government imposed a moratorium on drilling and reorganized the office of the Department of Interior responsible for oversight of offshore drilling. Previously, the Minerals Management Service of the Department of Interior provided safety and environmental oversight, as well as revenue collection. The reorganization separated those activities into three new offices: the Bureau of Ocean Energy Management, Regulation and Enforcement; the Bureau of Safety and Environmental Enforcement; and the Office of Natural Resources Revenue (DOI 2010b). After this reorganisation was completed and new rules were introduced to improve the safety of drilling operations, the moratorium was lifted in October 2010 (DOI 2010c).

HEAVY DUTY VEHICLE EMISSION STANDARDS

The Environmental Protection Agency and National Highway Traffic Safety Administration recently proposed the first fuel economy standard for heavy duty vehicles. In the absence of such standards, the fuel economy of heavy duty trucks has changed very little in the past four decades (EIA 2010h). The proposed rules are expected to reduce the fuel consumption of heavy duty vehicles by 10–20% between 2014 and 2018, depending on the type of vehicle. Based on projected fuel savings, vehicle owners are expected to recover the additional upfront costs of the more efficient vehicles in one to five years (NHTSA 2010).

RECOVERY ACT PROGRAMS

Of the USD 32.7 billion in funding authorised for energy under the 2009 Recovery Act, USD 32.6 billion has been awarded to specific projects/recipients, and USD 8.9 billion has been spent. More than USD 1.8 billion has been spent through the Weatherization Assistance Program, which invests in energy efficiency improvements for the homes of low-income families. Other large investment programs are the State Energy Program and the Energy Efficiency and Conservation Block Grant Program, which fund state and community projects to improve energy efficiency and to address other energy goals. More than 5000 separate funding awards had been made through November 2010 (DOE 2010c). The EIA estimated that the provisions of the Recovery Act would result in over 50% more generation of renewable electricity (excluding hydro) in 2012, as well as efficiency measures that reduce residential and commercial energy expenditures by 2.6% in 2020 (EIA 2009b).

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VIET NAM

Introduction

Viet Nam is in South-East Asia; it shares a border with Cambodia and Laos to the west and China to the north. The Gulf of Tonkin lies to the east, the Gulf of Thailand to the south. Viet Nam has an area of 331 212 square kilometres, and a marine exclusive economic zone stretching 200 nautical miles from its 3260 kilometre coastline. In 2008, Viet Nam's population was 85.12 million. Market-oriented reforms since 1986 and rapid economic development have transformed the economy of Viet Nam. In 2008, Viet Nam had a GDP of USD 196.31 billion and an income per capita of USD 2277 (both in USD (2000) at PPP). GDP grew at an average annual rate of 7.6% from 2000 to 2008.

The government set targets for average annual GDP growth of 7.5% from 2005 to 2010, based on export growth increasing by 16% per year, total annual capital investment in the economy reaching around 40% of GDP, and population growth staying under 1.1%. However, due to the economic recession in 2008 and 2009, the government's targets for the annual average GDP growth rate for 2005–10 have been reassessed down to 7%.

In January 2007, Viet Nam joined the World Trade Organization, taking the organisation's membership to 150.

Energy contributes greatly to Viet Nam's economic development, supporting industrial growth and generating foreign revenue from exports. Viet Nam is relatively rich in diverse fossil energy resources, such as oil, gas and coal, as well as renewable energy such as hydro, biomass, solar and geothermal. Viet Nam's proven energy reserves consisted of 615 million tonnes (Mt) of oil, 600 billion cubic metres (bcm) of gas, 5883 Mt of coal, and a hydropower potential of 20 000 megawatts (MW). Natural gas and crude oil are found mainly offshore in the southern region, while coal reserves (mainly anthracite) are in the northern region. Since 1990, Viet Nam has become a net energy exporter; its main energy exports are crude oil and coal.

Table 36 Key data and economic profile, 2008

Key data		Energy reserves	
Area (sq. km)	331 212	Oil (million tonnes)[a]	615
Population (million)	85.12	Gas (billion cubic metres)[a]	600
GDP (USD (2000) billion at PPP)	196.31	Coal (million tonnes)	5883
GDP (USD (2000) per capita at PPP)	2 277		

a Proven reserves as at 2005 – the most recent official data available.

Sources: EDMC (2010); General Statistics Office (2009).

Energy demand and supply

PRIMARY ENERGY SUPPLY

Viet Nam's total commercial primary energy supply (TPES) in 2008 was 35 331 kilotonnes of oil equivalent (ktoe), an increase of 10.1% from 32 062 ktoe in 2007. By energy source, 41% of this came from oil, 34% from coal, 18% from natural gas and 7% from other resources.

Viet Nam's proven oil reserves of 615 Mt in 2005, the latest year for which figures are available, are likely to increase following increased exploration activity. Crude oil production has grown rapidly, from only 2530 ktoe in 1990 to 15 172 ktoe in 2008. From 2000 to 2008, oil production and exports grew at an average annual rate of 8%. Viet Nam has 14 producing

oilfields: Bach Ho, Rong, Dai Hung, Rang Dong, Ruby, Emerald, Su Tu Den, Bunga Raya, Bunga Tulip, Ca Ngu Vang, Phuong Dong, Song Doc, Cendor and Bunga Kekwa fields (PVN 2009).

Most oil exploration and production occurs offshore in the Cuu Long and Nam Con Son basins. Viet Nam did not have its own refinery in 2008, and all crude oil production was exported. The economy imports most of its petroleum products, but the Dung Quat refinery in Quang Nam province (capacity 150 000 barrels per day) has been in operation since February 2009, providing around 6.5 Mt of petroleum products annually for domestic consumption (Vietnam News 2009).

Oil product imports increased from 4713 ktoe in 1995 to 14 757 ktoe in 2008 at an average annual growth rate of 9.2%. Oil is still the most important energy source in Viet Nam, accounting for 41% of the economy's primary supply in 2008, compared to 45% in 2007.

Viet Nam's gas reserves are more promising than its oil reserves. In 2005, the latest year for which figures are available, proven gas reserves were estimated at 600 bcm, although that figure is likely to increase as more oil and gas are discovered. Gas resources are found in many parts of Viet Nam, but large gas reserves are almost all found in offshore basins.

A 160-kilometre pipeline from the Bach Ho field has been operating since 1995; associated gas is gathered and transported to shore to fuel power plants. Associated gas from the Bach Ho and Rang Dong oilfields has a capacity of 2 bcm per year and is capable of supplying 1.7 bcm of dry gas, 350 000 tonnes of liquefied petroleum gas and 130 000 tonnes of condensate annually for domestic use. The gas development complex at Lan Tay field in Block 06.1 of the Nam Con Son Basin has an output of 2.7 bcm per year and a gas pipeline 400 kilometres long with a maximum capacity of 7.5 bcm per year; phases 1 and 2 of this were completed in November 2002 and October 2008, respectively. In addition, phase 1 of a gas pipeline system from the PM3-CAA gas fields to Camau, supplying gas to a power plant–fertiliser manufacturing complex, was completed in 2008 (this complex is expected to be fully completed in 2012). Thus, from 2008, Viet Nam's total gas supply was 6.8 bcm per year, which was capable of supplying enough gas to the Camau power plants and the Phu My power generation plant, both of which have a generating capacity of 6000 MW. The share of natural gas in the total primary energy supply increased from 186 ktoe (2%) in 1995 to 6408 ktoe (18%) in 2008. The largest increase in gas use has come from power generation.

Viet Nam has two large coal fields. In Quang Ninh Province in northern Viet Nam, where anthracite coal is found, there are about 5.83 billion tonnes of reserves at a depth of 300 metres, and over 10 billion tonnes at a depth of 1000 metres. In the Red River delta there is a brown (sub-bituminous) coal basin with reserves of hundreds of billions of tonnes. Survey work has been ongoing for that basin, which Viet Nam will use foreign investment to mine in the next 10 years. Viet Nam's commercial coal production increased steadily from 4.6 Mt in 1990 to 38.6 Mt in 2008, matched by a growth in exports and domestic demand. In 2008, Viet Nam exported 17.2 Mt, a decrease of 5 Mt compared to 2007. Over 50% of coal production in 2008 was exported to China, Japan, Korea, Chinese Taipei, Thailand, France and other economies. Primary coal supply increased by 12.5% per year from 2000 to 2008, from 4372 ktoe to 12 017 ktoe.

Electricity generation increased at an average annual rate of 13.4% between 2000 and 2008, from 26.562 terawatt-hours (TWh) in 2000 to 73.017 TWh in 2008. The structure of primary energy use in Viet Nam's power plants has changed drastically within the past decade. Oil product use in generation decreased substantially, while the share of gas in electricity generation increased from 7.6% of total generation in 1995 to 48% in 2008. The share of coal declined from 33% in 1995 to 16% in 2008. In the meantime, hydropower decreased from 72% of total generation to 36% in 2008 due to the rapid expansion of natural gas use and foreign companies becoming increasingly involved in the growing power market of Viet Nam. In 2008, the economy's installed generating capacity was 15 763 MW; of that total, 69% was managed by Viet Nam Electric Power Group (Electricity of Viet Nam, or EVN) and 29% was managed by others. In addition, more than 3200 GWh was imported from China.

Table 37 Energy supply and consumption, 2008

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	46 997	Industry sector	11 244	Total	73 017
Net imports and other	–10 622	Transport sector	9 863	Thermal	47 013
Total PES	35 331	Other sectors	7 312	Hydro	25 986
Coal	12 017	Total FEC	28 479	Nuclear	–
Oil	14 394	Coal	8 289	Other	–
Gas	6 408	Oil	13 806		
Other	2 512	Gas	540		
		Electricity	5 844		
		Other	14 848		

Source: EDMC (2010).

For full details of the energy balance table see: APEC Energy Statistics 2008 (2010)

FINAL ENERGY CONSUMPTION

In 2008, Viet Nam's total commercial final energy consumption (TFEC) was 28 479 ktoe, up 11.3% from 2007. By fuel source, oil contributed the largest share (48%), followed by coal (29%), electricity and others (21%) and gas (2%). Between 2000 and 2008, consumption of electricity grew rapidly, at an annual growth rate of 11%.

Industry remains one of the biggest energy consumers, accounting for 44% of final energy consumption in 2008. The steel, construction materials, pulp and paper and fertiliser manufacturing industries consumed the most energy. From 2000 to 2008, the annual average growth rate of energy consumption in industry was 13%.

The transport sector's share was 30.4% in 2008 compared 31.7% in 2007. Oil products (diesel, gasoline and fuel oil) are mainly used in transportation.

Other sectors (electricity, excluding biomass) consumed 21.6% of Viet Nam's TFEC, a slight change compared with 2007.

Policy overview

ENERGY POLICY FRAMEWORK

The Ministry of Industry and Trade (MOIT) was formed after the merger of the Ministry of Industry and the Ministry of Trade. MOIT is in charge of activities related to the energy sector and other industries, in accordance with Decree 189/2007/ND-CP issued by the Prime Minister on 27 December 2007.

MOIT is responsible for the state management of all energy industries, including electricity, new renewable energy, coal, and the oil and gas industries. It is in charge of the formulation of law, policies, development strategies, master plans and annual plans for those sectors, and submits them to the Prime Minister for issuance or approval. The ministry is also responsible for directing and supervising the development of the energy sector and reporting its findings to the Prime Minister.

Inside MOIT, the Energy Department administers the Viet Nam Electric Power Group (EVN), the Viet Nam National Coal and Mineral Industries Group (Vinacomin) and the Viet Nam Oil and Gas Group (PVN).

Many other ministries also have responsibilities relating to energy. The Ministry of Planning and Investment sets the Socio-economic Development Strategy and Plan, coordinates the distribution of economy-wide capital investment among projects submitted by ministries and agencies, and distributes foreign direct investment. The Ministry of Finance has jurisdiction over tariffs and taxation related to energy activities. The Ministry of National Resources and Environment plays an important role in research and development in energy and environmental protection.

The National Energy Development Strategy was approved by the Prime Minister in December 2007. The strategy set up the following main targets for energy development (PMVN 2007a):

- Ensuring sufficient supply of energy to meet the demands of socioeconomic development, in which primary energy is expected to reach 47.5–47.9 Mtoe in 2010, 100–110 Mtoe in 2020 and 310–320 Mtoe in 2050
- Ensuring the phased development of refineries to meet domestic demand for petroleum products, and increasing the capacity of refineries to about 25–30 Mt of crude oil in 2020
- Ensuring strategic oil stockpiling adequate for 45 days in 2010, 60 days in 2020 and 90 days in 2025
- Achieving a share of renewable energy in the total commercial primary energy supply of 3% in 2010, 5% in 2025 and 11% in 2050
- Completing the rural energy program for rural and mountainous areas, and increasing the proportion of rural households using commercial energy to 50% in 2010 and 80% in 2020
- Changing the electricity, coal and oil–gas sectors to operate in competitive markets with state regulation; establishing a competitive electricity retail market in the period after 2022; establishing a coal and petroleum product business market by 2015
- Actively preparing the conditions for putting the first unit of a nuclear power plant into operation in 2020, and then growing nuclear power in the economy's energy structure (by 2050, nuclear electricity will account for about 15%–20% of total commercial energy consumption).

ENERGY SECURITY

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 places priority on ensuring that energy supplies are adequate to meet the needs of a growing population and to support socioeconomic development.

Beyond 2015, Viet Nam expects a transformation from being a net energy exporting economy to being a net importing economy. This inevitable change requires special consideration of energy security policies and the preparation of a long-term policy to ensure the supply of energy.

The economy needs to overcome many challenges to ensure energy security: oil products will still have to be imported, although Viet Nam's first oil refinery was completed in 2009; the economy currently has no strategic oil stockpiling in place; the power sector is still in the early stages of reform; electricity shortages still occur; and power systems operate without adequate reserves. Investment in energy development, especially in electricity generation, is insufficient to meet the rapid growth in demand. In the coal sector, there are still many challenges: the need for greater environmental protection, declining coal reserves, and the need to develop new coal reserves and supply infrastructure to meet the increasing demand. Although the potential for oil and gas discoveries is high, the size of those reserves is relatively small. In addition, relatively large oilfields that are in production (such as Bach Ho, Block 06.1 and other fields) are in decline, and are estimated to be depleted within the next 10 to 15 years.

To lessen dependency on oil product imports and to ensure energy security, Viet Nam is implementing the following policies (PMVN 2007a):

- Strengthen domestic energy supply capacity through legislative reforms and the expansion of infrastructure
- Apply preferential policies for financing and widen international cooperation to strengthen the exploration and development of indigenous resources, thereby increasing reserves and the exploitability of oil, gas, coal and new and renewable energy
- Strengthen the exploitation and use of domestic energy resources to reduce dependence on imported energy that is prone to price volatility, especially petroleum
- Improve energy efficiency, reduce energy losses and implement extensive measures for the conservation of energy
- Support Viet Nam's oil companies to invest in exploration and the development of oil and gas resources overseas
- Intensify regional and international energy cooperation and diversify energy import sources
- Develop clean fuels, especially nuclear and new and renewable energy.

ENERGY MARKET

POWER SECTOR

Electricity of Viet Nam (EVN) is a state-owned utility founded in 1995 and now called Viet Nam Electric Power Group. The group is engaged in the generation, transmission and distribution of electricity for the whole of Viet Nam. EVN is responsible for electricity supply to support economic development and to provide power to meet the consumption needs of the people. EVN also has the key responsibility of ensuring investments in power generation and network expansion meet the power demand in the economy. Apart from EVN, other companies are also responsible for much of this, supplemented by the Build–Operate–Transfer and independent power producer schemes run in partnership with private investors. In 2008, 30% (23 080 GWh) of the power supply system in Viet Nam was owned by companies other than EVN.

The Electricity Law, approved by the Viet Nam National Assembly, came into effect in July 2005. The law outlines the major principles for the establishment of the power market in Viet Nam. The Prime Minister's Decision No. 258/2005/QD-TTg clearly stipulates the functions, duties and organisation of the Electricity Regulatory Authority of Viet Nam (ERAV) (PMVN 2005a). ERAV's main function is to assist the Minister for Industry and Trade in implementing regulatory activities in the electricity sector; to contribute to a market that is safe and stable, and provides a high-quality supply of electricity; to foster the economical and efficient consumption of electricity; and to uphold the equity and transparency of the sector in compliance with the law.

In January 2006, the Prime Minister approved the development of a competitive electricity market that attracts investment from foreign and domestic companies operating in the electricity sector (PMVN 2006a). Under this legislation, Viet Nam's power market will be established and developed through three levels, each of which will be implemented in two steps:

- Level 1 (2005–2014): a competitive generation power market will replace the current monopoly and subsidised power
- 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 aims of the legislation are to reinforce the effects of production and business activities within the electricity sector, to decrease upward pressure on electricity prices, to ensure

the stable supply of reliable electricity and an increase in quality over time, and to ensure the robust development of the electricity sector.

As part of the reform of the electricity sector, EVN has been proceeding with plans to corporatise member enterprises since the early 2000s. So far, the restructuring of the generating and distributing companies has been completed. However, under this process, big hydropower plants (including Hoa Binh, Tri An and Yaly), nuclear power plants, and four existing power transmission companies will remain under the management of EVN.

COAL SECTOR

The Prime Minister's Decision No. 199/2005/QD-TTg transformed the state-owned Viet Nam National Coal Corporation (Vinacoal) into the new Viet Nam National Coal and Mineral Industries Group (Vinacomin), which operates in the form of a holding company and is Viet Nam's first state-owned enterprise with diversified business interests (PMVN 2005b). Vinacomin has been formed by restructuring Vinacoal 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.

In July 2008, the Prime Minister approved the Viet Nam Coal Development Strategy to 2015, with an outlook to 2025 (PMVN 2008a). One of the main aims is to speed up the corporatisation of coal production companies and the creation of a coal market with diversified ownership and business activities.

OIL AND GAS SECTORS

The Prime Minister approved a scheme to form the Viet Nam Oil and Gas Group (PVN) in August 2006 by reorganising the core business and its subsidiary units. PVN has multiple owners, but the government holds the dominant share.

The restructured PVN comprises four businesses, which will hold 100% of the assets: the Petroleum Exploration and Production Corporation, the Gas Corporation, the Electricity Production and Trading Corporation (established when Viet Nam National Oil and Gas Group power plant investments come into operation), and the Oil Refining and Petrochemical Corporation (established when the group's refining and petrochemical plants come into operation). PVN also includes joint stock companies, joint venture enterprises, scientific and technological enterprises, and training organisations.

In the area of exploration and production, foreign companies active in the market mostly operate through production sharing contracts or joint operating contracts with PVN. The international players are companies such as JNOC, KNOC, Shell, Total, BP, Mobil, ConocoPhillips and Unocal (now Chevron).

FISCAL REGIME AND INVESTMENT

POWER SECTOR

According to the national electricity development plan for the 2006–25 period approved by the Prime Minister in July 2007, the electricity sector needs a total investment of around USD 108.7 billion through to 2025; around USD 72.4 billion of that amount will be invested in power generation and the rest in the electricity transmission and distribution network. The capital is sourced from EVN and other domestic state-owned companies, foreign direct investment, the government's annual budget and loans. The plan also contains a list of power plants to be put into commercial operation during the 2006–15 period (PMVN 2007b).

OIL AND GAS SECTOR

Upstream

PVN has begun to expand its activities overseas, which include 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. PVN plans to speed up exploration work inside and outside the economy in a bid to accomplish the target of increasing access to reserves.

PVN strives to attract more foreign investment in exploration and seeks greater opportunities to invest in foreign economies and to increase the construction speed of key projects, such as the Dung Quat oil refinery, the Ca Mau gas–electricity–fertiliser complex, and the gas pipeline linking Phu My District in Ba Ria–Vung Tau province with Ho Chi Minh City.

Regulations on direct investment abroad in the oil and gas sector by Viet Nam-based foreign investors have been stipulated in a Decree signed by Viet Nam's Prime Minister in July 2007 (PMVN 2007c). The regulations contain detailed provisions on investment procedures and the state management of direct offshore investment in the oil and gas sector, as well as the implementation of oil and gas projects overseas. The new regulations are applicable for limited liability companies, partnership and private companies, state-owned companies, foreign-invested companies, cooperatives, household businesses and individuals.

Viet Nam has started 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, and the project is expected to be operational after 2010. For the long-term security of gas supply, the connection between Viet Nam and the Trans-ASEAN Gas Pipeline is within the framework of cooperation. Gas could be imported via this gas network.

Downstream

The construction of Viet Nam's first oil refinery, the Dung Quat Refinery, began in June 2005 and the refinery was in operation in 2009. The refinery is designed to have a capacity of 6.5 Mt of oil per year, sufficient to produce 33% of the economy's entire demand for petroleum products.

Although Viet Nam has exported crude oil for the past two decades, its petrochemical industry is still only in its preparatory phase. Almost all fuel and other oil products consumed have to be imported, as the Dung Quat Refinery does not yet meet domestic demand. This constraint is considered a potential threat to energy security in particular and to the economic stability of the economy in general. According to the development strategy for the oil and gas industry, Viet Nam plans to build three oil refineries with a total capacity of about 20 Mt of crude oil.

Four petrochemical centres will be completed by 2020. Three will be combined with oil refinery plants and the other, in the western area of the south of Viet Nam, will use natural gas resources in the area to produce fertiliser and other products from ammonia.

COAL SECTOR

The government of Viet Nam has at times, in the interests of economic stability, requested Vinacomin supply coal to the market at below cost price. This subsidising has had a positive impact on the development of industries that are fuelled by coal, but it has also resulted in reduced profit for Vinacomin and re-investment difficulties. The government has now begun the gradual deregulation of the domestic coal price. Since July 2009, Vinacomin has been allowed to set the price for local customers (except power generators) at rates lower than the export price, up to a maximum 10% discount. In addition, the government is preparing a strategy to deregulate the price of coal used for power generation.

ENERGY EFFICIENCY

In April 2006, the Prime Minister approved the Viet Nam National Energy Efficiency Program (VNEEP) for the 2006–15 period (PMVN 2006b). The program's overall objectives cover community stimulation, motivation and advocacy; science and technology; and mandatory management measures for carrying out coordinated activities related to the economical and efficient use of energy in the whole society. The aim of the program is to save 3%–5% of total energy consumption over the 2006–10 period and 5%–8% in the 2011–15 period. The program includes six components: strengthen state management of energy efficiency and conservation by

developing a management system for energy saving; strengthen education, disseminate information and enhance public awareness to promote energy efficiency and conservation (EE&C) as well as environmental protection; develop and popularise highly energy-efficient equipment by phasing out low-efficiency equipment; promote EE&C in industry; promote EE&C in building; and promote EE&C in transportation.

MOIT is the focal coordinator of EE&C and is authorised to administer the implementation of the VNEEP. As part of this mechanism, the Energy Efficiency and Conservation Office within the Ministry of Industry and Trade was established on 7 April 2006 (MOIT 2006). The main work of the office is to develop organisations and systems for improving energy efficiency and conservation at the government level, from the central government to local governments.

A National Steering Committee chaired by MOIT was established to monitor the VNEEP. The committee includes representatives from the Union of Vietnam Associations of Science and Technology and the Ministries of Construction; Transport; Education and Training; Culture and Information (renamed as Culture, Sports and Tourism in August 2007); Science and Technology; Planning and Investment; Justice; and Finance.

The United Nations Development Programme (UNDP) and the Viet Nam Ministry of Science and Technology have been implementing a project to raise the effectiveness of energy use in small and medium enterprises (SMEs). The project is funded by the Global Environmental Fund through the UNDP. Over the five years from 2006 to 2010, USD 29 million will be spent to implement the project at 500 SMEs operating in the areas of clean production, ceramics, weaving, paper and pulp manufacture, and food processing. The project includes six sub-programs: supporting policy and institutional development; improving communications and awareness; building technical capability; supporting providers of energy-saving services; providing financial assistance; and providing guidance in using energy economically and effectively. The project saved about 136 000 tonnes of fuel oil and reduced CO_2 emissions by 962 000 tonnes by 2009.

The Promotion of Energy Efficiency and Conservation project, funded by Japan, began in 2000 with a planned finish date of 2010. This project is jointly implemented by the Association of South East Asian Nations (ASEAN) Centre for Energy, ASEAN economies and the Energy Conservation Center, Japan. The project has focused on the building, industry, energy management and transport sectors.

RENEWABLE ENERGY

Viet Nam is relatively rich in renewable energy resources. Those suitable for electricity generation include small hydro, solar, biomass, wind and geothermal. The potential for small hydropower resources (with a capacity of less than 30 MW per site) is estimated to be about 4000 MW; the total capacity of geothermal is estimated at 300–400 MW; and power from biomass at about 800 MW. Wind, solar and biogas are relatively abundant, with a potential capacity of over 2000 MW (Institute of Energy 2009).

Key organisations studying or developing renewable energy are MOIT, the Ministry of Science and Technology (MOST), EVN, PVN and the Institute of Energy. MOIT is responsible for establishing and monitoring the implementation of energy policies such as the National Energy Development Strategy and the National Electricity Development Master Plan.

In Viet Nam, renewable energy plays an important role in rural development. About 70% of the economy's 85 million people live in rural areas, but about 5% of households in those regions are not expected to have access to electricity by 2010. The government has provided significant support and legislated a number of policies to promote rural electrification and renewable energy development, such as the National Energy Development Strategy (PMVN 2007a) , which addresses the following matters:

- The 'basis for development' includes giving priority to developing new and renewable energy resources, such as wind, solar and hydropower; and motivating the power development program for rural areas.
- Development objectives include developing new and renewable energy, increasing its proportion from its currently inconsistent level to around 3% of total primary commercial energy, or 1.4 Mtoe by 2010, 9.02 Mtoe (5%) by 2025 and 35 Mtoe (11%) by 2050; and providing 100% of rural households with access to electricity by 2020.
- Development strategies include engaging in research and development for the new and renewable power sector, giving priority to hydropower development; and promoting rural electrification to contribute to industrialisation and the modernisation of agriculture and rural areas by developing management mechanisms to maintain and develop power resources.

The conditions for encouraging the development of renewable energy in Viet Nam in the coming years are favourable. The target is to increase the share of renewables in total electricity production to 5% or higher by 2025.

NUCLEAR

In June 2010, the Prime Minister approved the plan to build and develop a nuclear technology industry and to actively contribute to socioeconomic development and the strengthening of the economy's nuclear scientific and technological capacity (PMVN 2010).

MOIT submitted to the government for approval a 2005 pre-feasibility study on the building of a 2000 MW nuclear power plant in Ninh Phuoc or Ninh Hai (two districts of Ninh Thuan Province in central Viet Nam). In mid-2009, MOIT submitted a revised version of the study (now called an investment report), which was approved by the National Assembly in November 2009.

In June 2010, the Prime Minister also approved a project on Orientation on Nuclear Power Development Planning by 2030. This proposes that one unit with a capacity of 1000 MW would be operating by 2020.

The construction of both plants will begin in 2014–15, and that would be followed by the further development of the economy's nuclear energy capacity to reach 15 000 MW by 2030 (EWG 40, 2010).

CLIMATE CHANGE

Viet Nam signed the United Nations Framework Convention on Climate Change in November 1994 and ratified the Kyoto Protocol in August 2002. Viet Nam fulfils all requirements to be a host economy for the development of clean development mechanisms (CDMs) under the protocol.

The government considers that climate change due to anthropogenic greenhouse gases is a real threat, and that Viet Nam is one of the economies most vulnerable to climate change. By participating in CDMs, Viet Nam has shown 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 (part of the International Cooperation Department of the Ministry of Natural Resources and Environment, or MONRE) as Viet Nam's CDM National Authority. The CDM National

Executive and Consultative Board, comprising officials from MONRE and other ministries, was established in April 2003.

In December 2008, the Prime Minister of Viet Nam approved a budget of about VND 1965 billion for the National Targeting Program for Protection from Climate Change (PMVN 2008b). At the same time, a National Steering Committee was established, with the Prime Minister as its chair. This program aims to achieve two general objectives: to evaluate the potential impacts of climate change in each sector and area at different time intervals; and to identify effective responses which are based on the close, reasonable and harmonious coordination of economic, social development and environmental protection goals.

The World Bank is helping Viet Nam to build particular projects, such as risk management of natural disasters and responses to climate change; land management for sustainable forestry under climate change conditions; the reduction of greenhouse gas emissions through efforts to combat deforestation and forest degradation; and rural development in Cuu Long River delta to cope with climate change.

Notable energy developments

ENERGY EFFICIENCY

In a statement to the Energy Working Group (EWG 40) in November 2010, Viet Nam highlighted these achievements in the area of energy efficiency in the economy:

- Approval of a law on energy efficiency and conservation by the National Assembly (in June 2010).
- Creation of a standard for energy efficiency for electrical equipment including refrigerators, air conditioners, electrical cookers, street lights, and six sets of energy efficiency standards and testing procedures for household appliances (Center for Vietnamese Standard).
- Survey of energy consumption in 500 key enterprises.

RENEWABLE ENERGY

Some recent wind power developments include a 15 kW solar PV–wind power hybrid system in a 40-household village. The project was implemented by the Institute of Energy with a grant from Tohoku Electric Company of Japan. Another is an 800 kW wind power generator in Bach Long Island, financed completely by the government of Viet Nam. Future wind energy developments, with a total installed capacity of 385.5 MW, include the Ly Son island project (2 MW), the Phuong Mai wind farm in Binh Dinh province (65 MW), a wind power project in Ninh Thuan province (126 MW), a wind farm in Phu Yen Province (15 MW), a wind farm in Binh Thuan province (165 MW), the Con Dao island project (2.5 MW) and the Phu Qui island project (10 MW).

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Useful links

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PetroVietnam—www.pvn.com.vn

United Nations Development Programme in Vietnam—www.undp.org.vn

Vietnam Economic Times—www.vneconomy.com.vn

Vietnam Electric Power Group—www.evn.com.vn

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